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Observations on Some Tasmanian Fishes: Part V

By

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WITH 4 TEXT FIGURES

SUMMARY

1. Some general observations are made on *Anguilla reinhardtii* Steindachner, 1867 (large individuals), *A. australis* Richardson, 1841 (abnormally colored specimen; elver), *Bovichtus variegatus* Richardson, 1846 (rock-pool sample), differential effects of rotenone on rock-pool fishes (under *Bovichtus*).

2. Little-known species described are *Muraenichthys breviceps* Günther, 1876, *Macruronus novæ-zelandiæ* (Hector, 1871), *Brachionichthys hirsutus* (Lacépède, 1804).

3. Records are given confirming the inclusion in the Tasmanian faunal list of *Leptoichthys fistularius* Kaup, 1853, *Leptonotus semistriatus* Kaup, 1856, *Syngnathus curtirostris* Castelnau, 1872, *Callionymus calauropomus* Richardson, 1844.

4. Keys to the Tasmanian species of the families Anguillidae, Echelidae, Macrouridae, Bovichtidae, Callionymidae, Brachionichthyidae are supplied.

INTRODUCTION

This paper, the precise scope of which is set out in the Summary, follows the general plan of previous communications under the same title (Scott, 1934, 1935, 1936, 1939). In Part IV keys to the Tasmanian or Tasmanian and ad-Tasmanian [' ad-Tasmanian ' = occurring in, or otherwise pertaining to, the vicinity of Tasmania: the convenience of this apparent neologism would seem to justify its adoption] members of the families represented were for the first time included. It has been found there is a strong and widespread desire, especially among extra-Australian workers, for these synopses; and they are accordingly supplied again here. Where it has seemed likely to be helpful, the simple alternatives offered by the definitive clauses of the key have been supplemented by data not confined to mutually exclusive attributes: this additional information [set out in square brackets] should either increase the reliability of the identification, or serve to point towards the presence of an unexpected or unknown species.

Differences among statisticians on the definition of variance and the method of calculation of standard deviation—*cf.*, *e.g.*, Student (1908), Huxley *et al.* (1927), Simpson and Roe (1929), Fisher (1932), Ezekiel (1947), Snedecor (1950)—lead to alternative procedures the results of which are not strictly comparable; and it appears to be necessary at present in reporting numerical data to specify the conventions followed.[1] In computing the standard deviation of samples, ordinary, or unadjusted, standard deviation, defined by $\sigma = \sqrt{\frac{\Sigma\ (x-\bar{x})}{N}}$, is here used when $N > 15$; and special, or adjusted, standard deviation, defined by $\sigma' = \sqrt{\frac{\Sigma\ (x-\bar{x})}{N-1}}$,

[1] The differences here referred to are questions of convention and mode of approach. A 'probably true value of the standard deviation' appearing in the ichthyological volume (Kyle, 1926: 176) in a well-known series of Biological Handbooks, however, exists only in the misapprehension of the writer.

is here used when $N \leq 15$. By what seems to be a logical extension of this usage, two corresponding coefficients of variation are recognized, viz, unadjusted, $V = \frac{\sigma \times 100}{\bar{x}}$, and adjusted, $V' = \frac{\sigma' \times 100}{\bar{x}}$. Standard (not probable) errors are recorded: for both adjusted and unadjusted statistics these are calculated from the conventional formulae, consistently using N. Except where otherwise expressly indicated, linear dimensions are given throughout in millimeters; the designation of the unit then being, for brevity and clarity, customarily omitted. Standard length and total length are denoted by *LS*, *LT*, respectively.

Family ANGUILLIDAE

Of six species of *Anguilla* Shaw, 1803 in the Check-List (McCulloch, 1929), Schmidt (1928) regarded only four as satisfactorily established as Australian: *A. bicolor* McClelland, 1844, *A. obscura* Günther, 1872, *A. australis* Richardson, 1841 (type locality Port Arthur), *A. reinhardtii* Steindachner, 1867; of which only the last two are Tasmanian, or ad-Tasmanian.

An index introduced by Schmidt, and here designated Schmidt's index, *S*, is of considerable value in the classification of the Anguillidae generally. It is defined thus: $S = \frac{a-d}{t} \times 100$, where a = length to vent, d = length to dorsal origin, t = total length.

KEY TO ANGUILLIDAE RECORDED FROM TASMANIA

A. *S* ranging from + 7 to + 14, mean about + 11. Color variable but usually dark, without copper tints. Characteristically spotted or marbled with darker (spots and marblings may be missing in very young and in old individuals). Head broad. Lips thick; maximum depth of upper lip about 5-6 in length of lip from tubular nostril. Teeth in upper jaw in two separate rows: mandibulary teeth divided by longitudinal toothless groove. Vomerine teeth in subtriangular, pennon-like patch, widest anteriorly; usually extending as far, or nearly as far, back as rows in upper jaw. Vertebrae 104-110, mode about 108 ..... *A. reinhardtii*

AA. *S* ranging from — 2 to + 4, mean about + 1. Color usually pale, or rather pale, greenish brown, with some copper tints. Unspotted. Head narrow. Lips thin; maximum depth of upper lip about 7-8 in length of lip from tubular nostril. Teeth in upper jaw in a continuous band, at least four teeth wide at broadest portion: no longitudinal toothless groove in mandible. Vomerine patch of teeth more or less oval or obovate; usually not extending nearly as far back as bands in upper jaw. Vertebrae 109-116, mode 112 or 113 ..... *A. australis*

Genus **Anguilla** Shaw, 1803

Anguilla **reinhardtii** Steindachner, 1867

Anguilla reinhardtii Steindachner, *Sitz. Akad. Wiss. Wien*, LV, 1, 1867: 15, figs. *a*, *b* & *d*. McCulloch, *Mem. Aust. Mus. Sydney*, V, 1, 1929: 64.
Anguilla reinhardti Schmidt, *Rec. Aust. Mus. Sydney*, XIV, 4, 1928: 182.
Anguilla marginipinnis Macleay (in part), *Proc. Linn. Soc. N.S.W.*, VIII, 1883: 210.

The inclusion in the local list of this species, which was not regarded as Tasmanian by Johnston (1891) or Schmidt (1928), has been discussed earlier (1934).

Large Individuals.—The linear dimensions of four very large specimens already recorded (1934, 1935) are exceeded by those of an example obtained in the North Esk, at Launceston, by Mr. J. Teague on 13th August, 1937. Even a technical paper may perhaps not unfittingly devote a sen-

tence to noting the dramatic circumstances of the capture of this fish. Mr. Teague observed it swimming close to the rowing sheds near the Tamar Street bridge; stabbed it in or near the heart with a pocket knife; jumped into the river fully clad, and brought the animal to shore. Some dimensions are set out in Table 1, accompanied by comparative data for the four large specimens previously noted. Schmidt, who regarded records of maximum size in *Anguilla* as of considerable interest, remarked he had not handled any specimen of this species exceeding 135 cm. in length and 7 kg. in weight, but cited references to examples weighing up to 30 lbs.: see also Stead (1908), Roughley (1916). Johnston (1883*a*) spoke of eels in the Ringarooma River and South Esk exceeding 30 lbs. in weight and 20 inches in girth, but he ascribed these to *Anguilla australis* Richardson, the only Tasmanian species he recognized: for record of a large short-finned eel, see Scott (1934: 39).

These fish of course come under notice, and become available for examination, primarily on account of their exceptional size; and hence constitute a biased sample. Even when the circumstances are borne in mind, however, the similarity of length and weight exhibited remains striking, and affords a strong suggestion the fish are drawn from a population characterized by a genuine biological homogeneity; presumably in respect of age. Simpson and Roe (1939) state that on comparing dozens of V's for linear dimensions of anatomical elements of mammals, they find the great majority lie between 4 and 10, with 5 or 6 as good average values: coefficients much lower than these are usually attributable to inadequacy of the sample, while much higher coefficients are usually indicative of some degree of heterogeneity (as of age or minor taxonomic status) of the material (Haldane (1952), who notes a modal V of 5 per cent. for linear measurements of mammalian teeth, points out this value is equivalent to an interquartile range of about 7 per cent. of the median.) The writer's experience points to the existence of a similar situation among fishes (with, *inter alia*, the qualification that here, as in other groups, among juvenile populations, in which more rapid growth tends to produce greater variability, coefficients of 10-12 are not unusual). It will be seen that the eight linear dimensions for which at least two measurements are available here show an adjusted coefficient of variation, V^1, of 2·4-9·4. Again, as Thompson (1942) has pointed out, weight varies as the product of three linear dimensions, and may accordingly be expected to exhibit a coefficient of variation that is (for small deviations—the biological situation) the sum of those of the three component variates (or, say, thrice the value of an average linear coefficient) : likewise a girth coefficient tends to be twice a linear one. These expectations are well fulfilled by the present measurements, V^1 for weight being 3·5, V^1 for girth 2·1, times the crude mean for eight assorted linear dimensions (4·7). The appearance in Table 1 of several entries of $V^1 < 4$ exemplifies the tendency to low values characterizing numerically inadequate samples. At the same time, the entries for range/σ in general compare well with the values of the ratio range/standard deviation expected from random samples drawn from the normal population (the latter being: $N = 5$, mean 2·33, exceeded at $P = 0{\cdot}05$, $P = 0{\cdot}01$, 3·87, 4·59; $N = 2$, 1·13, 2·77, 3·64).

In all specimen S exceeds the mean (10·72) found by Schmidt for 84 specimens from New South Wales, and the present maximum closely approaches that among his material (13·2).

TABLE 1

Anguilla reinhardtii Steindachner: Dimensions of Five Large Tasmanian Specimens

Dimension: lengths and girths in mm.; weight in lbs.	Specimen (*a*) North Esk, near Launceston, 1937	(*b*) Hydro-electric fluming near Launceston, 1934	(*c*) 'Near Launceston, 1928	(*d*) Cataract Gorge mill-race, Launceston, 1908	(*e*) Longford (South Esk), 1908	Mean	Adjusted Coefficient of Variation, V'	Range/σ'
Total length	1671	1658	1531	1525	1635	1604·0	4·4	2·37
Length to base of caudal	1623	....	....	....	....	....	....	....
Length to origin of dorsal	540	488	517	476	501	504·4	5·0	2·55
Length to origin of anal	758	725	....	....	....	741·5	3·1	1·41
Length to origin of pectoral	225	208	....	....	....	216·5	5·6	1·08
Length of pectoral	119	....	....	....	....	....	....	....
Length to middle of vent	735	705	682	647	688	691·4	4·7	2·73
Length of head	212	....	....	....	....	....	....	....
Horizontal diameter of eye	14·8	17	....	....	....	15·9	9·4	1·47
Interorbital	58	60	....	....	....	59·0	2·4	1·41
Snout	40	42	....	....	....	41·0	3·4	1·41
Girth at vent	470	....	....	....	....	....	....	....
Girth, maximum	507	440	....	....	....	473·5	10·0	3·53
Weight	40	32	42	28	34	35·2	16·4	2·43
Schmidt's index, *S*	11·7	13·1	10·8	11·2	11·4	11·64	7·6	2·62

Anguilla australis Richardson, 1841

(FIGURE 1)

Anguilla australis Richardson, *Proc. Zool. Soc. Lond.*, IX. 1841: 22. *Id.* McCulloch, *Mem. Aust. Mus. Sydney*, V, 1, 1929: 63.
Anguilla australis occidentalis Schmidt, *Trans. N.Z. Inst.*, LVIII, 4, 1928: 388.

Variation in Color Pattern.—The short-finned eel is characteristically from pale greenish to olive brown, usually with some copper tints, above, silvery on sides, whitish below, and without any pronounced markings; notable divergences from this norm are very unusual. A remarkable variant, in which xanthochroism plays an important part, is afforded by a specimen secured in the South Esk, at Longford, on 30th November, 1931 by Mr. F. Wise. Principal dimensions: *LT* 329; length to origin of pectoral 41, of dorsal 128; length to vent 133; head 23, snout 7·5; horizontal diameter of eye 2·5; depth at origin of dorsal 17. $S = 1{\cdot}5$.

Lateral aspect: head almost wholly chrome yellow, with two superior rows of dark brown dots: ground-color of most of lower half of trunk chrome yellow, of most of upper half greyish; chief markings bold brown marblings, yellow-ivory spots, an elongated marbled whitish ventral preanal splash: greyish ground-color of tail marked with a good deal of brown, two rich ivory spots, and a fair amount of chrome yellow, the most brilliant of which occurs in sharply defined patches and spots: dorsal whitish, with thin basal yellow line, for about 90; thereafter brilliant chrome yellow, with one small brown blotch: anal whitish, marked posteriorly with four brownish blotches, the last very dark: details of pattern of lateral aspect shown diagrammatically in fig. 1. Elsewhere the fish manifests less abnormality: dorsal surface mainly greyish brown, becoming dark brown on nape; slightly in advance of dorsal origin an irregular greyish patch, about 14 x 10, in which occur some scattered dark brown spots; small dark spots mesially for about 20 cephalad from last-mentioned marking, and on occiput: ventral surface in general very pale yellow, becoming slightly pinkish on throat; only macroscopic markings are four irregular bluish brown blotches, 8-12 long, the first, beginning 50 behind tip of snout, situated mesially, second at right lateral profile, third and fourth at left profile, the last ending 90 behind snout.

Elver.—An elver in an early phase after the metamorphosis was observed in the Prosser River, at Oxford, about 150 yards from the harbor bar, on 10th September, 1952. At this point the complex of waves generated in the vicinity of the bar still persisted, meeting the sandy shore obliquely, with the production of a sinuous series of swift, swirling transgressions, smooth water being first encountered some 50 yards inland. The fish, which in gross appearance was virtually transparent, was swimming strongly upstream a few inches from the right bank; it was secured by a scoop of the hand. Examination after preservation in alcohol shows that though the general appearance in life approached transparency, a certain amount of pigment has been deposited. Chromatophores are in general subcircular on upper lateral and dorsal surfaces of trunk, where their area is subequal to area of their interspaces: on head, where they are more sparsely distributed, they exhibit a noticeable, but variable, tendency toward anteroposterior elongation.

Lower jaw projecting markedly beyond upper. Gape to below front of eye. Principal dimensions: *LT* 56·1, *LS* 55·2; length to origin of pectoral 6·4, of dorsal 20·6, of anal 21·6; length to vent 21·3; head 4·2, snout 1·4,

pectoral 1·1, horizontal diameter of eye 0·5; depth at origin of dorsal 1·1. Compared with the adult fish of *LT* 329 noted above the elver has lengths from tip of snout to origins of all fins relatively smaller, eye relatively larger (though not markedly so: 8·4, *cf.* 9·2, in head), relative depth much less (about-one-third). $S = + 1{\cdot}2$. This individual falls within the size-range (47-57) of a sample taken by Anderson and Whitley in 1926 in a creek crossing the beach at Long Bay near Sydney: none of these was a quite transparent elver, and Schmidt assigned them to Strubberg's (1913) Stage VI A ii.

Family ECHELIDAE

Only one Tasmanian genus, *Murænichthys* Bleeker, 1865. Check-List admits two Tasmanian species, *M. breviceps* Günther, 1876 (type locality Tasmania: Victoria, New South Wales), *M. tasmaniensis* McCulloch, 1911 (type locality Tasmania); a Tasmanian record of *M. australis* Macleay, 1881 (type locality New South Wales) by the writer (1936). For definition of Schmidt's index, *S*, used below, *cf.* Key to Anguillidae.

KEY TO ECHELIDAE RECORDED FROM TASMANIA

A. Dorsal originating in advance of vent. Preanal length 1·6-2·0 in postanal length. Teeth in jaws biserial (sometimes triserial anteriorly?).
[Origin of dorsal nearer to tip of snout than to vent. $S = + 16$-23. Anal begins below about 80th-90th dorsal ray. Lateral line well arched over branchial sac. *LT* about 580 (larger type 20 inches).] ..... *M. breviceps*

AA. Dorsal originating behind vent. Preanal length 1·3-1·4 in postanal length. Teeth in jaws uniserial.

B. Anal originating in advance of dorsal by < length of mouth. $S = - 2$ (type).
[Snout 5·3 in head. Interval between dorsal and anal origins about 1 in head. Lateral line somewhat arched over branchial sac. *LT* (type) 248.] ..... *M. australis*

BB. Anal originating in advance of dorsal by > length of mouth. $S = - 7{\cdot}6$ (type).
[Snout 4·8 in head. Interval between dorsal and anal origins about 5-7 in head. Lateral line almost straight anteriorly (?). *LT* (type) 170.] ..... *M. tasmaniensis*

Genus **Murænichthys** Bleeker, 1865

Murænichthys breviceps Günther, 1876

(FIGURE 2)

Murænichthys breviceps Günther, *Ann. Mag. Nat. Hist.* (4), XVII, 1876: 401. *Id.* McCulloch, *Mem. Aust. Mus. Sydney*, V, 1, 1929: 67.
? *Murænichthys macropterus* Klunzinger, *Arch. naturges*, XXXVIII, 1, 1872: 43 (*nec.* Bleeker).
? *Murænichthys devisi* Fowler, *Proc. Acad. Nat. Sci. Philadelphia*, LIX, 111, 1907 (1908): 421, fig. 2.
? *Murænichthys ogilbi* Fowler, *Proc. Acad. Nat. Sci. Philadelphia*, LIX, 111, 1907 (1908): 423, fig. 3.

The original description, based on a 20-inch specimen from Tasmania sent to England by Morton Allport, and on a second smaller example of unknown origin, is brief and restricted in scope. The following observations on a specimen caught by Mr. Lyall in the Tamar River, at Blackwall, on 5th July, 1935, supplement in several directions the available information on this species.

Proportions and dimensions.—Length to origin of dorsal (94) 6·20, to anterior margin of vent (219·5) 2·66, to origin of anal (225) 2·59, in *LT* (583). Depth (and, in brackets, width) at eye 8·5 mm. (7·5 mm.), at middle of branchial sac 16·5 (12), at gill-opening 15 (12·5), at dorsal origin 14 (13), at vent 14 (13·5), the last, the maximum depth of trunk, 41·6 in *LT*. Mouth-cleft extends 13·5; maxilla 16, or to two eye-diameters beyond eye: a pronounced rictal fold.

Fins.—There appear to be no readily accessible records of radial formulae: a count here gives D.349, A.252. Anal begins below 85th dorsal ray. Fins, which were described by collector as 'lace-like,' were sunk, when specimen was received, in median grooves: erected as fully as practicable, they proved comparatively high, the anal slightly, but consistently, the taller. Height of anal (and, in brackets, of dorsal) at 25 anal rays behind vent 8 (7); at 150 mm., 50 mm. from tip of tail 7 (6·5), 3·5 (3).

Pore Systems.—Conspicuous systems of large pores on lateral and dorsal surfaces of head (fig. 2). Trunk series continuous anteriorly with the 6 on branchial sac, dipping rapidly (in about 5 pores) to, and thereafter following, about midline of flank; comprises 18 to dorsal origin + 35 to vent. On tail pores not countable with certainty posteriorly; total about 102.

Coloration.—Dorsal surface and upper half of lateral surface olive throughout. Ventral and lower lateral surfaces of tail whitish, speckled in parts with brownish; delimited fairly sharply from upper olive along pore-line. Lower lateral surface of trunk concolorous with corresponding region of tail; ventral surface silvery. Head conspicuously bicolor, with abrupt contrast, along a straight mediolateral line, between upper olive and lower light, mostly pale golden: the portion (about one-fourth) of the branchial sac lying in former region darker than surrounding area. Iris silvery, shot, especially above, with gold. Membrane of anal completely hyaline, without even microscopic punctulation: colorless to within about 100 of posterior extremity, behind which it assumes a greenish tinge, at first faint, becoming pronounced only in last 40-50. Membrane of dorsal mostly hyaline, with sparse brownish punctuations in basal one-sixth or one-fifth to within about 100 of end, punctulations then extending to basal one-third , or more; also a few scattered punctulations on outer part throughout length; but whole fin essentially clear macroscopically: colorless anteriorly; faint greenish amber developing in about last 100, becoming marked only in about last 50. Rays of both fins silver.

Remarks.—For the three proportions recorded by Günther (1876), the original material, *Endeavour* specimen, present example shows significant agreement, approximate values being: head 33 or 29, 37, 24 per cent of trunk, or 91, 93, 75 per cent of *LT;* dorsal-gill interval 50, 43, 47 per cent of dorsal-vent interval. Compared with our fish, the South Australian juvenile, 195 long, shows larger eye, longer snout, slightly larger mouth-cleft, lesser depth (all relative to head), decidedly smaller dorsal-vent interval in terms of length to dorsal origin; much lower fins.

Synonymy.—McCulloch expressed the opinion that specimens from Port Phillip and the Murray River identified as *M. macropterus* Bleeker, 1865 were probably *M. breviceps* (Günther distinguishes his species from Bleeker's only by its comparatively shorter head and longer snout). In his *Endeavour* synonymy he formally notes the possible identity of

M. breviceps with *M. macropterus* Klunzinger, 1872: the suggestion is, however, abandoned in the Check-List. I have not access to Klunzinger's diagnosis of his *M. macropterus*: in view of the implication of the specific name, however, it seems desirable to call attention to the quite respectable development of the fins in the present specimen. In *M. australis* dorsal and anal are 'scarcely visible' (Macleay, 1881), 'very low, except near the end of the tail where they are a little broadened out' (McCulloch, 1911); in *M. tasmaniensis* 'very low, almost rudimentary'. No mention is made of fins in Günther's account of *M. breviceps;* but those of the *Endeavour* juvenile are 'very low'. McCulloch's figure of the last-mentioned fish shows combined height of dorsal and anal shortly behind vent as about one-third of depth of body there, or subequal to eye; whereas in our example it slightly exceeds maximum depth of body, and is 1·3 combined eye and snout, or 6·3 eye.

Fowler's two species from Victoria described in 1908 do not seem to have been recognized since by Australian workers. There is, I think, little doubt that *M. devisi* is to be identified with *M. breviceps.* From the type of *M. devisi* the type of *M. ogilbyi* differs chiefly in dentition: the differences may be significant, but I am inclined to think the two specimens are probably conspecific. From Fowler's figures I estimate $S = ca$ 21 in both fish.

Family SYNGNATHIDAE

The Check-List credits Tasmania with 6 genera and 7 species: other contributions in present series (1934, 1935, 1939) add 3 genera and 6 species. A key covering these Tasmanian and some ad-Tasmanian species has already been given (1939); and the point of entry in this synopsis of *Syngnathus tuckeri* Scott, 1942 (haplotype of *Mitotichthys* Whitley, 1948) is indicated in its description. One species is here added to this local list and the inclusion in it of two other species is confirmed. (Recent fission of long-established genera (e.g., Whitley, 1948) would increase the generic tally given above.)

Genus **Leptoichthys** Kaup, 1853

Leptoichthys fistularius Kaup, 1853

Leptoichthys fistularius Kaup, *Arch. Naturges.*, XIX, 1, 1853: 233. *Id.* McCulloch, *Mem. Aust. Mus. Sydney*, V, 1, 1929: 92.
Leptoichthys castlenaui Macleay, *Proc. Linn. Soc. N.S.W.*, VI, 2, 1881: 295.

The recognition of this species as a Tasmanian form has hitherto rested on a single beach-dried example (1939). The collection of the Queen Victoria Museum, Launceston now contains a second specimen (Q.V.M. Reg. No. 1951·5·2), obtained at Woolnorth.

Fin Counts, Annuli.—D.36. P. *ca* 20-25. A.? C.10. Annuli: total 23 + 20; subdorsal 2·9 + 5·3.

Principal Dimensions.—*LS* 405·8, *LT* 416·3 (caudal probably imperfect). Length to origin of pectoral 71·5, of dorsal 176·0; to termination of dorsal base 219·0; to vent 202·0. Head 63·3, snout 46·7, eye 6·2, interorbital 4·1. Depth (and, in brackets, width) at middle of snout 3·1 (1·2), front of eye 6·7 (4·0), opercular margin 9·0 (6·0), vent 7·5 (5·4), origin of caudal 3·0 (1·2): maximum 10·6 (11·1) at 13th-14th annulus (ditto) about 115 behind tip of snout.

Remarks.—The conventionally-recorded proportions of this specimen fall in general within the normal range; though at 3·1 in trunk and 6·1 in *LS* head is, relatively, rather short. The number of annuli is exceptionally small, Waite and Hale's (1921) values (with the range found in their material followed, in brackets, by the wider range recorded by others) being 25-26 (28) + 20 (23-27). This fish exceeds the normal maximum length as given in the key (1939: 140); that value (360) being based on the largest example reported by Waite and Hale, the fact that the type itself measures 22 inches (Kaup, 1856) being unfortunately overlooked.

Genus **Leptonotus** Kaup, 1853

Leptonotus semistriatus Kaup, 1853

(FIGURE 3)

Leptonotus semistriatus Kaup, *Arch. Naturges.*, XIX 1, 1853: 233, *nom. nud. Id.* Kaup, *Cat. Lophobr. Fish Brit. Mus.*, 1856: 48. *Id.* McCulloch, *Mem. Aust. Mus. Sydney*, V, 1, 1929: 85
Syngnathus semifasciatus Günther, *Cat. Fish. Brit. Mus.*, VIII, 1870: 162: *emend. pro. Leptonotus semistriatus* Kaup. *Id.* Johnston, *Pap. Proc. Roy. Soc. Tasm.* 1882 (1883): 134.
Syngnathus verreauxianus Duméril, *Hist. Nat. Poiss.*, II, 1870: 573.

Though Johnston and Lord & Scott observe it is not uncommon (and Tasmania is type locality of Duméril's species), I have not hitherto seen any Tasmanian examples, and in providing a redescription and figure I was obliged earlier (1939) to employ a Victorian specimen. A pipefish from Low Head, Northern Tasmania, in the Aldie Museum, the private museum of Mr. Peter Mercer, Launceston, proves to be an adult male.

Fin Counts, Annuli.—D.38. P.14. A.?3. C.6. Annuli: total 20 + 46; subdorsal 4·2 + 5·1; brood 0 + 0·9 — 14·5.

Principal Dimensions.—*LS* 161·8, *LT* 164·5. Length to origin of pectoral 23·5, of dorsal 58·0; to termination of adpressed pectoral 26·5, of dorsal base 76·2; to vent 64·5. Head 22·0, snout 12·4, eye 2·9, interorbital 2·4. Depth (and, in brackets, width) at middle of snout 1·6 (1·4), front of eye 3·0 (3·2), opercular margin 4·8 (2·9), vent 4·7 (4·5), origin of caudal 0·9 (0·6): maximum 5·9 (4·8) at 10th (9th) annulus, about 43 (40) behind tip of snout.

Sexual Dimorphism.—The chief features distinguishing *Leptonotus* Kaup from *Syngnathus* Linné are the conspicuously elevated superior profile and the acute ventral surface in female in former. This sexual dimorphism is well illustrated in *L. semistriatus* by the following comparative proportions of the female from Victoria, *LT* 216, previously figured and the present male. Depth, at various points, in *LT*: at opercular margin 33·2, 34·3; at origin of dorsal 22·7, 32·9; at level of maximum depth 18·0, 27·9; at vent 32·2, 35·0, at middle of tail 72·0 74·8. Maximum width of body in maximum depth 2·4, 1·2 (in a female of the South Australian *L. costatus* Waite and Hale (1918), this ratio exceeds 3).

Brood Pouch.—I do not know of an illustration in local literature of the brood pouch: the ovisac (Mr. Mercer's specimen) is shown in fig. 3. It is constituted by two dark skinny flaps, 29 long, and contains 55-60 ova. Posteriorly the eggs are disposed in a single row below each flap (with occasional, usually less-developed supernumeraries), but in anterior one-third they tend, especially under right flap, to form an irregular double, or even at some points triple, series.

Genus **Syngnathus** Linné, 1758

Syngnathus curtirostris Castelnau, 1872

Syngnathus curtirostris Castelnau. *Proc. Zool. Soc. Vict.*, 1, 1872: 243. *Id.* McCulloch, *Mem. Aust. Mus. Sydney*, V, 1, 1929: 86.
Pugnaso curtirostris Whitley, *Rec. Aust. Mus. Sydney*. XXII, 1, 1948: 75.

The Check-List gives South Australia only: though included in Johnston's second local list (1891), the species is not accepted as Tasmanian by Lord (1923) or Lord and Scott (1924). A specimen collected, among *Hormosira* near low-tide level, at East Beach, Low Head, Northern Tasmania by Miss Ann Mather on 21st February, 1952 satisfactorily establishes this form as a member of our fauna.

Fin Counts, Annuli.—D.23. P.10. A.?3. C.6. Annuli: total 18 + 44; subdorsal 1·1 + 4·1.

Principal Dimensions.—*LS* 139·7, *LT* 142·8. Length to origin of pectoral 14·0, of dorsal 47·6; to termination of adpressed pectoral 17·0, of dorsal base 58·5; to vent 50·2. Head 13·0, snout 5·1, eye 2·4, interorbital 1·3. Depth (and, in brackets, width) at middle of snout 1·8 (1·4), front of eye 2·6 (2·0), opercular margin 4·7 (3·4), vent 5·0 (3·9), origin of caudal 0·9 (0·7): maximum 5·7 (4·9) at 7th (14th) annulus, about 27 (40) behind tip of snout.

Proportions.—Some important body-ratios, first in material examined by Waite and Hale (1921), secondly in type, thirdly in present individual: snout in head 2·5-2·7, twice, 2·5; eye in snout 1·8, once and a half, 2·1; eye in head 5·0, no data, 5·4; head in trunk 3·0-3·5, n.d., 2·9; head in *LT* 11·2, twelve, 13·8; base of dorsal in length to dorsal 4·8 (from fig.), n.d., 4·4.

Coloration.—It is proposed to make the coloration and color pattern of this fish the subject-matter of a separate paper.

Family MACROURIDAE

Six genera, with nine species, in Check-List: *Macruronus* Günther, 1873, *M. novæ-zelandiæ* (Hector, 1871); *Lepidorhynchus* Richardson, 1846, *L. denticulatus* Richardson, 1846 (type locality Port Arthur, Tasmania); *Cœlorhinchus* Giorna, 1809 (also spelt *Cœlorhynchus* and *Cælorhynchus* by authors), *C. australis* (Richardson, 1839), *C. mirus* McCulloch, 1926, *C. innotabilis* McCulloch, 1907; *Malacocephalus* Günther, 1862, *M. lævis* (Lowe, 1843); *Lionurus* Günther, 1887, *L. nigromaculatus* (McCulloch, 1907); *Nematonurus* Günther, 1887, *N. armatus* (Hector, 1875)—the first three Tasmanian, the fourth ad-Tasmanian (Bass Strait). The wide geographical distribution (associated with deep-water habit) of many macrourids suggests the local list may be extended as the result of future investigations: accordingly a key covering all the Australian species is provided.

Key to Macrouridae Recorded from Australia

A. Trunk > head. Second dorsal originating in advance of anal. Barbel absent or rudimentary.
[Head about 1⅔ in trunk. Mouth terminal, normal; to middle of eye, or beyond: jaws equal anteriorly, or lower projecting slightly. Eye ≤ snout. Anal originating below about 18th-20th ray of second

dorsal. Interdorsal 5-6 in first dorsal base. First long dorsal spine smooth. First dozen, or fewer, anal rays longer than rest. Teeth in upper jaw biserial, those of outer row larger: in mandible uniserial. Silvery plumbeous; trunk whitish below. *LT*: modal, about 530; to 935] ..... *Macruronus novæ-zelandiæ*

AA. Head > trunk. Second dorsal originating behind anal. Submental barbel present.

B. Mouth lateral, high on side of face: top of upper lip about on, or above, level of inferior orbital border.

C. Trunk about 2 in head. Mouth terminal; snout anteriorly subvertical in profile, not projecting beyond upper lip. Anal originating behind first dorsal base. Premaxillary teeth noticeably heterodont.

[Jaws equal anteriorly. Snout 1½ in eye; orbital margin just cutting profile. suboperculum produced backwards as angular lobe. Second dorsal originating above about 20th dorsal ray. Interdorsal ≧ postorbital head. Anal high, subequal to snout: its rays at middle of tail several times dorsal rays there. No naked preanal groove. Head and body without markings, darker below; fins immaculate. *LT* about 530] ..... *Lepidorhynchus denticulatus*

CC. Trunk about 7-10, or more, in head. Mouth subterminal; snout conical in profile, projecting beyond upper lip. Anal originating beneath first dorsal base. Premaxillary teeth homodont (or virtually so).

D. Eye not cutting profile, ≦ 1½ snout. Mouth to beyond middle of eye. Interdorsal subequal to combined eye and snout. Anterior anal rays short, several times in snout, subequal to first rays of second dorsal: > 20 anal rays anterior to second dorsal origin. Premaxillary teeth uniserial or biserial; mandibulary uniserial.

[No naked preanal fossa. Depth about 6-7 in *LT*. First dorsal spine smooth. No pronounced markings. *LT* about 400] ..... *Malacocephalus lævis*

DD. Eye cutting profile, ≧ 2 snout. Mouth not to middle of eye. Interdorsal ≦ eye. Anterior anal rays long, about twice snout, many times first rays of second dorsal: < 16 anal rays anterior to second dorsal origin. Teeth in both jaws in villiform bands, the outer series somewhat enlarged.

[Tail abruptly narrower than trunk. Second dorsal spine serrate. Greyish; blackish on abdomen, posterior part of head; ventrals black; large black blotch on first dorsal. *LT* about 230] ..... *Lionurus nigromaculatus*

BB. Mouth lateral, low on side of face; or inferior: top of upper lip below level of inferior orbital border.

E. Trunk about 1½-3 in head. Depth at first dorsal < length of head. A sloping ridge from near tip of snout to, or nearly to, preopercular border, dividing infraorbital region into subvertical upper section, and oblique, sometimes nearly horizontal, lower section: mouth wholly in latter. First dorsal spine smooth. Suboperculum produced into acute angle posteriorly. Teeth in villiform bands in both jaws: in mandible broadest in front, sometimes narrowing to one or two series laterally.

F. Depth small, about 10-12 in *LT*. Anal and second dorsal subequal in height. Orbit reaching profile.

[Eye about 1¾ interorbital. Second dorsal originating barely behind anal origin. Interdorsal ≧ first dorsal base. Light grey, with minute black spots; abdomen lips, ventrals black. *LT* about 240] *Cœlorhinchus innotabilis*

FF. Depth moderate, about 5-6 in *LT*. Anal distinctly higher than second dorsal. Orbit not (or barely) reaching profile.

G. Body deeper, about 5-7 in *LT*. Scales on upper surface of head spaced. Lower surface of head wholly or almost naked.

H. Interdorsal > eye, about twice first dorsal base. Eye > postorbital head. Anal rays subequal to snout. Median scales in advance of dorsal not forming crest. Body without dark cross-bars.
[Dorsal low; originating above about 8th-9th anal ray. Anterior dorsal spine minute. Depth ≤ head. Naked area round nostril. Lower surface of head naked, except for rugose scales between angle of mouth and angle of preoperculum. Head and body uniform grey: small black spot on lower pectoral rays. *LT* about 275] .... *Cœlorhinchus mirus*

HH. Interdorsal < eye, subequal to first dorsal base. Eye subequal to postorbital head. Anal rays ≤ ½ snout. Median scales in advance of dorsal forming crest. Body with about half a dozen dark cross-bars.
[Dorsal low; originating above about 4th-6th anal ray. Depth < head. Upper and lateral surfaces of head with small rough scales, lower naked. Four scales in transverse series between first dorsal spine and lateral line. Whitish: usually some anterior cross-bars not extending to ventral profile. *LT* about 250] *Cœlorhinchus fasciatus*

GG. Body shallower, about 6-7 in *LT*. Scales on upper surface of head closely set. Lower surface of head covered with asperities.
[Interdorsal subequal to first dorsal base. Snout > eye; very sharply pointed. Two or more oblique dark bars on body, sloping downwards and backwards. A dark band (best developed posteriorly) along whole base of anal. Scales well defined on some parts of head. L. lat. 96. L. tr. 5+ 18. (All these characters contrast sharply with those of the closely allied New Zealand *C. aspercephalus* Waite, 1911). *LT* about 530] .... *Cœlorhinchus australis*

EE. Trunk subequal to head. Depth at first dorsal ≧ length of head. No pronounced long oblique suborbital ridge, and no sharp division of side of head into subvertical and subhorizontal planes: mouth, though well below eye, and opening inferiorly, is low lateral, rather than inferior. First spine serrated. Suboperculum not produced into acute angle posteriorly. Teeth in both jaws uniserial.
[Snout obtusely conical. Interorbital flat, > eye. Eight scales in transverse series between first dorsal and lateral line. Interdorsal ≧ ½ head. Adpressed pectoral not nearly extending to anal origin. Lateral line not (or not clearly) developed immediately behind head. Uniform dusky; but some specimens much lighter, approaching white. *LT* about 330] .... *Nematonurus armatus*

Genus **Macruronus** Günther, 1873

Macruronus novæ-zelandiæ (Hector, 1871)

Coryphænoides novæ-Zelandiæ Hector, *Trans. N.Z. Inst.*, III, 1871: 136, pl. XVIII, fig. 1.
Macruronus novæ-zelandiæ Günther, *Rept. Voy. Challenger, Zool.* XXII, 1887: 157.
Macruronus novæ-zelandiæ Waite, *Rec. Cantab. Mus.*, I, 3, 1911: 180, pl. XXX, fig. 1. *Id.* McCulloch, *Rec. Aust. Mus. Sydney*, IX, 3, 1913: 358.
Macruronus novæ-zelandiæ McCulloch, *Mem. Aust. Mus. Sydney*, V, 1, 1929: 128.
Coryphænoids tasmaniæ Johnston, *Pap. Proc. Roy. Soc. Tasm.*, 1882 (1883): 143.

Johnston's species is undoubtedly conspecific with Hector's, with which, his account suggests, he was unacquainted. It occurs seasonally in schools on the West Coast (Johnston; Lord and Scott, *fide* Rodway), and at times enters the Derwent: it has been recorded from Northern Tasmania (McCulloch, 1913), and there is a specimen, *LT* 346, from the Tamar River, at Beauty Point, in the Queen Victoria Museum, Launceston (Reg. No. 1940·284).

In August, 1934, large numbers from Strahan appeared in some Launceston fishshops: the fish proved not at all popular, and local retailers found it expedient to instruct their suppliers to cease forwarding it. Observations on three individuals from this material *LT* (*a*) 527, (*b*) 530, (*c*) 545 usefully extend, or render more precise, previous accounts. Where three values are given below for one variate, entries relate to specimens in order just specified.

Barbel.—Hector (1871) says of the type, ' From under the jaw there is a larger bifid barbel, as in the cod ', and his illustration—which by reproduction (in outline) in Hutton and Hector (1872) and in Goode and Bean (1895) gained wide circulation—showed the appendage attached near base of chin at level of nostril. Günther, diagnosing (subgenus) *Macruronus* on *Challenger* material, notes ' barbel none '; remarking Hector's artist must have been under some misapprehension ' as, at any rate, the barbel could not be at the place where he has drawn it '. Johnston remarks ' barbel rudimentary ', and Waite (1911), supplying the first good figure, expressly records barbel absent. No indication of presence, or previous presence, of a barbel was found in any of our specimens.

General Dimensions and Proportions:—Proportions noted are extremes: for the more important ratios, however, individual proportions can be calculated, if required, from dimensions recorded (in brackets) at first mention of relevant variates. Head (87, 83, 89) 6·1-6·4 in *LT* (527, 530, 545), or 5·8-6·0 in length to base of ' caudal ' rays (503, 499, 515); snout (29, 21·5, 26) 3·0-3·9 in head; eye (28, 21, 24·5) 1·0-1·1 in snout; (soft) interorbital (17, 21, 22) 1·1-1·6 in eye, and, for (*b*) and (*c*), 1·2-1·5 bony interorbital. Length to origin of first dorsal (115, 96·5, 101) 4·4-5·5, of second dorsal (150, 139·5, 154) 3·5-3·8, of pectoral (93, 82, 87) 5·6-6·5, of ventral (114, 93, 105) 4·6-5·7, of anal (235, 231, 235) 2·2-2·3, in *LT*. Interdorsal (6, 6, 9) 2·9-4·8 in snout, or 11·7-19·7 in length to its midpoint. Trunk (143, 144, 141) 2·7-2·9 in tail: anus nearer to tip of snout than to tip of tail by 2·3-4·0 snout (*cf.* ' twice ' in *C. tasmaniæ*). Depth of head at level of orbit (43, 43, 45) 1·9-2·0 in length of head. Depth at vent (—, 62, 74) 1·2-1·3, maximum depth (—, 75, 86) 1·0-1·1, in head. Vent under 18th, 19th, 18th ray of second dorsal.

Head.—Maxilla reaches to below anterior 0·3, 0·6, 0·8 of orbit: lower jaw to below posterior half of eye, to 0·1, 0·2, of eye-diameter beyond eye. Width of hind end of maxilla 0·4, 0·7, 0·6 in eye. Jaws equal anteriorly, or lower slightly projecting. Mouth somewhat protractile. Upper margin of operculum smooth, or slightly striate and denticulate; lower margin

striated or ribbed, and from very slightly to moderately denticulate. Branchiostegals 7. About 22 gill-rakers on lower anterior arch, the front 1-1·5, the hindmost 10-11 long.

Teeth, Scales.—In lower jaw, on either side of symphysis, a row of about 5 minute teeth, together occupying about 3 mm.; internal to this set, a row of about 7 equally minute, occupying 3-4; behind second series about 10 more, with sagittate crowns, increasing in size backward, last about 3 long. In upper jaw, on either side, one enlarged tooth, 3 mm. or more long, near front, followed by about 14, subequal to each other, about half size of first; all sagittate: inside these a row of very numerous very small teeth. On vomer either a small patch, anteriorly of one row of very small teeth, widening behind on either side to two or three rows of rather larger teeth; or a narrow proconvex arc, several rows wide throughout. An elongated group, of variable form, of cardiform inferior pharyngeal teeth on each side. Two oval patches of superior pharyngeal teeth on each side, the hinder the more extensive and with somewhat larger teeth. Scales subcircular, cycloid, without spines. L. lat.: (*a*) imperfect anteriorly, 138 behind level of middle of pectoral; (*b*) damaged, estimated 190-200; (*c*) 166. Sc. tr. 8, 8, 9 between first dorsal and lateral line.

Fins.—Second dorsal and anal continuous round extremity of tail: about half a dozen rays of pseudo-caudal so formed shared in present fin-counts between anal and dorsal. D. I, 11; 105: I, 11; 104: II, 12, 104: in (*c*) only, a small initial spine, 2 long: large spine smooth. A. I, 91; I, 91; I, 93. V. 8 in one fin, 7 in other; 8; 8. P. (*a*) 17; (*b*) and (*c*) 18 in one fin, 17 in other. First dorsal begins less than eye-diameter behind pectoral origin: base 1·0-1·7 snout: 1st, 2nd, last rays 1·8-1·9, 1·7-1·8, 8·3-9·7 in head. Anal begins beneath 18th-22nd ray of second dorsal; base 1·76-1·80 in LT: first dozen rays rapidly, succeeding rays slowly, decreasing in height caudad; 1st, 2nd, 30th, 50th 2·3-2·4 ((*b*) and (*c*) only), 2·4-3·0, 5·9-7·9, 7·5-13·7 in head. Adpressed pectoral extends to level of interdorsal or 1st ray of second dorsal; base 4·3-4·5 in its longest (3rd-5th) ray, which is 1·6-1·7 in head. Adpressed ventral reaches level of 4th ray of second dorsal (specimen (*a*)); 1st ray, which is undivided, 1·6-1·7 in head, subequal to 2nd ray, 1·8-2·3 last ray.

Color.—Trunk silvery plumbeous laterally; similar, but with some greenish lights, above; whitish below. Head black above; concolorous laterally with flank; dusky silver below: mouth bluish black. Pupil blackish; iris mother of pearl, with some dark shading at margin, particularly below. Membranes of anal and both dorsals clear, greyish, lightly punctulated with brown, the free margins tending to blackish, especially posteriorly. Membrane of ventral hyaline, scarcely punctulated postaxially, but between first two or three rays so heavily pigmented as to appear almost black. Pectoral dusky.

Remarks.—Lord and Scott state this species is smaller than *Cœlorhinchus australis*, but its modal length is apparently several inches greater: one *Nora Niven* specimen measured 935 (Waite, 1911). The type (LT 21 inches; here taken as 533 mm.), the specimen described by Waite [in legend for pl. XXX, fig. 1 'two-thirds' should presumably read 'one-third'], and the present examples constitute a compact series with LT 513-545, $\bar{x}$ 529·6 ± 5·15, σ' 11·5 ± 3·64, V' 2·18 ± 0·69. Periodically approaches the shore (Günther): probably lives chiefly at 10-30 fms., which is decidedly shallow for a macrourid.

Family BOVICHTIDAE

In its wider connotation—as understood by, *e.g.*, Regan (1913), Waite (1921), Lord and Scott (1924), McCulloch (1927)—the Bovichtidae comprises: *Pseudaphritis* Castelnau, 1872, *Bovichtus* Cuvier and Valenciennes, 1831, *Cottoperca* Steindachner, 1876, of which the first two occur in Australia: in the Check-List, however, *Pseudaphritis* is referred to a separate family (Pseudaphritidae). The subjoined key covers the Australian bovichtids *s.l.*: *P. urvillii* (Cuvier and Valenciennes, 1831), *B. variegatus* Richardson, 1846, *B. angustifrons* Regan, 1913, all of which occur in Tasmania.

B. angustifrons (not included in local lists of Lord and Lord and Scott), which is based on two, probably halfgrown, specimens, one Tasmanian, one of unknown origin, does not differ trenchantly from *B. variegatus*. The most has been made in the key of differences noted in Regan's (1913) rather brief description or suggested by his illustration: it is not improbable, however, that some of the distinctions noted would fail to hold good if a large series, with a wide size-range, were available for comparison.

KEY TO BOVICHTIDAE RECORDED FROM TASMANIA

A. With scales. Body subcylindrical; head small, somewhat depressed. First dorsal originating behind pectoral base; quite separate from second dorsal (interdorsal > eye). Anal originating beneath interdorsal. Rays of all fins branched. Fluviatile .... *Pseudaphritis*

[D. VII-VIII, 19-22. A. 23-25. Head wholly covered with scales. L. lat. 60-65. Reddish sandy above, with dark blotches and marblings; white below] .... *P. urvillii*

AA. Without scales. Body high anteriorly, somewhat compressed; head large, high. First dorsal originating in advance of (or above) pectoral base; united (or virtually united) by membrane with second dorsal. Anal originating well behind origin of second dorsal. Anal, dorsal, lower pectoral rays unbranched. Marine .... *Bovichtus*

B. Interorbital wider (about 8-10 in head). Pectoral longer, relative to head (about 1·3-1·6, in small individuals modally, 1·4, in head). First dorsal apparently higher; 2nd spine ≧ 2·0 in distance from 1st spine to 1st dorsal ray. First dorsal with some dark marblings (characteristically two bars or two rows of spots); usually with conspicuous black spot on, and between, last two or three spines. About five dark bars on body, above lateral line; other (non coincident) bars below lateral line .... *B. variegatus*

BB. Interorbital narrower (about 12-13 in head). Pectoral shorter, relative to head (about 1·7 in head). First dorsal apparently lower; 2nd spine < 2·0 in distance from 1st spine to 1st dorsal ray. First dorsal without pronounced markings. Dark blotches or bars on body above lateral line only (Regan's figure) .... *B. angustifrons*

Genus **Bovichtus** Cuvier and Valenciennes, 1831

Bovichtus variegatus Richardson, 1846

Bovicthys [*sic*] *variegatus* Richardson. *Zool. Voy. Erebus and Terror*, Fish, 1846: 56, pl. XXXIV, figs. 1-2.
Bovichtus variegatus Waite, *Subantartic Islands of N.Z.*, II, 1909: 595. *Id.* McCulloch, *Mem. Aust. Mus. Sydney*, V, III, 1929: 336.
Bovichiths [*sic*] *rosco-pictus* Hutton, *Trans. N.Z. Inst.*, XXXVI, 1904: 148.

Johnston notes 'rare' (1883*a*), 'extremely rare' (1883*b*); but Lord and Scott (who inadvertently use the original *Bovichtus* on p. 12 and Agassiz's 1845 emendation *Bovichthys* on p. 78) state immature examples

are often taken in the Derwent Estuary. A specimen, *LS* 121, *LT* 143, from Penguin is in the Queen Victoria Museum, Launceston (Reg. No. 1942·173). Collections of rock-pool fishes made over many years on the North West Coast, in general without the aid of poisons, have not yielded one individual—possibly because of the difficulty with which this species is detected (Waite, 1909). However, by the use of derris 11 specimens were obtained at Penguin on 23rd January, 1952 from a single pool of maximum dimensions 8 feet 6 inches by 5 feet by 7 inches: bottom mainly stony; a few clumps of *Hormosira* sp. Specification of sample in respect of *LS*: range 38·0-56·8, $\bar{x}$ 46·31 ± 1·39, σ' 5·26 ± 1·12, V' 11·4 ± 2·4.

Differential Effects of Rotenone.—This operation, which in an hour yielded 35 fish representing four species, throws interesting light on some differential effects of rotenone. The species first affected was the present one: the fish soon began to move about slowly near middle of pool, and before long migrated to margin, where they were readily secured: all died with mouth wide open and upper jaw thrust forward. Next came 5 small individuals of the weed fish *Clinus perspicillatus* Cuvier and Valenciennes, 1836, LT 37·0, 40·1, 42·2, 46·9, 55·2, caught near water's edge. There followed 13 examples of the common blenny, *Pictiblennius tasmanianus* (Richardson, 1849), exhibiting the typical blustering and spluttering behaviour that has gained for them the local names of 'bullies': all died characteristically with clenched teeth. This series shows a slightly positive ($g_1 = 0{\cdot}013$), non-significantly ($t = 0{\cdot}021$) asymmetrical *LS* distribution, with range 38·9-72·2, $\bar{x}$ 56·36 ± 3·33, σ' 12·0 ± 2·36, V' 21·3 ± 4·4 — and perhaps comprises two year-classes: (*a*) 8 specimens, 38·9-59·6, $\bar{x}$ 48·18 ± 2·41, σ' 6·82 ± 1·71, V' 14·2 ± 3·5; (*b*) 5 specimens, 68·1-72·2, $\bar{x}$ 69·46 ± 0·78, σ' 1·74 ± 0·55, V' 2·51 ± 0·79. A single cling fish, *Volgiolus cardinalis* (Ramsay, 1882), LS 56, which, though venturing into open shallow water, did not show any indications of pronounced stupefaction, briefly preceded 5 large *Clinus perspicillatus*, *LT* 74·9, 78·0, 81·1, 84·1, 99·5, of which a couple were captured comatose under stones, while the others dashed along the surface, and then hurled themselves noisily on shore. Two shore eels, almost certainly *Alabes rufus* (Macleay, 1881), whose convulsive movements suggested they were suffering from the effects of the poison, were observed: these, which would have come last on the list, were not secured. There is thus disclosed a striking strictness of specific succession, and, in one instance, of inverse proportionality between body-size and speed of narcosis.

Variation.—Comparison of these 11 juveniles with the original description, based on two specimens, 8 inches and 5 inches long, from Port Jackson, with Waite's (1909) account of a rock-pool specimen, 55 long, and with Parrott's (1948) biometric analysis of a sample of 30 specimens from 8 localities in New Zealand and neozealanic islands shows good general agreement, with several noteworthy variations. Points worthy of notice are: (*a*) D. VIII, 19 in ten specimens, VIII, 18 in one (No. 7) [Waite's specimen VIII, 19; Parrott gives $\bar{x}$ 7·9, 19·2, with a maximum of 8, 21, while his mode (not specified) is probably 8, 19]: (*b*) A. 14 in ten specimens, 13 in one (No. 7) [Parrott records 14-18, $\bar{x}$ 15·4; so that the 18, *tout court*, of Lord and Scott (1924: 78), possibly based on Waite's single individual, does not represent anything like a modal or mean value]: (*c*) P. 10 + 5 in five, 9 + 5 in two, 8 + 5 in four, fish [present minimum total thus one below that of Parrott's material, which runs 14-15, $\bar{x}$ 14·5; and

present mode agreeing with Waite's single value]: (*d*) counting all rays, branched or simple, directed along general anteroposterior axis, I find C. 16 (one specimen), 17 (four), 18 (six), plus countable procurrent rays ¼-⅝: (*e*) Waite records ventral spine 1·4 in head (no data in Parrott), and longest pectoral ray equal to head; but present series, of comparable general size, yields 2·3-3·2, $\bar{x}$ 2·65 ± 0·092, and 1·3-1·6, $\bar{x}$ 1·44 ± 0·171, in head [from means in Parrott's Table No. 5 one computes pectoral 1·33 in head]: (*f*) posterior anal rays thickened and of same general character as lower pectoral rays, of which Waite found 4, here number 4 (one specimen), 3 (four), 2 (three), 1 (three).

Proportions in Present Series.—In view of its general homogeneity, the present sample provides excellent material for the study of individual variation (and in this respect complements Parrott's material, with an LS range of 39-196, and a wide north-south and east-west distribution). Examination of an extensive series of measurements and body-ratios, however, raises certain general issues regarding current ichthyological practice in specifying proportions too far-reaching for adequate presentation here: the tables and a discussion on them are accordingly reserved for a separate communication.

Family CALLIONYMIDAE

Three genera occur in Australia: *Dactylopus* Gill, 1860, *Synchiropus* Gill, 1860, *Callionymus* Linné, 1758; only the last Tasmanian or ad-Tasmanian.

KEY TO CALLIONYMIDAE RECORDED FROM TASMANIA

The two species met with in Tasmania—*C. papilio* Günther, 1864, *C. calauropomus* Richardson, 1844—differ from all other Australian species in having preopercular spine devoid of basal antrorse barb, and provided with two terminal hooks (McCulloch, 1926). Both possess broad membrane uniting inner ventral ray with base of pectoral, and partly covering bases of lower pectoral rays: head and body depressed: dorsal rays branched.

A. Anal rays 6. Dorsals elevated; longest rays > ¼ LS. D. usually IV. 7. Ventral usually extending beyond origin of anal. Caudal normal ..... *C. papilio*

AA. Anal rays 7-8. Dorsals not elevated; longest rays < ¼ LS. D. usually IV, 8. Ventral not usually extending beyond origin of anal. Caudal sometimes (in old males?) with some rays greatly produced *C. calauropomus*

Genus **Callionymus** Linné, 1758

Callionymus calauropomus Richardson, 1844

Callionymus calauropomus Richardson, *Zool. Voy. Erebus and Terror*, Fish, 1844: 10, pl. VII, figs 4-5.
Id. McCulloch, *Mem. Aust. Mus. Sydney*, V, III, 1929: 338.
Callionymus achates De Vis, *Proc. Linn. Soc. N.S.W.*, VIII, 4, 1883: 620.

Lord and Scott list only *C. papilio*, treating *C. lateralis* Macleay, 1881, recorded as Tasmanian by Johnston (1891), as synonymic. (On the basis of original descriptions, this identification appears highly improbable; but McCulloch, who suggested it (1923), and maintained it in the Check-List,

examined the holotype of *C. lateralis*, and stated the D.8, A.8 of Macleay's account should be D.7, A.6). It is possible the inclusion of Tasmania among the Check-List localities for *C. calauropomus* is based on *Challenger* (Günther, 1880) or *Endeavour* (McCulloch, 1926) material from Bass Strait; and the recent capture of an example, *LS* 123, *LT* 165·5, in the Tamar River, at Launceston (Queen Victoria Museum Reg. No. 1952·5·3) appears worthy of record. The Museum has a second specimen without locality data, but probably of Tasmanian origin.

Both specimens are apparently females: as in the type, caudal is subequal to head, there being no marked extension of the 4th-7th caudal rays, in the form of filaments formed by terminal coalescence of the ray-branches, described by McCoy (1890) as characterizing old males; and the markings in the Tamar River fish (lost in other specimen) are consonant with McCoy's account of the female color pattern.

McCulloch and Waite (1918) draw attention to the fact that a South Australian specimen, *LS* 167, differs from the type in not having the teeth in the jaws reduced laterally to a single row; and McCoy's figures of a male, *LS, ca* 209, show the narrowest portion of the bands above and below as biserial. In the Tamar River specimen a number of the hinder teeth in both jaws are uniserial; while in the other example only the extreme tips of the bands of the upper jaw reduce to a single row.

Family BRACHIONICHTHYIDAE

The Check-List recognizes two Australian genera, each with two species: *Brachionichthys* Bleeker, 1885, (*a*) *B. hirsutus* (Lacépède, 1804), (*b*) *B. politus* (Richardson, 1849) ; *Sympterichthys* Gill, 1879, (*c*) *S. lævis* (Lacépède, 1804), (*d*) *S. verrucosus* McCulloch and Waite, 1918. Tasmania is type locality of (*a*), (*b*), (*c*) ; (*a*) recorded also from New South Wales, (*d*) from South Australia only.

The generic status of (*c*) and (*d*) is obscure. In the first place, *Sympterichthys* is separated from *Brachionichthys* primarily by a feature, the partial connexion by membrane of the three dorsal spines *inter se* and with the soft dorsal, regarding which different verdicts are derivable from two accounts—those of Lacépède and Cuvier—of the same specimen, the type of (*c*) [= *Chironectes unipennis* Cuvier, 1817]. Secondly, (*d*) is ascribed by its authors to *Sympterichthys* only by virtue of their so rediagnosing this genus as to exclude the palmary criterion on which it was based. It may be doubted whether among these fishes disjunction or partial connexion of some of the dorsal elements is in general of more than specific value (indeed, Johnston (1883*a*) was perhaps inclined to regard it as merely a matter of individual variation.). All species are provisionally referred below to *Brachionichthys*.

KEY TO BRACHIONICHTHYIDAE RECORDED FROM AUSTRALIA

A. Skin without spines.

B. Anal 9. Dorsal I, II, 17. First dorsal spine (which is free from second) without terminal fleshy appendage. First and second dorsals apparently joined. Skin perfectly smooth and soft. Anal base > first dorsal base; <2 in second dorsal base (measure-

ments direct, *i.e.*, not between normals to general anteroposterior axis). Dorsal and anal apparently not united by membrane to caudal peduncle. Outer margin of second dorsal with slight dip near middle, rounded off posteriorly. Red (in alcohol reddish brown), with lighter spots or marblings; two irregular pale blotches near base of second dorsal; some darker areas or markings over eye, between eye and pectoral, along base of dorsal ..... *B. politus*

BB. Anal 6. Dorsal I, II, 13-14. First dorsal spine (which is free from second) with terminal bunch of foliaceous appendages. First and second dorsals separate. Skin smooth or covered with low dermal tubercles. Anal base $\leqq$ first dorsal base; $>$ 2 in second dorsal base (measurements as for B). Dorsal and anal united by membrane to caudal peduncle. Outer margin of second dorsal virtually straight to about antepenultimate ray; penultimate ray projecting. In alcohol brownish, with lighter and darker areas; two whitish blotches behind head; some indefinite brownish markings on cheek, back, abdomen; two dark spots on first dorsal; oblique dark marking covering posterior dorsal rays, caudal peduncle, almost all anal; pectoral and caudal blackish distally ..... *B. verrucosus*

AA. Skin with numerous small, or very small, spines.

C. Anal 9-10. Dorsal I, II, 19-20. First dorsal spine (which is free from second) with (simple) terminal fleshy appendage. First and second dorsals separate. Skin rough, with small spines. Outer margin of second dorsal with slight dip near middle, rising again to round off in last one-fourth; last ray about half first. In formalin, whitish or greyish brown; sides of head, trunk, tail with numerous conspicuous brownish or reddish spots, sometimes tending, especially on flanks, to form longitudinal rows; soft dorsal with many small red-brown spots, and anterodistal blackish blotch or blotches; anal with some dark markings and/or clouding ..... *B. hirsutus*

CC. Anal 9. Dorsal I, II, 16-17 (? III, 16-17). First dorsal spine (which is free from second, *fide* Lacépède's figure; or united with second, *fide* Cuvier) without terminal fleshy appendage. Skin nearly smooth, covered with minute spines. Outer margin of second dorsal convex; last ray about one-third of first. Preserved; reddish brown without conspicuous color markings ..... *B. lævis*

Genus **Brachionichthys** Bleeker, 1855

Brachionichthys hirsutus (Lacépède, 1804)

(FIGURE 4)

Lophius hirsutus Lacépède, *Ann. Mus. d'Hist. Nat.*, IV, 1804: 202 and 210, pl. LV, fig. 3.
Chironectes punctatus Cuvier, *Mem. Mus. d'Hist. Nat. Paris*, III, 1817: 431, pl. XVIII, figs. 2 and 5 (skeleton).
Brachionichthys hirsutus McCulloch, *Mem. Aust. Mus. Sydney*, V, 3, 1929: 409.

Early brief notices of this species do not appear to have been supplemented by an adequate description: Johnston's (1883*a*) account is short (though containing several useful observations: in radial formula 10-19 should read 16-19), while of notices of two New South Wales specimens Günther's (1887) is a record only, and Waite's (1898) chiefly a note on synonymy. Avery good colored figure (labelled Tortoiseshell Fish, *Cheironectes politus*), however, was early provided by Mrs. Meredith (1881). Observations here given are based on a slightly damaged specimen, *LS* 67·0, *LT* indeterminable (caudal imperfect), secured in the Derwent Estuary by Mr. B. Mollison.

Fin Counts.—D. I, II, 20. A. 10. V. I, 4. C. 10.

General Dimensions and Proportions.—Head, to middle of gill-opening (28·1) 2·4 in *LS*, rather less than twice direct distance between two gill-openings; length to middle of vent (33·3) 2·0 in *LS*, about three-fourths second dorsal base: head, trunk, tail thus 42, 8, 50 per cent., respectively, of *LS*. Eye (4·8) 5·9 in head, 1·2 in interorbital (5·7) : snout (3·5) 1·4 in eye. Trunk high, fairly wide anteriorly, compressed posteriorly; tail high, compressed. Maximum depth (19·5), occurring near origin of pseudobrachium, 3·4 in *LS*, subequal to length to origin of second dorsal: depth at gill-opening (18·6), at vent (13·9), at termination of soft dorsal (6·0), 1·0, 1·4, 1·3 in thickness at these points. Caudal peduncle (8·1) 3·3 in total tail without fin, subequal to combined eye and snout; its depth (5·8) 1·4 in its length.

Head.—Elevated, broad: height at front of eye (10·5), back of eye (16·3), front of pelvic insertion (18·2) 1·5, 1·4, 1·1 in thickness at these levels. Superior contour from lower lip to highest point (near middle of interdorsal) closely approaches quarter-circumference of circle of radius 16 (*i.e.*, three-fourths of postorbital head) with centre on horizontal level of angle of gape. Mouth moderately oblique, its cleft at about 30 degrees to virtually rectilinear pelvic-vent section of inferior profile. Lower jaw shorter than, largely enclosed within, upper: with mouth closed, cleft, viewed laterally, barely visible. A deep sulcus above upper jaw, continuous from side to side, running parallel with, and simulating, mouth-cleft, for which, when lips are closed, it might conceivably be mistaken (fig. 4*a*). Superior boundary of sulcus constituted by two long, slightly tumid lateral folds and a median eminence that their anterior extremities briefly overlap: from middle, most advanced region of this tumescence arises first dorsal spine (fig. 4*b*). Maxilla to below 0·5 eye. A small free interramal fold; its median extension caudad less than half length of gape; its posterior portion on either side extending up over maxilla, the end of which it encloses, and being apparently continuous with lateral fold above sulcus. Eye rather small, subcircular; its diameter subequal to its distance from base of first spine; not cutting dorsal profile (though supraorbital ridge in part constitutes profile). Interorbital wholly occupied for about one-third of its width by first dorsal. Interdorsal with median groove. A shallow infraorbital depression; cheeks tumid; chin and throat flattened. Nostrils small, simple, with slightly raised rims, opening at ends of short barrow-like eminence: the anterior on a level with hind border of base of detached dorsal spine, from which it is separated by rather more than spine's basal diameter; the posterior above the anterior by one-third of its distance from its fellow.

Teeth.—In upper jaw small, subcylindrical, slightly recurved, depressible, forming on either side a band three or four rows in width anteriorly, narrowing to one or two rows posteriorly. In either ramus of lower jaw a similar, but rather narrower, band of teeth resembling, but rather larger than, those of upper jaw, and showing some tendency to increase in size from in front backwards. No other teeth recognized. Most of palate, which is spanned anteriorly by a fairly wide frenum, carries papillae somewhat similar to, but larger than, the teeth. Tongue large, adnate right to its anterior extremity, the face of which is subvertical.

Mucigerous System.—A series of paired subconical tubercles extends from mandibular symphysis towards each pseudobrachium; several pairs

of small pores occur above, and some pores below, eye: but full extent of system cannot be made out (partly, no doubt, because of confusion—not infrequently encountered in angler fishes—introduced by presence of other dermal structures; probably partly also as result of preservation).

Gill-opening.—Small (in specimen as preserved about 1·5 in greatest diameter), somewhat elongated anteroposteriorly; closable, wholly or partly, by valvule at anterior margin; about half eye behind, about one-fourth eye above level of, upper angle of axilla: situated in backwardly sloping posterior face of a longitudinal elevation extending forward for a distance exceeding interpelvic interval, rapidly narrowing cephalad from a narrow, semicylindrical ridge, about half eye in dorsoventral extent, to an almost flush indication of a tube less than 1 mm. in diameter. Length to middle of aperture (28·1) subequal to distance from level of termination of soft dorsal to ridge delimiting anal region anteriorly, or 1·9 direct transverse distance between two gill-openings.

Fins.—First dorsal spine a simple, smooth, tapering, translucent, flexible rod, surmounted by a simple, fleshy, lanceolate illicium scarcely distinguishable, save by its rather greater flexibility, from its support; base bulbous, movably inserted into eminence forming median superior boundary of supralabial sulcus, length to base (0·5) thus being only anteroposterior extension of upper lip; illicium (2·1) 5·2 in total length of organ (10·9), the latter 2·6 in head, equal to distance from base of spine to posterior rim of bony eyesocket; not connected by membrane with, and moving quite independently of, second spine; as preserved, lying laxly against, and following curve of, snout and early forehead. Second spine originating behind first by more than basal diameter of latter; its (possibly incomplete) length (11·1) 2·5 in head, or about half direct distance from its base to origin of soft dorsal; wholly enclosed in skin; anterior face, for at least four-fifths of length, thickly set with spinules, a few of which extend on to immediately adjacent fin-membrane. Third spine (imperfect; present length 7) originating above anterior one-third of eye. Second and third spines together forming cristiform fin; membrane very thick and fleshy, especially basally: length to origin (1·6) 5·3 in length to termination (8·5); base equal to width of mouth. Interdorsal (10·0) subequal to longest pectoral ray. Soft dorsal originating slightly behind anterior insertion of pseudobrachium; length to its origin (18·5) 3·6 in LS, 2·2 in base of fin (40·4), the latter subequal to combined trunk and tail; 5th (in specimen the first perfect) ray (15·3) 1·8 in head, subequal to 10th ray, 1·5 17th: only a few rays are perfect, making contour of fin indeterminable; base only of last ray connected by membrane to caudal peduncle (but a damaged condition possible). Rays glassy, strongly septate: most, perhaps all, divided basally by deep median groove, pressure (*e.g.*, by tip of stylus) on which causes ray to split in longitudinal side-by-side halves, which (at any rate in anterior part of fin) are separately rooted and independently movable. Anal originating below 11th dorsal ray; length to its origin (38·0) 1·8 in *LS*, 1·8 base of fin (20·6), which latter is slightly more than half second dorsal base; terminating almost vertically below (0·3 mm. in advance of) dorsal termination; first ray (6·0) 4·7 in head, 1·4 in second ray; posterior rays distally imperfect, and fin contour uncertain, the indications suggesting height increases somewhat for first two or three rays, thereafter descending, if at all, but slightly, with any possible rounding-off restricted to last ray or two; base only of last ray

attached by membrane to caudal peduncle. Caudal imperfect, only proximal one-third present: all rays actually divided in plane along which dorsal rays split when pressed upon basally, namely, the sagittal; division complete, the two stiff hyaline rods inserted by separate roots, the distance between which, for any pair, exceeds basal diameter of a rod, so that, in present condition, fin presents two distinct apposed fans, whose truncated bases are set parallel, about 0·3 apart.

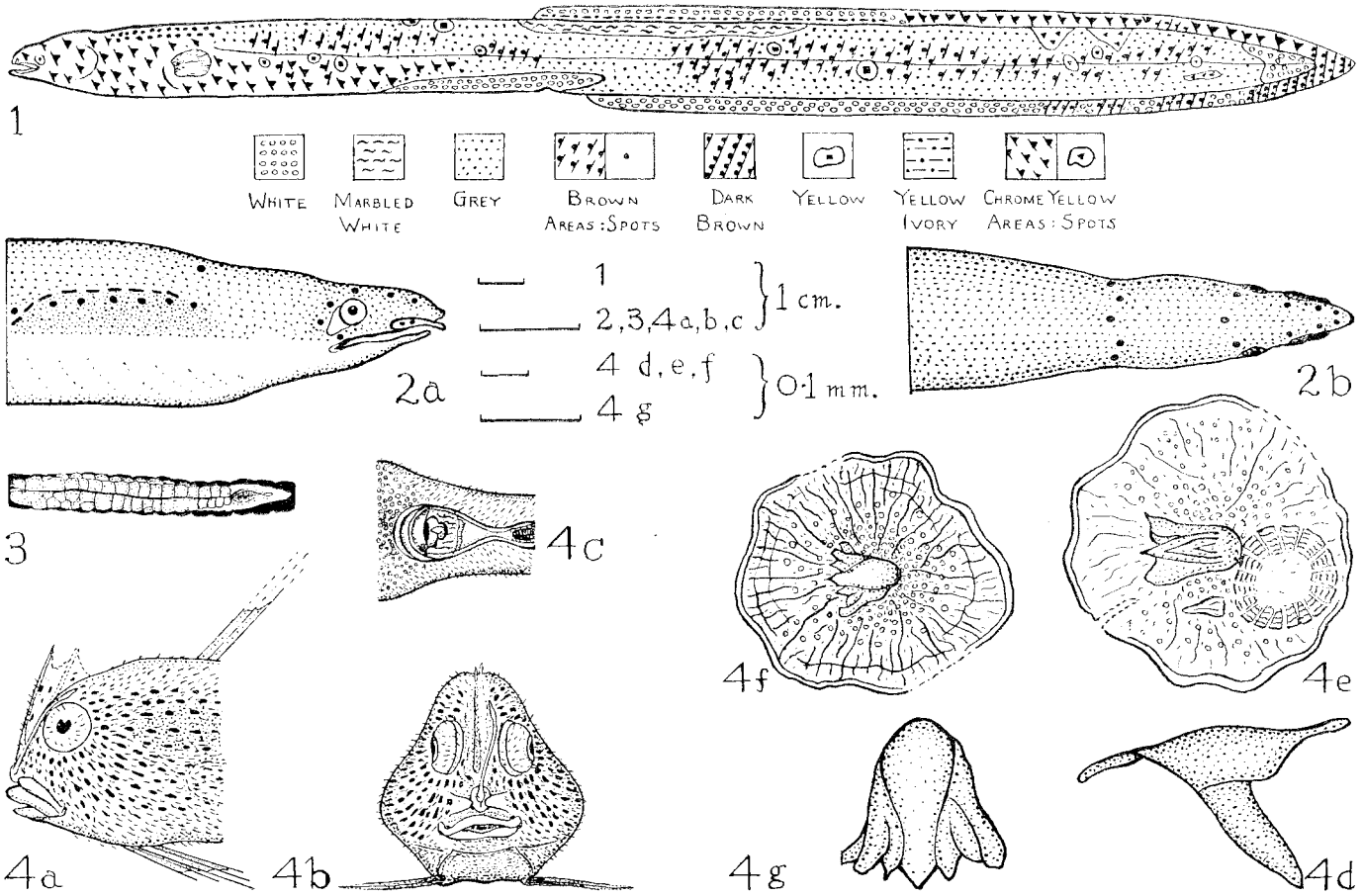
Ventrals originating just anterior to level of middle of interdorsal, or behind eye by about eye-diameter; length to origin (12·5) 2·2 in head, or about thrice anteroposterior extension of base of fin (4·0); longest (3rd) ray (11·3) 2·5 in head, 1·7 spine; laid back, extending almost to level of gill-opening; spine weak; rays externally simple, unbranched, but the glassy axis, when divested of membrane, readily splitting longitudinally in two. Interpelvic (8·8) exceeding width of mouth. The following account of the pectoral assumes fin to be adpressed to flank, with whole pseudobrachium subhorizontal, and rays directed upwards and somewhat backwards towards base of soft dorsal. Pseudobrachium well developed, with a bound anterior section, appearing as an obliquely longitudinal ridge below integument, and a free posterior section, from whose rounded extremity (chord of terminal arc inclined upwards and forwards at 45 degrees, or more, to horizontal line of belly) arise the simple rays, set in thick membrane; free section with superior border upwardly concave, inferior border nearly linear, oblique, the vertical height of lateral surface of arm at level of insertion of anterior rays (5·4) being 1·2 that at level of axilla; length to anterior insertion, beneath integument, (17·9) 1·5 in length to axilla (26·4), 1·9 in length to free distal border or ray-bearing 'wrist' (33·8), enclosed portion thus being 1·1 free; longest (4th) ray (9·4) 3·0 in head, tips of rays extending briefly beyond membrane. With pseudobrachium adpressed and held sufficiently obliquely just to cut inferior profile of fish (which it does at about vent), posterior border of fin, in unexpanded state, forms rather more than right angle with inferior border of pseudobrachium and points towards middle of soft dorsal base. Pectoral rays fissionable sagittally; less readily so than ventral rays.

Anal Region.—A lyrate region wholly free of spinules embraces, and extends behind, anus (fig. 4*c*); length (11·5) rather more than twice its width. Comprises, in succession caudad: two approximated proconvex ridges, separated by shallow groove; thick, fleshy anal flap, whose posterior border constitutes anterior border of vent; transverse aperture of vent; slightly tumid hinder lip of anus, middle one-third of lip being overlaid by small, wide-based subconical genital papilla; large, lightly longitudinally plicate depression, bounded laterally by subparallel ridges; less-depressed region, somewhat elevated mesially by continuations of same ridges (which thereafter extend caudad along base of anal fin).

Spinules and Scales.—Except for lyrate anal region, a small inferior portion of free section of pseudobrachium, lips and supralabial folds (including medial tumescence), central area of eye, bottom of interdorsal groove, fins in general (but see account of second dorsal spine), all external surfaces thickly beset with glassy spinules; which, however, exhibit some diversity of shape, size, frequency, inclination, relation to substratum. On midflank a typical spinule (fig. 4*d*) is subconical, slightly recurved, backwardly pointing, its main axis at about 60 degrees to body surface, set in a mammilliform eminence arising from near centre of subcircular

cycloid scale; lamina and a variable fraction of central boss of scale wholly buried in integument, through which, however, general shape of scale can usually be determined with lens; in example figured length of free spine (278 μ) is 2·9 its basal width (97μ) : in this region scales not contiguous, naked area about twice scaled area. On side of tail spinules similar, rather smaller; scales more closely set, less apparent. In a region roughly delimited in front and below by line from termination of first dorsal to near gill-opening and behind by vertical line from near gill-opening to base of second dorsal scales are somewhat more obvious, especially near superior profile at interdorsal, where they are contiguous, or virtually so: a scale from this region (fig. 4*e*) is 600μ by 555 μ; spinule complex, slant height 307 μ; secondary simple spinule, slant height 107 μ; ridge-system 253μ by 254 μ: a second scale from nearby (fig. 4*f*), 526μ by 502 μ, lacks ridge-complex; spinule (fig. 4*g*) massive and complex, slant height 156 μ, extreme width at tip 166 μ. On being drawn from head caudad along lateral surface of fish, finger-tip registers marked asperity, diminishing slightly on and near caudal peduncle. Much more difficult to run finger along skin in opposite direction; if any marked pressure is applied, impracticable to do so. On chin, throat, belly spinules set in circular concavities (particularly well-defined from level of ventrals caudad) and readily depressible: hence, with finger drawn caudad, surface feels almost smooth, while movement in opposite direction encounters resistance of the same order as that associated with caudad stroking on trunk.

Coloration.—Lateral surfaces in general a tolerably uniform, somewhat pinkish grey: ill-defined lighter areas behind and above eye; below front of eye; in advance of, and slightly above, pectoral insertion; inferolateral region of head; hinder portion of external surface of pseudobrachium; small patch on axilla. A broad dark stripe, most intense posteriorly, running forward and somewhat downward from below base of soft dorsal, a little behind level of gill-opening, towards eye, of which it stops short by more than eye-diameter; a short broad, oblique dark bar extending downwards and forwards from superior profile at termination of second dorsal to midlateral line, or beyond. On lateral surface about sixteen rows of red-brown markings, ranging from subcircular spots to anteroposteriorly elongated subrectangular blotches, radiating from eye: of these about half a dozen markedly oblique, terminating at, or a little above, inferior profile in advance of insertion of pseudobrachium, the first two of this series comprising each only three or four spots; three running down with moderate obliquity on to, and continuing nearly horizontally along, anterior half or more, of pseudobrachium; the rest running back, more or less parallel to body profiles, to beginning of caudal peduncle, and there ceasing abruptly. Behind vent a narrow inferolateral strip without markings. Anteriorly, several of the upper rows of spots contiuue in advance of eye on to dorsal surface, flanking base of spinous dorsal; posteriorly, uppermost row meets superior profile behind origin of second dorsal, so that interdorsal region is without spots not only on upper surface, but also along a strip of superlateral surface, of fish. Lower surfaces all immaculate; in head and trunk whitish; in tail concolorous with lateral surface. Lower lip whitish; upper lip and supralabial folds pale yellowish, nearly concolorous with inside of mouth. Pupil white; iris bluish. Thick membrane of first dorsal yellowish; with about half a dozen brownish spots, forming apparent continuation of series on forehead. Second



FIGS. 1-4.—1, *Anguilla australis* Richardson, 1841; abnormally colored specimen. 2, *Muræniehthys breviceps,* Günther, 1876: head, showing pores; *a,* lateral aspect; *b,* dorsal aspect. 3, *Leptonotus semistriatus* Kaup, 1856: ovisac. 4, *Brachionichthys hirsutus* (Lacépède, 1804): *a,* head, lateral aspect; *b,* head, frontal aspect; *c,* anal region; *d,* scale from midflank; *e, f* scales from shoulder region; *g,* detail of complex spine of *f.*

dorsal apparently whitish, with some obscurely preserved darker spots; posterior three or four rays dark, almost black, the marking continuous with oblique bar on trunk. Anal pale yellowish. Ventral whitish. Membrane and rays of pectoral pale, faintly tinged with greenish yellow. Rays of caudal hyaline. (Life colors of fins as shown in Mrs. Meredith's plate suggest her vernacular name, Tortoiseshell Fish, is an appropriate one.)

Remarks.—The presence in this fish of distinct, readily recognizable scales is of interest. No mention is made of scales in any description of this, or of an allied, species that has come under my notice; and the old family Pediculati, *sensu lato,* of which the present-day Brachionichthyidae represents one section, was diagnosed as without scales on head and anterior part of body. The curious proneness to sagittal division of the fin rays of the vertical fins might, in itself, plausibly be interpreted as a retention of an early phase in the usual process of formation of these fins by the apposition (and, in most fishes—save as an abnormality—the subsequent complete fusion) of two lateral moities: but the same phenomenon occurs also in the other fins, each of which might be expected to arise from a single ' muscle bud '. It is possible, however, that an indication of the double origin of the vertical fins really, does exist in the shape of the two-rooted insertion of their rays; and that the tendency of fins-rays in general to split longitudinally is idiosyncratic.

REFERENCES

EZEKIEL, M., 1947.—*Methods of Correlation Analysis.* Second ed. New York.

FISHER, R. A., 1932.—*Statistical Methods for Research Workers.* Fourth ed. Edinburgh.

GOODE, G. B. AND BEAN, T. H., 1895.—*Oceanic Ichthyology.* Washington*.

GUNTHER, A., 1876.—Remarks on Fishes, with Descriptions of New Species in the British Museum, chiefly from Southern Seas. *Ann. Mag. Nat. Hist.* (4), XVII: 389-402.

————————, 1880.—*Voyage of H.M.S. Challenger. Zoology* I. Report on the Shore Fishes.

————————, 1887.—*Voyage of H.M.S. Challenger. Zoology.* XXII. Report on the Deep Sea Fishes.

HALDANE, J. B. S., 1952.—Variation. *New Biology,* 12: 9-26.

HECTOR, J., 1871.—On a New Species of Fish, *Coryphænoides Novæ-Zelandiæ;* Native name, Okarari. *Trans. N.Z. Inst.,* III, 1870 (1871): 136, pl. XVIII, fig. 1.

HUTTON, F. W. AND HECTOR, J., 1872.—*Catalogue of the Fishes of New Zealand.* Wellington.

HUXLEY, J. S. *et al.,* 1927.—Recommendations of the British Association Committee on Biological Measurements. *Rept. Brit. Assoc.*: 286-298.

JOHNSTON, R. M., 1883*a*.—General and Critical Observations on the Fishes of Tasmania. *Pap. Proc. Roy. Soc. Tasm.,* 1882 (1883): 53-144.

————————, 1883*b*.—Notes on *Clinus despicillatus* Richardson, and *Bovichthys variegatus, ibid. Pap. Proc. Roy. Soc. Tasm.,* 1882 (1883): 170.

————————, 1891.—Further Observations upon the Fishes and Fishing Industries of Tasmania. *Pap. Proc. Roy. Soc. Tasm.,* 1890 (1891): 24-46.

KAUP, J. J., 1856.—*Catalogue of the Lophobranchiate Fish in the Collection of the British Museum.* London.

KYLE, H. M., 1926.—*The Biology of Fishes.* London.

LORD, C. E., 1923.—A List of the Fishes of Tasmania. *Pap. Proc. Roy. Soc. Tasm.,* 1922 (1923): 60-73.

LORD, C. E. AND SCOTT, H. H., 1924.—*A Synopsis of the Vertebrate Animals of Tasmania.* Hobart.

McCoy, F., 1878.—*Prodromus of the Zoology of Victoria*, dec. XX. Melbourne.
McCulloch, A. R., 1911.—*Zoological Results of the Fishing Experiments carried out by the F.I.S. "Endeavour"*, 1909-10. Part 1. Sydney.
———————, 1923.—Notes on Fishes from Australia and Lord Howe Island. *Rec. Aust. Mus. Sydney*, XIV, 1: 1-17, pl. I-III.
———————, 1926.—*Biological Results of the Fishing Experiments carried on by the F.I.S. "Endeavour"*, 1909-14. Vol. V, part 4. Sydney.
———————, 1927.—*The Fishes and Fish-like Animals of New South Wales.* Second ed. (Additions by G. P. Whitley). Sydney.
———————, 1929.—A Check-List of the Fishes Recorded from Australia. *Mem. Aust. Mus. Sydney*, V, I-III, (IV, Index, 1930).
McCulloch, A. R. and Waite, E. R., 1918.—Some New and Little-known Fishes from South Australia. *Rec. S. Aust. Mus.*, I, 1: 39-78, pl. II-VII.
Macleay, W., 1881.—Descriptive Catalogue of the Fishes of Australia. *Proc. Linn. Soc. N.S.W.*, V, III, 1880 (1881): 302-444, Part 1; V, IV, 1880 (1881): 520-629, Part 2; VI, I, 1881 (1881): 1-138, Part 3; VI, II, 1881 (1881): 302-387, Part 4.
Meredith, L. A., 1881.—*Tasmanian Friends and Foes, Feathered, Furred and Finned.* London.
Parrott, A. W., 1948.—Studies in New Zealand Fishes. *Rec. Cantab. Mus.*, V, 3: 137-160, pl. XXX-XXXI.
Regan, C. T., 1913.—The Antarctic Fishes of the Scottish National Antarctic Expedition. *Trans. Roy. Soc. Edinburgh*, XLIX, 11: 229-292, pl. I-XI.
Roughley, T. C., 1916.—*Fishes of Australia and Their Technology.* Sydney.
Schmidt, J., 1928.—The Fresh-Water Eels of Australia. With some Remarks on the Short-Finned Species of *Anguilla*. *Rec. Aust. Mus. Sydney*, XVI, 4: 179-210, figs. 1-14.
Scott, E. O. G., 1934.—Observations on Some Tasmanian Fishes, with Descriptions of New Species. *Pap. Proc. Roy. Soc. Tasm.*, 1933 (1934): 31-53, pl. VI-VIII, text figs. 1-2.
———————, 1935.—Observations on Some Tasmanian Fishes: Part II. *Pap. Proc. Roy. Soc. Tasm.*, 1934 (1935): 63-79, pl. V.
———————, 1936.—Observations on Some Tasmanian Fishes: Part III. *Pap. Proc. Roy. Soc. Tasm.*, 1935 (1936): 113-129, text figs. 1-3.
———————, 1939.—Observations on Some Tasmanian Fishes: Part IV. *Pap. Proc. Roy. Soc. Tasm.*, 1938 (1939): 139-159, text figs. 1-2.
———————, 1942.—*Syngnathus tuckeri sp. nov*: A New Tasmanian Pipefish. *Rec. Queen Vict. Mus. Launceston*, I, 1: 17-20, pl. V.
Simpson, G. G. and Roe, A., 1939.—*Quantitative Zoology: Numerical Concepts and Methods in the Study of Recent and Fossil Animals.* New York.
Snedecor, G. W., 1950.—*Statistical Methods Applied to Experiments in Agriculture and Biology.* Fourth ed. Ames.
Stead, D. G., 1908.—*The Edible Fishes of New South Wales.* Sydney.
Strubberg, A., 1913.—The Metamorphosis of Elvers as Influenced by Outward Conditions. *Meddelelser fra Kommissionen fur Havundersogelsea Ser. Fiskeri*, IV, 3.*
Student, 1908.—The Probable Error of a Mean. *Biometrika*, VI, 1: 1-25.*
Thompson, D. W. 1942.—*Growth and Form.* Second ed. Cambridge.
Waite, E. R., 1899.—Scientific Results of the Trawling Expedition of H.M.C.S. 'Thetis' off the Coast of New South Wales in February and March, 1898. *Mem. Aust. Mus. Sydney*, IV, 1.
———————, 1909.—*The Subantarctic Islands of New Zealand;* Vertebrata in Vol. II: 542-600.
———————, 1911.—Scientific Results of the New Zealand Government Trawling Expedition, 1907; Pisces, Part II. *Rec. Cantab. Mus.*, I, 3: 157-272, pl. XXIV-LVII, and figs. 1-3.
———————, 1921.—Catalogue of the Fishes of South Australia. *Rec. S. Aust. Mus.*, II, 1: 1-208, pl. 1, text figs. 1-332.
Waite, E. R. and Hale, H. M., 1921.—Review of the Lophobranchiate Fishes (Pipefishes and Sea-horses) of South Australia. *Rec. S. Aust. Mus.*, I, 4: 293-324, figs. 39-56.
Whitley, G. P., 1948.—Studies in Ichthyology No. 13. *Rec. Aust. Mus. Sydney*, XXII, 1: 70-94, figs. 1-11.

[* Not seen]