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forces upon us the consideration whether these characters, taken separately or in conjunction, should not entitle this and similar forms to generic rank. The latter character, however, that is the acute spiniferous ridge between the occiput and the dorsal fin, is common to all the fresh-water and estuary non-migratory Herrings of the cismontane rivers of the Colony, between the limits of the Richmond River and Botany Bay, which the author has had an opportunity of examining: the former character, that of the position of the ventral fin, has been extensively used by systematists as one on which to base a separate genus. This is not the place to discuss the importance or otherwise of this character, but it is worthy of notice that in our common fresh-water herring (*Clupea novæ-hollandiæ*, Cuv. & Val. = *C. richmondia*, Macl. = (?) *C. vittata*, Casteln.) the ventral fins are inserted immediately below the origin of the dorsal.

With regard to the dorsal serrature, we appeal to our fellow-workers in other countries to examine more carefully the anadromous herrings of their rivers and estuaries, for should it prove to be the case that all the fresh-water herrings have this characteristic, they are clearly separable from the typical *Clupea*.

All species, therefore, in which the occipito-dorsal serrature is present, might be separated therefrom under the name of *Hyperlophus*, and distinguished from *Clupea* by this character.

On the Structure and Affinities of *Panda atomata*, *Gray*.*

By C. Hedley, F.L.S.

[Plates IV. V. VI.]

Some uncertainty appears to prevail regarding the position which *Bulimus atomatus*, Gray, should occupy. The latest volume of the "Monographia Heliceorum Viventium" includes it in a section embracing another Australian and a dozen South American species, an arrangement which must surely violate natural

*Since this essay was written I learn that, by an odd coincidence, both Mr. Pilsbry and myself independently arrived at the conclusion that *atomata* should correctly be referred to *Panda*, and published our opinions simultaneously in America and Australia, in "The Nautilus," Vol. VI., No. 1, p. 9, May, 1892; and in the "Abstract" of the Proceedings of the Linn. Soc. N.S.W., April, 1892, respectively.

affinities. Albers' classification, "Die Heliceen," p. 229, though more correct, is not in accordance with the views of the writer, who has recently enjoyed an opportunity of studying this interesting creature alive in the recesses of its native forests. The following is the first record of the soft parts of this snail. The animal so resembles the figure of *Caryodes dufresni* appearing in the *P.L.S., N.S.W.* (2) vi. Pl. iii. f. 1. that this sketch would almost as well represent the former as the latter species. Colour; a pale ochreous yellow becoming redder on the head and tentacles; a dark brownish-black dorsal stripe extends from between the tentacles to the mantle, a similar but fainter stripe extends on either side along the facial groove from the lips to the mantle; sole of foot ashy-blue; mantle ashy-blue shot with ochreous yellow. Some snails are paler and some darker than the one described. Total length 70 mm., muzzle projecting 25 mm. in front, tail projecting 7 mm. behind the shell when crawling; tentacles 15 mm. long, bases 5 mm. apart; measured just in advance of the shell, the body is 15 mm. wide and 12 mm. high. Tentacles gradually tapering to one-third of the diameter of their bases, clad with fine longitudinal granulations; ocular bulbs asymmetrical, more swollen on the lower distal side, eye superior central in position. Two ill-defined grooves start from the mantle and enclose a series of rugæ which compose the dark median dorsal colour-band mentioned above; anteriorly these grooves are lost in the reticulations around the bases of the tentacles. From the median line, reticulating grooves extending outwards and downwards, intersect a series of prominent long narrow tubercles, from six to ten of which intervene between the dorsal band and the facial groove. The tail is rather flat and sharply pointed; the sides and tail are covered by flat, irregular polygonal tubercles which become smaller on approaching the tail. On emerging from its shell, *atomata* has a habit of spreading the margin of the foot into a wide, flat flange. I note that the left side of the mantle developes no rudimentary mantle lobes as in *Hadra*. When extended, the shell is carried slightly obliquely, the apex being a little to the right of the tail; when retracted, the animal does not usually shrink further back than the aperture, to which no epiphragm was observed.

The living snails were collected by Dr. Cox and the writer in tolerable abundance in a "cedar-brush" adjoining Mr. Ashford's estate on Sparke's Creek, near Scone, N.S.W. Their habit was to nestle beneath decaying logs or in drifts of fallen leaves, where they would occur singly or by twos and threes; one was taken in the act of ascending a tree a few feet from the ground. Specimens were obtained (April 1892) in all stages of growth. Dr. Cox informs me that on other occasions he has found this species to lay large, white, hard-shelled eggs.

The reproductive system of this form seems to me to be especially worthy of attention. Branching from the vagina, opposite to the entrance of the duct of the spermatheca, is a gland of unknown function, marked X in the accompanying illustration (Pl. v. fig. 13); this exactly corresponds to the gland marked *x* in Semper's illustrations of the genitalia of *falconeri* and *dufresni*, and also to the gland marked v. p. in the figure of the genitalia of *cunninghami* published by the author. It will be observed that Semper's drawings show a short, wide, recurved duct, and mine a narrow, subcylindrical one. On referring to a sketch of the organs of *dufresni*, which I took some time ago, I notice that the gland in question appears of the form observed in *cunninghami* and *atomata*; possibly each form may be proper to different periods of gestation. No other Australian helices are known to possess such an appendage, and its value as a means of classification cannot be denied. The musculature, which is shared by the species with which I would associate *atomata*, is also peculiar. The retractor muscle of the penis is not attached to the floor of the pulmonary cavity as in some helices, but is a broad band arising from the main retractor muscle of the columella. The narrow subcylindrical portion of the penis sheath extending from the insertion of the retractor muscle to the origin of the vas deferens, is also strictly analogous to the similar portions of *cunninghami*, *falconeri* and *dufresni*. The ovo-testis is a compact, yellow, bi-lobed body, not ramifying through the lobes of the liver.

The jaw (Pl. v, fig. 11) is 4½ mm. long, smooth, boomerang-shaped, ends tapering to a blunt point, cutting margin with a slight median projection.

The radula (Pl. vi. figs. 14, 15) measures 10 x 3 mm., is strap-shaped, formula, 185 rows of 45 : 22 : 1 : 22 : 45.; the rachidian is single, narrow, about the length of its base, sagittate at the root, slender in the stem, lanceolate at the apex, basal plate expanded posteriorly; laterals more bulky than the rachidian, unicuspidate, broadly ovate, apex acute, projecting past the basal margin, alate angle slightly expanded; the remoter laterals pass gradually into the marginals, which are characterised by single, entire, oval, much inclined cusps.

The classification of this species hitherto accepted seeming to the writer in disaccord with its real relationships, he would prefer to intercalate it among other Australian snails as follows:—

Family HELICIDÆ.

Foot flat, pointed, without mucous gland or pedal line; mantle without appendages; tentacles long and tapering.

Group MACROÖN.

Egg large, hard-shelled; apex of shell consisting of 2-2½ whorls of embryonic shell, sharply marked off and differently sculptured from the adult.

A.—Genital system furnished with an additional gland. Jaw oxygnathous.

Panda falconeri, Reeve.
" " var. maconelli, Reeve.
" " " azonata, Hedley.
" " " tigris, Hedley.
" atomata, Gray.
" " var. kershawi, Brazier.
" " " elongata, Hedley.
" " " azonata, Hedley.
" larreyi, Brazier.
Pedinogyra cunninghami, Gray.
" " var. mühlfeldtiana, Pfeiffer.
" " " compressa, Mousson.
" " " minor, Mousson.
Caryodes dufresni, Leach.

B.—Without the additional gland.

B*a*.—Jaw oxygnathous; lateral teeth of radula simple.
Anoglypta launcestonensis, Reeve.

*B*b*.—Jaw goniognathous; lateral teeth of radula with accessory cusp.

Liparus inflatus, Lamarck.
" " var. melo, Quoy & G.
" " " physodes, Menke.
" " " castaneus, Pfeiffer.
" " " bulla, Menke.
" " " rhodostoma, Gray.
" baconi, Benson.
" tasmanicus, Pfeiffer.
" mastersi, Cox.
" kingi, Gray.
" " var. trilineatus, Quoy & G.
" angasianus, Pfeiffer.
" brazieri, Angas.
" onslowi, Cox.
" dux, Pfeiffer.

The anatomical information on which the above synopsis is based chiefly consists of these illustrations and their accompanying letterpress:—Reis. im. Phil. III., Pl. xii. fig. 20, genitalia of

*Polynesian representatives of *Liparus* would appear to be *Placostylus*, and its derivatives *Diplomorpha* and *Partula*.

falconeri; figs. 23, 24, 25, ditto *dufresni;* Pl. xv. fig. 14, ditto *melo;* Pl. xvi. fig. 7, radula of *dufresni;* fig. 10, ditto *falconeri;* Pl. xvii. fig. 13, ditto *melo;* Proc. Roy. Soc. Queensland, VI., Pl. iii. jaw, radula and genitalia of *cunninghami;* Pl. xiv. jaw and radula of *mastersi;* P.L.S., N.S.W. (1) III. Pl. vii. fig. 1*a*, egg of *dufresni;* op. cit. (2) VI. Pl. ii. fig. 1, jaw of *dufresni;* figs. 2, 3 and 4, jaw, radula and genitalia of *tasmanicus;* figs. 5, 6 and 7, jaw, radula and genitalia of *launcestonensis.*

Should a lens be applied to the summit of a fresh specimen of any of the species enumerated above, the apex (Pl. v. fig. 10) will be seen to resemble a well worn thimble; the first two whorls are usually dome-shaped, and are always marked off from the adult shell by an oblique furrow. *Anoglypta* may perhaps be regarded as most retaining the ancestral sculpture. A wide band or bands round the base or periphery is a colour-pattern that is apt to occur throughout the group. The bands so conspicuous in *dufresni* recur in *inflatus* var. *castaneus*, in *baconi*, and in *angasianus;* they are represented on the base of *Anoglypta*, can be traced in the wide bands around the base of *falconeri*, and the pattern is distinctly repeated in some colour varieties of *cunninghami.* Another feature in common is the bluish-gleaming sub-nacreous lining of the interior of the shell.

Allusion is made above to the egg of *atomata.* Tenison-Woods figured the egg of *C. dufresni*, and it was re-described by the writer, P.L.S., N.S.W. (2) VI. p. 20. *A. launcestonensis* is reported (op. cit. p. 22) to lay a similar egg. A broken egg of *cunninghami*, collected by Mr. S. Stutchbury, is now in the Australian Museum, and is figured Pl. v. fig 12. It may be described as globose, 9 mm. in diameter, hard, calcareous, brittle, white, coarsely granular without, smooth within.

The subordination, in the foregoing synopsis, of *maconelli* to *falconeri* as a variety, is an innovation that demands an explanation which Plate iv. is intended to convey. In the latest notice of the genus, Pilsbry succinctly sums up the difference by stating (Man. Conch., 2nd Ser., Vol VI. p. 76) that *maconelli* is "Just like *H. falconeri* in color and sculpture, but narrower and and imperforate." It is here contended that a large series admits of a perfect graduation, traceable from the tightly coiled, narrow, elevated and imperforate *maconelli*, to the looser coiled, wide, depressed and umbilicate *falconeri;* while extreme forms exist more elevated and more depressed than either of Reeve's illustrations. Reduced outlines of Reeve's types of *maconelli* and *falconeri* are represented by figs. 1 and 6 respectively; figs. 2 and 8 are the extremes of each form as figured in the Monograph of Australian Land Shells; figs. 3, 4 and 5 are original sketches, from examples selected and lent for the purpose by Dr. Cox, to show the transition from *maconelli* to *falconeri;* while fig. 7 is

another original sketch, from a shell in the Australian Museum, intermediate between Cox's and Reeve's conception of *falconeri*. Did space suffice, and necessity demand, a further series of intermediate forms might be furnished more closely linking the one to the other of the preceding instances; but enough are afforded, it is supposed, to prove "quod erat demonstrandum."

Panda thus gives a curious and instructive illustration of the value placed by the elder systematists upon "Bulimus" and "Helix," since Reeve assigned *maconelli* to the former and *falconeri* to the latter, an arrangement in which Pfeiffer quite acquiesced. Two colour varieties of this species might with advantage be distinguished.

var. AZONATA, *var. nov.*

Bandless, entire shell straw-yellow coloured.

var. TIGRIS, *var. nov.*

The original dark spiral bands have here become disintegrated into separate blotches, and these latter have further become confluent with those above and beneath, so that the band pattern is changed from regularly spiral to irregularly longitudinal and zigzag, in which state it approaches the pattern of *atomata* and *larreyi*.

In this genus, neither contour nor colouration can be relied upon to furnish specific characters, and I cannot admit *kershawi*, Brazier (P.Z.S., 1871, p 641) as a valid species. No habitat has been recorded for this form between the valleys of the Hunter and of the Snowy River. Yet, despite their geographical isolation, southern specimens can be precisely matched, as Dr. Cox has kindly demonstrated to me, by northern shells. Fossil specimens of this species have been identified by Dr. Cox from Victoria, but none have come under the writer's observation, nor is he aware of any mention of the fact in the literature of the subject.

I add a sketch of the as yet unfigured *kershawi*, from the author's type, now in the collection of the Australian Museum.

Other variations of this species are—

var. ELONGATA, *var. nov.*

More elevated than the type, and represented by Mon. Austr. L. Shells, Pl. xviii., fig. 15.

var. AZONATA, *var. nov.*

Bandless, entire shell straw-yellow coloured.

EXPLANATION OF PLATE IV.

Fig. 1. Reduced outline of the type of *P. maconelli*, Reeve, from P.Z.S., 1851, Pl. xii., upper figure.

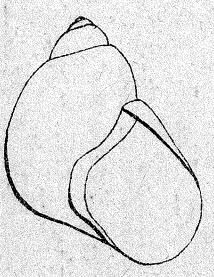
„ 2. Reduced outline of Mon. Austr. Land Shells, Pl. iii., fig. 5.

„ 3–5. Reduced outlines from specimens lent by Dr. Cox.

„ 6. Reduced outline of the type of *P. falconeri*, Reeve, from Conchologia Iconica, Vol. vii. (Helix), Pl. lxviii., fig. 355.

„ 7. Reduced outline of specimen from the Richmond River, N.S.W. (Aust. Mus. Coll.)

„ 8. Reduced outline of Mon. Austr. Land Shells, Pl. xvi., fig. 6.



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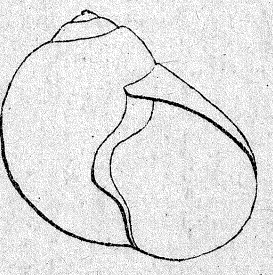

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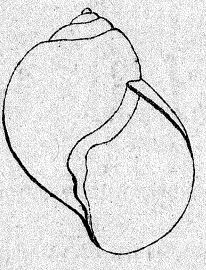

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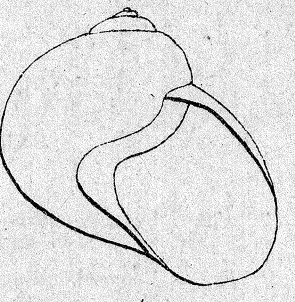

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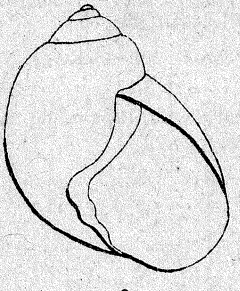

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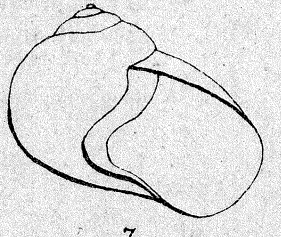

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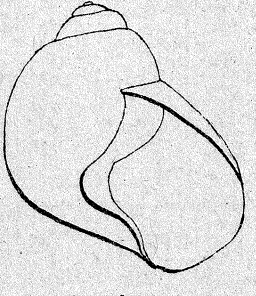

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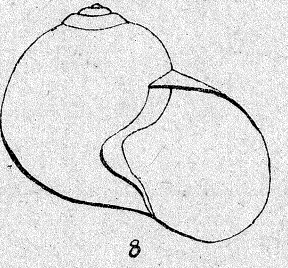

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C. Hedley, del.

EXPLANATION OF PLATE V.

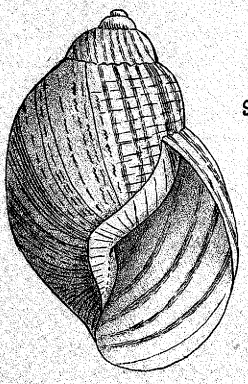
Fig. 9. *B. kershawi,* Brazier, from the author's type in the Australian Museum.

„ 10. Apex of shell of *P. atomata* to show sculpture of embryonic shell, magnified.

„ 11. Jaw of ditto, magnified.

„ 12. Egg of *Pedinogyra cunninghami,* natural size.

„ 13. Genitalia of *P. atomata.*



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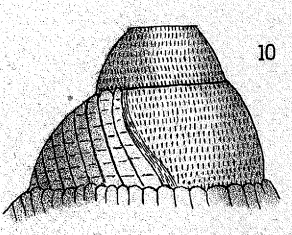

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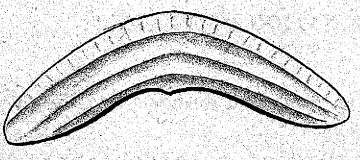

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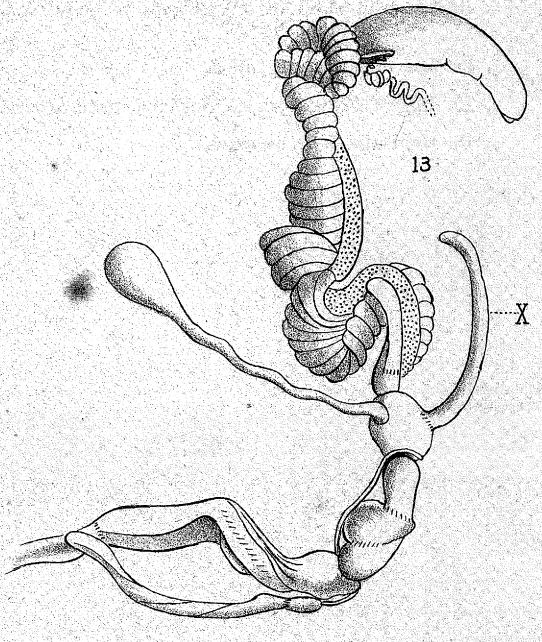


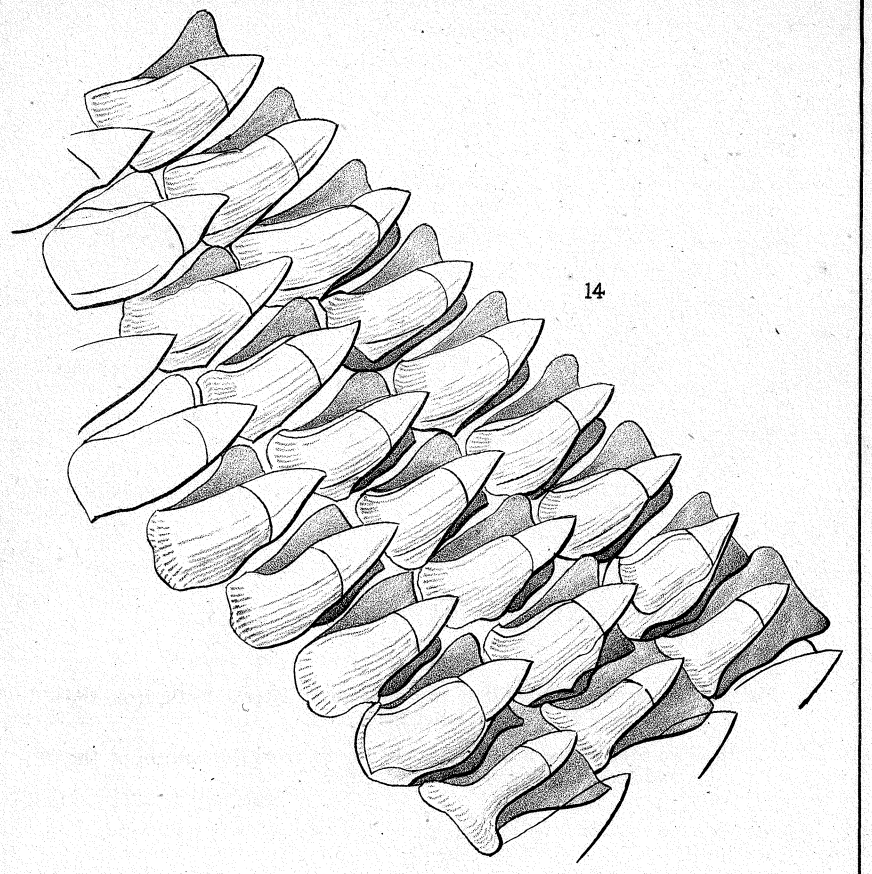
X

C. HEDLEY, del. ad nat. G. H. BARROW, lith.

EXPLANATION OF PLATE VI.

Fig. 14. Two rows of rachidian and immediate lateral teeth from the radula of *P. atomata,* much magnified.

„ 15. Two rows of the 36th to the 42nd teeth from the margin of the radula of the same, much magnified.



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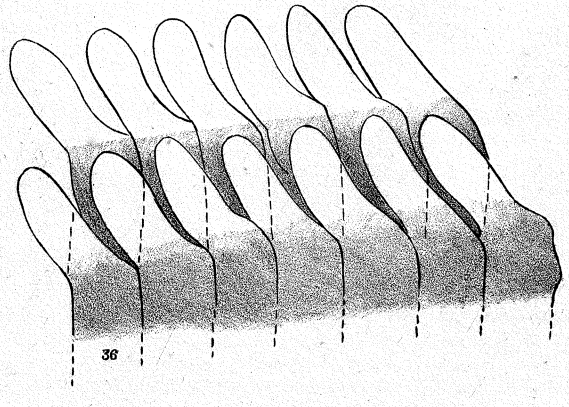

C. HEDLEY, del. ad nat. G. H. BARROW, lith.