

OBSERVATIONS ON SOME TASMANIAN FISHES: PART XII

By

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(With one text figure)

ABSTRACT

Two species are added to the Tasmanian list: *Parequula melbournensis* (Castelnau), 1872 [Gerriidae]; *Neoodax radiatus* (Quoy & Gaimard), 1835 [Neoodacidae] (the specimen exhibiting variation in formula and in shape of dorsal). *Apogon lemprierei* Johnston, 1883 [Apogonidae], apparently lost sight of since publication, is redescribed and figured: it is referred, with some reservation, to *Vincentia* Castelnau, 1872, the status of which *vis-a-vis* *Gronovitchthys* Whitley, 1930 is discussed. Examination of a sample of 7 females of *Syngnathus curtirostris* Castelnau, 1872 [Syngnathidae] yields some proportional values extending the ranges recorded in the conspectus of local syngnathids (Scott, 1961), and provides some information on relative rates of growth of the various morphological segments of the antero-posterior axis: variations in body ridges and in colour pattern in this sample are recorded, and a summary is given of a study of coloration in another specimen. The fifth recorded example of *Syngnathus tuckeri* Scott, 1942 [Syngnathidae] is noted, and some relative growth rates in this species are tabulated: new extremes of size and proportion, lying outside those of the conspectus, are reported.

Keys are provided covering the Tasmanian members of the families Neoodacidae, Apogonidae.

INTRODUCTION

This paper follows the general plan of others in the series. The symbols *Ls*, *Lt* denote standard length, total length, respectively; *TLs*, *TLt* signify thousandths of standard, of total, length. All linear dimensions are in millimetres, the name of the unit commonly being omitted.

Family SYNGNATHIDAE

Genus SYNGNATHUS Linné, 1758

Syngnathus curtirostris Castelnau, 1872

Syngnathus curtirostris Castelnau, 1872, *Proc. Zool. Acclim. Soc. Vict.*, 1: 243. Type locality: St Vincent's Gulf, South Australia.

Syngnathus curtirostris Castelnau. McCulloch & Waite, 1918, *Rec. S. Aust. Mus.*, I, 1: 39; pl. V, fig. 1. McCulloch, 1929, *Mem. Aust. Mus.*, V, 1: 86. Munro, 1958, *Handbk Aust. Fish.*: 82, fig. 569 [instalment No. 20 in *Fisheries Newsletter*, XVII, 2, February 1958: 18, fig. 569].

Low Head specimen.—A female specimen, *Ls* 139.7, *Lt* 142.8, obtained at Low Head, Dorset, Tas-

mania by Miss A. Mather has been noticed earlier in these Observations (1953: 150), and attention has since been called (1961: 62) to the non-inclusion of Tasmania among the States recorded for this species in the Handbook (Munro, 1958: 82). Some observations on the coloration and color-pattern of this individual are made below.

Clarence Point sample.—Using a handnet among eel-grass Mr R. H. Green secured in January 1962 a series of 7 examples—(a)–(g), *Ls* 56.2, 76.1, 87.1, 89.1, 93.5, 97.0, 97.9; *Lt* 58.4, 78.0, 89.1, 91.1, 95.6, 99.0, 100.0, respectively—at Clarence Point, Devon. None show any sign of brood pouch. Though rather small numerically the sample yields some interesting comparative data. Enumeration of counts, measurements and non-metrical features here given are set out in order of ascending magnitude of total length of fish.

The sample includes also 3 specimens of *Syngnathus phillipi* Lucas, 1891, *Ls* 73.3, 83.8, 88.0; *Lt* 75.1, 86.0, 90.1.

Extension of conspectus values.—A conspectus of Tasmanian syngnathids (Scott, 1961) provides, as the first 8 entries for each species, the minimum and maximum values, as recorded in the literature, for a count or body proportion. For several characters the present material extends a recorded value to stand now as follows: caudal annuli 42–47 (in conspectus 42–44); eye in snout 1.8–3.0 (1.8–2.1); head in trunk 2.4–3.5 (2.9–3.5); trunk in tail 2.2–2.8 (2.2–2.4).

The reason for the distinctly smaller eye in our material remains obscure—especially in view of the facts, first, that our specimens are smaller than those of those previously reported upon (Waite & Hale's 2 males, 2 females 125–164), and, secondly, that the published ratios take account of a Tasmanian example (from Low Head; *Lt* 142.8). All our values for head in trunk (2.4–2.6) and for trunk in tail (2.5–2.8) also stand outside the accepted ranges.

In giving in the conspectus snout in head as 2.5–2.7, the 'three times' of the original (two-sentence) notice of the species (1872 *b*) was overlooked.

Lt.—The estimated standard deviation of a random sample of 7 items from a normal population, the sample having a range equal to the *Lt* range of the present series (41.6) is 15.38 [a convenient table is given by Lindley & Miller (1953)]: the calculated standard deviation (unadjusted, using *n*) of Mr Green's collection is 13.66. These

values are not inconsistent with the hypothesis that that we are here randomly sampling a normal population of total lengths, a hypothesis that applies with equal force to the two populations, number of dorsal rays, number of caudal annuli, dealt with below. For *Lt*, *V* (unadjusted) is 15.6, which seems rather unexpectedly high for members of a single age-group: it is possible specimens (c)-(g) with *Lt*-range 10.9, and *V* 4.50, are coeval, with the 2 other individuals of a somewhat different age, or ages.

Dorsal rays, dorsal base.—Rays number 20, 23, 24, 20, 23, 23, 20; the range being identical with that recorded for the species in the conspectus: σ , estimated for normal population, calculated, 1.479, 1.414. Length of dorsal base, which like number of rays, exhibits no apparent correlation with *Lt* (see Table I) has estimated, calculated σ 1.109, 1.056. No correlation subsists in this small sample between base-length and ray number.

Other fins.—The minute anal appears regularly to have 3 rays. P. 10-11. Waite & Hale (1921: 300) give C.10; but our specimens have 5 or 6 rays, of which most, or all, are bifurcate.

Annuli.—All these fish have 18 trunk annuli (recorded range 18-19). Tail annuli number 44, 44, 45, 45, 46, 45, 44 (all exceeding the previously known maximum): with estimated, calculated σ 0.740, 0.700, a normally distributed population is suggested. No correlation is apparent between number of caudal rings and overall size.

Dimensions and proportions.—Table I sets out, for 8 important dimensions, first, the absolute extension along anteroposterior axis of fish as measured (mm); secondly, this value as estimated from the equation of regression of relevant region (*Y*) on total length (*X*); thirdly, the relative magnitude of the dimension (as measured), expressed as thousandths of total length (*TLt*); fourthly, the equation of regression of *Y* on *X*, together with its *t*-value; fifthly, the correlation coefficient of *Y* and *X*, both *r* and *z* being recorded (Simpson & Roe, 1939). Some comments on the table follow.

(i). The correlation of *Y* and *X* is seen to be exceptionally high: for one entry, snout, $P < 0.02$ (about 0.011); for the 7 remaining entries $P < 0.01$, indeed, for 4 of them, head, trunk, preanal region, tail, $P < 0.001$. The sample thus affords striking evidence of the validity and reliability (at least for this species, this sex, and the relevant size-range) of current taxonomic practice in employing as systematic criteria ratios based on body regions here dealt with. Not unexpectedly, the larger dimensions, measurable with relatively greater accuracy, yield the larger coefficients, *z* exceeding 2 only in head and regions longer than it.

(ii). The absolute magnitudes estimated from the regression equations are published alongside the measured magnitudes with the feeling that the potential systematic value of such equations is perhaps not as widely realized as it might be. In the writer's experience it has been found that with data of this type their predictive value is such (and this among various groups of fish) as to permit of the making of interpolations, and in

general of at least small-scale extrapolations, with a high measure of confidence. In not a few instances they afford reliable, at times surprisingly sensitive, criteria for specific, subspecific or sex distinction. As an indication of their accuracy of estimation—a good general idea of which may be gained directly from the table—the following summary is not without interest. With 8 dimensions in ascending order of size, the ranges (in parentheses, means) of the divergences between measured and estimated values are, in mm.: 0-0.1 (0.04), 0-0.3 (0.14), 0.1-0.4 (0.19), 0-0.4 (0.21), 0-0.3 (0.11), 0-0.2 (0.14), 0-0.2 (0.10), 0-0.2 (0.09); overall 0.4 (0.15). Expressed as percentages these quantities are: 0-9.1 (3.42), 0-9.1 (4.25), 2.3-10.5 (5.03), 0-8.0 (3.46), 0-3.3 (1.33), 0-0.9 (0.51), 0-0.7 (0.35), 0-0.5 (0.18); overall, 0-10.5 (2.65)—the high percentage differences among the smaller dimensions being of course largely attributable to the relative coarseness of the measuring technique here (in the case of the eye, a difference of one unit of measurement, i.e., one-tenth of a millimetre, represents up to 10% of total dimension); in no one of the largest 3 dimensions does the maximum divergence for any specimen amount to 1 mm.

(iii). It will be seen that the relative length of the tail increases with the increase in size of fish, the *TLt* values rising unequivocally across the table from left to right from 640 to 659. (Compare data given below for *S. tuckeri*, Table III and discussion). A breakdown of the preanal region into its primary components of head and trunk reveals both of these as exhibiting a tolerably clear trend of decrease in *TLt* from the smallest to the largest specimen. A secondary breakdown of head to its successive components of snout, eye, postorbital head fails to yield certain evidence in these elements of a similar decrease (or an increase); the most suggestive sequence of entries being that for eye. Further light is thrown on the general problem of regional growth among the members of this sample by a consideration of percentage growth increments.

Percentage length increments.—Table II gives, for each of the 8 morphological regions dealt with in Table I: in the first line the percentage increase in length over specimen (a) of each of specimens (b)-(g); in the second line this value as estimated from the regression equation; in the third line the (actual) percentage increase relative to the percentage increase in *Lt*, the latter being taken as unity. The procedure here adopted in calculating the increments, namely, in terms of the increase, in turn, of each of specimens (b)-(g) over (a)—which has the undesirable effect of attaching undue weight to the dimensions of (a)—derives from the fact that there is not invariably associated with an increase in *Lt* an increase in the relevant region (see first lines of Table I). In the case of the two main regions, in which no such problem arises, calculations in which the obvious course of determining values in turn for (b)—(a), (c)—(b) . . . (g)—(f) yield results not differing greatly from those entered in Table II; the preanal percentage increase in length relative to that of *Lt* as unity having an arithmetic mean of 0.837 (geometric mean 0.827), and that for tail 1.093 (1.090).

TABLE I

Syngnathus curtirostris Castelnau, 1871. Seven specimens from Clarence Point, Devon, Tasmania. Anteroposterior lengths of 8 specified regions—absolute (mm), first, as measured, secondly, as estimated from regression equation (recorded, with indication of significance) of relevant region (Y) on total length, *Lt* (X); relative, as thousandths of total length, *TLt*; also correlation of X and Y

Region (Y)		Specimen <i>Lt</i> (mm) (X)							Correlation of X and Y		Regression of region (Y) on <i>Lt</i> (X)	
		(a) 58.4	(b) 78.0	(c) 89.1	(d) 91.1	(e) 95.6	(f) 99.0	(g) 100.0	<i>r</i>	<i>z</i>	Equation	<i>t</i>
Snout	Measured	2.6	3.0	3.3	3.9	3.9	3.9	3.9	0.870**	1.334	$Y = 0.03437 X + 0.50$	6.26**
	Estimated	2.5	3.2	3.6	3.6	3.8	3.9	3.9				
	<i>TLt</i>	45	38	37	43	41	39	39				
Eye	Measured	1.0	1.1	1.3	1.4	1.3	1.4	1.4	0.940**	1.736	$Y = 0.01355 X + 0.37$	7.05**
	Estimated	1.0	1.2	1.3	1.3	1.4	1.4	1.4				
	<i>TLt</i>	17	14	15	15	14	14	14				
Postorbital head	Measured	2.4	3.8	4.1	3.9	4.3	4.1	4.3	0.949**	1.819	$Y = 0.04240 X + 0.14$	6.10**
	Estimated	2.6	3.4	3.9	4.0	4.2	4.3	4.4				
	<i>TLt</i>	41	49	46	43	45	41	43				
Head	Measured	6.0	7.9	8.7	9.2	9.3	9.4	9.6	0.981**	2.321	$Y = 0.08476 X + 1.19$	11.36**
	Estimated	6.1	7.8	8.7	8.9	9.3	9.6	9.7				
	<i>TLt</i>	103	101	98	101	97	95	96				
Trunk	Measured	15.0	19.6	22.2	22.3	23.5	24.5	24.5	0.999**	3.913	$Y = 0.2294 X + 1.63$	74.00**
	Estimated	15.0	19.5	22.1	22.5	23.6	24.3	24.6				
	<i>TLt</i>	259	251	249	245	246	248	245				
Preanal region	Measured	21.0	27.5	30.9	31.5	32.8	33.9	34.1	0.981**	2.324	$Y = 0.3150 X + 2.73$	86.17**
	Estimated	21.1	27.3	30.8	31.4	32.9	33.9	34.2				
	<i>TLt</i>	360	353	347	346	343	342	341				
Tail	Measured	37.4	50.5	58.2	59.6	62.8	65.1	65.9	0.981**	2.316	$Y = 0.6842 X - 2.67$	45.92**
	Estimated	37.2	50.6	58.2	59.6	62.7	65.0	65.8				
	<i>TLt</i>	640	647	653	654	657	658	659				
Dorsal base	Measured	3.9	5.0	6.5	6.6	6.9	6.7	6.9	0.950**	1.828	$Y = 0.7674 X - 0.63$	9.79**
	Estimated	3.9	5.4	6.2	6.4	6.7	7.0	7.0				
	<i>TLt</i>	67	64	73	72	72	68	69				

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TABLE II

Syngnathus curtirostris Castelnau, 1872. Seven specimens from Clarence Point, Devon, Tasmania. Percentage increase of length of each of 6 specimens (b)-(g) (Lt 78.0-100 mm) on specimen (a) (Lt 58.4) in respect of Lt and of 8 morphological regions along anteroposterior axis of fish. For each region there is entered: first, the actual percentage increase in length; secondly, this magnitude as estimated from regression equation (recorded, with indication of significance) of region (Y) on total length, Lt (X); thirdly, actual percentage increase relative to that of Lt as unity

Region (Y)		Specimen						Arithmetic mean (Geometric mean)	Regression of region (Y) on Lt (X)	
		(b)	(c)	(d)	(e)	(f)	(g)		Equation	t
Snout	Actual	15.4	26.9	50.0	50.0	50.0	50.0	40.36 (37.06)	$Y = 0.9447 X - 14.18$	3.33*
	Estimated	17.5	35.5	38.7	46.0	51.5	53.4	40.63 (38.07)		
	Relative to Lt value as unity	0.46	0.51	0.89	0.78	0.72	0.70	0.678 (0.661)		
Eye	Actual	10.0	30.0	40.0	30.0	40.0	40.0	31.67 (28.84)	$Y = 0.7394 X - 11.04$	3.73*
	Estimated	13.8	27.8	30.4	36.1	39.2	41.8	31.50 (29.71)		
	Relative to Lt value as unity	0.30	0.57	0.71	0.47	0.58	0.56	0.532 (0.514)		
Postorbital head	Actual	53.3	70.8	62.5	70.8	70.8	79.2	68.75 (68.42)	$Y = 0.4426 X + 43.19$	3.10*
	Estimated	58.0	66.5	68.0	71.4	73.9	74.9	68.77 (68.53)		
	Relative to Lt value as unity	1.74	1.35	1.12	1.11	1.02	1.11	1.241 (1.220)		
Head	Actual	31.7	45.0	53.3	55.0	56.7	60.0	50.27 (49.22)	$Y = 0.7289 X + 8.18$	8.09**
	Estimated	32.7	46.5	49.0	54.6	58.8	60.1	50.28 (49.20)		
	Relative to Lt value as unity	0.94	0.86	0.95	0.86	0.82	0.84	0.879 (0.877)		
Trunk	Actual	30.7	48.0	48.7	56.7	63.3	63.3	51.78 (50.34)	$Y = 0.8826 X + 0.80$	25.97**
	Estimated	30.5	47.2	50.2	57.0	62.1	63.6	51.80 (50.33)		
	Relative to Lt value as unity	0.91	0.91	0.87	0.89	0.91	0.89	0.898 (0.897)		
Preanal region	Actual	31.0	47.1	50.0	56.2	61.4	62.4	51.35 (50.05)	$Y = 0.8383 X + 3.15$	169.69**
	Estimated	31.3	47.2	50.1	56.5	61.4	62.9	51.57 (50.40)		
	Relative to Lt value as unity	0.92	0.90	0.89	0.88	0.88	0.88	0.892 (0.892)		
Tail	Actual	35.0	55.6	59.4	67.9	74.1	76.2	61.36 (59.49)	$Y = 1.0907 X - 1.64$	285.95**
	Estimated	35.0	55.7	59.4	67.8	74.2	76.1	61.37 (61.38)		
	Relative to Lt value as unity	1.04	1.06	1.06	1.07	1.07	1.07	1.060 (1.060)		
Dorsal base	Actual	23.2	67.7	69.2	76.9	71.3	76.9	64.96 (61.72)	$Y = 1.2374 X - 6.51$	5.22**
	Estimated	35.0	58.5	62.8	72.3	79.5	82.0	65.01 (62.67)		
	Relative to Lt value as unity	0.84	1.27	1.24	1.21	1.03	1.08	1.111 (1.110)		
Total length	Actual	33.6	52.6	56.0	63.7	69.5	71.2	57.76 (56.10)	—	—

It will be observed that, while among the smaller body regions there is some considerable measure of irregularity in the pattern presented by these values, even to the extent of the occurrence, in some instances, of entries in the first line that constitute a local reversal of the general trend of increase, proceeding from left to right, there is, in the case of the head and of larger regions, a very satisfactory overall regularity: to make possible a precise formulation of this consistency the regression equations of the percentage length-increments of the several regions (Y) on corresponding increments of Lt (X) have been calculated, and are recorded in the table; and the estimated percentage increments estimated from these equations are given in the second line, for each region, for comparison with the values as found, entered in the first line.

As in the preceding table, the extremely close correspondence between the measured and predicted entries of the first and second lines in all major regions is noteworthy; and the suggestion is here repeated that such reliability of estimation is surely not without useful systematic application. In both tables the tendency of the value of t to increase, *pari passu*, with increase in magnitude of body-segment studied is of a striking, almost textbook character: [extremely high t -values associated in the present table with two of the equations (those for the two primary moities of total antero-posterior extension of the fish) are probably in part attributable to the fact that we are here plotting, not primary length-measurements, but percentage increments, and treating these as basic data].

Inspection of the column of means (the discussion is based primarily on the arithmetic means: the geometric means, given in parentheses, follow the same sequence) reveals that for postorbital head, dorsal base, tail the relative increase in length exceeds that for Lt , while for 5 other dimensions it is less than for Lt . It is possible the divergences from unity of all the entries in the third lines point to genuine variations—at any rate in the indicated sense (in excess or defect of equality with the Lt mean), if not of actual magnitude—in the percentage increase of relevant region as compared with percentage increase of Lt that examination of further material may satisfactorily establish. However, data at hand for the smaller body-regions are at once too few and too erratic to permit of the drawing of any definite conclusions: on making tests of the significance of the regression coefficients of the equations for region on Lt it is found that for the three recognized segments of the head coupled severally with the head as a whole the differences fall below the level of satisfactory statistical significance (for snout-head, eye-head, postorbital head-head $t = 0.62, 0.05, 1.56$, respectively). Again, for dorsal base-head $t = 1.88$. On the other hand, significant differences between the regression coefficients are encountered in these pairs: head-trunk ($t = 9.99^{**}$), preanal length-tail ($t = 2.86^{**}$).

The overall picture of relative regional growth that emerges, then, is this. Percentage increase of postanal extension as a whole significantly exceeds that of total preanal extension; further,

there is a strong suggestion that the sequence head, trunk, tail exhibits a gradient of percentage length-increment, rising caudad. For the segments of the head the data are statistically inconclusive, but as far as the means may be accepted as provisional pointers the sequence of relative increases arranged in ascending order of magnitude does not parallel the morphological sequence of regions—snout, eye, postorbital having intermediate, least, greatest values, respectively. Dorsal base, which is chiefly postanal, appears to follow the high relative increase characteristic of the tail as a whole.

The employment of such statistical procedures as those involved in the above analyses has somewhat the appearance of the use of a sledgehammer to crack a nut: the conducting of the investigation at this level has, however, seemed worth while, inasmuch as there is thus rendered apparent, to a degree scarcely otherwise possible, the clarity and quite remarkable precision with which, even from very small samples, some basic features of the pattern of growth in these fish can be apprehended and formulated; the models thus arrived at lending themselves to systematically useful specification and prediction of body-form.

Other proportions.—The maximum width of the head is equal to, slightly greater than, less than, the maximum depth of head in 2, 3, 2 individuals; the former dimension being 3.1-3.6, \bar{x} 3.28, the latter 3.0-3.8, \bar{x} 3.23, in length of head. One specimen (c) has head, exceptionally, 1.2 times as deep as wide. The maximum depth of the body, on the other hand, consistently exceeds its maximum width (as Waite & Hale (1921: 300) also found); the former dimension being 2.5-3.2, \bar{x} 2.83, the latter 3.1-4.0, \bar{x} 3.47 in length of head. At middle of tail the width is 4.8-7.3, \bar{x} 5.95, the depth is 4.1-8.6, \bar{x} 5.75, in length of head.

Body ridges.—Some minor variations occur in the location of the free end, on the two sides of the fish, of the upper trunk (TU), median trunk (TM), and upper caudal (CU) ridges. Expressed in the terms of the anteroposterior extent of one trunk or caudal annulus, the differences are: TU 0 (1 specimen), 0.1 (4), 0.2 (1), 0.5 (1); TM 0 (4), 0.1 (2), 0.2 (1); CU 0 (2), 0.2 (1), 0.3 (3), 1.0 (1)—the overall mean being 0.11. Pooling, for each type of ridge, the 14 observations for the 7 specimens, and specifying the point of termination (or of origin; CU) as a decimal of the length of the relevant annulus (with front of ring as origin), we find TU ends at 0.5 (1), 0.6 (1), 0.7 (1), 0.8 (4), 0.9 (3), end (4) of third caudal; TM ends at 0.8 (1), end (8) of last trunk and at 0.1 (4), 0.2 (1) of first caudal; CU originates at 0.4 (5), 0.6 (2), 0.7 (2), 0.9 (2) of last trunk and at 0.1 (2), 0.4 (1) of first caudal. Only in TU, therefore, is an end-point restricted to the one annulus—a point not without systematic interest in view of the frequent specification in this context in descriptions of Australian syngathids of a single annulus.

In (f) CU is subcontinuous with an anomalous lateral ridge extending forward along the trunk, above TM, for about 11 (left) about 10½ (right) annuli.

Cephalic ridges.—Head with numerous striae, including: on dorsum behind eyes a whorled series (this region also heavily pitted); on small trapezoidal occipital plate about a dozen main striae running out from median ridge; many, the anterior subvertical, on side of head above operculum; a set between anterior opercular border and orbit; two rosettes and several longitudinal lines on side of snout. Interorbital honeycombed and pitted. Operculum without transverse ridge, with 30-40 main radial striae.

Rostral crest low: back to level of end of expanded snout-tip very low, its free margin here virtually horizontal; behind this rising tolerably evenly (with aid of lens, profile seen to comprise 2 segments, the posterior rather shorter, steeper); minute, but constant, notch at level of nostril; traceable back to about level of anterior $\frac{1}{3}$ of eye, lapsing in this vicinity into a forwardly-directed triangular tongue, somewhat elevated, the lateral borders of which may be defined by distinct minute ridges, and along the middle of which the line of the crest may be continued as a minute ridge. Supraorbital ridges originating near base of rostral crest, at, or a trifle in advance of, level of nostril; extending feebly behind eye to delimit laterally dorsum of head here, reaching exceptionally to level of middle of operculum (i.e., about $1\frac{1}{2}$ eye-diameter beyond orbit), but commonly lapsing, or becoming indistinguishable from striae, at about $\frac{1}{3}$ of this distance. A feeble median ridge (continuous in all except (b)) originating at level of posterior orbital border (or, (c), $\frac{1}{2}$ eye-diameter behind this); extending to, or virtually to, anterior border of small trapezoidal occipital plate, not quite continuous with its ridge, the latter continuous behind with the nuchal ridge, which is commonly about $\frac{2}{3}$ (in (c), 1) eye-diameter long: all these ridges rather feeble, the system best developed and most stable posteriorly. Between eye and inflated, striated region of operculum 4 ridges: 1 delimiting whole of upper and of short subvertical anterior border of operculum; 1, about $\frac{1}{3}$ eye-diameter long, running obliquely backwards and upwards across upper part of the flattened lobate beginning of operculum; 1 running from 4 o'clock on orbit (left side viewed) in an upwardly convex arc to operculum; 1, the longest, running, more or less horizontally, from 3 o'clock on orbit, to cease hard against hinder, more nearly horizontal segment of upper opercular border. Shallowly sigmoid ridge from top of upper lip to nostril.

Coloration and color pattern, Clarence Point sample.—For a sample taken at the one time and homogeneous for sex there is considerable diversity of coloration and color pattern: part of this, no doubt, is a question of size, but a good deal would appear to be individual. The fully adult pattern of the Low Head example, dealt with later, is not found in any of these specimens, of which one only, (b), shows any clear indication of broad cross bars, and one only, (f), has the 'festoon' marking along the mediolateral trunk ridge. The general ground color varies from almost black through dark and medium brown to light brown and grey, the sequence of specimens being (a), (g), (c), (b), (d), (e), (f); however, on dorsal surface (e) is darker than any other individual.

(i) *Head*.—Dorsal surface behind eyes lighter than early trunk, from whitish through pale greyish to fawn, immaculate, (b), (c), (d), (f), or with small brown splashes, (e), (g), or punctulations and reticulations, (a). Lateral surface from behind eye (which occupies from rather more than half space between dorsal and ventral profiles, (g), to virtually the whole, (a)) to anterior $\frac{1}{3}$ - $\frac{1}{2}$ of operculum carries an extension of light area of dorsum, from which it is usually separated (not in (a), (e)) by a more or less well-defined streak or line of brown; this region, which may contain some small darker markings, is delimited from cheek below level of inferior orbital border (which, except in (e), is somewhat, usually notably, darker) by dark line or row of reddish brown blotches. Operculum light colored (with or without darker markings) in anterior $\frac{1}{3}$ - $\frac{1}{2}$ only, except in (e), in which about upper $\frac{1}{3}$ is fawn, the rest whitish: along posterior and inferior margins an arc of minute spaced blackish dots, in (b), 5-6 dots, (e), 3-4, (g), 8; in (c), (d) about 8 short spoke-like brown lines bordering operculum behind, these being represented in (e), (g) by a few indistinct vermiculations. Except in (a), snout lighter than rest of head (quite apart from snout-size, the characteristic 'light-snouted' suffices to distinguish this species from *S. phillipi* in the same phial), ranging from ivory to very pale brown, the ventral surface usually the lightest, the darkest area on, and immediately flanking, the middorsal ridge; extreme tip usually paler. In (b), (g), 2 lines of dark brown (straight, except initially, just behind level of posterior border of orbit, where each presents a short arc, concave mesiad) run forward, following the converging mandibular ridges for $\frac{1}{2}$ length of snout; in (e) the line suffers an interruption in its anterior $\frac{1}{3}$, in (c) it is represented by a row of 7-8 dots, extending $\frac{2}{3}$ of snout; in (f) only part of the proximal arc is present, and the markings are absent in the others. In (b), (e) a row of 3 or 4 minute black dots runs external to marking just described. In the 4 larger specimens 2-3 reddish-brown spokes radiate from antero-inferior border of orbit.

(ii) *Trunk*.—Dorsal surface: in (a) uniformly dark brown, approaching black; in (e) black, quite different from (a), the black appearing as if present as a sort of encrustation on the brown substrate surface, of which some small patches are exposed, particularly laterally; in (b) midbrown, with 3, perhaps 4, darker bars, in others medium, or (g), darkish, brown, without bars; dark median stripe in (d) only; the sutures of the annuli marked, in (f), (g), by fine dark lines, in (b), (c) by small laterally placed light areas that become apparent on 1st annulus, (b), or on 5th, (c), and continue to increase in area and to throw inward longer prolongations that finally meet mesially. Lateral surface: in (a) as in dorsum; in other specimens the upper half more or less concolorous with the dorsal surface, the lower half usually somewhat lighter (in (d) sharp demarcation along whole TM ridge); in (b) partial, in (c) and (f) pronounced, rove-over of segmental division lines of dorsum; in (e) a double festoon of warm brown, one loop to an annulus, running closely above and below TM (better developed

below), and along inferior border of midbrown line, bulging up somewhat into each annulus; in (g) the decidedly lighter half abundantly punctulate and minutely vermiculate—dark bars noted on dorsum of (b) apparent also on this surface. Ventral surface: varies from black (a) through greyish and fawn to lightish brown, the anterior portion usually somewhat (in (d), (e) notably) lighter; a pair of minute lateral black spots may occur on each of the first few annuli, (b), or on most annuli, (c); lightbrown, chiefly longitudinal vermiculations may occur anteriorly, (d), or through most of the length (though best developed anteriorly) (e); in (f) the light vertical segmental lines of the lateral surface continue on to this surface, where they tend to assume a T-shape, the cross-piece along the inferolateral border, the main limb lying transversely—dark bars of (b) visible on this surface also.

(iii) *Tail*.—Ground color of all surfaces becomes lighter posteriorly (except in (e) in which the dark brown turns black caudad), the change most marked in posterior one-third, or more, tending to occur earliest on ventral surface (and most marked here, usually approaching, or, (d), becoming, pure gold), latest on dorsal; intersegmental lines generally well developed, better than on trunk, usually lighter anteriorly, darker (not in (d)) posteriorly, than their interspaces; commonly narrow near median line (tolerably broad in (b)), often expanding laterally to form patches (mostly subtriangular), which may give rise (if so, normally to an increasing extent caudad) to longitudinal segments lying along surface-junctions—in (b) indications of 9 dark bars, best seen on ventral surface.

(iv) *Fins*.—Dorsal: translucent, whitish, or pale yellow (in (c) light brown); rays, as often as not, more yellowish than membrane. Caudal: membrane yellowish or pale fawn in 3 larger individuals, light brown in 4 smaller; rays more or less uniform yellowish or light brown in (a)-(d), pale fawn in (g), lighter in central part of, (e), or in whole of, (f), basal half; except in (a), outer ray, above and below, spotted or banded with white, sometimes, (d), (f), (g), these, and one or two other rays, also with dark brown blotches; regularly tipped briefly white, or, (f), (g), pale, most noticeably so across central rays, except in (e), in which upper outer 2 rays are white in most of distal half. Pectoral: in (a) largely blackish, with lower ray (left) or 2 rays (right) partly silvery, and with some silver at bases of some other rays; in (g) largely silvery; in other specimens ranging, without marked differentiation between membrane and rays, from translucent to straw-coloured or pale golden.

Life coloration, Low Head specimen.—In the original record of Miss Mather's Low Head specimen, which added *S. curtirostris* to the Tasmanian list, it was stated (1953: 150): 'It is proposed to make the coloration and color pattern of this fish the subject of a separate paper.' The study referred to, which grew to rather unwieldy proportions, has not been published: most of the factual material and some of the discussion, much abbreviated, is presented below.

(i) *Ground coloration: description*.—Waite & Hale (1921) have provided an account (taking

notice of well-marked sexual dimorphism) of the coloration and color pattern of preserved examples, but nothing appears to be recorded of the appearance in life. The living fish is a very beautiful object as the following notes, based on Miss Mather's female, make evident. Ground color of head: lateral surface medium brown, becoming darker on upper and lower borders of snout, the upturned tip of the lower jaw very dark, approaching black; upper half of operculum pinkish, lower half amber; dorsal surface dark brown, lightest on nape; ventral surface of snout rich dark amber, very dark at tip; rest of head golden brown. Ground color of trunk and tail: lateral surface warm mid-brown on trunk, somewhat darker on tail, rather lighter near end of tail than ventral surface there; dorsal surface of trunk somewhat darker than sides; dorsal surface of tail distally at least as dark as, perhaps a trifle darker than, its under surface: ventral surface golden orange, brightest, most golden near midline; around, and just in advance of, vent glowing ruby; tail with anterior one-third light brown darkening posteriorly, middle one-third medium brown, posterior one-third very dark brown. Head and tail somewhat translucent. (Color markings described separately below).

(ii) *Ground coloration: discussion*.—The depth of the ground color thus exhibits an anteroposterior gradient, with a change of sense near the back of the head, from which point of inflection the general color progressively darkens, in the anterior section of the fish cephalad, in the posterior section caudad. The tone increment (alternatively, since in any one direction the anteroposterior intervals along any of the four superficial body-planes are identical, the rate of change of tone) is, however, not constant, with the result that while, anteriorly, on the trunk, the ventral surface is lighter than the lateral, posteriorly, on the tail, it becomes darker than the lateral. Symbolic representation of the data serves to clarify and emphasize the relevant relationships and symmetries. Let A, B, C be, respectively, inferior, lateral, superior surfaces on the postcephalic region, and a, b, c the same, respectively, on the head; let x be the level of the point of change of sense, and y the level of the distal point of the system (with y_1 = base of caudal fin, y_2 = tip of snout); and let $>$ signify greater than in respect of depth of ground color. Then in combined trunk and tail we have:

$$(A, B, C) y_1 > (A, B, C) x \dots \dots \dots (1a)$$

$$Cx > Bx > Ax \dots \dots \dots (2a)$$

$$Cy_1 > Ay_1 > By_1 \dots \dots \dots (3a)$$

$$A(x-y_1) > B(x-y_1) > C(x-y_1) \dots \dots \dots (4a)$$

Also, if p is the darkest surface at a given point along the anteroposterior axis, and q is either of the remaining surfaces,

$$(px-qx) > (py_1-qy_1) \dots \dots \dots (5a)$$

As inequality (5a) suggests, differences at y_1 are small: indeed, (3a) represents only a majority judgment of three observers, one reading $Ay_1 > Cy_1 > By_1$. Neither version, it may be noted, is however, symmetrical with (2): though clearly it is possible, with other data, to have formal identity at the levels x and y with retention of the basic $A > B > C$ of inequality (4a).

In the head the position is somewhat more complex: since, in the first place, much of the snout is almost trihedral, and in advance of the eyes *c* disappears (or virtually disappears, being represented perhaps by a median ridge); and secondly, color markings are here so extensive as to render determination of the ground color in parts somewhat uncertain. With Y_2 , the level of the posterior orbital margin, treated as a satisfactory estimate of Y_2 in *C*, the five propositions (1 β)-(5 β) symmetrical with (1 α)-(5 α) that are obtained on substitution of *a*, *b*, *c* for *A*, *B*, *C*, respectively, and of y_2 (or its estimate y_2) for y_1 are probably valid.

Satisfactorily to establish, or even adequately to analyse, the possible implications of these results would obviously necessitate the carrying out of an extensive investigation, covering a wide range of material and involving much experimental work. Several suggestive lines of inquiry followed, as far as available data permitted, in the unpublished paper already referred to are not, for lack of space, considered here. However, a brief comment on the significance of (4) can profitably be made. Two points may be noted: first, if instead of (3) as it now stands we had (*A*, *B*, *C*) $y = k$, to which condition (3 α) actually approaches, then (4 α) would be already determined, being merely a formal restatement of the conjunction of the supposed constant value at y and the statement of (2 α); secondly, considered in isolation, however, the essentially gradual and even character of the color gradient in (4 α), while possibly of apatetic value [the possible significance of the ground colors and the various pattern-elements as factors in protective coloration was the subject of consideration in the unpublished study], might well be interpretable as a direct pigmentary expression of a general anteroposterior physiological acceleration (though it is noteworthy that in (4 β) the tone-alteration, in *a* and *b*, while possibly also gradual is certainly in addition—a threshold phenomenon?—distally abrupt).

(iii) *Fins*.—Dorsal pale honey; rays scarcely darker than membrane. Anal minute, blotched longitudinally with brown. Pectoral pale golden; rays with red-brown streaks and dots. Caudal dark; rays distinctly darker than membrane.

(iv) *Chief pattern elements*.—The color pattern of Miss Mather's fish is highly complex (to a degree beyond that suggested by published accounts of this species): some suggestions towards its analysis are noted in subsequent sections. The chief elements involved include: broad cross-bars on head, trunk, tail (see (vi), below); segmental markings, largely in the form either of lines more or less completely coincident with the striae of the embossed shields of the annuli or of dark sub-circular or ovoid spots, either occurring in isolation on the upper or lower half of the lateral surface, or, more frequently, being continuous, by isthmuses of varying tenuity, over both these regions, to which they may be confined, or beyond which they may extend—differentially, in respect both of area and form, along the anteroposterior axis—on to the ventral surface; longitudinal markings, best developed inferiorly; a variety of non-segmental discrete elements of diverse form, non-serial or serial (in the latter condition exhibiting,

in some instances, marked gradients in respect of size and/or intensity); a complex series of cephalic markings, including circumocular spokes and their lighter interspaces, light and dark spots, vermiculations, punctuations, and cloudings resulting from an aggregation of pigment the resolution of which into its discrete elements is beyond the power of the naked eye.

(v) *Analysis of pattern elements*.—The formal analysis of such a complex system of patterns and subpatterns is of much interest. Half a dozen category-groups found to yield useful results, both singly and in combination, may be outlined.

(a) *Simple regional occurrence*.—It is sufficient to recognize three regions, head, trunk, tail. *A*, restricted to 1 region; *B*, to head; *BB*, to trunk; *BBB*, to tail; *AA*, no [i.e., not as in *A*; and similarly throughout below]; *C*, on 3 regions; *CC*, on 2 regions only; *D*, on head and trunk; *DD*, on trunk and tail; [formally: *DDD*, on head and tail]. [This set used in combination with any or all of (b)-(f) below].

(b) *Simple surface occurrence*.—*A*, restricted to 1 surface; *B*, dorsal; *BB*, lateral [exceptionally: *C*, right; *CC*, left]; *BBB*, ventral; *AA*, no; *D*, occurring on 2 surfaces [*E*, *EE*, *EEE* for combinations of surfaces]; *DD*, on 3 surfaces.

(c) *Size, pure spatial disposition*.—*A*, at macroscopic (naked eye) level continuous; *AA*, no; *B*, continuous at microscopic (X10) level; *BB*, no. Then follow either *AA*, or *BB*, or both, with: *C*, marking single; *CC*, no; *D* in pair; *E* single marking paired; *EE* group (2 or more) paired; *DD*, in set of more than 2 (serial); *F* serial rectilinearly; *FF*, serial curvilinearly; *H*, in open curve; *HH* in closed curve. [If *C-HH* used with both *AA* and *BB*, reletter, at second time, from *I* to *LL*].

(d) *Sculpture-determined, in respect of surface involved*.—*A*, marking not determined by sculpture [i.e., color elements not following local pattern of exoskeletal elevations and/or depressions]; *AA*, yes; *B*, surface-restricted [with *B*'s of (b)]; *BB*, no; *C*, not sculpture-determined on both surfaces; *D*, determined on origin-surface only [origin surface—that on which most of the marking is located: if equally distributed, or if degree of sharing varies from occurrence to occurrence of marking, accept priority-sequence, dorsal, lateral, ventral]; *DD*, on other surface only; *CC*, on both surfaces. [This series combines naturally with (b), and (c)].

(e) *Sculpture-determining, in respect of degree of coincidence of marking and sculpture*.—*A*, marking and sculpture-unit exhibit coincidence; *B*, wholly coincident; *BB*, partly; *C*, marking coincides with part of sculpture-unit only; *CC*, coincides with whole of sculpture-unit and spills over; *AA*, no; *D*, marking the smaller item; *DD*, the larger.

(f) *One-many, and cognate, relations*.—Another general line of approach is as follows. Let an italic lower-case letter denote 'one' and a capital italic letter 'many.' Consider, first, marking surface relations; and let the initial letters of the words 'marking' and 'surface' designate these elements. Then we can have: *ms*, one-one (one marking [throughout, in this context—of a given

kind] on one surface); *mS*, one-many (one marking extending on to more than one surface); *Ms* many-one (many markings on one surface): [since the object of the analysis is (at the normal level of investigation) to classify specific types of markings, the fourth combination, *MS*, is not pragmatically significant]. Similarly, there can be recognized a set of marking-annulus relations: *ma*, *mA*, *Ma*, [*MA*]; while logically prior to this lies the broad dichotomy, not treated in this summary account, of segmental, non-segmental. There is empirical justification also for a suite of marking-sculpture relations: deriving letter symbols from 'marking,' as before, and 'engraving' (or 'embossing'), we get: *me* (one marking on one sculpture-unit), *mE*, *ME*, [*ME*]. Further formulations, not without actual exemplifications, include those formed by the substitution, in the three systems above, for 'one or many markings of a given kind' of 'one or many kinds of markings.'

(vi) *The cross-bars*.—The cross-bars, most highly developed (except 2nd, which is largely confined to dorsal surface) on lateral surface, involve up to 2 annuli (band on nape narrowest, most sharply delimited), the anterior being in general larger than the posterior. With 2 on head, 4 on trunk, 15 on tail they occur in these 3 primary regions at the rate of 1 per 6.50, 9.30, 9.94 mm, respectively, of anteroposterior extension. The increase caudad of the ratio, number of bars/length from tip of snout is a simple one. With X = length to posterior extremity of region (13, 50.2, 139.7 mm), and Y = number of bars to that extremity (2, 6, 15), we find $Y = 0.1022 X + 0.76$ (giving $Y^1 = 2.1, 5.9, 16.0$); $t = 64.74^{**}$. The Y -intercept is small; and if the assumption is made that the true relation is one of direct proportionality ($Y = mX$), the coördinates (0, 0) being taken as a fourth point, the equation for the best straight line becomes $Y = 0.1053 X + 0.40$ ($Y^1 = 0.4, 1.8, 5.7, 15.1$); $t = 28.59^{**}$. The increase caudad of the mean interval between bars is conceivably associated with greater relative growth in the more posterior part of the fish (see data above on Mr Green's sample; Table II). If such is the case, there may be postulated a stage (perhaps coincident with the full establishment of this pattern) at which the bars are equidistant throughout the whole length. On the evidence afforded by Mr Green's material and Miss Mather's specimen the pattern appears at Lt 100-140. Waite & Hale (1921: 301), who describe the coloration of 'an adult male' and 'a female' unfortunately note only the length of their largest example (164 mm). Earlier McCulloch & Waite (1918: 40) gave an account, based on two males and two females, 125-164 long, in the course of which it is noted 'the markings vary in intensity in different specimens, but are similarly arranged in all': the color pattern of 'an adult male' is then described. Neither the 1918 nor the 1921 account makes mention of the broad cross-bars here discussed.

If the heuristic assumption is made of a first-degree relationship, in each of three main morphological regions, between numbers of bars (caudad: 2, 4, 9) and number of annuli (x 18, 44), the predicted number for the head is 7-8 (7.6), which is in general agreement with the value suggested by some studies of development in pipefishes.

SYNGNATHUS TUCKERI Scott, 1942

Syngnathus tuckeri Scott, 1942, *Rec. Queen Vict. Mus.*, 1, 1: 17, pl. V. Type locality: Bridport [Dorset], Tasmania; netted in shallow water.

Syngnathus tuckeri Scott. Munro, 1958, *Handbk Aust. Fish.*: 82, fig. 568 [instalment No. 20 in *Fisheries Newsletter*, XVII, 2, February 1958: 18, fig. 568].

Mitotichthys tuckeri (Scott). Whitley, 1958, *Rec. Aust. Mus.*, XXII, 1: 75. Scott, 1960, *Pap. Proc. Roy. Soc. Tasm.*, 94: 87.

General remarks.—Some comments on the generic status of this fish have been made earlier in these Observations (1960: 87): I here follow the conservative action of Munro (1958) in continuing to refer it to *Syngnathus* Linné; though not without some feeling the institution of *Mitotichthys* Whitley, 1948 to receive it may turn out to be justifiable.

I know of only 5 individuals: (a) the holotype, ♂, Ls 121.3, Lt 126.6, Bridport, Dorset, 1941 (G. V. Tucker); (b) ♀, Ls 91.2, Lt 95.6, Piper River Heads, Dorset, 1956 (Holyman); (c) unsexed, Lt 37, Piper River Heads, October 1957 (M. C. Burns); (d) ♂, Ls 126.9, Lt 132.4, Piper River Heads, November 1957 (J. Allichin); (e) ♂ Ls 132.6, Lt 137.9, locality unknown (Queen Victoria Museum, Launceston). Some data on (b), (d) have been published previously (1960): the only items, apart from Lt , available from Mr Burns' specimen, (c), are annuli 22 + 43, subdorsal annuli 10 + 2, dorsal 32. Of the 3 known males, the holotype carried eggs *in situ* (1942: 18; pl. V, fig. 3) (d) yielded a fusiform egg-mass that worked clear of the pouch after preservation of the fish (1960: 88); while (e) carries pouch young.

Fin counts, dimensions of (e).—The principal dimensions and meristic characters of (e) are here recorded for comparison with published information on other examples. Annuli 20 + 40. Subdorsal annuli 9.6 + 2.0. Brood annuli caudal 1.0-12.8. Dorsal 36. Pectoral 13. Anal 5. Head 17.8, eye 2.3 (orbit 2.5); interorbital 1.2; snout 9.2; length to origin, termination, of dorsal fin 40.0, 57.7; vertical height of dorsal, longest ray 5.4, 5.8; length of pectoral, pectoral base 4.5, 2.6; length to vent 52.4; Ls 132.6, Lt 137.9; depth (in parentheses, width) at opercular margin, middle of trunk, vent, middle of tail 4.6 (3.0), 4.0 (3.5), 4.0 (3.4), 1.9 (1.9).

Extensions of conspectus values.—Examination of specimens (e), (c) leads to the following new entries in the conspectus (see paragraph with same heading as this in treatment of *Syngnathus curtirostris*, above): brood annuli, caudal 1.0-12.8 (previously 1-12); dorsal rays 32-36 (33-35); eye in snout 3.1-3.7 (3.1-3.3); trunk in tail 2.1-2.5 (2.1-2.3); total length 138 (previous maximum 132).

Dimensions and proportions.—Table III sets out, for 8 basic dimensions, the same data as those given in Table I for *S. curtirostris*. In spite of the size of the sample, still smaller in this than in the preceding species, the correlation of X (body region) and Y (Lt) continues in general to be high, failing to reach a significance of P 0.05 in 2 dimensions only (eye, postorbital head), and in

3 dimensions having a significance better than P 0.01. The absolute magnitudes as calculated from the regression equations are again seen in most cases to approximate closely the raw data (showing for the two large divisions, preanal and post anal length a maximum absolute divergence of 0.4 mm, or 0.5%, a maximum percentage divergence of 0.6%, and a mean divergence of 0.21 mm. or 0.32%). This measure of reliability is the more striking in that these specimens, unlike the examples of *S. curtirostris* discussed above, were not collected as one sample; though, indeed, except in the case of (e), the source of which is not recorded, they come from the same locality.

In this species, as in *S. curtirostris*, the relative length of tail increases with increase in overall

length, the TLt values rising consistently across the table from left to right; concomitantly of course the total preanal length suffers corresponding relative decrease: with the length-range (44.3 mm) of the present sample, the variation (4%-6%) is small in terms of the wide tolerances found in some specific diagnoses. Unbroken sequences of entries characterize also trunk and eye (in table, rounding makes last 2 entries for eye identical); while for snout and head there are good indications of a trend, with increasing Lt , towards relative increase, decrease, respectively, of length of relevant region. As in both Table I and Table II, the correlation between proportion of Lt represented by body-region and magnitude of t is striking (Spearman's rank-correlation for the 2 sets here is 0.929).

TABLE III

Syngnathus tuckeri Scott, 1942. Three specimens, (b), (c), (d) from Piper River Heads, Dorset, Tasmania, one (e) of unknown locality. Anteroposterior lengths of 8 specified regions—absolute (mm), first, as measured, secondly, as estimated from regression equation (recorded, with indication of significance) of relevant region (Y) on total length, Lt (X); relative, as thousandths of total length, TLt : also correlation of X and Y

Region (Y)		Specimen Lt (mm) (X)				Correlation of X and Y		Regression of region (Y) on Lt (X)	
		(b)	(c)	(d)	(e)	r	%	Equation	t
		95.6	126.6	132.4	137.9				
Snout	Measured	6.2	7.5	7.7	8.5	0.965*	2.003	$Y = 0.04880 X - 1.53$	5.49*
	Estimated	6.1	7.6	7.2	8.2				
	TLt	65	59	58	62				
Eye	Measured	2.0	2.4	2.3	2.3	0.874	1.351	$Y = 0.08012 X + 1.26$	1.89
	Estimated	2.0	2.3	2.3	2.4				
	TLt	21	19	17	17				
Postorbital head	Measured	4.9	5.8	6.1	7.0	0.916	1.562	$Y = 0.04216 X + 0.76$	3.30
	Estimated	4.8	6.1	6.3	6.6				
	TLt	51	46	46	51				
Head	Measured	13.1	15.7	16.1	17.8	0.960*	1.943	$Y = 0.09898 X + 3.49$	5.11*
	Estimated	13.0	16.0	16.6	17.1				
	TLt	137	124	122	129				
Trunk	Measured	25.5	33.6	34.9	34.6	0.981*	2.314	$Y = 0.2326 X + 3.51$	8.64*
	Estimated	25.7	33.0	34.3	35.6				
	TLt	267	265	264	251				
Preanal region	Measured	38.6	49.3	51.0	52.4	0.999**	3.827	$Y = 0.3315 X + 7.00$	32.12**
	Estimated	38.7	49.0	50.9	52.7				
	TLt	404	389	385	380				
Tail	Measured	57.0	77.3	81.4	85.5	1.000**	4.511	$Y = 0.6685 X - 7.04$	64.78**
	Estimated	56.9	77.6	81.5	85.1				
	TLt	596	611	615	620				
Dorsal base	Measured	12.3	16.0	17.3	17.7	0.993**	2.831	$Y = 0.1294 X - 0.11$	15.30**
	Estimated	12.3	16.3	17.0	17.7				
	TLt	130	126	131	128				

Percentage length increments.—A table of percentage length increases for this species comparable with Table II for *S. curtirostris* has been made out; but in view of the generally small *t* values encountered it has not been thought worth while to publish it. With only 1 degree of freedom available, as in the present data, the approximation to linearity has of course to be extremely close and *t* values very high—divergences from an ideal model of magnitudes biologically expectable that would yield statistically significant evidence of consistency in a larger series failing to do so when encountered, as here, among only 3 entries. For the two larger regions, however, significant coefficients do characterize the regressions of percentage increments, in preanal length and in tail length, of individuals (*c*), (*d*), (*e*), on (*b*), (*Y*), on the corresponding increments in *Lt* (*X*). For the preanal region the equation is $Y = 0.6398 X + 7.50$ ($t = 45.59^*$); for postanal region $Y = 1.1437X - 0.75$ ($t = 31.07^*$): a test of the significance of the difference between these two regression coefficients gives $t = 9.93^{**}$.

The average percentage increases in length relative to percentage increase of *Lt*—arithmetic mean cited definitively (with geometric mean in parentheses)—for the 8 body regions studied, listed in the same order as in Table II for *S. curtirostris* are as follows: snout 0.705 (0.700), eye 0.499 (0.434), postorbital head 0.725 (0.705), head 0.674 (0.667), trunk 0.916 (0.913), preanal region 0.834 (0.834), tail 1.112 (1.112), dorsal base 0.994 (0.992). Though for each region only 4 specimens are involved, making available 3 percentages, the general stability that characterizes the mean, taken in conjunction with the marked general parallelism of the present results with those already found for *S. curtirostris*, would suggest the figure just given might well provide a probable picture of the chief features of the actual situation. In both species, we find that in the head the postorbital element has the highest increase relative to *Lt* increase, followed in turn by the snout and the eye; however, in *S. tuckeri*, entry for snout exceeds (in *S. curtirostris* is 0.77 of) entry for total head, thus compensating for the much lower datum in *S. tuckeri* for postorbital head. In both species, value for trunk exceeds that for head (difference more pronounced in *S. tuckeri*). In both species, relative percentage increase of postanal region exceeds that of preanal (with very similar ratios: in *S. tuckeri* postanal value is 1.26 preanal, in *S. curtirostris* 1.19). In both species, dorsal base value exceeds head value and trunk value (but in *S. tuckeri* dorsal base entry is less than tail, greater than postorbital, entry; while the inverse obtains in *S. curtirostris*).

Pouch young.—The specimen carries an apparently full complement of pouch young, with which it is hoped to deal in a subsequent contribution.

Family GERRIDAE

Of the 3 genera occurring in Australia, *Gerreomorpha* Alleyne & Macleay, 1877, with 1 species, is restricted to Queensland; *Gerres* Quoy & Gaimard, 1824 is met with chiefly in our northern waters [of the 14 species recognized in the Check List Queensland has 12, Northern Territory 4 (all

extending also to Queensland, 1 shared with New South Wales and South Australia), New South Wales 3 (one endemic), Western Australia 3 (one endemic); while 5 range extraliminally]: *Parequula* Steindachner, 1879, with 1 species, has hitherto been known only from the two southern States of Victoria and South Australia—this last entry, *Parequula melbournensis* (Castelnau), 1872, is now reported for the first time from Tasmania.

Schultz (1953: 556) recognizes the Gerridae and the Leionathidae as a single family, the latter name prevailing.

Genus PEREQUULA Steindachner, 1879

PEREQUULA MELBOURNENSIS (Castelnau), 1872

Gerres melbournensis Castelnau, 1872, *Proc. Zool. Acclim. Soc. Vict.*, 1: 158. Type locality: Melbourne, Victoria.

Parequula bicornis Steindachner, 1879, *Denks. Akad. Wiss. Wien*, xli, 1: 8. Type localities: Hobson Bay (Müller) and Murray River.

Chthamalopteryx melbournensis (Castelnau). Ogilby, 1887, *Proc. Zool. Soc.*: 616; unnumbered fig.

Tasmanian record.—A specimen, *Ls* 158.5, *Lt* 209.5, length to end of middle caudal rays 184.8, caught at Kelso, Devon, by Mr Bruce Porter on 7th July 1963 (Queen Victoria Museum Reg. No. 1963.5.4) adds this species to the Tasmanian list.

Meristic characters.—D. IX, 17. A. III, 17. P. 15 (right), 16 (left). V. I, 5. C. 17 (i.e., $8 + 1 + 8$) + 5/5. L. lat. 34.

Proportions, TLs.—Measurements were made to the nearest tenth of a millimetre; where its presence is necessary to allow of recovery of the raw data to this degree of accuracy, one decimal digit is recorded in the entries of thousandths-of-standard-length below. Lengths to dorsal, anal, pectoral, pelvic origins 303, 508, 296.5, 284. Bases of spinous dorsal, soft dorsal, anal 303, 566.6, 378. Snout, eye, interorbital, head, 82, 92, 99.7, 284. Length to vent 486.4. Depth at front of eye, back of eye, dorsal origin, vent 202, 287, 435, 473; caudal peduncle 90. Lengths of 1st–8th dorsal spines (9th imperfect) 58.7, 77, 96.5, 107, 113.6, 107, 106.6, 102. Lengths of 3rd, 8th, 10th, 14th, 15th, 16th, 17th dorsal rays 148, 176.7, 171.6, 131, 120.5, 99, 87. Lengths of anal spines 44.8, 66, 84. Lengths of 2nd, 3rd, 9th, 15th, 16th, 17th anal rays 114, 109, 107, 92, 81, 77.6. (Dimensions of dorsal, anal spines, rays represent full lengths, measured from base, inside sheath). Length of pelvic spine; 1st–5th rays 110.4; 150, 152.7, 143, 122, 101. Longest (4th) pectoral ray 246.

General remarks.—Comparison of the characters of Mr Porter's specimen with those given in the original description (1872 *a*) reveals some variations: items in parentheses in this paragraph relate to the Tasmanian fish. Height in length without caudal two and a half times (2.1). Eye in head, mouth not extended, two and two-thirds (3.1). 'The profile is very convex over the eye and the snout' (somewhat convex). Head, with mouth shut, four times (4.7) in total length. Of the

dorsal spines 'the first one is shorter than the following, which are about equal, the posterior ones being somewhat longer than the others' (increase to 5th, then decrease to 8th, probably to 9th, imperfect); longest spines equal to diameter of eye (1.23 eye). Dorsal rays 16 (17; recorded range 16-17): 'the first are about the same length as the last spines, but they become rather longer as they go backwards' (1st, 2nd imperfect; 3rd is 1.5 8th spine: rays increase to 8th, then decrease, the last a trifle more than twice in 8th). 'Caudal of eighteen long rays and of several shorter ones on each side' ($8 + 1 + 8 + 5/5$). Pectoral 15 (15, 16) 3rd (4th) longest. Eye twice (2.7) in caudal at its sides. Operculum, preoperculum, pre-orbital entire (angle, and one-fourth, or more, of posterior border of preoperculum denticulate).

The Tasmanian fish differs in some points from the standard figure (Ogilby's) reproduced in Australian catalogues. In the specimen the (rather less convex) sweep of the dorsal profile from tip of upper jaw continues to about level of middle, instead of about anterior one-fifth of eye, and beyond this the steeply rising curve runs unbroken to dorsal origin, the projection above eye that in the illustration forms a noticeable feature of the outline being much less developed and not reaching the profile: superior border of eye is further below profile than in figure: with mouth protracted as in figure, maxilla, which, as depicted and described, extends to anterior border of eye, fails to reach level of posterior nostril by a distance equal to eye-nostril interval, and even with mouth closed, reaches only to level of nostril: longest dorsal ray subequal to combined eye and snout (in figure, subequal to eye): outer caudal rays more produced, more than twice (figure, about one and a half times) middle rays. It agrees tolerably well with Ogilby's description (1887: 616), based on 2 examples $4\frac{1}{2}$ and $5\frac{1}{6}$ inches long. Points worthy of comment (apart from those already dealt with in the above comparison with his figure) are: preorbital $6/7$ of eye-diameter (in our specimen 1.1); dorsal spines gradually increase in height to last two or three, which are equal (increase to 5th, then decrease to 8th, probably to 9th, imperfect); ventral does not quite extend to vent (very briefly beyond).

Some amplifications of the original account may be noted. Gillrakers on lower limb anterior arch 7, subcylindrical, distally somewhat curved cephalad, the extremity usually flattened and sometimes slightly expanded; their height subequal to their interspaces: on upper limb 3-4, smaller, the uppermost minute. This species is noted (Scott, 1962: 201) as having the body and head covered with large cycloid scales. In our specimen scales are present on the side of the head, much like those illustrated. However, the region delimited on either side by a line running from preorbital border, at a little below level of nostrils, to nostrils, thence back along superior border of orbit to level of hindmost extension of orbit, and thence to middorsal line (meeting this at end of prominent middorsal ridge which extends cephalad from dorsal fin to this point, in advance of which the compressed body suddenly gives way to the much-depressed upper surface of the head) is in our specimen wholly naked: this is in agreement with

Ogilby, 'interorbital space, snout, and preorbital absolutely scaleless'—as noted in his account, scales of cheek extend on to mandible. Much of this region bears numerous pores of varying size: a particularly marked concentration of pores, with upwards of 50 in a lunule about 10 mm long and 2-3 in greatest width, occurs adjoining the hinder half of the superior border of the orbit, the openings being here so closely set as to present a honeycomb appearance. Numerous pores are found on the somewhat raised annulus of the orbit, including a continuous series of about 50, very closely set, extending from the lunule just noticed downwards and forwards, covering in all about half the ocular circumference. Other notable pore-groups include a sigmoid band from near middorsal line to near upper end of operculum; a series, in 1-4 rows, along lower two-thirds of posterior, and whole of free lower, borders of preoperculum; a small collection below, and in advance of, the nostrils. On first examination the premaxillary groove gave the impression of being naked: however, probing yielded one tolerably large, somewhat incomplete scale. Two small, but stout subconical glassy spines, about 2 mm long, the interval between their bases equal to one-third of eye diameter, project from the anterior margin of the preorbital over the groove, their tips reaching to within a distance subequal to their length from the anterior surface of the upper lip: left spine (probably normally) simple, right bifid. Villiform teeth very slender, mostly much recurved; the denticulous area several times wider anteriorly than laterally. Small adipose eyelid, best developed round inferior and lower half of posterior borders of eye. Anterior nostril small, less than its own longer (horizontal) diameter from the posterior, which is a little more than its own major (sub-vertical) axis from the orbit.

In this specimen part of the pectoral girdle is visible at the surface (possibly through the loss of deciduous scales, as the relevant region is depicted in the standard figure as normally scaled): by pulling on the pectoral fin it is possible to lift somewhat the whole structure from about level of mid-eye to level of bottom of pectoral base, revealing a shallow cleft, the floor of which is largely covered by formed and partly pigmented scales. As a purely individual variation, both fins have most of the pectoral rays more or less sinuous, this feature being most marked in the upper, stronger rays (which are simple, undivided rods throughout the whole, or almost the whole, of their length).

This species possesses no accessory pelvic appendage such as that found in *Gerres*. The two pre-orbital spines noted above were not mentioned in Castelnau's original account, but in a single-sentence comment in a supplement (1873 a: 37) he remarks, 'In the male we find the preorbital forms on each side, a spine in front'. Ogilby includes the character 'Preorbitals with a blunt bony protuberance in front' in the diagnosis of his *Chthamaloptyx*, based on this species.

Family NEOODACIDAE

Four species are already ascribed to Tasmania: (a) *Olisthops* Richardson, 1850, (1) *O. cyanomelas* Richardson, 1850; (b) *Haletta* Whitley, 1947, (2)

H. semifasciata (Cuvier & Valenciennes), 1840; (c) *Neodax* Castelnau, 1875, (3) *N. balteatus* (Cuvier & Valenciennes), 1838, (4) *H. attenuatus* (Ogbooy), 1897. The type locality of (2), given as 'Mers des Indes' (Peron) and that of (3), not recorded (Péron) are identified in the Check List (McCulloch, 1929) as Tasmania: this State is also the source of the unique holotype of (4).

To this short list may now be added (5) *N. radiatus* (Quoy & Gaimard), 1835, a specimen of which from Low Head, Dorset, is noted below.

Other names that have at various times appeared in local catalogues include (i) *Odax richardsoni* Günther, 1862; (ii) *Odax algensis* Richardson, 1840 (type locality: Port Arthur, Pembroke, Tasmania); (iii) *Olistherops brownii* Johnston, 1884 (type locality: Table Cape, Wellington, Tasmania); (iv) *Odax beddomei* Johnston, 1885 (type locality: Derwent River, Monmouth/Buckingham, Tasmania). Of these (i), (ii), (iii) are synonyms of (2), (3), (1), respectively; while the examination by McCulloch of a sketch found among R. M. Johnston's memoranda—later published by Whitley (1929, pl. IV, fig. 6)—led to his recognition of the fact that Johnston's fish was a species of *Siphonognathus* Richardson, 1858 (Family Siphonognathidae: differs trenchantly from Neodacidae in lacking ventral fins).

KEY TO NEOODACIDAE RECORDED FROM TASMANIA

- | | | | |
|---|---|---|---|
| 1 | { | Check without scales. Deep notch between spinous and soft dorsals; height of last spine $< \frac{1}{2}$ (usually $\leq \frac{1}{3}$) height of longest ray. Caudal lunate, its outer rays somewhat (female) considerably (male) produced <i>Olistherops cyanomelas</i> | |
| | | Cheek with scales. No deep notch between spinous and soft dorsals; height of last spine $> \frac{1}{2}$ (usually \geq) height of longest ray. Caudal rounded or pointed (unknown in <i>N. attenuatus</i>) | 2 |
| 2 | { | Lateral line > 50 (53-63) <i>Haletta semifasciata</i> | |
| | | Lateral line < 50 (39-45) | 3 |
| 3 | { | First dorsal spine produced (to about $\frac{1}{2}$ length of second spine). Outer ray or rays of ventral produced (fin \pm head). A black longitudinal bar along base of dorsal, covering about a dozen of the posterior spines and anterior rays: above this 4-5 thin light subparallel lines. Caudal pointed <i>Neodax radiatus</i> | |
| | | First dorsal spine not produced (\pm second spine). Outer ray or rays of ventral not produced (fin $\pm \frac{1}{2}$ head). No such bar or lines on dorsal. Caudal rounded in <i>N. balteatus</i> (unknown in <i>N. attenuatus</i>) | 4 |
| 4 | { | Dorsal spines and rays combined < 32 (XVI-XVII/12-13). Anal spines and rays combined < 17 (III/12). Sc. tr. > 14 (4/13). Depth of body < 7 (5-6) in total length. <i>Neodax balteatus</i> | |
| | | Dorsal spines and rays combined > 32 (XX/15). Anal spines and rays combined > 17 (19). Sc. tr. < 14 (4/6). Depth of body > 7 (8-9) in total length <i>Neodax attenuatus</i> | |

Genus NEOODAX Castelnau, 1875

NEOODAX RADIATUS (Quoy & Gaimard), 1835

Malacanthus radiatus Quoy & Gaimard, 1835, Voy. *Astrolabe*, Zool., III: 717, pl. XIX, fig. 2. Type locality: King George's Sound, Western Australia.

Neodax radiatus (Quoy & Gaimard). McCulloch, 1929, *Mem. Aust. Mus.*, V. 1: 324 (synonymy). Scott, 1962, *The Marine and Fresh Water Fishes of S. Aust.*: 282, unnumbered fig. on p. 282.

Tasmanian record.—Known hitherto only from Western Australia and South Australia—in which latter State it is 'not very common' (Scott, 1962)—this species may now be added to the Tasmanian list, an example, *Ls* 152.0, *Lt* 189.5, having been caught (on hook; meat bait) in the Tamar estuary, off Lagoon Bay, Low Head, Dorset, in green kelp, at 3-4 fathoms, by Mr R. Askeland during the latter part of January 1962.

Variation in dorsal.—The dorsal formula is usually given as XVII/12-13: in Mr Askeland's fish the count is XX/12 (last cleft to base). In the figure regularly reproduced in Australian works—e.g., Scott (1962, unnumbered on p. 162), Whitley (1962, unnumbered, on p. 219)—which is Richardson's (1848, pl. IX) illustration of his synonymic *Odax lineatus* (type locality: King George's Sound, Western Australia)—the fin is depicted with a pronounced bight in its anterior one-third, the height of the spines dropping sharply from 1st (much produced) to 3rd, remaining virtually constant to 6th or 7th, rising to 9th, which is subequal to 10th, and then through the remaining 2 spines and the whole series of rays (except perhaps the last, which may be a trifle longer than the penultimate) decreasing evenly caudad, the penultimate ray being contained about one and a half times in 10th spine. In the local specimen the fin profile, after the initial fall from 1st to 2nd spine, is quite without local excavation, and makes a rounded sweep back to about middle of soft portion (5th ray about twice in 10th spine, which is a trifle longer than 3rd), behind which ray-length continually increases, the penultimate ray being about 0.9 of 3rd spine.

It is difficult to assess the significance of these variations. An examination of literature at hand shows for species of this genus (*s.l.*, including *Haletta* Whitley, 1947) a modal reporting of a single entry for spine-number, with an occasional variation of up to one spine. Speaking of the commonest mainland species of rock whiting, *Haletta semifasciata* (Cuvier & Valenciennes), Castelnau (1872 a: 153) observed, 'Authors generally attribute a larger number of rays to the dorsal (thirty-two) than I have mentioned [thirty rays, the latter eleven branched, the others being very soft, it is often very difficult to distinguish one from the other]', but I have seen many thousands of this fish, and I have always found the same number.' It is possible the excess in the Tasmanian fish of 3 spines over the total usually reported in conjunction with the absence of the characteristic dip in the early portion of the fin may be indicative

of specific or subspecific distinction. With only a single example available, it seems expedient to treat these variations, at least for the present, as merely individual. In any case it would appear to be desirable to record the chief features of the specimen.

Meristic and other metrical characters.—D. XX/12 (last split to base). A. III/10 (last split to base). V. I/4. P. 13 (usually reported, 12). L. lat. ca 46. Proportions are shown, as *TLt*, in Table IV. (In several entries one decimal figure is recorded in the table; this makes possible the recovery of all absolute dimensions correct to the degree of accuracy of measurement, namely, one-tenth of a millimetre.)

TABLE IV

Neoodax radiatus (Quoy & Gaimard), 1835. Proportions, as thousandths of total length (*TLt*), of a specimen, *Ls* 152.0, *Lt* 189.5, caught in the Tamar estuary, off Lagoon Bay, Low Head, Dorset, Tasmania, January 1962

Dimension	<i>TLt</i>
Length to dorsal origin, termination	276, 825.7
Length to anal origin, termination	628, 789.5
Length to vent	622
Length to pectoral, ventral, origin	263, 322
Head, with, without soft opercular lobe	283, 260
Snout	106
Eye, interorbital	47, 55
Depth at front of eye, back of eye, end of head (with opercular lobe), vent	95.4, 115, 168, 164.5
Maximum depth	172.4
Caudal peduncle	92
Dorsal spines: 1st, 2nd, 3rd, 4th, 5th, 8th, 10th, 20th	189.5, 115, 102, 106, 105, 112.5, 112.7, 115
Dorsal rays: 1st, 6th, 8th, 11th, 12th	112, 66, 60, 85.5, 98
Anal spines: 1st, 2nd, 3rd	52.6, 85.5, 102
Anal rays: 1st, 5th, 9th, 10th	106, 77.6, 72.4, 69
Ventral: spine, 1st ray, 4th ray	145, 283, 68.6
Pectoral: longest (6th ray)	112

General features.—Greatly produced ventral reaches to vent; distal half of 1st ray filamentous. Maxilla fails to reach level of eye by half eye-diameter. Scales on dorsum of head terminate in two large median scales, the anterior borders of which lie midway between levels of nostril and front of eye; on cheek continued forward virtually to rictus, rather irregularly disposed, in 2-3 rows between eye and preopercular border; between, and partly obscuring, bases of ventrals, two pairs of specialized scales; the longer pair together form-

ing a lanceolate, largely free flap, subequal to orbit, overlapped in their proximal half by the anterior pair, each of which is rather bluntly lobate, the right superimposed upon the left mesially; scales on caudal base extend one-third of distance from hypural joint to tips of longest (middle) rays. Pectoral base about $2\frac{1}{2}$ in longest ray (in Richardson's figure <2), subequal to eye. Ventrals inserted midway between tip of lower jaw and 1st anal ray. After running back subparallel to dorsal profile of body for a distance equal to half head, the lateral line descends rapidly, in the course of 2-3 scales, to begin its longest, almost straight segment about below 9th dorsal spine; at least one (long) tubule extends beyond hypural joint.

Mr Askeland noted the general color as green; some conspicuous green spots; no red longitudinal stripe noted; dorsal (which, on preservation, exhibits the characteristic lineal pattern) 'rain-bow.'

Family APOGONIDAE

The following species have at one time or another appeared on the Tasmanian list: (a) *Dinolestes* Klunzinger, 1872; (1) *D. lewini* (Griffith), 1834; (b) *Vincentia* Castelnau, 1872; (2) *V. guntheri* Castelnau, 1872; (3) *V. novaehollandiae* (Valenciennes) 1832; (4) *V. lemprieri* (Johnston, 1883); (c) *Lovamia* Whitley, 1930; (5) *L. fasciata* (Shaw), 1790; (d) *Siphamia* Weber, 1909; (6) *S. cephalotes* (Castelnau), 1875 [the last species is not noticed in the Check List (McCulloch, 1929)].

In his first list Johnston (1883) gives (1) (as *Lanioerperca mordax* Günther, 1872 (family Sphyraenidae), of which Tasmania is the type locality, the British Museum type specimen having been forwarded by Allport, the inclusion in whose MS list of this species is noted by Johnston); (2) (with the notation: 'Rare. Considered by Mr Macleay [i.e., Macleay (1881: 345)] that it may be identical with Val., *A. Novae Hollandiae*'): with (4) described in the Addenda (p. 142). His second list (1891) is similar, but with (4) now incorporated as a normal entry. In both lists (2) and (4) are referred to *Apogon* Lacépède, 1802.

Lord (1923) admits (1), (3) (with which (2) is presumably now synonymized), (4), (5), the three small forms remaining in *Apogon*. In their preliminary enumeration of species (pp. 5-15) Lord & Scott maintain this position [in the main text *Ostorhinchus conwaii* (Richardson), 1840 (family Opleganthidae), entered as *Ostorhinchus conwayi*, intrudes, by an oversight, between a brief mention of (3), (4), (5) and an account of (1)].

The Check List (McCulloch, 1929) credits this State with (1), (3) (of which (2) is formally treated as a probable synonym), (4); of which (3), (4) are still referred to *Apogon*.

The Handbook (Munro, 1960) admits as Tasmanian (1), (3) (with (2) and (4) as synonyms), (5), (6) (this last with the notation: 'New records for W.A. and Tas. based on examples from Lady Barron I. [Bass Strait], Israelite Bay and Shark Bay'). Of these 4 species, (1), (3), (6) are recorded from Western Australia, South Australia, Victoria, Tasmania, New South Wales; while (5) is reported from Tasmania, New South Wales, Queensland, Northern Territory.

Evidence discussed below suggests the reinstatement on our local list of Johnston's species, (4) (type locality: Dunkley's Point, Sandy Bay [Buckingham]), thus giving this State 5 species, a key to which is subjoined. [By some recent authors, e.g., Scott (1962: 184), (1) is treated as constituting the family Dinolestidae.]

KEY TO APOGONIDAE RECORDED FROM TASMANIA

- 1 { Total length > 300 (≈ 500). Second dorsal: without spines; rays > 13 (≈ 18). Anal rays > 15 (≈ 25). L. lat. > 40 (≈ 65). Pelvic origin caudad of pectoral origin. *Dinolestes lewini*
Total length < 300 (≈ 120). Second dorsal: with 1 spine; rays < 13 (≈ 10). Anal rays < 15 (≈ 10). L. lat. < 40 (≈ 28). Pelvic origin cephalad of pectoral origin
Subcutaneous gland (silver, black-edged) forming a tube along, and in front of, anal base. First dorsal: 6 spines; separated from second by $< \frac{1}{2}$ its own base. Maxillary to below middle of eye
2 { No such gland. First dorsal: 7 spines; united with second, or separated from it by $< \frac{1}{2}$ ($\frac{1}{4}$ – $\frac{1}{2}$) its own base. Maxillary to beyond middle of eye
3 { With dark horizontal stripes on body (1st along dorsal profile, sometimes indistinct; 2nd from upper edge of eye to upper caudal peduncle; 3rd, widest, from snout, through middle of eye, across middle of caudal peduncle; in older examples 2 additional stripes, one on each side of lateral line, may appear). Dusky sub-basal streaks through second dorsal and anal. Anal base \approx eye + snout. First dorsal: longest spine $<$ eye + snout; base \leq base of second dorsal
No such dark stripes on body. No such streaks through second dorsal and anal. Anal base $<$ eye + snout. First dorsal: longest spine $>$ eye + snout; base $>$ base of second dorsal
4 { Dorsals united. Teeth in jaws 'fine villiform.' Longest dorsal spine \approx distance from tip of snout to hinder angle of preopercular ridge. Interorbital < 2 (1.0–1.1) eye
Dorsals separate. Teeth in jaws minute, subconical. Longest dorsal spine $<$ (about $\frac{4}{5}$) distance from tip of snout to hinder angle of preopercular ridge. Interorbital ≈ 2 (2.0–2.4) eye

Genus VINCENTIA Castelnau, 1872

VINCENTIA LEMPRIERI (Johnston), 1883

(Fig. 1)

Apogon lemprieri Johnston, 1883, *Pap. Proc. Roy. Soc. Tasm.*, 1882: 142. Type locality: Dunkley's Point, Sandy Bay [Buckingham], Tasmania.

Apogon lemprieri Johnston. Lord & Scott, 1924, *Synopsis Vert. Anim. Tasm.*: 10, 55. McCulloch, 1929, *Mem. Aust. Mus.*, V, ii: 172.

Vincentia novaehollandiae (Valenciennes). Munro, 1960, *Handbk. Aust. Fish.*: 144, fig. 901 [in *Fisheries Newsletter*, XIX, 10, Oct. 1960: 20, fig. 901], *partim*.

General remarks.—Johnston's species, based on a unique holotype, was described in the Addenda to his first catalogue; though it has survived on a number of succeeding lists (to become at last reduced in the Handbook to a synonym—together with *Apogon conspersus* Klunzinger, 1879, *Vincentia waterhousii* Castelnau, 1872, *Apogon guntheri* Castelnau, 1872, and *Mionorus ramsayi* Fowler, 1908—of *Vincentia novaehollandiae* (Valenciennes), 1832), it does not appear to have been recognized since its publication. A redescription and figure, based on 2 specimens that seem to be pretty clearly referable to it, are here offered.

Material.—Two specimens, (a), *Ls* 68.0, *Lt* 86.9, (b), *Ls* 73.0, *Lt* 91.1, from *Akaroa*, near St. Helens, George Bay, Cornwall, Tasmania: netted (Mr C. Burrows).

Description.—Where 2 comparable items (numerical or descriptive) occur in this account, the first entry relates to the smaller individual, (a).

D. VII, I, 9. A. II, 9. V. I, 5. P. II, 13. C. main rays 20; total 26, 24. L. lat. 27 + a terminal multiperforate scale on caudal base. L. tr. 2/1/9, 2/1/10.

Compressed; maximum thickness, occurring at posterior border of preoperculum, 4.9, 5.2, in *Ls*; thickness at level of vent 7.6, 7.7, at middle of length of caudal peduncle 16.6, 17.8, in *Ls*. Deep, maximum depth, occurring at level of first dorsal origin, 2.5, 2.6 in *Ls*, slightly exceeding length of head. General form more or less ovoid. In advance of eye, which in (a) barely reaches, in (b) cuts, dorsal profile of head, the upper profile is briefly in turn convex, concave, convex; between hinder part of eye and first dorsal origin profile shows in (a) an almost straight segment, followed (behind level of upper angle of preoperculum) by a segment, a little longer than an eye-diameter, the anterior moiety of which is shallowly concave, the posterior slightly convex; in (b) a short rather pronounced concavity, followed by a less well marked concavity, a short almost straight segment, and, at a noticeably lesser slope, a gently convex segment whose length is subequal to an eye-diameter. First dorsal base slightly concave, sloping slowly back and down; second dorsal base convex, the chord of the profile at an angle of about 35° to mediolateral axis. Upper part of caudal peduncle slightly concave, straight. In the ventral profile the most noticeable feature is the abrupt change in direction from the more or less even convex sweep from snout to end of anal base (this region rather more convex, near middle of its length, in (a) than in (b)) to the almost straight segment contributed by the caudal peduncle.

Head 2.6, 2.7 in *Ls*; 1.6, 1.8 times trunk. Eye 2.8, 2.8, snout 6.2, 6.4, interorbital 3.3, 3.4, in head. Jaws subequal anteriorly, a small elevation at the symphysis of lower jaw the most anterior point of the fish. Maxillary extending to below 0.8 of eye; the width of its free end about 0.8 distance from tip of upper jaw to level of orbit, subequal to pupil. Teeth in upper jaw minute, but tolerably

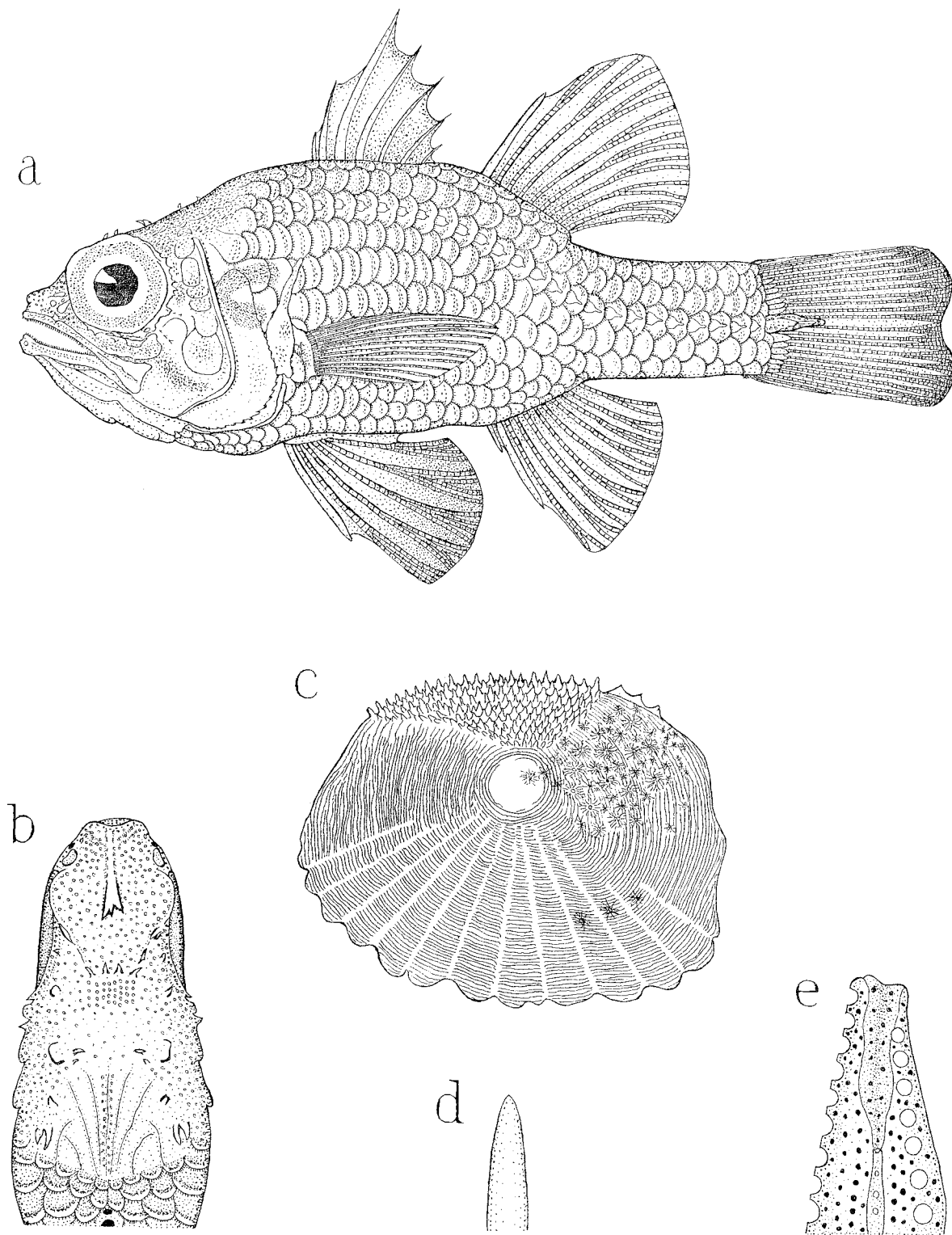


FIG. 1.—*Vincentia lemprieri* (Johnston), 1883. Specimen, standard length, 73.0, total length, 91.1 mm, from near Akaroa, near St Helens, George Bay, Cornwall, Tasmania; netted (Mr C. Burrows). *a*.—Lateral aspect (some detail of vertical fins conjectural); $\times 1\frac{1}{2}$. *b*.—Head, dorsal aspect; $\times 2$. *c*.—Scale from flank; $\times 15$. *d*.—One of a series of about 14 lanceolate scales partly overlapping bases of major caudal rays; $\times 8$. *e*.—Specialized posterior terminal scale of lateral line; $\times 8$.

stout, subconical: in a band on either side (a brief hiatus between them at tip of jaw), thickly set in about 6-8 rows anteriorly; width of bands decreasing posteriorly (more rapidly in (a)), to cease at about an eye-diameter before end of maxillary. In lower jaw much the same; with a slightly tumid hiatus that fits into non-dentigerous region of upper jaw; length of chord of band subequal to eye. Teeth on vomer rather smaller than those in jaws; in a bell-shaped band, whose maximum width, occurring mesially, is less than greatest width of jaw-band. Teeth on palatines small, in a brief narrow series. Gill rakers on anterior arch 3 + 12: slender, subcylindrical (except lowest one or two, which are stouter, subconical); maximum length, occurring at upper end of lower limb (above which, on upper limb, length does not decrease greatly; but below which, on rest of lower limb, there is a regular decrease in height to one-fourth, or less), equal to about half eye. On 2nd, 3rd, 4th, arches rakers successively shorter, relatively stouter.

Tongue whitish; stout; broadly ovate, with well-developed median lobe, behind which it begins to become adnate; upper surface of lobe slightly convex transversely, more so anteroposteriorly; immediately behind lobe, profile rises sharply, owing to presence of paired mounded regions, beyond which profile becomes subhorizontal; upper surface somewhat complex, but without papillae; edentulous.

After its first few scales (where, noticeably in (a), it is nearer dorsal profile than elsewhere) the lateral line runs almost exactly parallel with the dorsal profile, except that it maintains its even curve below the dorsal bases, which (notably first dorsal) introduce into the profile local approximations to rectilinearity. At level of vent, it is about $2\frac{1}{2}$ times as far from lower as from upper contour (measuring vertically); at middle of caudal peduncle, a trifle near dorsal profile (a), or equidistant from profiles (b).

Body covered with large ctenoid scales (Fig. 1 e). On breast a triangular area with 5-6 scales anteroposteriorly; at bases of pelvics in a transverse row of about 4, with 1 specialized elongated (in its exposed portion lanceolate) median scale, overlapping bases of the inner 2 or 3 pelvic rays. Normal scales extend for about 3 rows on to caudal base behind level of origin of first small outer caudal rays; being followed by 1 row of about 14 very narrow lanceolate scales partly overlapping bases of major caudal rays, their free tips being mostly in the interspaces between the rays (Fig. 1 d). Last scale along lateral line a specialized one; long, pennant-like, with about 8 pores along each border and a larger pore or partly open tube at tip (Fig. 1 e). Whole opercular region squamous; scales in 3-4 rows between orbit and angle of preopercular ridge. Dorsum of nape and head forward from a point in advance of first dorsal spine by a distance less than length of that spine; lateral surface above level of orbit to about an eye-diameter behind orbit; ventral surface of head; narrow half-annulus bordering eye inferiorly, all naked. Naked areas, except ventral surface of head, with small pores, most abundant on dorsum where there are upwards of 500. Much larger pores

include: 1 on orbital border at 5 o'clock (left side of fish viewed), 1 between nostrils, 2 pairs (1 pair ventral, 1 facing forward) at tip of lower jaw.

Most of hind and lower margins of preoperculum denticulate. Preopercular ridge and preorbital entire. Operculum without spines: near its posterosuperior angle a small, broad, short, bluntly rounded lobe; below this a small elongate, narrow, distally rounded, flattened fleshy flap, about 2 long, directed towards base of first dorsal. Orbital rim smooth sharp well developed between 2 o'clock, where it throws in on to the dorsum a short process running obliquely forward, and 10 o'clock, where it forms 1 or 2 flattened processes, below which, after decreasing somewhat in altitude, it continues as a narrow wall, scalloped, in parts jagged, to 6 o'clock, thereafter lower, smoother (in first half of this section its general course more nearly rectilinear) to 2 o'clock, giving off, on the way, at 3.30 a hemispherical process, more pronounced in (a). A median ridge, bifurcating in its hinder $\frac{1}{4}$, $\frac{1}{3}$, along dorsum of head from near snout-tip to level of anterior $\frac{1}{4}$, $\frac{1}{3}$ of eye. On either side of the hinder part of this ridge, the relevant region partly bounded anteriorly by the the inward spur from orbital rim at 2 o'clock, interorbital is mesially concave. In (a) both the posterior rami of the median project (in (b) only the left projects) as sharp bony blades. Other elevations, trenchant or acute, covered, in part or wholly, with integument, or bare include: (i) a pair of curved ridges, originating about at level of middle of eye, internal to orbit by about their own length (in (a) right ridge simple, left bilobate; in (b) right in 2 separate elements); (ii) a little anterior to level of hindmost point on orbit a line of 4 points across mesial $\frac{1}{3}$ of dorsum; (iii) on either side, at about vertical level of highest point on orbit a line of 4, extending over rather more than a eye-diameter, the first, shortly above orbit at 11 o'clock, a lanceolate blade, running forwards and downwards, its free border anterior, the second, a subhemispherical blade, free border behind and below; the third a blade with one free gently curved border, facing downward, the fourth, somewhat below level of rest, comprising 2 blade-like lips bordering a subhorizontal long linear opening; (iv) between fourth of (iii) and uppermost point of preoperculum (which is itself here trenchant), 2 small blades, the free edge of the hinder and upper standing out nearly at right angles to the general surface, the free edge of the lower directed more downwardly; internal to third of (iii), about along junction of lateral and superior surfaces of body, 2, the anterior, larger directly above the other just caudad of, third of (iii) (Fig 1 b).

Hinder part of dorsum of head and whole of nape with longitudinal ridges. In (a), in which they are more pronounced, they include: a median ridge (largest of the series) extending from about level of hinder $\frac{1}{4}$ of eye to base of first dorsal spine; on either side of this 4 ridges, following the same general course but shorter, gently sigmoid, the whole series (both sides) having a total width anteriorly of about $\frac{1}{2}$ eye-diameter; a sigmoid ridge, arising near anterior origin of the most internal of the paired ridges just mentioned, and running back, through about an eye-diameter, to

overarch commencement of lateral line; a less-elevated curved ridge, originating lower down on lateral surface, and more anteriorly (close to orbit), and proceeding back subparallel to last-noted ridge throughout most of length of latter.

First dorsal: 1st spine small, its length 0.3 of second, which is 0.6, 0.5 of 3rd, the longest, exceeding eye + snout, 1.2 times 4th; stoutest is 3rd, followed in sequence by 4th, 2nd, 5th, 1st, 6th, 7th; base of fin slightly less than, slightly greater than, eye. Interdorsal 0.3, 0.4 of first dorsal base. Second dorsal: spine subequal to penultimate ray, subequal to 4th spine of first dorsal; fin somewhat higher than first dorsal; base 0.9, 0.7 of base of first dorsal. Anal: 1st spine 0.3 2nd, the latter longer than 2nd, shorter than 4th, of first dorsal; lower than second dorsal; base 1.1, 1.0 of base of second dorsal; originating below 1st, 2nd dorsal ray; last 3 rays inserted behind level of second dorsal termination. Caudal slightly emarginate, with rounded lobes; its length subequal to length of caudal peduncle. Pectoral obliquely truncate; longest (5th) ray exceeding eye + snout, subequal to twice interorbital; extending to level of 2nd anal ray. Pelvic inserted just in advance of pectoral; 1st 3 rays subequal (2nd barely longest), all longer than rays in any other fin; extending to 2nd anal spine. Caudal peduncle: depth a trifle greater than eye-diameter, 2.0, 1.8 in its own length.

Proportions.—The principal dimensions are set out as thousandths of standard length, *TLs*, in Table V. Since Johnston's 'total length' is likely to be more strictly comparable with our similarly designated measurement than is his 'length of body' with our 'standard length,' the dimensions of Mr Burrows' specimens are given also as thousandths of total length, *TLt*, for comparison with those of the holotype reduced to the same form.

Johnston recognized only 6 dorsal spines, recording their lengths, in sequence, as 7, 16, 15, 13, 8, 3mm. In making the calculations for the present table, and throughout the discussion generally, it is assumed that he failed to observe spine I and that these are actually the measurements of spines II-VII. There are good grounds for this course: (a) a small or very small 1st spine is normal in this family, its length in Australian species of genera clustering round the present form (*Gronovichthys*, *Vincentia*, *Lovamia*, *Apogonichthys*) being contained at least 3 times in length of longest spine; (b) in our specimens I is small and easily overlooked; (c) matching Johnston's measurements against those for spines II-VII of our (a) (8.1, 14.0, 11.5, 9.4, 6.7, 2.4) and of our (b) (8.6, 16.0, 13.0, 10.7, 6.9, 3.0) we find, for (a), $r = 0.97$ ($z = 2.17$), $t = 8.61^{**}$, for (b), $r = 0.96$ ($z = 1.96$), $t = 6.96^{**}$; (d) the relation for spine-length, $L_N = L_3 - dN^k$ (see next section), found for spines IV-VII of our material is valid for the measurements of the holotype, if the first dimension recorded is that of spine II (see Table VI).

Coloration.—There are some differences between the specimens, particularly in the body, which in (a) bears some obscure dark markings not developed in (b).

(i) *Head.*—General color: very dark brown on dorsum, continuing to nape, where it is a trifle darker. Dark brown bar (convex upwards on left side of (b), otherwise virtually straight) from between 5 and 6 o'clock (left side viewed) on orbit to slightly below lower angle of preopercular ridge, subcontinuous anteriorly with an imperfect suborbital stripe running forward to nostril. Short, relatively broad spoke-like bars from orbit at 2 and 3 o'clock, former reaching to upper angle of preopercular ridge, and extending, continuously, or with brief interruption, in the same sense, for an equal or greater distance, length of whole marking about $\frac{2}{3}$ eye-diameter. Lobe of operculum immediately behind preopercular border (in same general sense as ocular spoke at 3 o'clock) with one or more dark markings: in (a), on left, 3, the hindmost somewhat above, the middle largely below, the anterior; on right only the 2 more anterior, partly confluent; in (b), on left, well-formed V-shaped dark marking, directed forwards; on right, 2 small well-separated spots. In (a) left operculum with 3 or 4 small dark brown spots, and left preoperculum with half a dozen smaller spots, neither set well developed on right: both absent in (b). Upper jaw narrowly bordered with blackish, the line extending (a) to, or (b) nearly to, free tip of maxilla. Lower jaw bordered, a trifle more broadly than upper, with brown. Iris darkish and/or silvery with fine brownish punctulations. Lower surface with, in (b) a few, in (a) many, punctulations: in (a) only, an obscure longitudinal line of 4 or 5 brownish splashes on each side. Brilliant iridescent bluish (most conspicuous), purplish, and gold (most restricted) all over opercle.

(ii) *Body.*—On side below lateral line, most (a), or almost all (b) scales back to level of vent or beyond with inframarginal brownish arcs, and with some reddish brown peppering; recognizable bands persisting caudad of anal base only on right of (a). On side above lateral line, in advance of dorsal termination, the brownish becomes more extensive, occupying from about $\frac{1}{3}$ of scale in (b) to most, or whole, of scale in (a); behind dorsal the brownish reduces to not very pronounced inframarginal arcs. Reddish brown punctulation more intense above than below lateral line. Bluish or purplish sheen on most of trunk below lateral line: ground color brownish yellow. Flank of (b) without special markings: that of (a) with a score or more small irregular very dark brown blotches below lateral line in advance of anal termination; the main concentration of pigmentation forming a rather ill-defined backwardly convex arc (better developed on left) extending from above upper angle of operculum to pass down, nearly to mid-ventral line, at level of middle of length of pectoral. Dorsal surface very dark on nape, dark or darkish along dorsal base, lighter, concolorous with flank, on caudal peduncle. Ventral surface more or less concolorous with lateral, except immediately in front of pelvic base, where it is lighter.

(iii) *Fins.*—What remains of membrane of first dorsal is translucent, heavily peppered, especially between the hinder spines, with red brown; 2 or 3 small spots between spines VI and VII. Basal remnants of membrane of second dorsal show more

TABLE V

Vincentia lemprieri (Johnston), 1883. Dimensions, expressed as thousandths of standard length (*TLs*), and as thousandths of total length (*TLt*), of 2 specimens (a) *Ls* 68.0 mm, *Lt* 86.9, (b) *Ls* 73.0, *Lt* 91.1, both from near St Helens, George Bay, Cornwall, Tasmania: also Johnston's data for the holotype, *Lt* 4 inches, expressed as *TLt*

Dimension	<i>TLs</i>		<i>TLt</i>		Holotype
	(a)	(b)	(a)	(b)	
Total length	1278	1248	—	—	—
Standard length (holotype: 'length of body')	—	—	782	801	800
Head	387	377	303	302	346
Snout	60	60	47	48	49
Eye	143	136	112	109	108
Interorbital	116	111	91	81	89
Length to middle of vent	596	610	466	468	
Length to origin of first dorsal	376	388	295	311	
Length to termination of first dorsal	543	555	425	445	
Length to origin of second dorsal	587	615	459	493	
Length to termination of second dorsal	706	734	552	588	
Length to origin of anal	618	629	483	504	
Length to termination of anal	751	748	588	619	
Length to pectoral origin	393	382	307	306	
Length of pectoral (total)	265	259	207	207	
Length of longest (5th, 5th) pectoral ray	240	227	188	182	
Length to pelvic origin	353	358	276	287	
Length of pelvic (total)	307	293	241	235	
Length of pelvic spine	184	164	144	132	
Lengths of pelvic rays 1-5 (holotype, 'longest')	280, 284, 280, 249, 207	260, 264, 260, 232, 193	219, 222, 219, 195, 162	209, 212, 209, 186, 155	207
Lengths of spines, I-VII of first dorsal (for assumption regarding holotype see text)	40, 119, 206, 169, 138, 99, 35	36, 118, 219, 178, 147, 95, 41	31, 93, 161, 132, 108, 77, 28	29, 94, 176, 143, 117, 76, 33	—, 69, 157, 148, 131, 79, 30
Length of spine of second dorsal	177	164	138	132	131
Lengths of rays, 1-8, of second dorsal: no entry, ray imperfect (holotype, 'longest')	—, 263, 252, 235, 222, 197, 173, 147	—, —, —, 233, 218, 193, 175, 122	—, 206, 197, 184, 174, 154, 136, 115	—, —, —, 187, 175, 155, 141, 98	187
Lengths of anal spines, I-II	44, 145	33, 123	35, 114	26, 99,	30, 187
Lengths of rays, 1-9, of anal: no entry, ray imperfect (holotype, 'longest')	—, 219, 222, 206, 191, 176, 168, —, 109	204, 202, 200, 180, 166, 164, —, 130, 110	—, 171, 174, 161, 150, 138, 131, —, 85	164, 167, 160, 144, 133, 132, —, 104, 88	187
Depth at anterior, posterior, border of eye	172, 331	164, 301	135, 259	132, 241	
Depth at opercular border, vent, termination of anal	397, 353, 184	370, 336, 178	311, 276, 144	296, 269, 143	
Depth at first dorsal origin, which is maximum depth (holotype, 'greatest depth')	404	384	316	307	346
Depth at caudal peduncle	150	151	117	121	

punctulation; rays greyish, darkening noticeably distally. Anal much like second dorsal, the tips of the rays less blackish. Pectoral pale grey, with some golden lights on rays. Pelvics briefly whitish basally, thereafter darkening—in (a) progressively to tip, where they are almost black; in (b) for more than half their length, beyond which they bear nearly a score of very narrow reddish brown cross bars, the interspaces being greyish. Caudal mostly light, faintly reddish brown, darkening somewhat in distal $\frac{1}{2}$ – $\frac{1}{2}$, the tips lighter.

Comparison with holotype.—(i) *Meristic characters.*—If, as has been suggested above, Johnston overlooked the 1st spine of first dorsal, meristic characters are in agreement. (ii) *Proportions.*—The 18 dimensions given for the holotype (some recorded in inches, some in millimetres) are exhibited in Table V, expressed as *TLt*. It will be seen agreement is in general satisfactory. In the Apogonidae the ratio of the lengths of the 2nd and 3rd dorsal spines is regarded as of diagnostic significance. (In 10 Australian species of *Gronovichthys* 6 are noted as having 3rd > 2 2nd, with 1 species noted as exhibiting each of these conditions; 3rd < 2 2nd, 3rd = 2 2nd, 3rd = 2 2nd, 3rd = 2-3 2nd). In (a), (b), holotype 3rd is 1.7, 1.9, 2.2 2nd. (iii) *Coloration.*—The holotype was stated to be 'uniformly brownish,' but, as noted above, though our specimens are not wholly unornamented, the markings are small and relatively inconspicuous. Two of the fins reported by Johnston as light reddish (anal, caudal) exhibit in our material some distal darkening. (iv) *General morphological features.*—General features recorded in the short description of the holotype are in good agreement with those observed in Mr Burrows' specimens.

It may be regarded as highly probable that the present material does indeed constitute a recovery, after upwards of three-quarters of a century, of Johnston's *Apogon lemprieri* and a confirmation of its specific distinctness.

Generic status.—Since the publication of the Check List (McCulloch, 1919) the taxonomic position with regard to the Australian members of the Apogonidae has undergone considerable revision. The Handbook (Munro, 1960) recognizes 16 genera as follows (number of Australian species in parentheses): (i) *Apogonops* Ogilby, 1896 (1); (ii) *Dinolestes* Klunzinger, 1872 (1); (iii) *Gymnapogon* Regan, 1905 (1); (iv) *Cheilodipterus* Lacépède, 1802 (1); (v) *Paramia* Bleeker, 1863 (1); (vi) *Siphamia* Weber, 1909 (6); (vii) *Archamia* Gill, 1863 (1); (viii) *Epigonus* Rafinesque, 1810 (1); (ix) *Apogon* Lacépède, 1802 (5); (x) *Glossamia* Gill, 1864 (2); (xi) *Kurandapogon* Whitley, 1939 (1); (xii) *Pristiapogon* Klunzinger, 1870 (1); (xiii) *Gronovichthys* Whitley, 1929 (11); (xiv) *Vincentia* Castelnau, 1872 (1); (xv) *Lovamia* Whitley, 1930 (7); (xvi) *Apogonichthys* Bleeker, 1854 (8).

From all Australian species of (i), (ii), (iii), (iv), (v), (vii), (ix), (x), (xi) Mr Burrows' fish is at once distinguished by a different (except in the case of (i) a greater) number of spines in first dorsal; from (vi) by the absence of a lateral subcutaneous gland; from (viii) by the presence of a

preopercular ridge; from (xi) and (xv) by color pattern; from (xvi) by shape of caudal. We are left with *Gronovichthys* and *Vincentia*: the relation between these genera and the validity of the second—problems that appear in the Handbook to have received neat solution—are acutely brought in question by the present material.

In the original diagnosis (Castelnau, 1872 b: 245) *Vincentia* was defined as having, *inter alia*, (i) dorsals separate ('its two dorsals are inserted the one very near the other'; again, later, 'two dorsals'; also 'general characters of *Chilodipterus* [sic] . . .'), (ii) palatines lacking teeth: type species, *V. waterhousii*, with sole notation 'reddish colour'. The genus was subsequently further discussed and rediagnosed (1873 b: 59), additional points in the new account being: (a) teeth now described as villiform in both jaws; (b) no canines; (c) 7 branchiostegals; (d) operculum denticulated; (e) scales large, adherent: the notation regarding the dorsal still reads 'two dorsals placed one near the other'. In the new, full account of *V. waterhousii* teeth are expressly noted as being absent from the vomer, 'but the pharyngeal bones are covered with small granular teeth': 'the second dorsal almost touches the first'. In the Check List *V. waterhousii* is synonymized with *Apogon conspersus* Klunzinger, 1872.

The establishment by Whitley of *Gronovichthys* [first published as a footnote (1929: 305), to replace *Amia* Gronow, 1703, non-binominal = *Amia* Meuschen, 1871 preoccupied; with diagnosis later (1930: 11)] and of *Lovamia*, 1930 has in the Handbook provided accommodation for 18 species, of which 15 had appeared in the Check List under *Apogon* (2 of them as synonyms), 1 under *Apogonichthys*, with 2 not noted. The present problem is largely concerned with the generic status of *Apogon novaehollandiae* Valenciennes, 1832 (which in the Check List remains in that genus), which differs from the 18 species just referred to in having the dorsals united. Whitley, rehandling Castelnau's genus *Vincentia* in 1930, defined it thus, '*Vincentia* may be distinguished from *Lovamia* and *Gronovichthys* by its united dorsals and the much greater depth of the body, the depth being greater than length of head or about one-third total length': agreeing with the Check List, he treats the holotype, *V. waterhousii* as synonymic with *Apogon conspersus* Klunzinger, 1872. As the Handbook synonymizes *A. conspersus* [together with *A. waterhousii* Castelnau, 1872, *A. guntheri* Castelnau, 1872, *A. lemprieri* Johnston, 1883 and *Mionorus ramsayi* Fowler, 1908] with *A. novaehollandiae*, the latter species appears in it as a *Vincentia* (sole species of the genus). Castelnau's genus, established for a species with edentulous palatines (and vomer?) and having 2 separate dorsals thus becomes (via the synonymization of its type species with a species having the characters just to be mentioned) a repository for a form possessing toothed palatines and vomer and differing from all its immediate allies in having the dorsals united.

Regarding the 2 characters on which *Vincentia*, as now interpreted, is based, it may be noted: (a) at least one genus in this family, *Apogonichthys*, includes one species, *A. ahimsa* Whitley, 1959, that differs from the remaining Australian species in

having the dorsals united; (b) depths exceeding length of head and more than one-third total length are encountered in species ascribed in the Handbook to *Gronovichthys*.

Examination of the present material leaves me with a strong feeling that Mr Burrows' fish, in spite of its separate dorsals, is congeneric with the species occurring as entry 901 in the Handbook (Munro, 1960: 144) under the designation *Vincentia novaehollandiae* (Valenciennes), 1832. Whether these two species should remain in *Vincentia* or whether one or both of them should be relegated to *Gronovichthys*, is a problem regarding the solution of which I have arrived at no firm opinion. It should be remarked that in the Handbook the lateral line of Valenciennes' species is noted as being continued to tail base 'here it ends in a long pointed scale which has about 5 pores along upper and lower edges and a larger one terminally.' This observation, which does not appear in the Handbook for any species of *Gronovichthys*, is applicable also to the present species, and the possibility arises that this shared feature, if it is, indeed, lacking in other forms, may conveniently be taken as marking off this two species generically.

Specific affinities.—If Johnston's species remains in *Vincentia*, it is at once distinguished from *V. novaehollandiae* by its separate dorsals and by its much broader interorbital: apart from these features, it approximates that species more closely than it does any species of *Gronovichthys*. The teeth of *V. novaehollandiae* are stated to be 'fine, villiform': those of the present form may be described as small, conical. The occurrence within a single genus of species with these two kinds of teeth is paralleled in *Gronovichthys*.

If *Vincentia* is to stand as a genus characterized by separate dorsals and the present species is relegated to *Gronovichthys*, it will be adequately segregated by the subjoined tabulation, which notes at least 2 points of difference between it and each of the Australian species of that genus, with the exception of *G. rudis* (De Vis), 1884, imperfectly known from a single specimen (that species has interorbital 4.5, snout 5, in head: the Tasmanian species 3.4-3.5, 6.3-6.9). The following appear in the Handbook (the catalogue-numbers being retained for convenient reference below): 890, *G. aureus* (Lacépède), 1802; 891 *G. chrysurus* (Ogilby), 1889; 892 *G. atripes* (Ogilby), 1916; 893 *G. darnleyensis* (Alleyne & Macleay), 1877; 894 *G. opercularis* (Macleay), 1878; 895 *G. ruppelli* (Günther), 1859; 896 *G. brevicaudatus* (Weber), 1909; 897 *G. bandanensis* (Bleeker), 1854; 899 *G. rudis* (De Vis), 1884; 900 *G. punctatus* (Klunzinger), 1879.

With A. II, 9 our species differs from 890, 891, 892, 893, 896, 897, 898 (all with A. II, 8) and 900 (II, 10-11). Orbital rim [partly scalloped] entire in 893, 894 (?), 895, 897, 898. Caudal [emarginated] truncate or rounded in 891, 892, 893. Pelvics [to 2nd anal spine] failing to reach anal in 894, 896, 897. Gill-rakers on lower limb of anterior arch [12] exceed 16 in 890, 897, 898. Eye [2.2-2.4 snout] < 2 snout in 890, 891, 892, 894, 895, 896, 897, 900. The color pattern of Johnston's species approaches that of *Vincentia novaehollandiae* more closely than it does that of any species of *Grono-*

vichthys, the divergence being most notable in 890, 892, 896, 897, 898, 899.

Length pattern of spines of first dorsal.—The lengths of the spines of the first dorsal follow, with significant fidelity, a simple pattern: first, for the anterior suite of spines (1st-3rd), in which spine-length increases caudad, the logarithm of of length of spine is a linear function of serial number of spine: while, secondly, for the posterior suite of spines (4th-7th), in which spine-length decreases caudad, it is the logarithm of the difference between length of longest spine (3rd) and length of spine considered that is a linear function of the spine's (total) serial number. That is, with L = length of spine, and N (whether used as on-the-line symbol or as suffix) = serial number of spine, we have for the anterior spines

$$\begin{aligned} \log L_N &= k \log N + \log d & (i) \\ \text{or} \quad L_N &= d N^k & (ii) \end{aligned}$$

For spines I, II, III of specimen (a) (lengths in mm) the best straight line (squares of the departures of the estimated logarithmic values from the actual logarithmic values a minimum) is

$$\log L_N = 1.5071 \log N + 0.4377 \quad (iii)$$

with $t = 21.94^*$. For (b) the corresponding equation is

$$\log L_N = 1.6617 \log N + 0.4202 \quad (iv)$$

with $t = 32.23^*$. For spines IV, V, VI, VII the general equation is

$$\begin{aligned} \log (L_3 - L_N) &= k \log N + \log d & (v) \\ \text{or} \quad L_N &= L_3 - d N^k & (vi) \end{aligned}$$

For specimens (a), (b) the best straight lines are, respectively

$$\begin{aligned} \log (L_3 - L_N) &= 2.6504 \log N - 1.1892 & (vii) \\ \log (L_3 - L_N) &= 2.6564 \log N - 1.1235 & (viii) \end{aligned}$$

with $t = 6.38^*$, 35.33^* , respectively.

If the assumption (see above) that the lengths of the spines of the holotype recorded by Johnston as those of I-VI are those of II-VII be accepted, the length pattern for the hinder series of spines found for our material continues to hold good; though the parameters of the equation differ noticeably from those of equations (vii), (viii)—the best straight line being

$$\log (L_3 - L_N) = 4.6891 \log N - 2.8048 \quad (ix)$$

with $t = 9.21^*$.

Granted the establishment, at an acceptable degree of statistical significance, of the formal relation, the systematist may be presumed to be interested to learn the measure of agreement between values predicted by such equations and spine-lengths as measured. It may be noted that a somewhat better estimation of absolute lengths than that yielded by the procedure adopted above can usually (though here in only 2 of the 4 instances) be obtained by calculating the equation for the line fitted under the condition that the sum of the squares of the absolute (instead of the logarithmic) residuals will be a minimum. For specimen (a) the two such equations are

$$\begin{aligned} \log L_N &= 1.4257 \log N + 0.4682 & (x) \\ \log (L_3 - L_N) &= 2.7878 \log N - 1.2943 & (xi) \end{aligned}$$

and for (b)

$$\log L_N = 1.5845 \log N + 0.4495 \quad (xii)$$

$$\log (L_3 - L_N) = 2.9556 \log N - 1.3649 \quad (xiii)$$

For Johnston's data, with the same assumption made as for (ix), the equation corresponding to equations (xi) and (xiii) is

$$\log (L_3 - L_N) = 3.8437 \log N - 2.1257 \quad (xiv)$$

Spine-lengths, as measured, and as estimated from the above equations are set out in Table VI. Though no further investigations along these lines have been carried out, it would seem not improbable that comparably simple and elegant relationships may characterize spine-length in some other fishes.

TABLE VI

Vincentia lemprieri (Johnston), 1883. Lengths of spines (mm) of first dorsal; measured values and values estimated from 10 equations set out in text: 2 specimens from near St Helens, George Bay, Cornwall, Tasmania, and holotype (for assumption concerning the serial numbers of the spines of which see text)

Spine No.	Specimen (a)			Specimen (b)			Holotype		
	Measured	Estimated		Measured	Estimated		Measured	Estimated	
		Equations (iii), (v)	Equations (x), (xi)		Equations (iv), (vi)	Equations (xii), (xiii)		Equation (ix)	Equation (xiv)
I	2.7	2.7	2.9	2.6	2.6	2.8	—	—	—
II	8.1	7.8	7.9	8.6	8.3	8.4	7	—	—
III	14.0	14.3	14.0	16.0	16.3	16.1	16	—	—
IV	11.5	11.4	11.6	13.0	13.0	13.4	15	15.0	14.5
V	9.4	9.4	9.5	10.7	10.6	11.0	13	13.0	12.4
VI	6.7	6.7	6.5	6.9	7.2	7.4	8	9.0	8.7
VII	2.4	2.8	2.5	3.0	2.8	2.4	3	1.6	2.7

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