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# OBSERVATIONS ON SOME PHASES OF THE LIFE CYCLE OF *ICHTHYOPHTHIRIUS MULTIFILIIS* FOUQUET, 1876, A CILIATE PROTOZOAN PARASITE OF FRESH-WATER FISH.

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(Plates vi. and vii.)

## INTRODUCTION.

The material for this paper was obtained by the author while investigating, in his capacity as Biologist to the Victorian Freshwater Research Committee, two serious outbreaks of ichthyopthiriasis (White Spot, itch disease or Fleckenkrankheit) at the trout hatcheries of the Ballarat Fish Acclimatisation Society in 1939 and 1940.

The field aspect of the problem has been discussed already in a previous paper (Butcher, 1941); in the present communication certain incidental observations on the life history of the infecting organism will be dealt with.

## TECHNIQUE.

The material used in this investigation was obtained from the Ballarat hatcheries during the severe outbreak in the 1939-40 season. Live infected trout were brought to the laboratory and kept in suitable aquaria. I have experienced the same difficulty as have most previous investigators in maintaining the parasite under these artificial conditions. MacLennan (1937), by maintaining aquaria at a constant temperature of approximately 26°C. by means of an electric heating element controlled by a thermostat, has succeeded in maintaining the infection; these facilities unfortunately were not available to me. However, on two occasions, using carp, a complete life cycle was obtained under these adverse conditions, and this will be reported on fully later in this paper.

Observations on the free-living parasite after leaving the fish were made on numerous individuals pipetted out from the aquaria into petri dishes or other suitable receptacles. Under these conditions the encystment and post-encystment phases can readily be observed on the living material. In addition, I have examined fixed material, using Corrosive Acetic, Carnoy, Bouin, etc., as fixatives and various stains, including Methyl Green and Acid Fuchsin, Ehrlich's, Delafield's, and Heidenhain's Haematoxylin, etc.

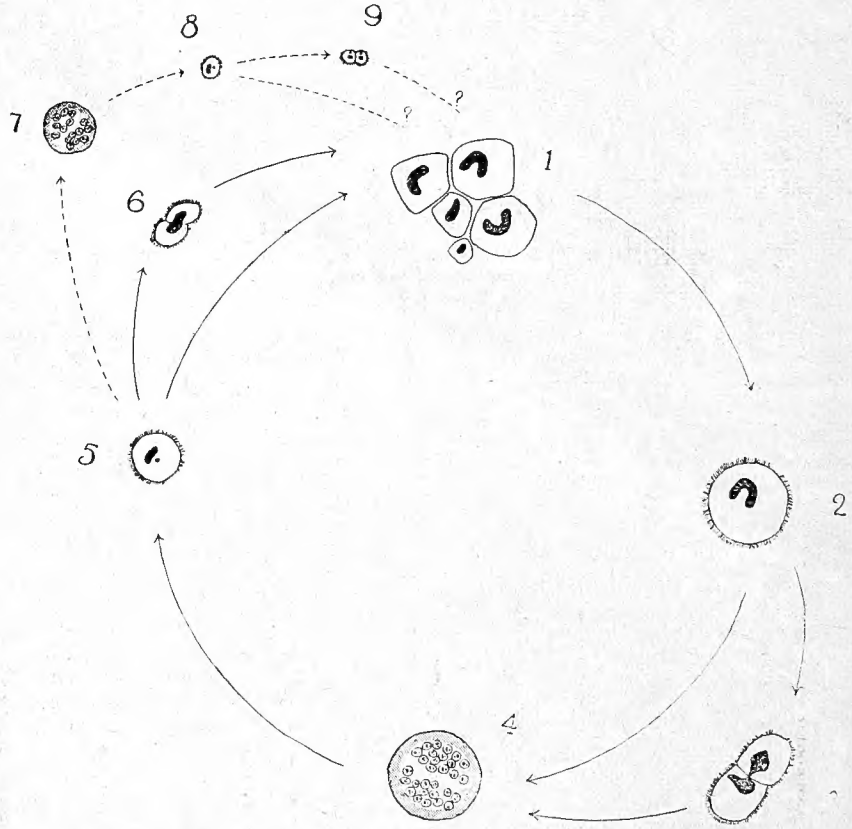
The parasite on the fish was examined in the living condition and on formalin fixed material after paraffin imbedding and staining with Delafield's Haematoxylin.

## OUTLINE OF THE LIFE CYCLE.

A preliminary outline of the life history of the ciliate will facilitate the subsequent description.

The complete life cycle is shown in text-fig. 1. The adult organism (1) emerges from the pustule and becomes the free-swimming precystic form (2) with a diameter of approximately 420 micron, although diameters of up to just under 1 mm. have been recorded. This form may either directly

encyst (4) or may first undergo a single division (3). By repeated binary fission within the cyst the minute postcystic forms (5) arise and these may either directly infect another fish or may first undergo a single division (6). There is no certain evidence of a sexual phase; see Haas (1933). The terms precystic and postcystic are used in the sense in which I defined them in my earlier paper. The minute postcystic forms are variously spoken of by other authors as swarm spores, ciliospores or simply spores. In addition to the life cycle which takes place when fish are available for infection, another, and perhaps abnormal, cycle of events may ensue in which the postcystic form may re-encyst (7) and undergo further reproduction in this condition. This accessory cycle is indicated by dotted lines in text-fig. 1. Whether the forms which thus arise are capable of infecting fish I could not determine.




Text fig. 1.—Diagrammatic representation of the life cycle of the parasite. (Broken arrows represent phases which occur only if no host is available.) 1.—Organisms in pustule on host. 2.—Precystic form. 3.—Division in precystic form. 4.—Cyst. 5.—Postcystic form. 6.—Division in postcystic form. 7.—Second cyst. 8.—Second postcystic form. 9.—Division in second postcystic form.

## OBSERVATIONS.

### 1.—Free Living Phases.

(a) Division in the precystic stage.

Usually the parasite (fig. 1) after leaving the fish, proceeds to encyst; but occasionally, as Stiles (1893) has already observed, a single division may precede encystment (figs. 2-5); these two halves I have observed to encyst, but their further development was not followed. Like MacLennan (1937) I have never encountered an example of the complete multiplication of the ciliate in the free-swimming condition as described by Minchin (1922); in all instances the multiplication is completed, in my experience, within the cyst wall.

Not uncommonly I have found that one of the products of this division of the precystic form is a peculiarly shaped organism having a nipple-shaped projection at one end (fig. 3).

(b) Encystment.

At a time ranging from 3 to about 25 hours after liberation from the fish encystment of the parasite takes place. As already stated a single fission may precede encystment; but if more divisions take place, then, as MacLennan (1937) has also observed, the ciliates do not encyst but disintegrate.

It would seem, in agreement with MacLennan (1937), that the parasites must have attained to a certain degree of maturity on the fish for encystment to take place; for if liberated artificially from the pustules then encystment rarely occurs.

I have on several occasions been able to observe the actual process of encystment. First the ciliates drop to the bottom of the vessel, their movement becoming gradually slower, then the beat of the cilia practically ceases and locomotion by the action of cilia gives way to a type of amoeboid movement. A single pseudopodium developes and the flow of protoplasm can be followed as in an amoeba. At this period the cilia are still present but are not sufficiently active to move the parasite. Finally all movement ceases, the cilia disappear, and the thick wall of the cyst is formed. The cyst wall is surprisingly thick; this will be readily seen from fig. 6, which is a camera lucida drawing of a living cyst.

Cyst formation takes place on any suitable submerged object. There is, however, no certain evidence that encystment normally occurs on the bodies of fishes. Zacharias (1893) states that he frequently found encysted individuals on a young fish, and Roth (1908) also recorded the presence of such cysts on the skin of living fishes. I have myself never seen anything to confirm this. According to MacLennan (1937) it is quite a common occurrence to find encystment on the semi-detached epithelium of a dead fish.

(c) The cyst.

Owing to the great variation in size of the precystic forms there is a large range of variation in the size of the cysts themselves, and, in consequence, in the number of postcystic forms arising from the cysts.

Within the cysts repeated binary fission of the organism now ensues. I

have observed the process in numerous fixed and stained preparations (Methyl Green and Acid Fuchsin was a satisfactory double stain for cysts). There is considerable difficulty in obtaining the cysts intact, for they are firmly attached to the substratum. This difficulty can be overcome satisfactorily, without injury to the delicate cyst, by drawing a fine glass thread under it.

Division does not always proceed with any regularity within the cyst. Sometimes a complete partition may develop across the cyst, division in the two halves proceeding independently, and the postcystic forms leaving from their respective sections. Stages in the division of the cyst content are shown in Figs. 7-10, fig. 8 being the two-celled stage, fig. 9 the four-celled stage and fig. 10 the sixteen-celled stage. Fig. 7 shows an example of the extreme irregularity of division which is sometimes encountered, four of the division products having lagged much behind the remainder.

In my experience the number of fission products liberated from the cysts never exceeds a few hundred. This agrees roughly with Doflein's (1909) observation; other authors, Fouquet (1876) and Prytherch (1923) have observed them in much greater number. Prytherch quotes cases where they were liberated up to 2,200 in number.

(d) Postcystic form.

After 8 to 24 hours (at an average temperature of 17°C.) the young postcystic forms begin to emerge from the cyst. As they work their way through the gelatinous cyst wall they become elongate but soon revert to a more or less spherical shape (figs. 11-12). These postcystic forms measure about 75 micron in diameter. I could not with certainty recognise the presence of a mouth; MacLennan (1935) states, however, that he has been able to detect one.

Fouquet (1876), Pearson (1932) and MacLennan (1935) all agree that the young postcystic forms remain elongate long after leaving the cyst, but this has never been my experience.

(e) Division of the postcystic form.

The postcystic forms are now ready to infect another fish. Nevertheless at times the postcystic form may divide once again (figs. 15-16) before reinfecting a fish; this occurs, indeed, fairly commonly, but to my knowledge has been noted by only one other worker, Buschkiel having recorded it in 1911.

(f) Survival of the postcystic form in absence of the host.

In a number of experiments the young postcystic forms were isolated in petri dishes, without the opportunity to gain access to a fish. Under these conditions a phase in the life cycle was revealed, which has not, to my knowledge, been hitherto observed. Within 24 hours, at least fifteen of the free-swimming forms had again encysted, and within the cysts division of the ciliates recommenced. Owing to the minute size of the organisms a limit is necessarily set to their further reproduction; actually cases ranging from 2 to a maximum of 16 new individuals were observed within the cyst. By the end of the second day these second postcystic forms (fig. 17) were swimming around, having been liberated naturally from the cysts. They continued to swim around for about 24 hours and

some had even begun to divide as free-swimming ciliates (figs. 18-19). The diameter of the second postcystic forms prior to this division was about 24 micron. At this period unfortunately, following on the introduction of water from a different source into the petri dishes, the culture became contaminated with another small ciliate, of approximately the same size but of different shape, and the observations had to be discontinued. Whether these second postcystic forms are themselves capable of infecting fish I have not determined.

The appearance of these minute second postcystic forms as seen in fixed and stained preparations is shown in figs. 17-19. The preparations were obtained by mixing the culture fluid with egg albumen which was spread on to a coverslip and fixed in the ordinary way with Corrosive Acetic and stained with Delafield's Haematoxylin.

### 2.—Parasite on the Fish.

I have already alluded above to the difficulty which I and most other observers have had of bringing about natural infection of fishes with *Ichthyophthirius multifiliis* in aquaria. Nevertheless on two occasions, using carp, such infections did take place, thereby completing a life history under experimental conditions. These two cases have been included in Table I. It will be observed that under these conditions at a temperature of about 17°C. the complete life cycle has a duration of 13-16 days. It is probable that this furnishes an explanation to the periodicity of the epidemics that have been observed among trout at the Ballarat hatcheries. There were in one season four recorded outbreaks of Ichthyophthiriasis of varying degrees of severity and these occurred at regular intervals of about a fortnight; namely, in the middle of November, the beginning of December and the middle of December. The next was recorded on the 30th January of the following year. Presumably there was a less virulent and therefore undetected outbreak during the middle of January. The temperature range throughout these months was 14.5 to 18°C.

(a) Mode of entry.

In order to observe the passage of the postcystic ciliate into the host I placed a detached caudal fin from a recently killed healthy fish into a petri dish to which were added numerous free-swimming postcystic forms. Very soon the parasites settled on the fin and began to rotate with considerable speed. After a period of approximately 40 minutes the organisms had by this means burrowed into the epithelium and could no longer be detached by violent agitation. This confirms essentially the observations of Neresheimer (1908), Buschkiel (1911), Haas (1933) and MacLennan (1935 a. & b.). Haas and MacLennan were actually able to detect a large solid hyaline knob or perforatorium at the anterior end of the ciliate, free of cilia, which the organism seems to use as a wedge to force an entrance between the cells.

(b) Site of infection.

This has been described as occurring in the epithelium over the entire head, body, fins and gills, as well as in that of the mouth, opercula and around the eyes. Wolf (1938) found in sections through rainbow trout that the parasites were almost entirely beneath, not in, the epidermis, sometimes even partly beneath the scales.

TABLE 1.

Duration of phases of the life cycle under laboratory conditions.

| Life History | Exptal. Host | Av. Temp. °C. | Precystic | Cystic | Postcystic | Spots First Noticeable | On Fish | Total Length | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| (1) | Small carp | 16.0 | 16½-19¾ hours | | | | | | The period on the host in these life cycles refers to the reinfected fish and not the original host which was obtained already infected. |
| (2) | „ „ | 17.2 | 8-11 hours | 15-24 hours | | | | | |
| (3) | „ „ | 16.8 | 3-25 hours (Mostly 3-11 hours) | 8-16 hours | Sev. hours | After 4 days | 12-15 days | 13-16 days | |
| (4) | „ „ | 16.0 | 3-6 hours | 12-21 hours | Sev. hours | After 3 days | 11 days | 13 days (approx.) | |

In my own work sections through a complete brown trout fry and through portions of six others, some two thousand sections in all were examined. Parasites were found in all the positions described above and also in others. The majority of the parasites were in the epidermis itself (see figs. 24, 25), and many others were in positions as described by Wolf (1938). Some were in contact with the connective tissue layers (see fig. 26), others in contact with the developing scales, and others again in the actual pockets of the developing scales (see fig. 26). These deeply embedded parasites were not in the majority, as in the case described above by Wolf. In one case a parasite was observed in a lymph space.

The most unexpected position in which a parasite was found was in the actual body cavity of its host (see fig. 27), the parasite being in the posterior end, in the region of the cloaca. As it was thought that this might be a isolated case, serial sections were made through the cloacal region of six more infected fish. Parasites were found in the body cavity in three more cases; two parasites were found in the cloaca of the fourth and only two had no parasites in this region. It would, therefore, appear that the presence of parasites in this position is a regular occurrence. It is not difficult to visualise the passage of the parasite from the cloaca through to the body cavity, as the wall of this chamber is quite thin. In no case had the parasite moved far along the body cavity.

(c) The pustule.

The pustules vary greatly in size, being sometimes as much as a millimetre or more in diameter. Cases containing as many as three or four parasites per pustule have frequently been deemed worthy of comment in the literature; it has therefore been a matter of considerable surprise to find in the Ballarat outbreak that individual pustules sometimes contained over fifty organisms. These cases are, of course, extreme, but even an observed average of six (based on one hundred counts) is unusually high. Probably this is related to the extraordinary severity of the infection in the hatcheries; a quart of water taken at random from one of the ponds contained many hundreds of the free-swimming parasites. Within the pustules the parasites lie closely compressed and often considerably distorted. This will be seen in figs. 13 and 14 (fig. 14 represents only a fragment from a single large pustule).

As Fouquet (1876) and, following him, many other observers have recorded, the parasites undergo slow rotation within the pustules. This is due to the action of cilia at their surface. (Cilia are usually difficult to see in fixed preparations and were not visible in the organisms from which figs. 14 and 15 were drawn).

Several explanations have been advanced for the presence of more than one parasite within a single pustule. It may be due (1) to union of adjacent pustules (Prytherch, 1923); (2) to the simultaneous entrance of more than one individual at one point, Buschkiel (1911) having observed a congregation of as many as ten individuals at the point of entrance; (3) to various ciliates using already formed entrances and passage ways under the epidermis (Buschkiel, 1936). There is no critical evidence for deciding between the three suggestions.

From time to time there have been reports of the actual division of the parasite within the pustule—Stiles (1893), Prytherch (1923), Roughley

(1933) and Suzuki (1935). Neither Doflein (1909), nor Haas (1933) nor MacLennan (1935a) could find any evidence for this. In my own experience, based on the examination of many hundreds of pustules, there has been no evidence whatsoever for such fission. Roth (1908) and Buschkiel (1911) both state that division takes place on the fish—not in the pustule, but in the slime covering the fish.

3.—Occurrence of a Mouth and the Supposed Occurrence of an Anus.

There has been much discussion as to the position and shape of a mouth in *Ichthyophthirius multifiliis*. In his original description, Fouquet (1876) described it as a small prominence which has a circular opening with a divided edge "like a stamping machine" and occurs at the extreme anterior end of the body; according to Zacharias (1893) it is ventral in position in the anterior third; Kerbert (1884) placed it laterally near the anterior end of the body; Stiles (1893) states that it is situated terminally at the posterior extremity; Guberlet (1933) places it at the anterior end, while Haas (1933) and MacLennan (1935) describe it as sub-terminal in position.

My own observations have been made (1) on the living precystic form viewed on a dark background (figs. 20-21); (2) on sections of the same (fig. 23); (3) on sections through the parasite on the host (fig. 22). In my material the oral opening is situated almost terminally; it is circular and is surrounded by a thickening of the cuticle; it leads into a ciliated gullet. The cilia surrounding the mouth are approximately the same length as those covering the body; those lining the gullet are very much longer. The mouth opening in all forms examined was, however, considerably wider than any I have seen illustrated by the authors above referred to.

A possible explanation for the discrepancies in the accounts of the mouth given by various observers, including myself, relating as they seem to do to one and the same species of *Ichthyophthirius* lies perhaps in the difference of host and of environmental conditions under which the organisms existed.

Bütschli (1883), Doflein (1909) and Wenyon (1926) all record the presence of an anus or cytopyge. Neither Fouquet (1876) or Kerbert (1884) were able to observe one, but Kerbert states that the faeces are expelled from various points on the surface of the organism. Stiles (1894) could observe neither an anus or defecation. I have myself examined large numbers of individuals, both in section and in the living condition, without being able to detect any trace of an anus.

It is noteworthy that MacLennan (1935 b, 1936) has even been able to observe the retention of indigestible material by one of the products of fission after encystment, this faeces-laden form being non-viable.

4.—Effect upon the Fish.

(a) Feeding.

Fouquet (1876), Zacharias (1893) and Prytherch (1923) uphold the view that within its host the ciliate absorbs liquid nutriment directly through the surface of its body. As long ago as 1884, however, Kerbert claimed to have observed the ingestion of pigment cells from the host into the body of the parasite. MacLennan (1935 b.) also speaks of the ingestion of host tissue in the form of small globules 5 micron in diameter derived by

fragmentation of host cells. Pearson (1932), on the other hand, holds that both types of feeding occur.

My own observations leave no doubt as to the ingestion of whole cells, often in large quantity, into the protoplasm of the parasite (figs. 30-31). Most of the ingested cells lie freely in the cytoplasm, although some are contained in food vacuoles (see particularly fig. 31). I have not observed the presence of fragmented cells as described by MacLennan.

Whether in addition fluid nourishment is absorbed into the parasite I have not been able to determine.

(b) Reaction of the skin.

In the extremely heavy infections with which I have worked I have found in all cases a very pronounced thickening of the epidermis—the consequence of a proliferation of its cells. This may be seen by comparing fig. 29 from an uninfected fish and fig. 28 from a heavily infected fish. Since in heavily infected fish the parasites are scattered over the entire body, practically the whole epidermis has undergone this thickening. Even when the parasites are found in the deeper layers of the skin the overlying epidermis shows this thickening. This proliferation does not, however, take place in the epithelium of the gill filaments (fig. 30).

(c) The cause of death of the fish.

No satisfactory explanation has yet been given for the markedly lethal effect of the parasite upon fish. Commonly we find that infection with *Ichthyophthirius multifiliis* is followed by attacks of *Saprolegnia*, and Doflein (1909) regards this secondary infection as the actual cause of death, whilst Roughley (1933) states that these *Saprolegnia* growths upon the gills may have the effect of choking the fish. Nevertheless, in the Ballarat epidemics, when several hundred thousand fish perished, *Saprolegnia* was conspicuously absent. Wolf (1938) also recorded an epidemic with heavy mortality in the complete absence of the fungus. Prytherch (1924) and Roughley (1933) observed red blotches and heavy secretion of slime over the fish; neither of these symptoms again were in evidence in the Ballarat outbreak. It is to be noted that Roughley's observations were made on aquarium fish; Prytherch's on catfish, bass, bream and sunfish, whilst my own observations were on rainbow and brown trout and carp. Stiles (1893) could recognise no gross lesions, death being due presumably to general injury of the epidermis and the enormous amount of slime present on the body and over the gills. MacLennan (1935 a. & b.) also attributes death to epithelial destruction, at least in heavy infections. Yet in my own material there has been little evidence of epidermal destruction, the epidermis showing, on the contrary, a considerable thickening. Wolf (1938) suggests that death may be due to osmotic derangement consequent upon epidermal injury; but there is no evidence, in the form of water-logging of the fish, to support this.

I can only suggest as the most likely hypothesis that the parasite is the source of a toxin which is the cause of death. It is worth noting that, even in the trout, which is a very susceptible species of fish, some individuals are unaffected by the parasites; for in the Ballarat outbreaks there were sometimes up to a dozen healthy fish left in ponds in which several thousand fish had died. These fish could not possibly have escaped the

general infection. Buschkiel (1911) suspected that immunity might arise and carried out an investigation into the matter, but came to no conclusion. Unlike many other hosts, carp appears to possess a natural tolerance for *Ichthyophthirius multifiliis*. It acts as a carrier, and from my knowledge, apart from small ornamental types, is seldom killed.

## SUMMARY.

The life cycle of the parasite consists of four major phases; the parasitic phase on the host; the precystic stage; the cystic stage and the postcystic stage.

The life cycle is not, in fact, always so simple, as division may occur in the precystic and postcystic stages. It is further complicated by reencystment of the first postcystic form in the absence of the host.

Detailed periods are given for each phase of the life cycle, and the total time for the complete life history obtained under laboratory conditions (13-16 days) probably furnishes an explanation to the periodicity of the epidemics observed in the Ballarat hatcheries; the temperature range in each case was approximately the same.

The ciliates penetrate the epithelium and other tissues of the host by means of a boring apparatus.

The numerous positions on the host in which the parasite is found are described; of particular note is the discovery of parasites in the posterior end of the body cavity.

The number of organisms found within the pustules varies immensely, being sometimes as many as fifty individuals; possible explanations for this heavy infection are outlined.

The species of fish infected may have some influence on the form of the mouth of *Ichthyophthirius multifiliis* which has been described differently by various authors. A description is given of the mouth in living forms and in sections through the ciliate. There is no anus and defecation does not take place.

The parasites feed on the whole cells which they dislodge.

As a reaction to very heavy infection, proliferation of the cells over the whole of the epidermis occurs, with the exception of that of the gill filaments.

Various suggestions as to the cause of death of the host are discussed and a hypothesis that a toxin is produced is brought forward.

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## EXPLANATION OF PLATES.

All drawings made with aid of camera lucida from fixed specimens (except where otherwise stated); cilia not shown except in figs. 1 and 23.

(Plate i.)

Fig. 1. The precystic form of the parasite; note the typical horse shoe-shaped macro-nucleus. X 30.

Figs. 2- 5. Division in the precystic form. All X 30.

Fig. 6. Living cyst; illustrating the thickness of the wall. X 30.

Fig. 7. Cyst; the initial division has been repeated only twice in one portion of the cyst. X 30.

Fig. 8. Cyst; initial division. X 80.

Fig. 9. Cyst; 4-cell stage. X 80.

Fig. 10. Cyst; 16-cell stage. X 80. The author was unable to obtain a series of cysts, in different stages of division, of uniform size. The cysts illustrated in figs. 8-10 have developed from precystic forms differing greatly in size.

Figs. 11-12. Postcystic forms of the parasite. X 90.

Fig. 13. Small pustule on the skin of a fish. X 30.

Fig. 14. Portion of a large pustule on the skin of a fish. Note the variety of forms assumed by the parasites in the restricted space of the pustule. X 30.

Figs. 15-16. Division in the postcystic form. X 80.

Fig. 17. Second postcystic form. X 167.

Figs. 18-19. Division in the second postcystic form. X 167.

In fig. 19 the products of the division have not yet separated. As the mount was made in a thick egg albumen preparation each of the individuals had to be drawn at a different focal distance. The second individual in each case is indicated by the shaded outline.

(Plate ii.)

Figs. 20-21. Living precystic forms of the parasite showing position and form of the mouth; drawn against a dark background.

Fig. 22. Section through a parasite (taken from a fish) illustrating

the form and position of the mouth. The nucleus has been cut through in two places. X 132.

Fig. 23. Section through a free parasite showing the long cilia lining the distinct gullet. X 80.

Fig. 24. Transverse section through portion of an infected fish; parasite imbedded in the epidermis. X 82.

Fig. 25. Transverse section through portion of an infected fish; the parasite is imbedded in the epidermis and epithelial cells, dislodged by the parasite, may be seen in the space of the pustule surrounding the parasite. X 132.

Fig. 26. Transverse section through portion of an infected fish; the parasite is in the pocket of a developing scale and in contact with the connective tissue. X 82.

Fig. 27. Transverse section through an infected fish; the parasite (p) is in the body cavity of its host. X 21.

Figs. 28-29. Transverse sections through portion of an infected and a healthy fish respectively. The epidermis of the infected fish is much thicker than that of the healthy fish as indicated by the line drawn on the left-hand side of each figure. X 82.

Fig. 30. Section through a parasite in a gill filment from an infected fish. Note the single ingested cell within the food vacuole. X 80.

Fig. 31. Section through a parasite taken from an infected fish; five ingested cells may be seen in a food vacuole. X 132.

# ON THE EXTERNAL CHARACTERS OF THE POUCH YOUNG OF SOME AUSTRALIAN MARSUPIALS.

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(Thirteen text-figures.)

In a series of papers which commenced with a description of the young of *Trichosurus vulpecula* var. *typicus*, Wood Jones (1) drew the attention of zoologists to the hiatus which exists in our knowledge of the Australian marsupials by the lack of information concerning the characteristics of the pre-adult stages, particularly that part of the life-history spent in the pouch. In the present contribution examples of two further species, *Perameles nasuta* and *Vombatus hirsutus*, are considered, together with an excellent series of *Phascolarctos cinereus*, of which Wood Jones had access to only a single individual. The specimens, while of considerable interest in themselves, have their value increased in that they stand in close relationship to forms already described.

The disposition of the hair tracts appears to be the most important additional external feature obtained by examination of the pouch young. Often there is revealed a complexity of pattern the presence of which is not even suggested by the closest inspection of the fur of the adult. Insufficient work has been placed on record for it to be other than premature to attempt to draw conclusions involving an assessment of the taxonomic value of hair pattern in marsupials. It must be admitted, however, that the evidence at present available, gathered principally by Wood Jones, does seem to point to specific constancy in hair pattern, but it will be necessary to examine the young of a much wider range of species in complete series of the significant developmental stages to establish this on the irrefutable basis which the systematist demands. It must also be recognised that hair pattern may contain characters only some of which are useful for separation of species and subspecies. For instance, the whorl on the front of the leg above the ankle in *Phascolarctos* would probably be a point in the generic diagnosis. Some features of the hair tracts may be assignable to even higher categories of classification.

The investigations recorded herein of series of the koala and wombat show considerable variation to exist, especially with reference to the arrangement of whorls and radiating centres. It would seem that these structures are subject to duplication both longitudinally and laterally within the defined limits of the species. For instance, in stages F and G of *Vombatus hirsutus*, both of which have hair growth sufficiently far advanced for charting, at the proximal end of the gular field in G there is a single radiating centre, but in F there are two arranged one in front of the other in the midventral line. The series of *Phascolarctos cinereus* (which is probably not subspecifically homogeneous) shows a similar phenomenon in the whorls of the upper back—in one group a single mid-dorsal whorl between the attachments of the limbs, but in the other this system has the appearance of having undergone duplication laterally and

(1) Wood Jones, Trans. Roy. Soc. S. Austr., xliv., 1920, pp. 360-373.

triplication longitudinally to form three pairs of partly whorled radiating fields. Moreover, the hair whorl is not constant either in position or form. In *Vombatus* a short length of divergent hair parting on the crown of one specimen appears in another as a clockwise whorl somewhat more caudally placed, whilst the six dorsal radiating fields in stage H of the *Phascolarctos* series show varying degrees of whorling between members of the same pair. These results, then, throw open the question of the specific value of the hair whorl. One is justified from an examination of this material in suggesting the possibility of the configuration of the hair whorl changing with growth as the stresses in the skin, which have been postulated as the cause of hair pattern, are presumably not constant during growth.

A note of caution in the use of hair patterns for taxonomic purposes is sounded by the whimsical variability found on the frontal region of man as recorded by Bolk (2) in a paper in which he describes and figures minutely the variation in a restricted area of the human skin. The foetuses used in the investigation were mostly Dutch in origin and must, therefore, be regarded as from a population mixed racially, a fact, as suggested by the author, which may account for the results obtained. Perhaps the most significant part of Bolk's work lies in his examination of two dicephalic monsters in one of which the two heads displayed an identical pattern, but in the other "there were considerable differences." Also, Kidd (3) has shown the existence of a similar range of variability in the arrangement of the hair at the side of the neck in the horse.

The specimens on which this work was carried out are housed in the Australian Institute of Anatomy at Canberra. They are all, except where otherwise indicated, from eastern Victoria. To facilitate comparison the length of the individuals of the koala and wombat series has been taken as that obtained by placing them between parallels—the crown-rump length. In addition, in these two species, I have also given the preserved weight; there is, undoubtedly, a difference between the live weight and that of the formalin-soaked specimen, but the difference is unlikely to be sufficiently wide to invalidate the figures as a source of comparison between the various members of a series (4).

Figures 2, 6, 7, 8, 10A, and 11-13 are from the pen of Mrs. K. Pilcher.

### Perameles nasuta Geoffroy.

The single specimen of this species represented in the collection is a female measuring 140 mm. from the tip of the snout to the base of the tail. It is covered with a short pelage which dorsally consists of black hispid hairs intermingled with a shorter, very pale under-fur. The fur is at a satisfactory stage for consideration of the hair tracts.

*Hair Tracts.*—The course of the hair on the trunk, tail, and the dorsal and lateral portions of the head is from the anterior to the posterior end without the interposition of reversed fields or whorls. On the throat (Fig. 1A) caudad of the interramal papilla there is a reversed field brought about

(2) Bolk, Journal of Anatomy, lviii., 1924, pp. 206-221.

(3) Kidd, "Initiative in Evolution," 1920, p. 51 *et seq.*

(4) A paper by A. H. Schultz, "Changes in Fetuses due to Formalin Preservation," in Am. Jour. Phys. Anthrop., ii., 1919, pp. 35-41, is of much interest in connection with this question.

by the existence of a pair of whorls near to each other, one on either side of the midventral line just above the level of the shoulders at the root of the neck; the right whorl is anticlockwise, the left clockwise. From these whorls a stream of hairs is directed medially to form a weak hair ridge midventrally, cranially towards the interramal papilla, caudally on to the chest and fore-limbs, whilst laterally a stream originates which flows outwards and backwards on to the sides of the face and neck and over the shoulder. On the limbs the hair flow is distally and towards the postaxial margin along which, as in the case of *Isoodon barrowensis* (5), there is, on the fore-limb, a reversal between the wrist and the elbow; the proximal limit of the postaxial reversed stream is marked by a convergent point somewhat distal of the eminence of the elbow; the dorsum of both the fore- and hind-feet has the hair extending to the base of the ungual phalanx. On the pes (Fig. 3B) the hair pattern is similar to that described by Wood Jones for *Isoodon barrowensis;* from the dorsum the hairs flow round the medial and lateral margins on to the plantar surface, those behind the level of the base of the first digit flowing down and at the same time describing an arc towards the heel, those in front of this line down and forwards towards the distal extremity. The result of this arrangement is that where the two currents meet on the sole along a line which passes through the centre of the heel and the pad at the base of the fifth digit a small convergent interval is formed opposite the base of the first digit; distal of the convergent interval the hairs stream towards the fifth digit, proximally there is a well defined convergent stream flowing to the heel. The heel is naked, but hairs from the sole and leg converge on it in a symmetrical radial fashion.

*Facial Vibrissae.*—A complete and conspicuous set of facial vibrissae is present. The mystacials are arranged in six rows, the two ventralmost of which are placed just outside the margin of the upper lip. Rows one to three (counting from above downwards) contain, for the most part, vibrissae which are pigmented a dark brown, but some of them are lighter or practically without pigment; rows four to six are, except for an odd lightly pigmented vibrissa, colourless. The superior row contains three, the second four, the third seven, the fourth seven or eight, and the fifth eight bristles; the lowest or labial row has two or three which are placed towards the caudal end of the mystacial region. The unspecialised body hairs round the base of the mystacials are distinguishable from those of the surrounding area by the relatively greater growth of the under-fur which, at this stage of development, is here much less regular in texture than elsewhere. The genal papilla is prominent and is situated low down on the side of the face; its position is defined as beneath the eye on a line which continues backwards the line of the oral fissure; five or six very lightly pigmented or colourless vibrissae, directed backwards and downwards, issue from each papilla. The supraorbital papilla, also distinctly defined, has two vibrissae which are darkly pigmented proximally, colourless distally. The submentals form a single row of seven on each side; they are colourless and point directly downwards. The interramal papilla is circular in shape; it lies on the line joining the angles of the mouth and has six vibrissae consisting of a shorter anterior pair and four behind which are longer; as with the interramals they are colourless and point downwards.

(5) Wood Jones, Trans. Roy. Soc. S. Austr., xlvi., 1922, p. 39.

*Brachial Vibrissae.*—There is a strong ulnar carpal papilla with three vibrissae. No other tactile hairs were observed.

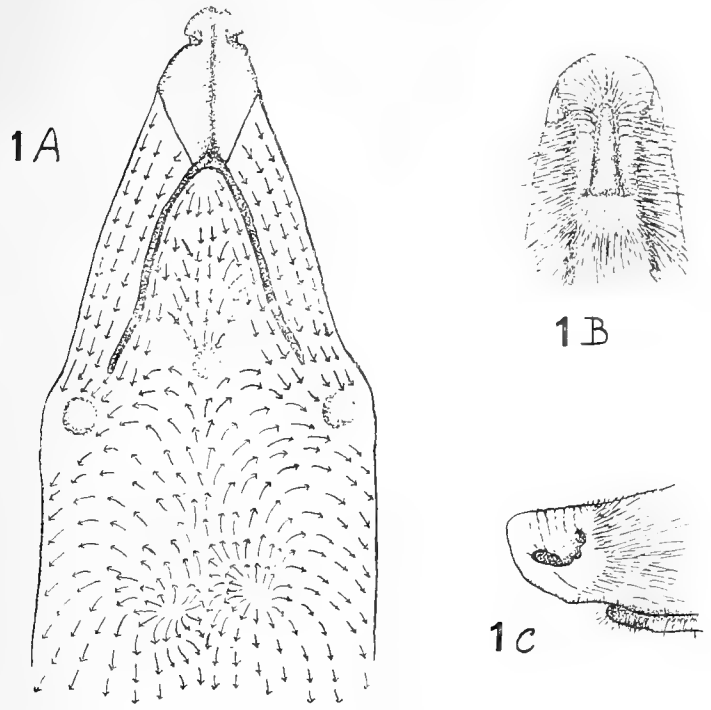


Fig. 1. *Perameles nasuta.* A, the gular hair tracts; the positions of the interramal and genal papillae are also indicated. B, the dorsum of the rhinarium. C, lateral view of the rhinarium.

*The Rhinarium.*—The rhinarium (Fig. 1) has the conical shape characteristic of the genus. A sulcus incises the upper lip and is produced on to the rhinarium as a groove well marked till it reaches the level of the middle of the medial border of the nostrils above which it is continued round the point of the snout on to its dorsum; its course on the dorsum is terminated at about the centre of the portion overlying the nostrils. The dorsum of the rhinarium (Fig. 1B) is produced caudally as a tongue with approximately parallel borders, the end of the tongue being cut off transversely behind; continuous with the end of the tongue there is a semicircular pink area, its convexity posterior clothed with very short caudally directed hairs which sharply separate it from the surrounding hairy zone; this last-mentioned area is regarded as belonging to the rhinarium proper. The sculpture on the dorsum of the rhinarium consists of a series of radially arranged shallow grooves which originate from the vicinity of and behind the termination of the median sulcus and flow over the margin of the rhinarium to the dorsal border of the nostril. The tongue-like backward projection of the rhinarium is impressed by two longitudinal grooves, one on each side of the median line, which diverge slightly caudally. The narial

apertures are crescentic, consisting of a medial aperture with a large upturned arc-like lateral process.

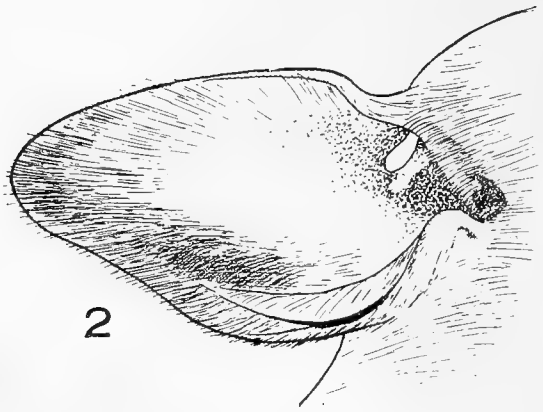


Fig. 2. *Perameles nasuta.* The form of the external ear.

*External Ear.*—The auricle (Fig. 2) has the contours general in the genus *Perameles,* that is, long and narrow with an obtusely pointed tip; it is hairy, both medially and laterally. The medial surface, due to the differing density and coloration of the hairs, presents a characteristic pattern obviously the forerunner of what Thomas (6) has recorded as "back of ears brown, rather darker anteriorly, and paler basally"; at the base of the ear there is a pale grey zone about one-third of the length of the auricle deep, similar in colour to that of the rest of the head and separated from the more distal part of the auricle by a line which runs approximately parallel to the line of attachment; elsewhere the medial surface is browner in colour, a dark brown in the anterior half, much lighter posteriorly. On the lateral surface of the auricle the hairs are more numerous and browner towards the margin, particularly between the tip and the sulcus auris posterior; in the middle of the auricle beyond this pigmented zone the hairs are sparse and transparent. The inferior notch is very clearly defined, but there is no tragoid process. The antitragus occurs as a low ridge which is continued posteriorly somewhat less than half of the length of the auricle and within, but parallel to, the margin of the ear; in its posterior half between it and the margin of the ear there is an elongate sulcus auris posterior. Immediately superior to the notch and anterior of what is normally the position of the tragoid projection there is a deep pre-auricular depression. The metatragus (processus antihelicis) is about as high as wide, rounded distally and excavated on its caudal surface so that it appears concave from above downwards; on its cranial surface which is granular there is a corresponding convexity. The secondary processus antihelicis lying in front of the metatragus or main process is in the form of a lamina attached to the auricle along a line about parallel to that of the base of the main process; its line of attachment is longer than that of the metatragus; the structure is of about the same size as the main

(6) Thomas, Cat. Marsup. Brit. Mus., 1888, p. 243.

process towards which it is inclined so that between its inner surface and that of the auricle there is a large pocket which opens backwards.

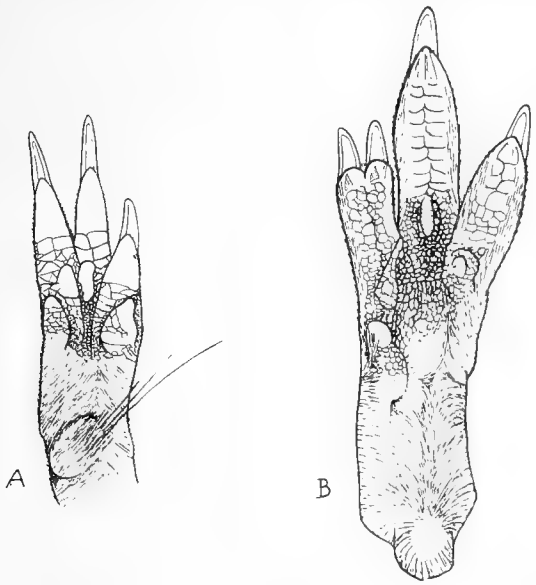


Fig. 3. *Perameles nasuta.* Volar surface of the left manus (A) and the left pes (B).

*The Manus.*—In its general features the fore-foot (Fig. 3A) resembles that of the adult. The first and fifth digits are greatly reduced; they are situated at about the same level on the palmar surface and proximal to and in line with the base of digits two and four respectively. The largest digit is the third; the second is only very slightly shorter, the fourth much smaller. The palm is coarsely granular and sparsely hairy in the concavity between the first and fifth digits, more hairy proximally; the hairs are pigmentless. There is an irregularly shaped volar pad at the base of the second and third digits; the pads are smoother than the surrounding surface and do not bear markings except a faint granulation. At the base of the fourth digit there is a further pad, but it is imperfectly separated from the general palmar surface and does not form a clearly defined entity. The large triangular apical pads of the second, third and fourth digits bear a faint longitudinal striation.

*The Pes.*—As with the manus the pes (Fig. 3B) approaches in form that of the adult. The first digit is vestigial and lies proximal to and in line with the base of the syndactylous digits; the fourth digit is greatly enlarged and the fifth, the next in size, much smaller; the syndactylous digits are very little shorter than the fifth. The plantar surface of the pes is granulated in a manner similar to that described for the manus. Disposition of the hair on the sole has been considered under hair tracts (*v. supra*). The interdigital pads are represented by a series of three at the base of third, fourth and fifth digits; that associated with the third digit is small and triangular, but the other two are larger and sub-oval in

a longitudinal direction. Only the summit of the pads is modified, being grey in colour and very finely granular, with a tendency towards transverse striations in one or two cases; the basal portion of the eminence is coarsely granular like the adjacent parts of the sole. What appears to be a rudimentary pad occurs at the base of the small first digit. Apical pads are present at the extremities of all digits and, except the small one at the end of the rudimentary first digit, show weak longitudinal striations.

*Remarks.*—The juvenile which forms the subject of the above notes bears a close resemblance to the adult. Feet, ear and rhinarium are all miniatures of the condition found in mature examples; its pouch is well developed and has the mouth directed downwards and backwards.

Wood Jones' (7) account of *Isoodon barrowensis* when compared with that of the present species, shows many points of close resemblance as would be anticipated with two related genera. This applies particularly to the structure of the plantar surface of the pes and its hairy investment, and the presence of the gular reversed field. Proximal to the base of the first digit the feet of the two animals are similar except that the median hair ridge is somewhat differently orientated; distal to this level, however, *I. barrowensis* differs from *P. nasuta* in the presence of a stream of hair on the plantar surface of the syndactylous digits. The gular fields of the two species, while bearing some similarity to each other in that they present a reversal of the normal hair direction, are differently composed; in *P. nasuta* the reversal is brought about by a pair of whorls at the root of the neck, but no such arrangement is found in *I. barrowensis.* Wood Jones records for his specimens that the facial sensory vibrissae and papillae are not very conspicuous; in *P. nasuta* these structures are highly developed. The ears of the two species embody both the generic distinctions and familial resemblances; they differ little from the condition described for their respective adult stages (8).

PHASCOLARCTOS CINEREUS Goldfuss.

| *Specimen* | *Sex* | *C.R. Length* | *Weight* |
|---|---|---|---|
| A | ♂ | 28 mm. | 3.0 gm. |
| B | ♂ | 28 mm. | 2.9 gm. |
| C | ♀ | 54 mm. | 13.7 gm. |
| D | ♀ | 85 mm. | 49.8 gm. |
| E | ♀ | 100 mm. | ?* |
| F | ♀ | 116 mm. | 147 gm. |
| G | ♂ | 118 mm. | 210 gm. |
| H | ♀ | 123 mm. | 309 gm. |

* Part of body dissected away.

A series of eight specimens is referable to this species. The available data are insufficient to permit subspecific determination in accord with modern views, therefore the remarks made must be taken as referring to the species as a whole. There is no noteworthy difference between specimens A and B, so that whenever A is referred to in the text it is assumed that B may be spoken of similarly. A and B are probably not more than a day old. Burnet (9) states that at birth the koala measures one inch.

(7) Wood Jones, Trans. Roy. Soc. S. Austr., xliv., 1922, pp. 39-45.

(8) See Wood Jones, "The Mammals of South Australia," Part II., 1924, p. 137, fig. 91 (*Isoodon*), p. 146, fig. 100 (*Perameles*).

(9) Burnet, "The Native Bear Book of Australia," 1934, p. 17.

*Hair.*—Specimen A is naked; early hair is present on C (54 mm., ♀) mostly as just discernible tips protruding through the skin, but on the face and dorsal aspect of the head back to about the crown the hairs are noticeably longer. In stage D, which is more than three and a half times larger than C, the hair growth has proceeded little further. E and F both have a pelage of fine down hairs which have a greater length the nearer they are to the head. G, the penultimate member of the series, shows a great advance, particularly on the head and anterior half of the body. The rate of growth and, probably, the time of initiation of development of the hairs appear to be in accord with the existence of an axial gradient having the centre of highest activity, as would be expected, in the head region. Also in G the hair is better developed on the right side than on the left, a feature which, if it is not an abnormality, is possibly associated with posture in the pouch; this difference in the two sides (which is not noticeable in the older or younger examples) is accompanied by asymmetry of the hair tracts (*v. infra*).

*Hair Tracts.*—The largest member of the series, H (123 mm., ♀) is the most favourable for examination of the disposition of the hair (Figs. 4 and 5).


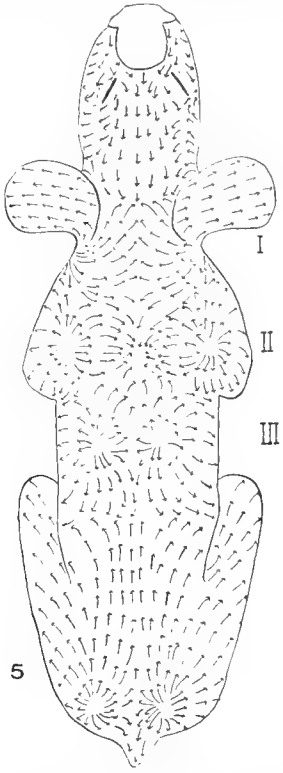


Fig. 4. *Phascolarctos cinereus.* Lateral view to show the disposition of the hair tracts (stage H).

Fig. 5. *Phascolarctos cinereus.* Dorsal view of the head and body to show the disposition of the hair tracts (stage H).

Behind the rhinarium and along the top of the head back almost to the posterior limit of the skull the hair is directed uniformly caudalwards; at this line it encounters a pair of craniomedially directed tracts which results in the formation of a well defined transverse hair ridge between the anterior portions of the attachment of the auricles. Laterally the hair ridge does not quite reach the base of the ear, but, turning cranialwards, crosses towards the posterior canthus of the eye just behind which it bends vertically downwards and is lost at about the level of the line of the lips. Except on the chin, where they are directed caudally, the hairs on the underside of the head trend craniomedially from the sides of the face and neck to form a midventral convergent stream line; between the hairs of the chin and those behind there is a weakly developed hair ridge.

The arrangement of the hairs on the sides of the neck and the upper three-fifths of the trunk is greatly complicated by the presence of three pairs of radiating fields bilaterally and symmetrically placed. The first pair (I., Fig. 5) is situated at the side of the neck between the attachment of the ear and the shoulder; they have a tendency to be whorled (clockwise on the right, anticlockwise on the left) but scarcely sufficiently to be referred to as a whorled system; their craniomedially directed hairs meet the caudally directed hairs on the top of the head to form the hair ridge referred to above. The members of the second pair of radiating fields (II., Fig. 5) have their centres in the angle formed between the lateral border of the scapula and the humerus and, especially on the right side, also show some of the characters of a whorled system. The third pair (III., Fig. 5) lie close together near the middorsal line and slightly caudad of the level of the border of the posterior fold of the axilla (exceptionally well developed in the koala), that is, at about the middle of the back. Consequent upon the nearness to one another of these radiating areas there is formed between them a series of more or less well defined ridges of convergent hairs each with a convergent interval at its middle. Between I and II the hair ridge extends from just behind the shoulder caudomedially almost to the middorsal line; between II and III there is a similar but weaker ridge, the direction of which from behind forwards is craniomedial. A strong hair ridge runs down the middle of the back from the occipital region to beyond the caudalmost of the three pairs of radiating fields; the direction from which the hairs proceed to make this ridge changes according to the relationship the part bears to the radiating fields in the vicinity; between the hindmost of the three pairs of fields there is a middorsal convergent interval and caudal of them the posteriorly directed hairs form with the reversed stream from the sacral vortices a transverse hair ridge about level with or just below the lower margin of the thorax. For the rest, the hair tracts, including the relationships of the sacral vortices and the presence of the whorled area just above the ankle at the front of the leg are as Wood Jones (10) recorded them for his specimen.

Comparison of the hair tracts in H, described above, with E, F and G its predecessors in the series, shows marked differences. Considering first G (118 mm., ♂) which is not so thickly covered with hair as H, particularly in the posterior third (the greater development of hair on the right side has already been commented on). The differences are found in the arrangement of the radiating fields of the neck and upper part of the trunk

(10) Wood Jones, Trans. Roy. Soc. S. Austr., xlvii., 1923, p. 129.

which, in this specimen, display a high degree of asymmetry. Of the cranialmost pair of these fields that on the left side is in the same position as described in H, but the right member is situated more caudally and is near to the middorsal line. The second pair displays a similar anomaly, the left one being in approximately the position described for H, but that on the right is shifted caudally and medially so that it is actually slightly to the left of the middorsal line. Only the right member of the pair is present and this is somewhat more cranial in position than described in H. Stages E and F are covered with short pale down hairs not sufficiently advanced to permit detailed charting but far enough to serve for comparison of the arrangement of hair in the anterior part of the body. Again, the only detectable differences from H lie in the same region and in these cases the condition described by Wood Jones obtains, *viz.*, a single whorled system having its centre on the middle line of the back between the attachment of the limbs.

*Facial Vibrissae.*—One of the characteristics of the adult animal is the poor development of the sensory vibrissae of the head. At the 28 mm. stage no vibrissae are developed but numerous small papillae in their respective zones forecast the position of the mystacials and submentals, whilst a relatively large genal papilla situated below the posterior canthus of the palpebral fissure is present; there is no indication of the position of the supraorbitals. In specimen C (54 mm., ♀) a series of very short pigmentless mystacials and submentals has grown and a couple of similar bristles protrude through the genal papilla; neither supraorbital papillae nor vibrissae are in evidence. In D (85 mm., ♀) three or four backwardly directed darkly pigmented supraorbital vibrissae are present on each side arising from a low papilla with not clearly defined limits which lies immediately above the anterior canthus contiguous with the eyelid; there are four black vibrissae of about the same dimensions as the supraorbitals issuing from the single genal papilla. As growth proceeds the genal papillae become less prominent; in the oldest specimen the vibrissae are still recognizable but the associated papilla is more easily palpated than seen. Neither interramal nor brachial vibrissae were observed at any stage.

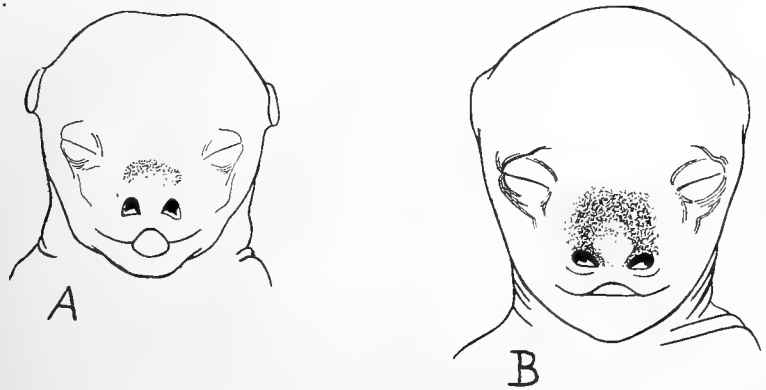


Fig. 6. *Phascolarctos cinereus.* Frontal view of the face showing the pigmentation of the rhinarium and the relationships of the nostrils. A, the 28 mm. stage; B, at 54 mm.

*Lips and Oral Fissure.*—In specimens A, B, C and D, the lips lateral of the opening through which the nipple passes are sealed by an investing layer of epitrichium. In C there is a deepening of the groove which marks the junction of the upper and lower lips; in D the lips, by thickening and further deepening of the groove, have reached an advanced stage of formation. The lips are separated for their full extent in E (100 mm., ♀).

*Rhinarium.*—Specimen D (85 mm., ♀) has a rhinarium which resembles in general features the condition described for the adult; it is dark brown in colour in the upper half above the slit-like external nares, lighter between and around them; its surface is clothed with fine backwardly directed hairs. C (Fig. 6B) shows an earlier stage in which the external nares are more rounded and relatively more widely separated from each other; the covering of fine down hairs is present but the "hare-lip" appearance seen in older examples is not yet apparent. The extent of the rhinarium is defined in A (the 28 mm. stage) by the pigmentation of the area above the nasal apertures (Fig. 6A). In none of the specimens does the rhinarium extend back as far as the anterior canthus of the eye.

*Eye.*—In the first four members of the series the palpebral fissure is sealed under the epitrichial layer. The eyelids in E (100 mm., ♀) are readily separable. Eyelashes are observable at stage C (54 mm., ♀).

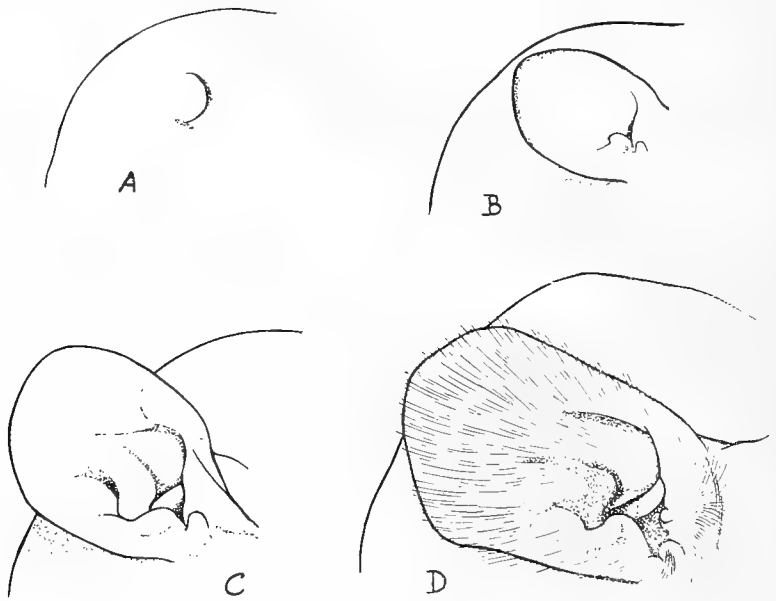


Fig. 7. *Phascolarctos cinereus.* The development of the external ear. A, at 28 mm.; B, at 54 mm.; C, at 85 mm.; D, at 116 mm.

*External Ear.*—At the 28 mm. stage (Fig. 7A) the auricle is folded forwards, the whole structure being closely applied to the side of the head; in C (Fig. 7B) it has opened and become recurved so that the tip is directed backwards and, while separated from the head, the ear is near to it and approximately follows its contours. In stage D (Fig. 7C) the auricle is flat

and stands erect making an angle with the head of about 65 degrees; in the remainder of the series it is folded forward as a flap over the meatus.

Hair appears on the ear at the same time as elsewhere on the body. Characteristically the auricle is hairy internally as well as externally; in the specimens before me the hairiness stops short at the antihelix so that this structure and the deeper part of the concha may be described as naked. There is a tuft of hair on the external portion of the antitragus in the older members of the series.

The antihelix can be discerned at stage C but is not clearly recognizable till stage D. In the larger specimens (as exemplified by H) it occurs as a curved hairless ridge, the upper end of which is hidden beneath the overhanging oblique ridge which defines the cavity of the ear dorsally near its attachment; ventrally it is directed towards the external auditory meatus but ceases opposite the antitragus. There are no processi antihelicis in any of the specimens.

The antitragus is a conspicuous feature of the ear of C, and in D the position of the bursa behind it is indicated. In H, the terminal member of the series, the antitragus has the form of a high rather narrow ridge set back from the margin of the ear and obliquely placed so that it is directed towards the meatus; it is higher laterally, gradually decreases in size medially, and extends for a considerable distance into the concha; there is no connection between it and the antihelix. The antitragus as here named corresponds to what Wood Jones (11) has called the "inferior portion of the antihelix." I have adopted this nomenclature in view of the relationship of the structure to the helix and the absence of any evidence of continuity with the antihelix ("superior part of the antihelix"—Wood Jones). The appearance of being bent back on itself is given to the antitragus by the occurrence behind it of the bursa, the inner portion of which excavates its substance; part of the posterior wall of the bursa is provided by a curved ridge which runs upwards and then backwards from the antitragus.

The tragus is early (stage C) identifiable as a distinctly separated circular lobe of the helix; as growth proceeds it becomes less obvious.

*The Manus.*—Claws and apical pads are developed on the digits of the smallest specimens (A and B) of the series. Also, in this early stage of development the first and second digits are in the isolated position of opposability to the third, fourth and fifth which is characteristic of the adult. Pocock (12) has described and figured the palmar surface in the adult and the accuracy of his description is confirmed by the examination of a series of formalin-preserved hands housed in this institute. Comparison of the adult condition with that found in the younger stages of the series of pouch young shows clearly the manner in which the configuration of the palmar surface has been formed by the growth and fusion of elements originally separate. Considering stage C (Fig. 8) it is found that at the base of each of digits II-V there is a subcircular pad; at the base of the pollex and occupying the postero-internal angle of the palm there is a triangular thenar pad and opposite to it in the postero-external angle a hypothenar of similar size, the two pads being nearly confluent at their

(11) Wood Jones, Trans. Roy. Soc. S. Austr., xlvii., 1923, p. 135.
(12) Pocock, Proc. Zool. Soc. Lond., 1921, p. 601, fig. 25A.

Fig. 8. *Phascolarctos cinereus.* Palmar surface of the left manus at stage C (54 mm.).

medial apices. Pocock (13) has suggested that the pad at the base of the second digit represents the "first or external element of the plantar pad," that is, is the first interdigital. The occurrence of the distal pads digitally and not interdigitally is atypical and may be a consequence of the wide separation of the second and third digits resulting in the second interdigital migrating laterally and causing a similar shift in the third and fourth; if this has occurred there seems no reason why the first interdigital pad should move to the base of the second digit. Specimens A and B are not of assistance in making more specific suggestions for clarification of the nomenclature. It should be emphasized that the absence of an epidermal ridge pattern on the pads in question, taken in conjunction with their unusual position, throws some doubt on their claim to be regarded as true volar pads.

*The Pes.*—The relatively great size of the syndactylous digits is seen as early as stage A; in fact, they are as long or longer than the fourth digit; Dankmeijer (14) has figured this condition in a 60 mm. embryo. In all stages the plantar pads are too feebly differentiated for exact description.

*The Pouch.*—Five of the eight specimens which comprise the series are females and provide an interesting picture of the early development of the pouch. The youngest female is C (54 mm.) in which the pouch is a deep longitudinal groove the lips of which are united anteriorly but separated posteriorly so that the groove may be said to be open posteriorly; it is

(13) Pocock, Proc. Zool. Soc. Lond., 1921, p. 601.
(14) Dankmeijer, Gegen. Morph. Jahrb., 82, 1938, p. 303, fig. 9.

deeper at the middle than elsewhere and the two nipples are visible as low circular mounds which face each other from opposite sides of the groove and are somewhat nearer its caudal than cranial end. The pouch in D is similar to that in C but the cavity has deepened considerably and has also widened internally. In both these stages, in contradistinction to what is found in the adult, the pouch is longer than wide. Specimen E is marked by a lateral and anterior extension of the cavity, so that the muscular rim now overhangs it in the middle line in front and the opening therefore tends to look backwards. Neither F nor H show any noteworthy advance on the condition described for E.

*Pigmentation.*—In addition to the well marked pigment zone on the muzzle which defines the limits of the rhinarium (Fig. 6), various parts of the epidermis show pigment deposition. In the 28 mm. stage the pigmentation of the palm and sole has commenced; it is densest near the proximal border between the thenar and hypothenar pads. At stage C (54 mm., ♀) the palm and sole and corresponding surface of the digits have become much darkened, but the various pads including the apical series are lighter than elseswhere; in this specimen the margin of the auricle in the half opposite its attachment to the head is deep brown in colour. The definite line of pigment at the margin of the auricle disappears in D; the whole of the auricle, however, is seen to be darker in colour than the skin of the head generally. Also in D there is a small smudge of dark pigment with its centre just behind the anterior canthus of the eye; this canthal zone is visible on E and F and probably on G.

*Remarks.*—Wood Jones (15) described a koala pouch embryo in 1923 which was obtained from the Queensland Museum. Its C.R. length of 110 mm. is less than that of stage G, but evidently the growth of the hair was more advanced and appears to approximate the condition displayed by stage H. Of the four specimens of the present series in which the hair is sufficiently developed for charting (at least in the anterior half of the body) two, E and F, are similar to Wood Jones's example. The other two, G and H, agree with his account except in that they show a greatly increased complexity in the arrangement of the hairs at the side of the neck and dorsal surface of the upper back, the complexity being due to what appears as a longitudinal increase in the number of radiating fields (they are almost whorls) and their duplication to form a double series symmetrically arranged in one specimen but highly asymmetrical in the other. I am inclined to regard G with its pronounced asymmetry (*v. supra*) as an abnormal variant of the arrangement seen in H. This leaves two distinct hair patterns in the regions named by which the specimens can be separated. Two explanations may be offered to account for their occurrence. In the first place it may be postulated that hair pattern is not specifically constant. The balance of evidence as provided by Wood Jones's investigations on other marsupials controverts this, so that, while little is known of the amplitude of the variation which hair pattern presents in the group, it seems likely that there is for the species a constancy in basic pattern. Secondly, there is the possibility that the material represented in the series is not subspecifically homogeneous. This I consider probable as the precise origin of the specimens is not recorded. Also, the possibility of the inclusion of specimens from New South Wales

(15) Wood Jones, Trans. Roy. Soc. S. Austr., xlvii., 1923, pp. 129-135.

or Queensland parents or even a hybrid must not be overlooked (16). The original species *P. cinereus* is now divided into three subspecies, viz., *cinereus, adustus,* and *victor* from New South Wales, Queensland and Victoria respectively. There is undoubtedly marginal overlap in the distribution of these forms and the Victorian and Queensland races at least are not intersterile (17).

In considering the external ear Wood Jones described two tragoid projections. In my specimens a single lobe-like tragus is a conspicuous feature of the developing ear but becomes less prominent as growth proceeds; only one specimen, F (Fig. 7D), shows signs of duplication of this process. The facial vibrissae are similar except that all specimens have a genal papilla and the furred examples have a genal group of sensory hairs. Pocock (18) has figured the genal group in a much older (adult) specimen.

VOMBATUS HIRSUTUS Perry (19).

| *Specimen* | *Sex* | *C.R. Length* | *Weight* |
|---|---|---|---|
| A | ?* | 22 mm. | 2 gm. |
| B | ♂ | 51 mm. | 18.3 gm. |
| C | ♀ | 122 mm. | 203 gm. |
| D | ♂ | 140 mm. | ?** |
| E | ♂ | ca.160 mm. | ?** |
| F | ♀ | 167 mm. | 372 gm |
| G | ♀ | 175 mm. | 459 gm. |

* Probably a female since there is no sign of a scrotum.
** Part of body dissected away.

The seven specimens included under this name are all referable to the subspecies *hirsutus.* The series provided is rather irregular the gaps occurring in the lower half. However, the principal features sought for description are, for the most part, available, but in the consideration of one or two points such as the nomenclature of the volar pads additional stages would have been very helpful.

Stage G was collected by the late Mr. G. H. Logan in the vicinity of Mount Coree, Australian Capital Territory, in June, 1938.

*Hair.*—Hair is first in evidence in B on which, in addition to the sensory vibrissae, tips may be seen protruding through the skin between the eyes and from thence forward to the rhinarium; their presence could not be detected further back. The growth of hair is not rapid. E (ca.160 mm., ♂), a much larger specimen, is covered with short down which in some regions, particularly on the dorsal surface of the head, the cranial and lateral aspects of the auricles and the distal extremities of the limbs has a deep brown pigmentation. F (167 mm., ♀) shows a considerable advance on E and though the hair is still short its brown colour has given a brown

(16) Some of the material of this species is, in all likelihood, from the Melbourne Zoological Gardens.

(17) Ambrose Pratt in his book, "The Call of the Koala," gives a photograph (opp. p. 48) of the offspring of the cross Queensland ♂ x Victorian ♀.

(18) Pocock, Proc. Zool. Soc. Lond., 1921, p. 596, fig. 23A.

(19) The well known name *Phascolomys mitchelli* has become a synonym (see Iredale and Troughton, Austr. Mus. Mem., vi., 1934, p. 34).

tinge to the general surface of the body. In G the hair is well developed except in the lower part of the back approximately corresponding with the limits of the pelvis.

*Hair Tracts.*—The terminal member of the series, G (175 mm., ♀), is in the best condition for examining the disposition of the hair tracts.

As in the related *Vombatus ursinus tasmaniensis* described by Wood Jones (20) the primitive arrangement of the hair—caudalwards and ventrally on the head and trunk, postaxially on the limbs—is in evidence, but not so completely as in that form. In the specimen before me variations from this arrangement occur on the head and neck. There is no reversal on the muzzle immediately behind the rhinarium, but the hairs are readily separable from those adjacent by their more bristly character, their darker pigmentation, and the fact that they do not lie flat against the skin but are distinctly elevated from it. From this restricted somewhat specialized zone two currents take origin, each flowing towards the anterior canthus of the eye on their respective sides; no divergent parting is in evidence except on the caudal margin of the main area; some hairs from the left side flow towards the right so that the stream on the left side is noticeably smaller at its origin than that on the right (Fig. 9). The even backward flow of hair on the top of the head is interrupted immediately in front of the line joining the anteriormost portions of the attachment of the auricles by the interposition of a divergent parting about 1 cm. in length from which hair flows towards the base of the ears; this parting is not quite symmetrically placed but lies obliquely with reference to the middorsal line (Fig. 9).

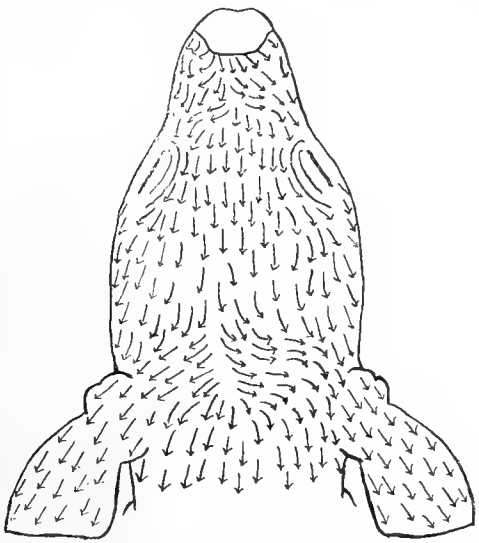

Fig. 9. *Vombatus hirsutus.* Hair tracts of the head as seen from above (stage G, 175 mm.).

(20) Wood Jones, Trans. Roy. Soc. S. Austr., xlviii., 1924, p. 145.

The disposition of the pelage on the throat calls for some comment. At the root of the neck between the shoulders there is a radiating field with a longitudinally elongate spindle-shaped centre from which hair flows forward and laterally, caudally on to the thorax, and laterally and caudally over the shoulder and on to the side of the face and neck. The flow from the throat round the ear encounters behind the base of the ear the backwardly directed current from the top of the head, the junction being marked by a weak hair ridge. Between the chin and the interramal papilla the hairs ar edirected backwards and laterally; there is a tendency to form a weak hair ridge where they encounter the forward and lateral flow from the radiating centre just described.

Stage F is the only one in which the hair is developed sufficiently far for comparison witih G. There is general agreement between the two specimens. The radiating field on the throat is in F duplicated in the midventral line, the more anterior unit lying just anterior of the mandibular articulation, the other just posterior of the level of the shoulders; between the two there is a divergent interval but the sum total of their influence is the same as that of the single centre in G. Further, in F, instead of the parting on the crown described in G there is a vortex (clockwise) the centre of which lies on the line joining the hindmost part of the attachment of the auricles to the head, that is, further back than in G; from the cortex hairs stream forwards to form almost immediately a weak hair ridge where they encounter the backflowing stream on the crown and laterally to form behind the ear a further weak hair ridge with the stream flowing from the side of the face.

*Facial Vibrissae.*—There are no vibrissae in A, the youngest specimen, but the genal papilla is present as a prominent swelling; no other papillae are discernible with certainty. In B the genal papilla is a well defined oval pad pierced by nine or ten very short bristles; there is a small supraorbital papilla with four or five vibrissae showing through; the mystacials and submentals are developed to a similar degree and the interramal tuft is seen also to be breaking through on to a single not strongly developed transversely oval papilla.

*Brachial Vibrissae.*—Only the ulnar carpal group can be detected; the bristles are first seen in C issuing from a small circular papilla, but they probably appear earlier than C as there is a considerable gap between this specimen and its predecessor in the series.

*Lips and Oral Fissure.*—Specimens A and B present the typical condition of the lips in embryos still attached to the teat, viz., the medial circular aperture for the passage of the teat and the fused line of the more lateral portion of the lips represented by a groove which deepens and becomes more defined with age. The other members of the series have the lips fully formed and separated. In all specimens above B the lower lip displays externally a well marked medial groove which runs from the margin of the lip caudally for about 3 mm.

*Rhinarium.*—The rhinarium is not defined in A. In B (Fig. 10B) its limits are indicated by a smoothness of the skin as contrasted with that of the surrounding areas which is pierced by hair tips; the superior margin is concave anteriorly. The nostrils in B are obliquely placed oval openings lying completely within the confines of the rhinarium; the slit, prominent

in the adult, is not in evidence at this stage. The infranarial portion of the rhinarium is wedge-shaped and, compared with the adult, relatively wide below; in front of a transverse line which passes approximately through the centre of the narial apertures and particularly at the margins

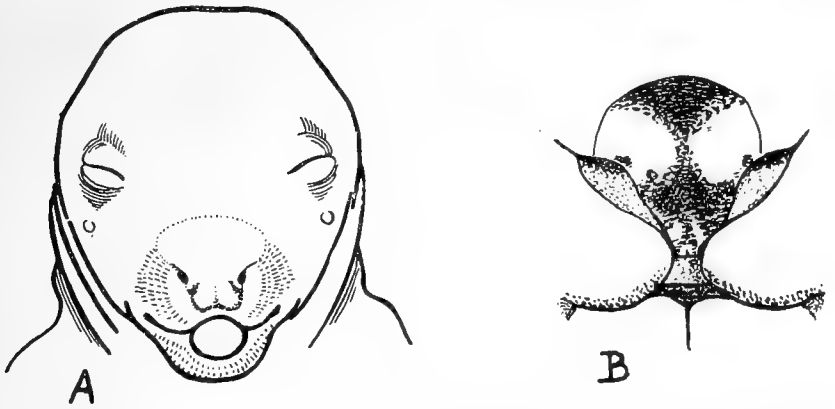


Fig. 10. *Vombatus hirsutus*. A, frontal view of the face of the 51 mm. embryo showing the mystacial zone and the rhinarium; B, the rhinarium of stage E (ca.160 mm.).

of the area thus cut off the rhinarium is lightly pigmented (brown). C shows the main characteristics of the adult rhinarium; its surface is naked, coarsely granular, and is marked by numerous blotches of pigment which are arranged in a broad roughly bilaterally symmetrical medial band which widens out at the superior margin. The slit of the nostrils is well developed and the hairs of the muzzle have encroached over it.

The rhinarium of the remaining members of the series is of interest chiefly in connection with the distribution of the pigment. In D there is practically no pigmentation at all, only a small quantity occurring between and below the level of the nostrils. In E, however, there is a heavy deposition which is laid down in a bilaterally symmetrical pattern produced by two laterally placed circular pigmentless areas in the supranarial portion of the rhinarium (Fig. 10B); the surface in this specimen is granular, the granules being thrown into optical relief wherever pigment is present. The rhinarium of F is peculiar in that the pigment is evenly diffused so that its colour is a very light brown in the infra- and internarial portions, pink supranarially. In G, a stage considerably in advance of F, there is heavy pigmentation in a pattern more irregular than, but clearly derivable from, that described for E. It will be seen that pigmentation of the rhinarium as illustrated by this material does not form a continuous series of developmental stages but falls into two distinct groups—one in which there are condensations of pigment or diffused pigment in the infranarial portion of the structure (specimens D and F), and a second in which the pigmentation is much heavier, extends from the superior to the inferior margin, and is arranged in a pattern which is a precursor of, or derivable from, the condition figured for E (specimens C, E and G). This feature is not a sexual character, males and females bearing one type or the other indiscriminately.


Fig. 11. *Vombatus hirsutus*. The external ear. A, at the 51 mm. stage; B, at 160 mm.

*External Ear.*—In stage A the auricle is folded forward in the usual manner but the flap has not become separated from the side of the head. In B (Fig. 11A) the auricle is fully opened and lies pressed against the side of the head so that it is backwardly curved; the process of backward extension of the overturned lip of its anterior margin (*v. infra*) is observed to have commenced and the antihelix is also visible; there are no tragoid projections and the presence of an antitragal ridge is uncertain.

There is little difference in the structure of the external ear between the members of the remainder of the series. The brief description which follows refers to G the oldest of the group. The ear is broad, pointed distally (more so than in other members of the series), and is attached to the head by a broad base; it is hairy both medially and laterally. The "antero-internal ridge" described by Pocock (21) as characteristic of the genus *Phascolomys* is present (this structure is apparently that which Wood Jones (22) more accurately designated in the Tasmanian wombat as "the hyoid portion of the antihelix"); the sculpture on the medial wall of the concha at its inferior end is similar to that figured by Wood Jones. There are no clearly defined processi antihelicis. A conspicuous feature of the ear is the extension caudally of the anterior margin of the auricle resulting in the approach to the external auditory meatus being through a funnel-like concha. There are no tragoid projections. I am unable to identify certainly an antitragal ridge. Pocock, presumably referring to the adult, says "The antitragal ridge is also simple. It ascends and forms the posterior edge of the cavity of the pinna." If by the "cavity of the pinna" is meant the concha, that is, the deeper portion of the cavity which opens into the meatus then the specimens before me do, indeed, present a straight ridge which is probably the one referred to; it commences just behind the inferior portion of the backward extension of the anterior margin of the auricle referred to above and proceeds for a short distance caudally and dorsally.

It will be seen, then, that the ear of the wombat is of basal simplicity. This simplicity may, I think, be correlated with the fossorial activities of

(21) Pocock, Proc. Zool. Soc. Lond., 1921, p. 598.
(22) Wood Jones, Trans. Roy. Soc. S. Aust., xlviii., 1924, p. 147, fig. 4.

the animal, particularly with respect to the function of the laterally protected concha which appears to be an adaptation designed to keep the auditory meatus free from fragments of earth when the animal is engaged in burrowing.

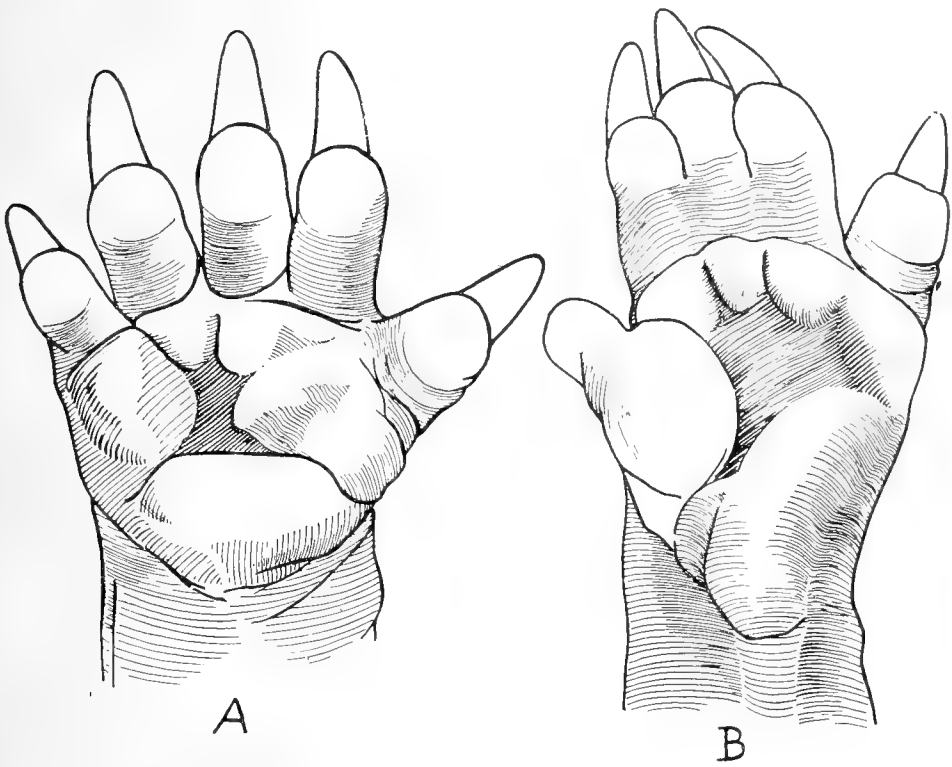


Fig. 12. *Vombatus hirsutus.* A, palmar surface of the left manus; B, plantar surface of the left pes. Drawn to illustrate the configuration of the volar pads in the 51 mm. embryo.

*The Manus.*—In A, which is apparently a newly-born individual, the apical pads are formed below the relatively long claws; the palmar group of pads is poorly developed, the interdigital series being undifferentiated, though the thenar and hypothenar are weakly defined. Specimen B (Fig. 12A) presents the full primitive complement of volar pads with the exception of the first interdigital which appears to be either missing or is fused with the thenar pad. The apical series in this specimen is well developed and each presents a smooth surface in contrast with the granular appearance of the rest of the underside of the digit. Assuming that the first interdigital has been eliminated in one or other of the two ways suggested, the nomenclature of the remaining pads is satisfactorily reconcilable with their position. The pads of the palm are arranged fairly symmetrically round a central depression. The most proximal, which is also the largest, is the hypothenar; it occupies the posterolateral angle of the palm; at the

base of the fifth digit on its lateral side there is a pad of considerable size separated from the hypothenar by a deep groove, but it would appear probable that this is a detached part of the hypothenar. The thenar pad is large and lies in its normal position at the base of the thumb. The second, third and fourth interdigital pads are delineated by shallow grooves. In the higher members of the series (Fig. 13A) the thenar and hypothenar pads remain fairly distinct; the lobulation of the pad caused by the fusion of the interdigitals follows more or less closely the arrangement of its constituent parts; the fourth interdigital has a marked tendency to fuse with the distal element of the hypothenar.

The digital formula is $3 > 4 > 2 > 5 > 1$. It is noteworthy that the skin of the terminal phalanges of the digits is naked, the growth of hair

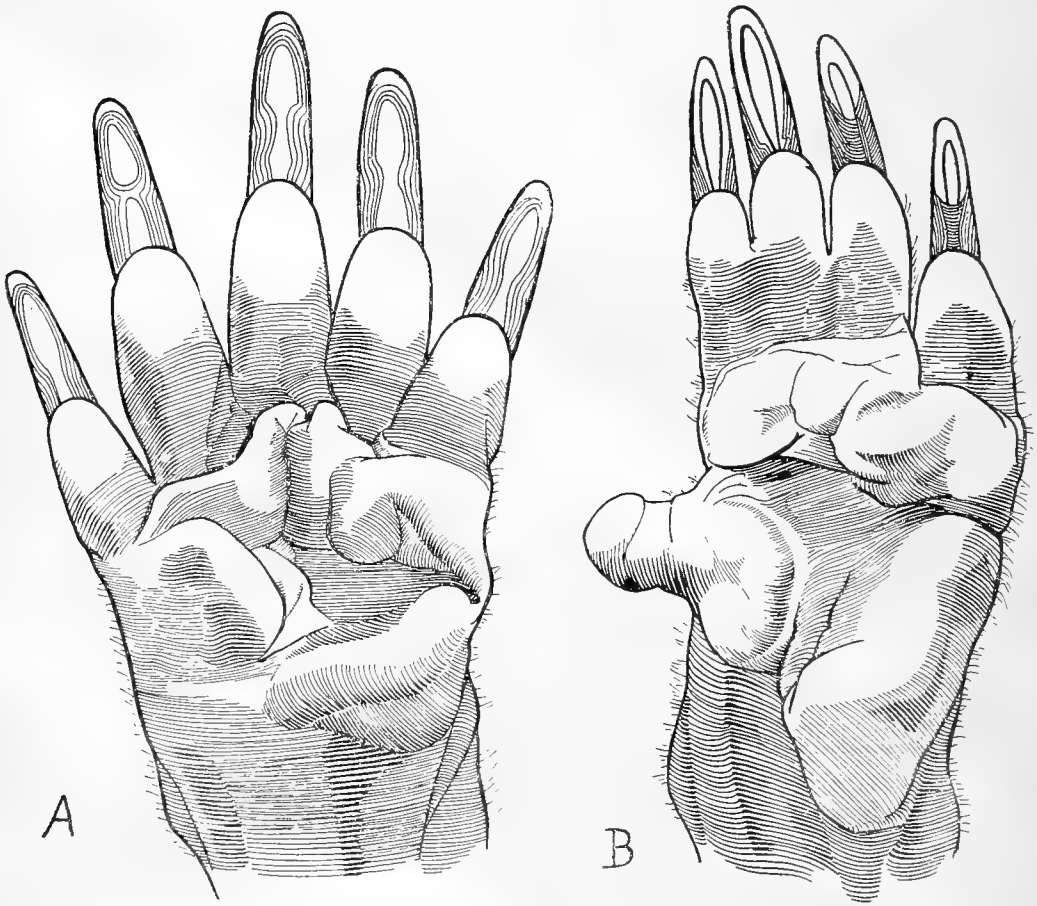


Fig. 13. *Vombatus hirsutus*. A, palmar surface of the left manus, B, plantar surface of the left pes, showing the effect of growth on the contours of the volar pads (stage F, 167 mm.).

stopping short at about the distal limit of the penultimate phalanx in each case.

*The Pes.*—Except for the apical series there is no development of definable pads on the foot of A. In B (Fig. 13B) almost the whole of the proximal two-thirds of the plantar surface is taken up by the large thenar and hypothenar pads, the former at the base of the very diminutive hallux. As in the case of the manus, it would appear that a pad at the lateral side of the base of the fifth digit is a separated part of the hypothenar and that the first interdigital is either missing or absorbed into the large thenar. The remaining interdigitals are, together with the supposed part of the hypothenar at the base of the fifth digit, fused into a narrow rectangular pad which lies across the distal part of the plantar surface of the foot at the base of the digits; the boundaries of its constituent parts are indicated by shallow furrows. Growth does not efface the contours of the thenar and hypothenar pads, but the demarcation lines of the original interdigital pads are for the most part lost and can only occasionally be traced in the lobulation (which is considerable) of the composite structure which represents them (Fig. 13B).

The digital formula is $2 > 3 > 4 > 5 > 1$. The distal half or so of the skin of the terminal phalanx is naked in a manner similar to that described for the manus.

*Remarks.*—Wood Jones (23) has described the principal features of the pouch embryo of the Tasmanian wombat, *Vombatus ursinus tasmaniensis*. The single specimen which he examined appears to be approximately at the same stage of development as G of the series of *hirsutus* considered above. While there is a general likeness between the young of the two forms the differences between them are precise. In fact, it would appear that the young of these two animals are more readily distinguishable than the adults. Thomas (24) in 1888 (before Spencer and Kershaw had claimed the distinctness of the Tasmanian form from that restricted to the islands of Bass Strait) wrote of *ursinus*: "Similar in every respect to *Ph. mitchelli*, except that its size is about one fourth smaller." Recently, Troughton (25) has stated that "with the exception of size, which clearly separates the Bass Strait race from the geographically nearer Tasmanian one, it seems that the general similarity of the Tasmanian and mainland animals may ultimately prove them to be linked as races of the Bass Strait species." The pouch young, however, differ in several important characters appraisal of which suggests that they provide sound grounds for continuing to regard the Tasmanian and mainland forms as specifically distinct. In *tasmaniensis* the ear has two tragoid projections (ill-defined) and a well marked processus antihelicis, but neither feature is present in *hirsutus*. Comparing the volar surface of the manus on which the pads show distinctly in both forms, it will be seen that there are considerable differences in the size and shape of homologous pads which give in each case a characteristic appearance to the palm; the hypothenar pad, in particular, shows a wide dissimilarity in size in the two animals. Also, the palm of *tasmaniensis*

(23) Wood Jones, Trans. Roy. Soc. S. Austr., xlviii., 1924, pp. 145-148.
(24) Thomas, Cat. Marsup. Brit. Mus., 1888. p. 216.
(25) Troughton, "Furred Animals of Australia," 1941. p. 142.
(26) Wood Jones, "The Mammals of South Australia," 1924, p. 265, fig. 186.

as figured by Wood Jones (26) lacks a feature which is strongly in evidence in all specimens of *hirsutus* in this series, *viz.*, a central depression around which the pads are more or less regularly grouped. In a figure of the manus of *hirsutus* (presumably that of an adult) by Wood Jones this character is clearly delineated and is readily recognizable as the same hand figured above (Fig. 13A). Pocock's (27) figure of the hand of *ursinus*, though probably from the dried skin of an adult, is immediately seen to be similar to that of the pouch embryo of the subspecies *tasmaniensis* figured by Wood Jones and in nowise could it be confused with that of *hirsutus*. Finally, a consideration of the disposition of the hair currents shows that the unrelieved primitive arrangement described in *tasmaniensis* is in *hirsutus* subject to considerable interruption on the head and neck.

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(27) Pocock, Proc. Zool. Soc. Lond., 1921, p. 603, fig. 25C.

# ADDITIONS TO THE LIST OF AUSTRALIAN BIRDS AND OTHER NOTES.

By Gregory M. Mathews, C.B.E.

## Genus Calonectris M. & I.

1915. *Calonectris* Mathews & Iredale, Ibis, July 2, pp. 590-592. Orthotype, *Procellaria leucomelas* Temminck and Laugier, 1835.

The genus includes *Procellaria diomedea* Scopoli, Annus I. Hist. Nat., p. 74, 1769. Carniolia, Adriatic Sea. This name is older than *Procellaria kuhlii* Boie, Isis, 1835, for a bird from Corsica. The genus is admitted by the American Ornithologists' Union Check-List, as is the genus *Ardenna* with which some wrongly synonomise *Hemipuffinus* of Iredale, introduced for *Puffinus carneipes* Gould, 1844.

### Calonectris diomedea disputans (Mathews).

Kerguelen Great Shearwater.

1937. *Puffinus diomedea disputans* Mathews, Bull. Brit. Orn. Club, Vol. 57, p. 123, May 4. Kerguelen (?).

Gould reported this bird from the "Australian Seas" and at one time considered it to be *Adamastor cinerea* (Gmelin, 1789). Gould described *Procellaria* (*Puffinus*) *flavirostris* in Ann. and Mag. Nat. Hist., Vol. XIII, May 1st, 1844, p. 365, from off the Cape of Good Hope. This is indeterminable and is also pre-occupied by *Puffinus flavirostris* S. D. Wood, Analyst, Vol. III., January, 1836, and by an anonymous reviewer, ib., Vol. IV., p. 97, April, 1836.

The above bird was wrongly considered Gould's type and is in the British Museum. Another subspecies of this bird, *Calonectris diomedea borealis,* has been recorded from New Zealand.

The name *P. diomedea* which Scopoli adopted from Pliny was given to a bird from the Adriatic Sea. There was an Island Diomedea off the south-east coast of Italy.

Iredale and I pointed out in the "Austral Avian Record," Vol. v., Nos. 2-3, February 21st, 1923, p. 87, that this name applied to the Mediterranean Great Shearwater only and was older than *P. kuhlii* Boie, 1835. The name was accepted by the Americans; and Peters in his "List" also uses it.

## Genus Cymochorea Coues.

1864. *Cymochorea* Coues, Proc. Acad. Nat. Sci. Philad., p. 75, No. 2, March-April, = June 30th. Orthotype, *Procellaria leucorhoa* Vieillot, 1818. *Synonym.*

1913. *Pacificodroma* Bianchi, Faune de la Russie Ois., Vol. 1, pt. ii., pp. 516-559, January. Orthotype, *Thalassidroma monorhis* Swinhoe, 1867. *Loomelania,* 1934, synonymised with this is considered by Murphy to be a separate genus.

### Cymochorea castro (Harcourt).

1851. *Thalassidroma castro* Harcourt, Sketch of Madeira, p. 123. Deserta Island.

CYMOCHOREA CASTRO CRYPTOLEUCURA *Ridgway. Hawaiian Fork-tail Petrel.*

1882. *Cymochorea cryptoleucura* Ridgway, Proc. U.S. Nat. Mus., Vol. IV., p. 337, March 29th. Kauai, Hawaiian Islands. There is a skin in the British Museum of this form collected in Australian waters. Another species in this genus, *Cymochorea leucorhoa kaedingi,* has been recorded from New Zealand.

*MAGAZIN VON MERKWURDIGEN NEUEN REISEBESCHREIBUNGEN.*

The works of Johann Reinhold Forster must always be examined, as he was an accurate observer and introduced many names to the scientific world.

The discovery of his books has always been a disturbing factor in our nomenclature. In the "Emu," Vol. 37, pp. 95-99, October 1st, 1937, Mr. Tom Iredale brought before us a work by Forster, published in Berlin in 1794.

In the Public Library (Mitchell Wing) are two octavo volumes, the contents of which are identical, except for the title page and preface. These works are a translation by Forster into German of White's "Journal of a Voyage to New South Wales" . . . 1790. They are:—

No. 1.—Reisen in der Südsee / — / von / John White, / erstem Wundarzte der Kolonie in Neu-Holland, / und von / William Bligh, / Befehlshaber des Schiffes Bounty. / von / Johann Reinhold Forster, Berlin, 1791.

No. 2.—Magazin / von / merkwürdigen neuen / Reisebeschreibungen, / Bd. V. Berlin, 1791. This volume contains:—

(i) Tagebuch einer Reise nach Neu-Süd-Wallis von John White, Esq.

(ii) William Bligh's Bericht von dem Aufruhr an Bord des Schiffes Bounty . . . and others.

This Berlin edition of the "Magazin" was in 37 volumes, and the dates were 1790-1828. (See Kayser-Bücher-Lexikon, Theil, 4, M.-R., p. 9.)

The "Magazin" was re-issued in Vienna and is quite different in pagination. It is in twenty-five 12mo. volumes and was published between 1792 and 1801. (National Library.) The volume containing White's Journal was Vol. IX. of the Vienna edition and the date is 1792, a year later than the Berlin edition. For the sake of uniformity we can accept the "Magazin" for quotation and in the following paragraphs, the pages given first refer to the 1791 work, while those in brackets are of the Vienna edition of a year later.

The translation follows the original except that it is considerably abridged, for we find in White a description of the "Anomalous Hornbill" on p. 142, with a plate, whereas Forster mentioned the episode as given by White, and omits the description, calling the bird *Buceros anomala* on pp. 74 and 120 and on pp. 127-207 and 208 is a translation by Forster of White's description. This bird is now known as *Scythrops novaehollandiae* Latham, 1790, so that Forster's name becomes a synonym of Latham's.

Another example occurs in White, p. 144, and plate is a description of the Wattled Bee-eater, and in Forster, p. 74 and p. 121, we find the passage and the bird called *Merops carunculata,* with the description again omitted, White, on p. 240, had so named the bird. In White, p. 190 and plate, is the Knob-fronted Bee-eater, and in Forster, p. 97 and p. 158, it is called *Merops nodifrons,* and on p. 129 and p. 211 Forster called it *Merops tuberculatus.* This bird is now called *Tropidorhyncus corniculatus* (Latham, 1790).

In the "Magazin" the appendix commences on p. 115 or p. 188, and in White on p. 219. Forster starts off with the mammals A, and opposite p. 116 and p. 190 is a plate, including two of White's, viz., the Kangaroo and Poto Roo; opposite p. 121 and p. 198 is a reproduction of White's plate of the Hepoona Roo. The birds "B" commence on p. 124 and p. 203, opposite which is a reproduction of White's plate of the Emu, and the feathers of this bird as figured on the plate opposite p. 290. The footnotes on the birds are signed "F" (Forster, the editor of the work).

On p. 130 and p. 212, Amphibians "C"; on p. 131 and p. 214, Fish "D"; on p. 133 and p. 217, insects "E"; and on p. 133 and p. 218 the Botany.

The Parrots are discussed under one head on pp. 77-78, 126, 205-206, in which no new names are introduced. On p. 128 and p. 210 *Motacilla australis* is the same as of White, p. 239 and plate; *Motacilla pusilla* of White, p. 257 and plate; *Caprimulgus cristatus* of White, p. 241 and plate; p. 129 and 211 *Merops carunculatus* of White; p. 240 the Red-wattle Bird. On p. 130 and 212 Forster mentioned *Procellaria aequinoctialis* Linn., for the Fuliginous Peteril, *Procellaria fuliginosa* of White, p. 252 and plate, and *Sterna caspia* of Latham's Synopsis of Birds, Vol. II., p. 351 (an error for Vol. III.). Forster has mentioned every bird mentioned by White.

BIRDS.

P. 126 (206). "Latham, Synopsis, Vol. II., p. 609," where we find a description of the Great Brown Kingfisher. In a footnote on p. 126 Forster says that he had called this bird *Alcedo cyanea*. The bird is figured and described by White on p. 137, and plate, and is now known as *Dacelo novaeguineae* (Hermann, 1783) Kookaburra.

Forster's name becomes a synonym. (It is *A. cynea* in 1794.)

P. 127 & 98 (207). "Latham, Vol. II., p. 622," where we find a description of the Sacred Kingfisher. In a footnote Forster says that he had called it *Alcedo collaris*. Fortunately this name is preoccupied by Scopoli, 1786, so no change is necessary, and *Sauropatis sancta* (Vigors and Horsfield, 1827) remains as always. The bird is described and figured by White on p. 193 and plate.

P. 74 (207). The Anomalous Hornbill is described, as from White, p. 142 and plate; the description was omitted on p. 74 (120), where it was called by Forster *Buceros anomala*, which name becomes a synonym of *Scythrops novaehollandiae* Latham, 1790.

P. 128 (209). In a footnote, signed "F," is *Falco leucaëtos* given to the Tasmanian White Goshawk, the *Leucospiza novaehollandiae* (Gmelin, 1788). Called *Falco albus* by White, p. 250 and plate. Both names become synonyms of Gmelin's name.

P. 128 (209). *Fulica candida* becomes a synonym of *Fulica alba* of White, p. 238 and plate, now in the genus *Porphyrio*.

P. 128 (209). *Corvus leucopyx* becomes a synonym of *Corvus graculinus* White, p. 251 and plate, now in the genus *Strepera*.

P. 128 (209). *Turdus phaeus* is given to the Port Jackson Thrush described by White on p. 157 and plate. This is the earliest name

given to this bird named *Turdus harmonica* by Latham in 1801.

The Grey Shrike-Thrush will now stand as *Colluricincla phaea* (Forster, 1792). (It is *T. phacus* in 1794.)

P. 128 (210). *Muscicapa chlorotis* is given to the Yellow-eared Fly-catcher of White, p. 161 and plate, and is an older name than *Sylvia chrysops* Latham, 1801. However, Latham in "Index Ornithologicus," Vol. II., p. 478, No. 43, 1790 (before December 9th) gave a Latin description to White's bird and called it *Muscicapa novaehollandiae*.

The Yellow-faced Honey-eater will now be called *Paraptilotis novaehollandiae* (Latham) and Forster's name becomes a synonym, as well as Latham's of 1801.

P. 128 (210). *Motacilla elegans* is given to the Superb Warbler of White, p. 256 and plate. This changes the name of the Blue Wren of New South Wales from *Malurus cyaneus australis* North, 1904, to *Malurus cyaneus elegans* (Forster, 1792), and *Malurus* (*Leggeornis*) *elegans* Gould, 1837, to *Malurus* (*Leggeornis*) *warreni* Mathews, 1916 (the Red-winged Wren).

P. 129 (211). *Certhia varia* is given to the New Holland Creeper of White, p. 186 and plate, and p. 297 and plate, and becomes a synonym of *Meliornis novaehollandiae* (Latham, 1790) the Yellow-winged Honey-eater.

P. 129 (211). *Merops tuberculatus* is given to the Knob-fronted Bee-eater of White, p. 190 and plate, and becomes a synonym of *Merops corniculatus* Latham, 1790, now in the genus *Tropidorhyncus*. The Noisy Friar-bird. *Merops nodifrons* Forster, p. 97 (158) is also a synonym.

P. 129 (212). *Columba chrysoptera* is given to the Golden-winged Pigeon of White, pp. 145-6 and plate, and becomes a synonym of *Phaps chalcoptera* Latham, 1790, now in the genus *Phaps*, the Bronze-wing.

Thus only three changes in nomenclature are necessary, viz.—the Grey Shrike-Thrush, Yellow-faced Honey-eater, and the Red-winged Wren. All the other names falling as synonyms.

Forster's Translation of John Hunter's work is entitled "Reise nach Neu-Südwallis," at the end of which appears Lieutenant King's "Nachrichten von der Norfolk-Insel." It is issued as Bd. XI of "Magazin," Berlin, 1794, but was issued in other forms in the same year. P. 313 contains the following note signed "F." (for Forster).

"When we arrived on 10th October, 1774, at Norfolk Island, we came across the following birds, also met with by us in New Zealand: A big green parrot which we named *Psittacus hypopolius;* a parrokeet of such a kind as one also finds in New Amsterdam, *Psittacus euchlorus,* a beautiful browny-red dove with a white belly, *Columba argetraea;* a Quecksterz with fan-tail *Mostacilla* (*sic*) *ventilabra*; three Procellarians, *Procellaria gavia, Procellaria tridactyla* and a species of Linné's *Procellaria aequinoctialis*.

On the rocks the Cormorant nested, Linné's *Pelecanus piscator.* In addition we came across a new very beautiful Fly-catcher, *Muscicapa*

*dipapha*. It was black, had a white forehead and upper cover feathers and wings; breast and belly of a magnificent scarlet colour."

He then goes on to speak of the fishes and plants.

Of these bird names:—

(1) *Psittacus hypopolius* replaces *Plyctolophus productus* Gould, 1836, now in the genus *Nestor*.

(2) *Columba argetraea* is older than *Columba spadicea* Latham, 1801, and will replace it as *Hemiphaga argetraea* (Forster, 1794). It is interesting to find that Bonaparte in 1854 pointed this out.

(3) *Mostacilla* (*sic*) *ventilabra* is a synonym of *Rhipidura flabellifera* (Gmelin, 1789).

(4) *Muscicapa dipapha* is a synonym of *Petroica multicolor* (Gmelin, 1789). The other names are nude.

King's account of Norfolk Island with Forster's important note can be found in:—

(1) Magazin von merkwürdigen neuen Reisebeschierbungen: Bd. XI, p. 313, Berlin, 1794.

(2) Die neuesten Reisen nach der Botany Bay: Bd. III, p. 313, Berlin, 1794.

(3) John Hunter's "Reise nach Neu-Südwallis," p. 313, Berlin, 1794.

(4) Magazin von merkwurdigen neuen Reisebeschierbungen, Bd. XXII, p. 253, Vienna, 1795.

For want of more exact information re the actual day of publication of the Berlin issues, we cannot regard any one as having priority over any other.

I have set this out merely because the issues have been so confusing, as the publisher used his sheets over four times!

As the other publications are of equal date we must select one, to be used till details are available.

For the sake of uniformity in quoting these names given by Forster, either as the species name or as synonyms, I suggest we use "Magaz. Merkw. neuen Reiseb," Vol. and page, as examples:—

*Turdus phaeus* Forster, Magaz. Merkw. neuen Reiseb., Vol. III., p. 128, 1791. Sydney.

*Columba argetraea* Forster, Magaz. Merkw. neuen Reiseb., Vol. XI., p. 313, 1794. Norfolk Island.

### Salvado's Work, 1851.

In 1851 appeared a book by Monsig. D. Rudesindo Salvado called "Memorie Storiche dell, Australia particolarmente della Missions Benedettina di Nuova Norcia," published in Rome.

On p. 45 he described No. 13 *Pelecanus spectabilis*. This name replaces *P. conspicillatus westralis* Mathews, 1912.

No. 14. *Anas novaehollandiae*. "It is grey in colour, the tips of its wings white." This name is indeterminable.

### Hunter.

J. R. Forster published a German translation of "Hunter's Historical

Journal, 1793," in "Magazin Reisebeschreibungen," volume eleven, and also in a separate publication, and in a third publication, "Die neuesten Reisen nach der Botany Bay : . ." all three printed from the same type and differing only in title-page and preface. On p. 100 is an account translated by Forster of Hunter and his men living on the "Bird of Providence" after the wreck of the "Sirius" off Norfolk Island.

In a footnote to this account Forster says, "In Dusky Bay, New Zealand, we came across in various places thousands of nests of the "storm-bird" (*Procellaria*) dug in the mountains by the sea and in every hole only one young. The old birds fly far and wide by day, over the sea to catch fish, little "ink" worms, shell-fish and other sea animals, which in the evening they regurgitate into the open throat of the young. At daybreak the old ones fly away again and cause a deafening noise when they do so." The bird mentioned here is called in White's Journey Magazin Bd. V, p. 130, the "Sooty Stormbird." This refers to the 1794 edition. In the Vienna edition, Bd. IX, 1792, the p. is 212.

The bird is figured and described by White, 1790, p. 252, and plate. While Forster's note may not refer to this bird, it is a very early account of the breeding habits of a Petrel.

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## THE CTILOCERAS PROBLEM.

By Tom Iredale.

Nearly sixty years ago a very curious little shell was described from Torres Strait by Watson (Rep. Chall. Zool., Vol. xv., p. 465, pl. xxxi., fig. 1, 1885), who placed it among the worm-like shells, but recognising the probable ineptitude of this location, suggested relationship to Caecum and introduced a new name, *Ctiloceras*. The shell was very small and looked like a ring as it was wound in a loose circle, but the nucleus was a small tube with a coiled apex. Nearly twenty years later, Hedley (Proc. Linn. Soc. N.S.W., 1902, p. 22, pl. ii., figs. 28-30) added two other species also from Torres Strait. In the intervening forty years this curious molluscan form has not been discussed, but it is now suggested that "Ctiloceras" will class with *Sinusigera, Agadina* and *Macgillivrayia*. Many specimens have recently been picked out of shellsand collected by Corporal J. Laseron at Port Darwin, Northern Territory, and at least five distinct groups are concerned in a medley, each bearing the distinctive apex, which is similar to that of *Caecum*. *Parastrophia* and *"Strebloceras"* also occur, but the inter-relationship of these is obscure. A full account with figures will be furnished at the earliest opportunity as, if this curious mollusc be restricted to Australian waters, it may class as the Platypus or Lyre Bird of the molluscan world.

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# ICHTHYOLOGICAL NOTES AND ILLUSTRATIONS. (PART 2.).

By Gilbert P. Whitley, F.R.Z.S.

(Text-figs. 1-10.)

In preparing the letterpress for volume two of my "Fishes of Australia" (work upon which has had to be deferred for the time being), I have accumulated some miscellaneous notes and figures which call for separate treatment in a scientific journal. A selection from these notes is accordingly presented here, in continuation of an earlier paper (Austr. Zool., x., 1, 1941, pp. 1-50). Again, I have to thank Mr. G. C. Clutton for his photography.

References to genera will be found in Neave's *Nomenclator Zoologicus*, to species in McCulloch's 1929 Check-List (Austr. Mus. Mem., v.).

## Family Triakidae.

### Fur, *gen. nov.*

Orthotype, *F. macki, sp. nov.*

Pupil horizontal. Nictitating fold and spiracles present. No nasoral groove. Nasal cirrhus acute. Five gill-slits on each side. Labial folds present. Teeth acute, compressed, those of upper jaw with about four cusps; of lower with one.

Body subcylindrical to fusiform, back gibbous anteriorly. Two dorsal fins, without spines. Anal fin present. Caudal axis not much elevated. No caudal pits.

Latin; *fur*, a "shark" or villain.

This new genus is distinguished from all the many genera of Galeoid sharks by having the above combination of characters. It enters the family Triakidae of White, 1936, but is easily separable from *Triakis scyllium* (see Müller and Henle, Syst. Plagiost., 1839, p. 63, pl. 26), the genotype of *Triakis* Müller and Henle, 1838, by the following key characters, apart from various minor features.

A. Snout longer than width of mouth.
Nasal cirrhus acute.
Teeth of upper jaw with three cusps to one side of central cusp; of lower jaw without cusp.
Back humped anteriorly . . . *Fur*, gen. nov.

AA. Snout much shorter than width of mouth.
Nasal cirrhus broad and rounded.
Teeth with two small cusps on each side of central cusp.
Back not humped anteriorly . . . *Triakis*.

A few generic types superficially like the new one may be distinguished as follows:—

*Paragaleus* Budker (Bull. Mus. Hist. Nat. Paris, vii., 1935, p. 107. Type, *P. gruveli* from Dakar) has dental features like my new shark, but has a more acutely pointed snout, with consequent modification of head proportions; nasal lobes not cirrhiform, caudal pits present, interdorsal space less than upper caudal lobe, five crests on denticles and more uniform coloration. *Hemigaleus* Bleeker, 1852 (= *Negogaleus* Whitley, 1931) has caudal pits above and below.

From the American *H. pectoralis* Garman, 1906, as figured by Garman (Mem. Mus. Comp. Zool., xxxvi., 1913, pl. iv., figs. 1-5), the new shark differs in form of nostril-lobes, elevation of back, teeth, larger spiracles and varied coloration. It is doubtful whether Garman's species is a true *Hemigaleus*, i.e., *Negogaleus*, the typical species of that genus (*microstoma* Bleeker, 1852, from the East Indies and Queensland), differing markedly in dentition and proportions (see Whitley, Fish. Austr., i., 1940, p. 108, fig. 108).

*Hemitriakis leucoperiptera* Herre (Philippine Journ. Sci., xxiii., 1923, p. 67, pl. i.) from the Philippines, has small nasal flaps, and teeth more as in *Triakis*, with small cusps on each side of the central fangs.

FUR MACKI *sp. nov.*

Snout bluntly rounded, profile acute. Nostrils large, with nasal flaps which do not reach the crescentic mouth. Eye moderate with small pupil. Nictitating fold as long as eye. Spiracle small. Teeth in upper jaw rather like those of the School Shark, *Notogaleus*; but with four acute cusps on outer margin of each, the deflected inner margins smooth. There appear to be several small erect points on the upper symphysial teeth. Teeth of

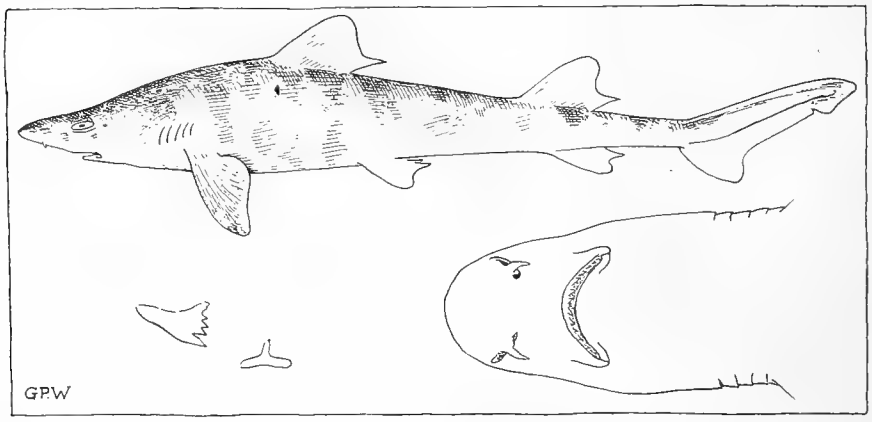



Fig. 1. Shark, *Fur macki*. Holotype, Mordialloc, Victoria. Also teeth and ventral surface of head. G. P. Whitley, del.

lower jaw each with a single median cusp, acute and suberect, with broad, entire bases. Several functional series in each jaw but dentition weaker at symphyses. Upper labial folds longer than lower. First to third gill-openings subequal, longer than fourth and fifth. Last gill-slit over pectoral base.

Head and body together shorter than rest of shark. Form deep anteriorly, tapering posteriorly, caudal axis not much elevated. No inter-dorsal ridge but a rather shallow groove. No caudal pits. Shagreen dense and hard, denticles varying from tricarinate on dorso-lateral surfaces to smooth on belly and top of tail, not notably enlarged over caudal.

The stomach contained a small octopus. Spiral valve of the "spiral type" of Dr. White's classification (Bull. Amer. Mus. Nat. Hist., lxxiv., 1937).

First dorsal fin over pectoral-ventral interspace. Second dorsal fin very large, subequal to first. Anal fin small. Pectorals and ventrals rather small. Subcaudal notched. Origin of lower caudal lobe in advance of that of upper.

The general proportions and relative positions of the fins are as shown in the figure: following are the principal dimensions of the holotype in millimetres:—

Head to first gill-slit, 85 mm.
„ „ fifth „ „ 102.
Snout to anterior margin of eye, 34.
Diameters of eye, 16 by 7.
Interorbital, 33.
Internarial, 16.
Preoral length, 37.
Width of mouth, 32.
Predorsal length, 163.
Depth at origin of first dorsal, 72.
First dorsal fin; anterior margin, 59.
„ „ „ ; base, 46.
„ „ „ ; lobe, 25.
Interdorsal space, 108.
Second dorsal fin; anterior margin, 58.
„ „ „ ; base, 44.
„ „ „ ; lobe, 19.
Distance from second dorsal to base of caudal, 59.
Anal fin; anterior margin, 44.
„ „ ; base, 31.
„ „ ; lobe, 13.
Anal base to caudal base, 41.
Pectoral; length, 64.
„ ; base, 20.
Ventral; anterior margin, 35.
„ ; base (to outer angle of clasper), 25.
„ ; lobe, 20.
Caudal; upper lobe, 103.
„ ; lower „ 42.

Ground-colour yellowish with about a dozen ill-defined cross-bands of light brown extending to near ventral surface. A few round light spots are symmetrically disposed on top of head, there are one or two on back anteriorly, and six or less along each side near lateral line, besides one or two on upper surface of pectorals. Eye bluish, after long preservation in alcohol.

Described and figured from the holotype of the species, an immature male, 500 mm. in total length, caught at Mordialloc, Victoria, in 1906. National Museum (Melbourne) regd. no. R. 13258.

Named in honour of Mr. George Mack, ornithologist and ichthyologist of the National Museum, Melbourne.

Family CLUPEIDAE.

ESCUALOSA MACROLEPIS (Steindachner, 1879).

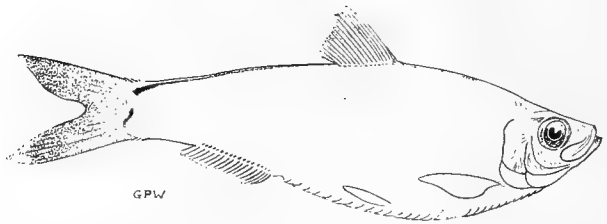



Fig. 2. Deep Herring, *Escualosa macrolepis*. Young topotype, Townsville, Queensland. G. P. Whitley, del.

Here figured from a specimen (Qld. Mus., No. I., 7195) from the type-locality, Townsville, Queensland, 3-1/8th inches in total length. D.17; A.18. Head, 13 mm.; depth, 21; standard length, 63. Eye, 4.5; snout, 3.1; maxillary, 6.3 mm. Scales deciduous, in about 35 transverse and 7 longitudinal series. About 18 pre-ventral scutes and 11 post-ventrals. A blackish stripe runs along back and thickens out before tail; there is a separate dark blotch at hypural; 14 black dots below dorsal and 17 over anal fin.

Family CLUPANODONTIDAE.

FLUVIALOSA *gen. nov.*

Orthotype, *Chatoessus elongatus* Macleay, 1883.

Large fluviatile or estuarine Australian herrings, with the mouth small, subterminal, toothless, notched at symphysis, the jaws forming a sharp angle. Maxillary narrow, expanded distally where its downward angle extends a little past end of premaxillary. Only one supra-maxillary on each side. Edge of dentary reflected outwards in front of maxillary. Exposed part of subopercle rather small and suboblong. Second suborbital not covering cheek, with oblique antero-inferior edge, distant from lower limb of preoperculum, which has a naked area above it. Gill-rakers very numerous. Last dorsal ray elongated.

D. 13-16. A. 18-20. Low scaly sheaths to dorsal and anal fins. Ventrals 7-rayed, inserted below anterior dorsal rays, or in advance of level of same. No dark humeral blotch. Body compressed. Belly serrated. Scales large, cycloid.

The genotype of *Nematalosa* Regan (Ann. Mag. Nat. Hist. (8), xix., 1917, p. 312), the genus in which *elongatus* has lately been pigeon-holed, is the marine *Clupea nasus* Bloch, selected in Jordan's "Genera of Fishes." True *Chatoessus* Cuvier, 1829, is a very different genus from the Antilles.

Besides *Fluvialosa elongata*, my new genus includes *F. horni* (Zietz, 1896) and *F. richardsoni* (Castelnau, 1873).

FLUVIALOSA ELONGATA (Macleay, 1883).

*Chatoessus elongatus* Macleay, Proc. Linn. Soc. N.S. Wales, viii., July 17, 1883, p. 209. Mary River, Queensland; freshwater lagoons.

The holotype of this species, from Maryborough, Queensland, is in the

Australian Museum (Regd. No. IA. 6018) and is not figured. It has D.3, 11; A.1, 18; P.1, 14; V.1, 6; C.17. Sc. 42. Tr. 17. About 15 predorsal scales. Ventral scutes 17 + 11. Gill-rakers very numerous. No teeth. A broad skinny flap behind operculum. No axillary pectoral scale. Total length, 11 inches. Standard length, 225 mm. Head, 71; eye, 14; depth of body, 80; longest dorsal ray, 84 mm. Other characters as defined for the genus.

Colour, olivaceous above, silvery below.

Range: Central and eastern Queensland (freshwater): Mary River; Boulia district, Longreach and Cunnamulla, Queensland.

The gills are sometimes infested with Sporozoan parasites. (See Johnston and Bancroft, Proc. Roy. Soc. N.S. Wales, lii., 1919, p. 526 and Proc. Roy. Soc. Qld., xxxiii., 10, 1921, p. 177). A larval trematode from this species is recorded by Johnston (Rec. S. Austr. Mus., vii., 1942, p. 187).

Family Engraulidae.

Genus Amentum Whitley, 1940.

Amentum carpentariae (De Vis, 1882).

*Engraulis carpentariae* De Vis, Proc. Linn. Soc. N.S. Wales, vii., 1882, p. 320.

Norman River, Gulf of Carpentaria.

*Stolephorus waitei* Jordan and Seale, Bull. Mus. Comp. Zool. Harvard, lxvii., 1926, p. 379. [North] Queensland.

*Amentum carpentariae* Whitley, Austr. Zool., ix., 1940, p. 403, fig. 10.

Thanks to the courtesy of Professor Thomas Barbour, Director of University Museum, Museum of Comparative Zoology at Harvard College, Cambridge, Massachusetts, I have been supplied with a photograph of the type specimen of *"Stolephorus waitei"* (M.C.Z., Regd. No. 18,254).

Fig. 3. Anchovy, *Amentum carpentariae*. Holotype of *Stolephorus waitei* from Queensland. Photo. from Mus. Comp. Zool., Harvard.

The type of *waitei* differs from *carpentariae* in having snout 2 in eye instead of about 1.2 to 1.5 in same, anal fin with 19 rays instead of 20 to 21, originating below about 10th dorsal ray instead of 5th. These differences may well be due to variation or change with growth, and *waitei* is in my opinion a synonym of *carpentariae*.

Family Opisthoproctidae

Monacoa *gen. nov.*

Orthotype, *Opisthoproctus grimaldii* Zugmayer (Bull. Inst. Oceanogr., 193,

1911, p. 2; Res. Camp. Sci. Monaco, xxxv., 1911, p. 13, pl. i., fig. 5) = *Monacoa grimaldii*.

This new generic name is to replace *Grimaldia* Chapman (Ann. Mag. Nat. Hist. (11), ix., April, 1942, pp. 272, 299 and 300), which is preoccupied by *Grimaldia* Chevreux (Bull. Soc. Zool. France, xiv., 1889, p. 283), a genus of Crustacea Amphipoda. Chapman's definition of *Grimaldia* constitutes the diagnosis of the new genus, *Monacoa*.

Family TACHYSURIDAE.

Genus COCHLEFELIS Whitley, 1941.

COCHLEFELIS COLCLOUGHI (Ogilby, 1910).

*Hemipimelodus colcloughi* Ogilby, Proc. Roy. Soc. Qld., xxiii., November 7, 1910, p. 7. Croker Island, Northern Territory. Holotype (No. I., 1538) in Queensland Museum. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, p. 61.

*Hemipimelodus colcloughi* is evidently a second species of *Cochlefelis* differing from the genotype, *C. spatula* (types compared), in being of more robust form, having the anterior nostrils closer together than the posterior, in having a few granular teeth on palate, and a better developed vertical l.lat. system, besides its smaller predorsal shield, free orbital margin, interorbital wider than mouth, nine gill-rakers on lower half of first branchial arch, conspicuous vent, adipose dorsal fin short and over middle of anal, and base of anal less than half head.

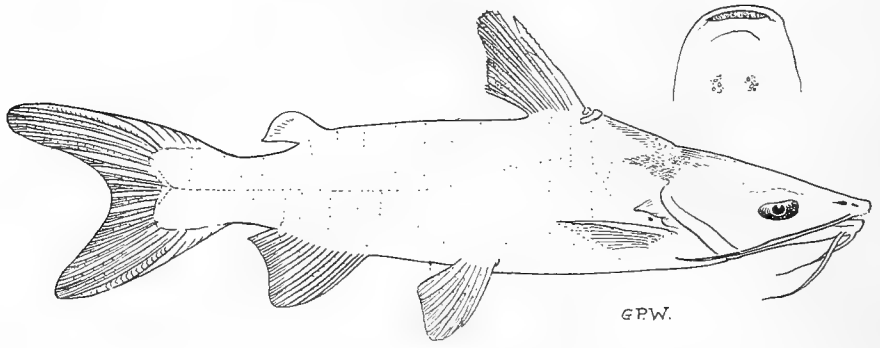



Fig. 4. Catfish, *Cochlefelis colcloughi*. Holotype, Croker Id., Northern Territory. G. P. Whitley, del.

Here figured from the holotype of the species kindly loaned by the Director of the Queensland Museum. The vomerine dentition was not mentioned by Ogilby; he evidently had difficulty in finding it, judging from the way the type has been cut about. There appears to be a patch of granular teeth far back on each side of the palate.

*Cochlefelis colcloughi* is also allied to *Hemipimelodus papillifer* Herre, 1935, from the Sepik River, New Guinea, but has fewer anal rays, more flattened head, base of adipose fin 6½ in interdorsal space instead of 3 or 4, and has an axillary pore at pectoral. In all these respects, except the last, it also differs from *Pimelodus borneensis* Bleeker, 1851, the genotype of *Hemipimelodus* Bleeker, 1858.

Family SYNODONTIDAE.

Genus XYSTODUS Ogilby, 1910.

*Xystodus* Ogilby, Proc. Roy. Soc. Qld., xxiii., November 7, 1910, p. 5. Orthotype, *X. banfieldi* Ogilby [= *sageneus* Waite, 1905].

*Allouarnia* Whitley, Austr. Zool., viii., March 12, 1937, p. 219. Orthotype, *Synodus sageneus* Waite, 1905.

Lizard fishes with palatine teeth in a single band. Large teeth of jaws spear-shaped. A pit, fringed with papillae, behind and below eye. Lateral line present. No adipose dorsal fin (except in young). Pectorals small. About 14 anal rays. Inner ventral rays much longer than outer. Pelvic bones with short laminar posterior processes.

XYSTODUS SAGENEUS (Waite, 1905).

*Synodus sageneus* Waite, Rec. Austr. Mus., vi., 2, September 15, 1905, p. 58, pl. viii., fig. 1. Trawled between Fremantle and Houtman's Abrolhos, Western Australia. Type in Western Australian Museum, Perth. *Id.* Norman, Proc. Zool. Soc. (London), April 3, 1935, p. 117.

*Xystodus banfieldi* Ogilby, Proc. Roy. Soc. Qld., xxiii., November 7, 1910, p. 6. Near Dunk Island, Queensland (E. J. Banfield). Type (No. I., 14) in Queensland Museum, Brisbane. *Id.* Norman, Proc. Zool. Soc. (London), April 3, 1935, p. 101 (Bowen, Qld.).

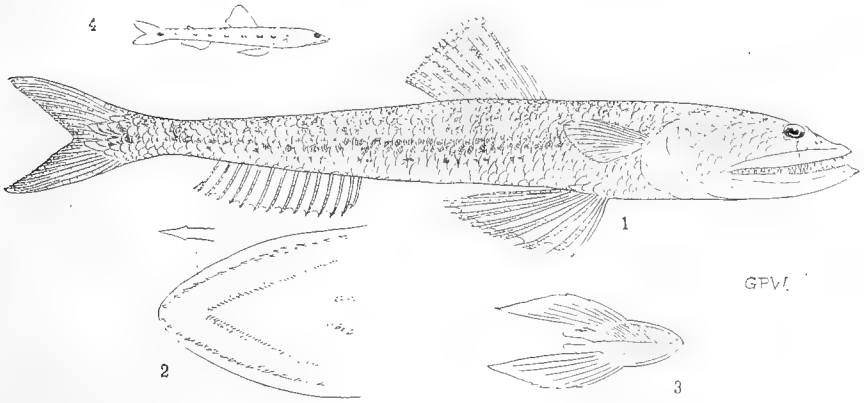



Fig. 5. Lizard Fish, *Xystodus sageneus*. No. 1. Holotype of *X. banfieldi* from near Dunk Island, Queensland. (2) Dentition of palate of same and a spear-shaped tooth enlarged. (3) Pelvic processes and ventral fins of same. (4) A postlarval specimen from Lindeman Island, Queensland. G. P. Whitley, del.

Mr. H. Longman, Director of the Queensland Museum, has kindly lent me Ogilby's type of *X. banfieldi* for figuring. He suggested that owing to a mechanical error, certain features were reversed in the original description which is inaccurate in several respects. Ogilby says, "no lateral line," but one is discernible under the microscope. He says, "dorsal fin inserted midway between the tip of the snout and the root of the caudal," but probably meant dorsal fin *situated* thereabouts. Also his "vent much nearer to the ventral than to the anal" is an obvious mistake, the reverse being the case.

His specimen is now curled and a little squashed, but even when due allowance is made for distortion, several discrepancies between it and his description are apparent.

Misled by these mistakes, later authors have been unable to classify Ogilby's genus and species which is evidently a young *sageneus* Waite, 1905, unless its different colour pattern entitles it to rank as an eastern subspecies.

Ogilby's type has about 15 predorsal scales and the pectoral fin reaches to about the 10th scale of the lateral line. L.tr. 4/1/5. The Australian Museum has several specimens from off Lindeman Island, Queensland, collected by M. Ward and myself, and one from Mapoon, Gulf of Carpentaria, Queensland, collected by Charles Hedley (I.6140). Records of the American *Saurus intermedius* from the Arafura Sea may refer to this species. Small examples have a minute adipose dorsal fin, but this is lost and its site covered by scales in larger fish. A post-larval specimen (No. IA.6486), about 29 mm. in standard length, from off Lindeman Island is illustrated here. It has eight pairs of dots along each side of back; nine blotches along sides of body, the first small, behind the gill-slit, and the last large on root of tail. No spots along belly. A few dusky specks on snout, chin and opercle. Mucus canals on the head, also scales, and lateral lines are well developed.

## Family Myctophidae.

### Genus Gonichthys Gistel, 1850.

*Gonichthys* Gistel, Isis (Munich) (5), 1850, p. 71. Haplotype, *Alysia loricata* Lowe, 1839 = *Scopelus cocco* Cocco, 1829. *Id.* Whitley, Rec. Austr. Mus., xix., 1933, p. 64. Type, *Gonichthys cocco*.

#### Gonichthys barnesi *sp. nov.*

D., 11-12; A., 18-21; L.lat., 38; Tr., 2/1/3. Predorsal, 11.

Head compressed, deep, snout rounded, overhanging the mouth. Lower jaw included. Jaws and palate-bones with villiform teeth. Maxillary extending well behind eye. Eye not nearly reaching profile, about 3.7 in head. A V-shaped internasal ridge. Gill-rakers long, 10 on lower part of first branchial arch.

Size small, body compressed, with adherent cycloid scales, with four or five basal furrows. Lateral line scales enlarged. Depth of body less than length of head which is about 4 in standard length. Caudal peduncle long and tapering. Distance from origin of anal to caudal longer than distance from anal to centre of eye (though not as long as in *hians* Richardson).

Large antorbital luminous organs.

Photophores: Br. 3. Max: O. Op: 1. PLO: 1. PVO: 2. PO: 5. VLO: 1. VO: 4. SAO: 3. POL: 1. AO: 7. PA: 11. Prc: 2. The PO photophores are equidistant. The anal photophores vary from AO: 6 to 8, and PA: 11 to 12. SAO form an obtuse angle. First SAO slightly in advance of third VO. VLO level with first and second SAO.

Nine supracaudal scales, of which seven are luminous in most specimens; probably males; others (females) have four or five infra-caudal luminous plates. 41 vertebrae.

Origin of dorsal before middle of body. Anal fin originating below the

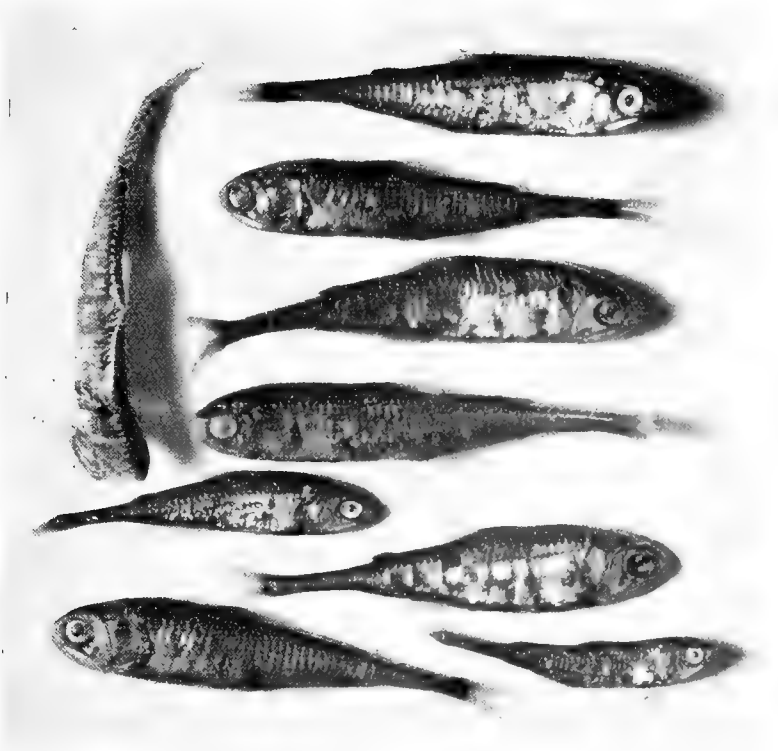


Fig. 6. Lantern Fish, *Gonichthys barnesi*. Holotype and paratypes. Lord Howe Island. G. C. Clutton, photo.

posterior dorsal rays, behind middle of standard length. Pectorals longer than ventrals, but not nearly reaching anal. Caudal forked.

Colour in alcohol brownish or bluish, with burnished silvery scales on flanks. Luminous areas yellowish. Fins whitish, or with scattered dark dots. Roof of mouth blackish.

*Locality*.—Lord Howe Island, washed up on Blinkenthorpe Beach in 1922 and 1926, after light inshore winds and smooth seas.

Holotype and paratypes, up to 54 mm. long in Austr. Mus. (Regd. No. IA.953) figured here. Other paratypes are Regd. Nos. IA.952 and 2650. Forty-one specimens, up to a little over two inches long.

Named after Mr. William Barnes, who has collected specimens in New South Wales and at Lord Howe Island, and whose labours contributed largely to the recent re-organisation of the fish collections in the Australian Museum.

Australasian records of the Atlantic *coruscans* Richardson, 1845, may refer to this species. A deeper fish with comparatively shorter caudal peduncle, *coruscans* is described as having no glandular apparatus over the caudal peduncle and with the scale having about three basal furrows; *G.*

*cocco* also differs in its deeper habit. AO 8 is a higher value in *barnesi* than in other species of *Gonichthys*.

Range.—Between Australia, Lord Howe Island, and New Zealand.

Family SYNGNATHIDAE.

CAMPICHTHYS FATILOQUUS *sp. nov.*

Fig. 7. Pipefish, *Campichthys fatiloquus*. Holotype, Shark's Bay, Western Australia. G. C. Clutton, photo.

D., 13; A., vestigial; P., 7; C., 6.
Rings, 13 + 46; subdorsal rings, 2 + 2.

Head (5 mm.) 12.8, depth of body (less than 2) more than 32 in total length (64). Head and body, 17 mm.; predorsal, 16; caudal, 2.5; eye, 1.5; snout, 2; postorbital, 3 mm.

Head smooth, slightly compressed, with median crest along snout and a weak ridge below nostril. A small filament over each eye. Operculum longer than high, with a weak ridge right across it, and some downward striae.

Body five-angled in transverse section. Form very elongate. No brood pouch in type-specimen. Ventral carina present. Superior cristae of trunk and tail continuous. Median crista of body dips below dorsal fin to join lower crista of tail. Inferior cristae of trunk converge and cease near vent, and are discontinuous with those of tail. Small dermal flaps at intervals along body-rings which are lightly sculptured, with few radiating grooves, and without tooth-like spines.

Fins well developed, except the anal, which is vestigial.

Colour in life fairly uniform blackish. In spirits, dark brown with lighter yellow patches behind interorbital and on opercula. Body and tail mottled with darker and lighter browns, corresponding to annuli. Dorsal yellowish, with the anterior rays brown. Caudal dark brownish. Pectorals yellowish. Eye bluish with yellow mottling.

Described and figured from the holotype, 64 mm. or $2\frac{1}{2}$ inches long. Austr. Mus. Regd. No. IB.340.

*Locality.*—Dredged in the pearling grounds, Shark's Bay, Western Australia; 1939, by G. P. Whitley.

The Freycinet Harbour specimens identified as *Ichthyocampus filum* by Günther (Cat. Fish. Brit. Mus., viii., 1870, p. 178) are most likely this species, which I (Austr. Zool., vi., 1931, p. 313) believed required a new name since true *filum* has 16 body-rings.

Differs from *C. runa* Whitley (l.c., 1931) in having larger dorsal and pectoral fins, in proportions, and colour. From *C. tryoni* (Ogilby, 1890), the number of rings and disposition of cristae separate *fatiloquus*.

Genus Parasyngnathus Duncker, 1915.

Parasyngnathus altirostris (Ogilby, 1890).

*Syngnathus altirostris* Ogilby, Rec. Austr. Mus., i., 3, July, 1890, p. 55. Moreton Bay, Queensland and Clarence River, N.S. Wales.

The Black-chinned Pipefish belongs to the genus *Parasyngnathus* of Duncker (Mitt. Naturh. Zool. Mus. Hamburg., xxxii., 1915, p. 14. Logotype, *Syngnathus spicifer* Ruppell, by present designation). This generic name has been omitted from Jordan's "Genera of Fishes" and from standard nomenclators.

The accompanying illustrations are from the types in the Australian Museum, a female lectotype from Moreton Bay and a male co-type (with broken tail) from Clarence River. Mr. T. Iredale has also collected this fish at Noosa River, Queensland.

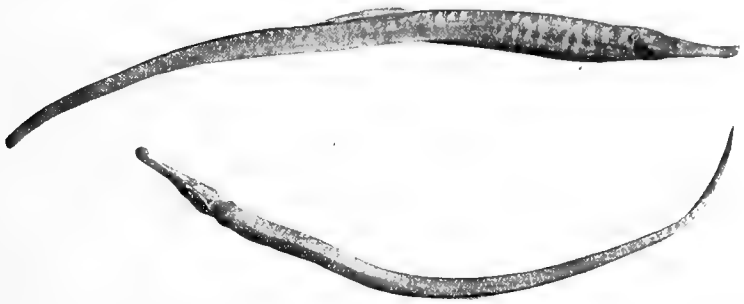


Fig. 8. Pipefish, *Parasyngnathus altirostris*. Female lectotype from Moreton Bay, Queensland, and (above) male co-type (with broken tail) from Clarence River, New South Wales. G. C. Clutton, photo.

The main specific characters may be diagnosed as follows:—

Upper profile of snout evenly continued in that of forehead. Gill-openings sealed except for a superior oval slit. Eye small. Snout longer than postorbital portion of head. Middle of opercle with a ridge and with downward radiating striae. Body deeper than broad. Rings 15 to 17/40-42. Dorsal ridge of body ends below dorsal fin, median ridge ends a little before this; neither continuous with dorsal ridges of tail. A median ventral ridge present.

Dorsal fin situated on seven anterior caudal rings entirely behind level of vent, with about 26 to 28 rays, and its base not elevated. Anal fin minute. Pectorals well developed, with about 14 rays.

Brood pouch subcaudal, from anal fin backwards over 16 rings as a very elongate median slit with raised lips. Tail very elongate. Dark streak along middle of chin, or a series of spots. Stripes over lower part of gills.

South of Maryborough, Queensland, to northern N.S. Wales, entering and living in freshwater.

Family Hemiramphidae.

Euleptorhamphus longirostris (Cuvier, 1829).

The Australian Musem has an abnormal juvenile specimen (with no ventral fins) from the Noosa River, Queensland. Also normal examples

from Bateman's Bay and north of Tuggerah Entrance, N.S. Wales (washed up on beach, January, 1941). Another, from the Albany district, constitutes a new record for Western Australia.

Family Mugilidae.

Oedalechilus kesteveni *sp. nov.*

D. iv/i., 8. A.iii., 9 (last divided); P.i., 15; V.i., 5; C., 12 branched rays. Sc., 35; Tr., 11; predorsal, 22.

Head (37 mm.) nearly 4, depth (42) 3.5 in standard length (147). Snout (6.5) nearly 5.7, eye (9) 4.1, interorbital (17) 2.2 in head.

Head longer than high and higher than wide. Two rows of cycloid cheek-scales. Scales around preoperculum with deep mucous channels.

Snout short and blunt, excavate anteriorly. Nostrils small, oval, the posterior larger. Interorbital roundly convex. Eye large, half the post-orbital, without adipose lids, except for a narrow rim anteriorly. Cleft of mouth much broader than deep. Upper lip deep, with a transverse fold, without papillae, its cultrate margin ciliated; lower lip less deep but with similar ciliae at edge, and with double symphysial knob. Tongue with slight median crest. Preorbital slightly notched, serrated. Maxilla extending beyond level of posterior nostril to below margin of eye. Tip of maxilla exposed. Opercles almost meeting along median ventral line. Posterior margin of operculum steep.

Body compressed, deep, the rostro-dorsal profile strongly arched. Ventral profile straighter and less steep. Scales with clear margins and ragged edges, and about six radiae. Some extend on to all the fins except the ventral. Axillary scales present. Depth of caudal peduncle (20 mm.) more than half head.

Origins of dorsal fins corresponding to about 12th and 22nd body-scales respectively. First dorsal spine equidistant from snout and caudal base, reaching more than half its distance from first dorsal rays. Anal origin in advance of level of second dorsal origin. Pectoral slightly longer than head, inserted high and reaching to below spinous dorsal fin, and to about 13th body-scale. Caudal emarginate.

Colour in alcohol, silvery, darker above; a dark blotch over base of first pectoral ray. No stripes.

Described from the holotype, a specimen 147 mm. in standard length, or $7\frac{1}{2}$ inches overall. One of three examples $2\frac{3}{4}$ to 13 inches long. Austr. Mus., Regd. No. A.4797.

*Locality.*—Port Essington, Northern Territory; coll. A. Morton, 1879.

Differs from *O. papillosus* (Macleay, 1883) in characters of head and mouth, also in having longer pectoral fins. From *labiosus* it differs in having lower lip ciliated and larger scales.

Named after Mr. Geoffrey Kesteven, B.Sc., of the C.S.I.R. Marine Biological Laboratory, Cronulla, N.S. Wales, who is investigating the mullets of Australia.

Family Centrolophidae.

Tubbia *gen. nov.*

Orthotype, *Tubbia tasmanica, sp. nov.*

A genus of small Stromateiform fishes with the body ovate, compressed,

with flesh firm. Eyes fairly large, without adipose lids. Interorbital tumid. Maxillary reaching below pupil. A single row of compressed, pointed teeth in each jaw, none on vomer and palatines. Oesophageal teeth cannot be examined without damaging the specimen. Head with many mucous pores. Cheeks and opercles scaly. Preoperculum serrate. Interoperculum not spinous. Opercular spines weak. Gill-openings very wide, the membranes overlapping on the narrow isthmus. Median gill-rakers slender, spinigerous, about 12 on lower limb of first branchial arch.

First dorsal fin much reduced, of only a few small spines increasing in size backwards and joined to the extensive soft dorsal fin which, like the anal, is rounded and many-rayed. Second anal spine much longer than first. Pectorals moderate, rounded; ventrals small, rather pointed. Caudal bilobed.

Scales minute, imbricate, cycloid, often with wavy edges; l.lat. with a raised ridge of tubes roughly parallel to outline of back. Scales extend over soft dorsal, anal and caudal fins. Vent slit-like, without papilla.

Coloration plain.

Differs from *Centrolophus* in fin-formulae, in lacking a nuchal crest of spines, and having dorsal and anal fins convexly outlined, and from all other genera of the family in the combination of characters given above.

TUBBIA TASMANICA *sp. nov.*

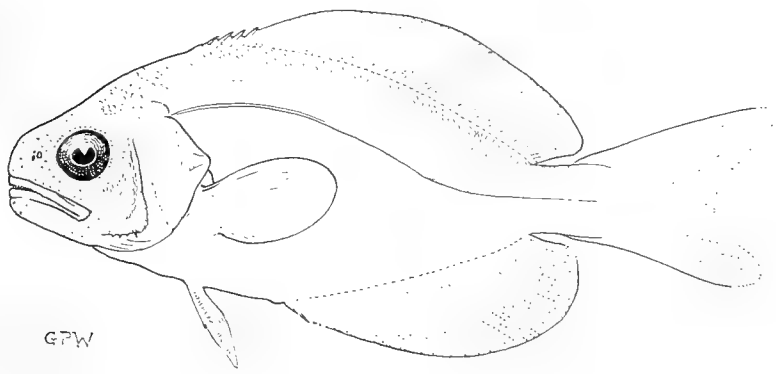



Fig. 9. Tasmanian Ruffe, *Tubbia tasmanica*. Holotype. Tasmania. G. P. Whitley, del.

Br., 7; D.iv., 45; A.ii., 33; P.ii., 16; V.i., 5; C., 17; L.lat., 144. Tr. 17/1 plus about 70.

Head (26 mm.) 3, depth (30) 2.5 in standard length (77).

Eye (7 mm.) equal to snout (7) and less than interorbital, 9 mm.

General characters as defined for genus.

A live specimen obtained by Mr. J. A. Tubb in Tasmanian waters (Austr. Mus., Regd. No. IB.1148) had the following coloration: "Dorsally and laterally pale mauve, fading to silver below. Spots on head silver. Fins slightly darker than body."

Total length, 4 inches.

*Locality.*—Off eastern Tasmania; M.V. "Warreen" Station, 60/41 at 42½° 42' S.lat. by 148° 34' E.long. Netted between 50 metres and surface, 22/1/41.

C.S.I.R. collection. Austr. Mus., Regd. No. IB.1148.

### Family Terapontidae.

The fishes of this family, generally known as Grunters or Therapons, are edible perch-like forms, generally of small size, found in the fresh waters of Australia and New Guinea, but there are allies, in salt water, as well as fresh, in the Indian and Western Pacific Oceans from the Red Sea, east coasts of Africa, Madagascar, through the East Indies to the Pacific Islands. Their characteristics are as follows:—

Head mostly naked except on sides which have small scales.

Eyes and mouth small, lips thick. Teeth in bands, the outer series enlarged. Preoperculum serrated. Two opercular spines, the lower longer.

Body oblong or ovate, compressed, covered with finely ciliated, adherent scales. Lateral line complete, bordered by larger scales. Cleithrum and supracleithrum serrated, generally exposed.

First dorsal fin with usually twelve or thirteen heteracanth spines, its outline generally emarginate, and its base longer than that of soft dorsal which has 8 to 14 rays. Anal with three spines and about 7 to 12 rays. Dorsal and anal fins with basal scaly sheaths. Ventrals inserted well behind level of pectoral base.

Colour of freshwater species usually modest, grey, silver, bronze or blackish, sometimes with small spots or dusky stripes. Marine species often silvery with dark stripes and blotches.

The numerous species of these fishes are sometimes united under the genus *Terapon,* although several nominal genera and subgenera have been proposed by authors. Analysis of their characters convinces me that separation is necessary to avoid the confusion which has been caused by indiscriminate lumping. In order to determine the names for the necessary sections, it is first necessary to tabulate, in chronological order, the generic names proposed for these fishes.

### Genus Terapon Cuvier, *sensu lato.*

*Terapon* Cuvier, Règne Anim. ed. 1, ii., "1817" = December, 1816, p. 295. Logotype, *Holocentrus servus* Bloch, 1790, selected by Bleeker, Arch. Neerl. Sci. Nat. Harlem, xi., 1876, p. 267—*fide* Fowler, 1931. The earlier selection of *Sciaena jarbua* by Bory, Dict. Class. Hist. Nat., xiii., 1828, p. 204, is invalid as that species was not mentioned in Cuvier's original account. However, this point is not very important, since Bory, as well as later authors, regarded *Holocentrus servus* Bloch, 1790, as a synonym of *Sciaena jarbua* Forskal, 1775, non-binom = Bonnaterre, Tabl. Encycl. Meth. Ichth., 1788, p. 123, a marine Red Sea type.

*Therapon* Cloquet, Dict. Sci. Nat., xv., 1819, p. 299. Emended spelling of *Terapon.*

*Pterapon* Gray, Illustr. Ind. Zool. (Hardwicke), ii., February. 1835, pl. 88. Emendation for *Terapon.* Type, *P. trivittatus* Gray = *jarbua* Bonnaterre.

*Mesopristes* Bleeker, Nat. Geneesk. Arch. Neerl-Ind., ii., 1845, p. 523. Orthotype, *M. macracanthus* Bleeker = *Datnia argentea* Cuv. & Val.

*Datnioides* Canestrini, Verh. Zool.-bot. Ges. Wien., x., 1860, p. 305. Not *Datnioides* Bleeker, 1853, another genus of fishes (*fide* Neave, Nomencl. Zool.).

*Homodemus* De Vis, Proc. Linn. Soc. N.S. Wales, ix., 2, August 19, 1884, p. 395. Haplotype, *H. cavifrons* De Vis = *Hephaestus fuliginosus* (Macleay). Preoccupied by *Homodemus* Fieber, 1858, a genus of Hemiptera.

*Autisthes* De Vis, *ibid.*, 398. Haplotype, *A. argenteus* De Vis = *Therapon puta* C.V.

*Hephaestus* De Vis, Proc. Linn. Soc. N.S. Wales, ix., 2, August 19, 1884, p. 399. Haplotype, *H. tulliensis* De Vis = *H. fuliginosus* (Macleay).

*Eutherapon* Fowler, Journ. Acad. Nat. Sci. Philad. (2), xii., 4, 1904, p. 527. Orthotype, *Therapon theraps* Cuv. & Val.

*Leiopotherapon* Fowler, Bull. U.S. Nat. Mus., 100, xi., May 8, 1931, pp. 328 and 353. Orthotype, *Datnia plumbea* Kner.

From the above, it is at once seen that the true genus *Terapon* applies to *servus* Bloch, a marine species with the spinous dorsal fin emarginate, its penultimate spine much shorter than the ultimate, a large black blotch on first dorsal membrane, very small scales on body, caudal fin with oblique dark bars and with the lower opercular spine enlarged and reaching beyond opercular lobe. *Therapon* and *Pterapon* are classical emendations only and thus direct synonyms of *Terapon,* with the same genotype.

The next name, *Mesopristes,* was proposed in a book which is not available to me, so I quote the reference from Neave's "Nomenclator Zoologicus." Although said to have been published in 1845, the name *Mesopristes* is not in Sherborn's excellent "Index Animalium." The genotype is *Mesopristes macracanthus* Bleeker, 1845, from Java, regarded by authors as conspecific with *Datnia argentea* Cuvier and Valenciennes (Hist. Nat. Poiss., iii., April, 1829, p. 139, pl. 54), also from Java.

The tautotype of the genus *Datnia* Cuvier, 1829, is *Coius datnia* Hamilton Buchanan, 1822, a Gangetic Sparoid wrongly regarded by Cuvier as conspecific with his Java type, so *Mesopristes* comes in for *macracanthus* = *argenteus.*

*Mesopristes* is at once separable from *Terapon* in almost every particular. The spinous dorsal fin is not emarginate, but the anterior spines are very long and strong, the penultimate and ultimate spines subequal; no dark blotch on first dorsal membrane and no stripes on body; caudal fin plain; lower opercular spine not enlarged and scarcely reaching opercular lobe; preorbital deep with longer snout, scales much larger, second anal spine very long and strong, soft anal margin convex instead of concave.

In Australia, *Mesopristes argenteus* has been reported from Queensland.

*Datnioides* and *Homodemus* are doubtful synonyms of *Terapon,* but since both names are preoccupied they are invalidated and there is no need to consider them further.

*Autisthes* is available for *puta,* which is closely allied to true *Terapon,*

but may be maintained as distinct on account of its enlarged preopercular armature, more widely spaced nostrils, and the stripes following the axis of the body.

*Hephaestus* is obviously the generic name to be used for the majority of the Australian freshwater "Therapons." Its facies is well shown in Ogilby and McCulloch's description and figure of *"Therapon" fuliginosus.*

With *Eutherapon,* we revert to the striped marine forms, this genus being separable from *Terapon* and *Autisthes* by having much larger scales, seven or eight rows between lateral line and spinous dorsal fin and about 55 in lateral series. In 1931, Fowler wrongly included this genus of his in the small-scaled section of his key.

The last name requiring consideration, *Leiopotherapon,* is based on *Datnia plumbea* Kner, which is very similar to *Mesopristes,* but has the supracleithrum and cleithrum covered by scales and the preorbital smooth; its type-locality is unknown, but Fowler's specimens came from the Philippines.

As a development from the foregoing, it is now possible to provide names for some hitherto unrecognized generic groups, as follows:—

BIDYANUS *gen. nov.*

Orthotype, *Acerina (Cernua) bidyana* Mitchell (Three Exped. Int. E. Austr., i., 1838, p. 95, pl. viii. Gwydir and McIntyre Rivers, New South Wales) = *Bidyanus bidyanus.*

Lower opercular spine not enlarged. Nostrils close together on each side. Mouth small, not reaching below eye. Twelve dorsal spines, the longest longer than the rays and the last two subequal. Second anal spine elongated. Supracleithrum exposed. Sc. 75 to 89. Supralateral scales 13 or 14. Colouring plain.

*Bidyan* is the aboriginal name of the type-species.

Murray River system from Queensland to South Australia, and, as *ellipticus,* in rivers of Western Australia.

*Therapon macleayi* Ramsay (Ann. Rept. Austr. Mus., 1882 (1883), p. 13) is a synonym of *Bidyanus bidyanus.*

In order to dispose of another superfluous name, the nomen nudum, *Therapon pittii* Krefft (List of Australian Reptiles and Freshwater Fishes in the collection of the Australian Museum, Sydney, 1862, p. 12), from the Hawkesbury River, New South Wales, where Terapontidae are unknown, is hereby formally designated a synonym of *Percalates colonorum novemaculeatus* (Steindachner, 1866).

PAPUSERVUS *gen. nov.*

Orthotype, *Therapon trimaculatus* Macleay (Proc. Linn. Soc. N.S. Wales, viii., 2, 1883, p. 259, from Goldie River, Papua) = *Papuservus trimaculatus.*

Head three in standard length. Lower opercular spine not reaching opercular margin. Supracleithrum exposed. Less than 8 supralateral scales. Thirteen dorsal spines, last two subequal. Anal rays with convex margin. Body with obscure bands. Several dark spots before base of caudal fin. No black blotch on first dorsal fin.

New Guinea and North Queensland, freshwater.

AMNIATABA *gen. nov.*

Orthotype, *Therapon percoides* Günther (Ann. Mag. Nat. Hist. (3), xiv., November 1, 1864, p. 374, from Fitzroy River, Queensland) = *Amniataba percoides.*

Lower opercular spine not reaching lobe. Mouth small. Supracleithrum hidden by scales. Body deep, compressed, crossed by several dark vertical bands. Scales large, in less than forty series. Thirteen dorsal spines, longest spines and rays subequal. Anal spines moderate.

*Ataba* is an aboriginal name used in Queensland for marine *Terapon.*

Tropical Australia; freshwater.

AMNIATABA PERCOIDES BURNETTENSIS *subsp. nov.*

A new subspecific name is required for the specimens mentioned by Ogilby and McCulloch (Mem. Qld. Mus., v., 1916, p. 107) from the Upper Burnett River. The key-characters given by those authors will serve to separate *burnettensis* from typical *percoides* from the Fitzroy River. Holotype of the subspecies: a specimen 5 inches long from Eidsvold; Austr. Mus. Regd. No. I.12197, from Dr. T. L. Bancroft.

PELSARTIA *gen. nov.*

Orthotype, *Therapon humeralis* Ogilby (Proc. Linn. Soc. N.S. Wales, xxiv., 1, August 8, 1899, p. 177, from Houtman's Abrolhos, Western Australia) = *Pelsartia humeralis.*

Profile of head convex. Mouth small. Lower opercular spine not produced. Nostrils widely separated on each side of head. Supracleithrum exposed. Body elongate-ovate. Sc. 80-90. Supralateral scales 14 or 15. Longest of the twelve dorsal spines much longer than the rays.

A dark humeral blotch. Several dark bars on body, and small spots on soft dorsal, anal, and caudal fins.

Coasts of Western Australia; marine.

AMPHITHERAPON *gen. nov.*

Orthotype, *Datnia* ? *caudavittata* Richardson (Zool. Voy. Erebus and Terror, Fish, 1845, p. 24, pl. xviii., figs. 3-5, from Harvey River, Western Australia) = *Amphitherapon caudavittatus.*

Lower opercular spine not reaching beyond lobe. Mouth small, barely reaching below eye. Suprascapular bone hidden by scales. Less than sixty lateral and 8 supralateral scales. Thirteen dorsal spines, the longest longer than the rays. Caudal fin with a conspicuous black blotch on each lobe.

Tropical Australia and New Guinea; estuarine.

SCORTUM *gen. nov.*

Orthotype, *Therapon parviceps* Macleay (Proc. Linn. Soc. N.S. Wales, viii., 2, July 17, 1883, p. 201, from Upper Burdekin River, Queensland) = *Scortum parviceps.*

Head small, about one-fourth standard length. Lower opercular spine not reaching lobe. Supracleithrum exposed. Scales in 70 or less lateral series and 8 or more supralateral. Thirteen dorsal spines, the longest much

longer than the rays. Body without bands and tail without spots, the coloration uniform.

Inland Queensland; freshwater.

This genus also includes *Therapon hillii* Castelnau, 1878, which has head $3\frac{1}{2}$ in standard length, and the deep-bodied *Therapon barcoo* McCulloch and Waite, now *Scortum hillii* and *Scortum barcoo* respectively.

Family SILLAGINIDAE.

SILLAGO ANALIS *sp. nov.*

D.xi/17; A.i., 15; P.i., 15; V.i., 5; C., 15 branched rays. L.lat. 60 to hypural joint. L.tr., $5\frac{1}{2}$/1/10; below first dorsal, to 4/1/5 on caudal peduncle. About 24 predorsal scales.

Head (95 mm.) 3, depth (62) 4.7, width (44) 6.6 in standard length (294). Eye (17) 5.58 in head. Snout, 40; interorbital, 22; length of pectoral, 51; depth of caudal peduncle, 31 mm., the latter being less than postorbital portion of head (34.5 mm.).

Snout subconic. Upper jaw the longer, but not reaching back to level of nostrils. Interorbital slightly depressed, wider than eye. Four rows of cheek-scales below eye. Teeth coarsely villiform, in bands in each jaw, none enlarged. Preopercle entire. Scales of head cycloid, of body weakly ctenoid.

General form of head and body and disposition of fins as usual in the family, none of the spines or rays produced, though the first ventral ray-tips are pointed. Dorsal fins separate. Base of soft dorsal (83 mm.) much longer than that of anal (62). Ventral spine not expanded as a cartilaginous pad, originating well before level of first dorsal fin. Caudal emarginate, upper lobe longer, equal to pectoral.

General colour, after long preservation, pale brownish, without any conspicuous bars or spots. The median parts of the scales of back and flanks are finely infuscated and there are dusky tinges on snout, opercles, pectoral bases, and towards tip of first dorsal fin. Other fins plain. Slight grey trace of what may have been a silver axial streak in life. Eye bluish grey.

Described from the holotype of the species, a specimen 294 mm. in standard length or $13\frac{3}{4}$ inches overall. Austr. Mus. Regd. No. I.13118.

*Locality.*—Shark's Bay, Western Australia; Fisheries Department, Western Australia, 1914.

Distinguished from its congeners mainly by its fin- and scale-counts, and comparative size of eye.

In authors' keys, it comes apparently nearest *Sillago macrolepis* Bleeker (Nat. Tijdschr. Ned. Ind., xvii., 1858-9, p. 166; figured in Atlas Ichth., ix., 1877, pl. 389, fig. 1) from the East Indies, but differs in having deeper body, smaller eye, more cheek-scales and fewer anal rays.

Family ACANTHOCYBIIDAE.

Genus ACANTHOCYBIUM Gill, 1862.

ACANTHOCYBIUM SOLANDRI (Cuv. & Val., 1832).

*Cybium solandri* Cuvier & Valenciennes, Hist. Nat. Poiss., viii., 1831 (Jan., 1832), p. 192; ed. 2, p. 141. No locality [= Between Lagoon and Thrumb

Cap Islands, Paumotus; about 18° S.long. by 138° W.lat. Cook's first voyage, 4 April, 1769—*fide* Günther, 1876, and Hooker, 1896]. *Id.* Günther, Journ. Mus. Godef., xi., 1876, p. 153, pl. xciv., figs. A (type, from Solander's drawing) and B.

*Scomber lanceolatus* Cuv. & Val., *loc. cit.*, p. 204, *ex* Solander (*not* Forster) MS. Same locality. *Id.* Hooker, Journ. Sir J. Banks, 1896, p. 70. *Id.* Sherborn, Index Anim., pt. 29, 1932, p. 100.

*Acanthocybium solandri* Boulenger, Proc. Zool. Soc. London, 1897, p. 272, and of modern authors. *Id.* Marshall, Mem. Qld. Mus., xii., 1941, p. 62 (Queensland). "Wahoo" McPhee, Power Boat, September 10, 1939, p. 13 (N.S. Wales). *Id.* Simpson, Angling and Gun Sport, October 31, 1939 (Queensland). *Id.* McPhee, Power Boat, January 10, 1940, p. 8. *Id.* Serventy, C.S.I.R., Pamph. 104, 1941, p. 20 (Australia).

The Wahoo or Peto, a celebrated sporting fish in other waters, was only recently recorded from Queensland by Marshall (1941). The late Professor A. Watson obtained a specimen before 1935 in North-western Australia which was identified at the British Museum. Two large trematode worms from it were sent to Dr. T. Harvey Johnston, from whom I first heard of this fish in Australia.

In August, 1939, Mr. T. C. Roughley informed me that Queensland anglers had caught Wahoo on the Great Barrier Reef. In "Power Boat," September 10, 1939, p. 19, one was recorded from off Coff's Harbour, New South Wales. It is thus evident that the Wahoo is found in northern New South Wales, Queensland and N.W. Australia.

The record trolled fish, caught off Bird Island, Hawaii, was 6 ft. 8 inches long and weighed 124¾ lb. The largest specimen seen by me in the Brisbane Fish Markets, March 29, 1943, was 51 inches overall and weighed 35 lb.

Though *Acanthocybium solandri* is often credited with a world-wide range, it is possible that several separate geographic species are concerned. The following names have been proposed:—

*A. sara* (Lay and Bennett, 1839), Japan.

*A. petus* (Poey, 1860), Cuba.

*A. verany* (Doderlein, 1872), Sicily.

*A. forbesi* Seale, 1912, Philippines.

### Family Salariidae.

### Istiblennius *gen. nov.*

Orthotype, *Salarias mulleri* Klunzinger, 1879.

Blennies with the general facies of *Salarias* Cuvier, 1816, but with the dorsal and anal fins very high, the former incised and united with the caudal, and the latter free; ocular tentacle simple.

From *Entomacrodus* Gill, 1859, *Istiblennius* is separable, notably by having superciliary tentacles, dorsal joined to caudal, more anal rays, and in lacking the large recurved teeth in lower jaw. This genus enters section EE of my key (Great Barrier Reef Exped. Sci. Rept., iv., 9, 1932, p. 297) but differs from *Rupiscartes* Swainson, 1839, in having fewer ventral rays and in not being anguilliform.

ISTIBLENNIUS MULLERI (Klunzinger, 1879).

*Salarias mulleri* Klunzinger, Sitzb. Akad. Wiss. Wien., lxxx., 1, 1879, p. 388. Hobson's Bay, Victoria. Type in Wurrtemb. Naturaliensammlung, Stuttgart, seen. *Id.* Macleay, Proc. Linn. Soc. N.S. Wales, ix., May 23, 1884, p. 36; Cat. Fish. Austr., 1884, suppl., p. 36. *Id.* Lucas, Proc. Roy. Soc. Vict. (2), ii., 1890, p. 29. *Id.*, Weber, Siboga Exped., lvii., Fische, 1913, pp. 528 and 535. *Id.* McCulloch and McNeill, Rec. Austr. Mus., xii., 2, 1918, p. 16. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, p. 344.

? *Entomacrodus calurus* Fowler, Journ. Acad. Nat. Sci. Philad. (2), xii., 4, 1904, p. 555, pl. xx. Padang, Sumatra. Has fewer anal rays and mandibular canines present.

No species of *"Salarias"* is found so far south as Victoria, so that it is obvious that the type-locality "Hobson's Bay" for *S. mulleri* is an error. It is more likely to have come from the Indo-Australian archipelago or adjacent shores. Perhaps Baron Müller obtained it from Darwin, but the locality must remain doubtful. I sketched the type-specimen in Germany before the war and give the first illustration of the species here.

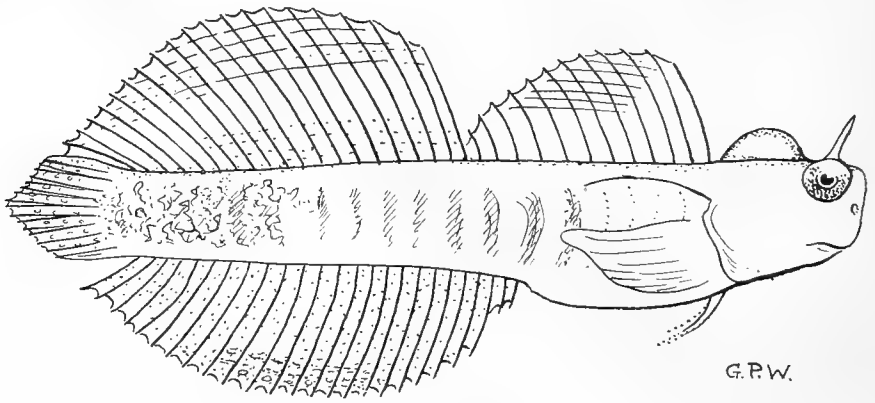



Fig. 10. Blenny, *Istiblennius mulleri*. Holotype in Stuttgart Museum. G. P. Whitley, del.

D., 12/20; A., 2 + 23-24; height, 8; head, 5½ in total length; eye, 3 or rather more, in head.

Fairly long but low, roundly curved crest on the nape. Orbital cirrhus simple, shorter than eye. Profile of head rectangular or the snout even slopes somewhat backwards. Upper lip entire. No canines. Dorsal fin deeply incised. First dorsal fin slightly lower than second, somewhat more than height of body and as high as the anal fin. Second dorsal fin united to caudal, rounded behind. Anal fin free from caudal, with two short rays anteriorly.

Colour brownish; in the middle part of the body are numerous, dark-margined, small crossbands, which do not reach the back or belly; posteriorly they become indefinitely wavy and reticulated. Body anteriorly with pale blue cross-stripes which are bent with the convex side forwards. Abdomen and sides of thorax colourless in all the vicinity of the pectorals. Head without any particular markings. Nuchal crest with black margin.

Both dorsal fins with numerous oblique (bluish ?) brown marginal stripes, which, however, are missing in the middle of the height of the second dorsal fin. Anal fin only towards the margin with fine azure blue dots or little streaks, about four above one another, otherwise uniformly dusky. Pectoral and ventral fins unicoloured. Caudal fin with numerous white (or blue ?) dots. The colour markings have now almost faded from the type-specimen so have been largely restored in my figure. Length about 72 mm. or $2\frac{3}{4}$ inches.

Family ALEUTERIDAE.

Genus NAVODON Whitley, 1930.

NAVODON AUSTRALIS (Donovan).

*Balistes australis* Donovan, Nat. Repos., iii., May 1, 1824, pl. lxxvi. Van Dieman's Land.

*Navodon australis* Whitley, Rec. Austr. Mus., xviii., 1931, p. 123 (refs.).
D., i/37; A., 36; P., 13; C., 10 branched rays.

Head (74 mm.) 3.6, depth at origins of dorsal and anal fins (90) 3 in standard length (270). Eye, 18 mm.; snout, 57; gill-opening, 24; first dorsal spine, 52; interdorsal space, 79; interorbital, 22; pectoral, 20; depth of caudal peduncle, 32.

Upper profile notched before eye, not so steep as the more rounded lower profile. Teeth compressed, alternately large and small; pointed in upper jaw and incisor in lower.

Eye large, below dorsal spine, and over gill-opening.

Form elongate oval, strongly compressed. Head and body covered with a rough shagreen of small irregularly shaped denticles or spine-like papillae in close-set groups, to which debris becomes attached.

The shagreen is very coarse on caudal peduncle, but does not form a patch of setae or brush, nor are there any hooks or dermal filaments. Pubic spine obsolete. Vent large.

Dorsal spine elongate, smooth on posterior surface, very spinulose anteriorly, the spines resolving themselves into four main rows.

Soft dorsal and anal fins similar, the anal base a little further back; no perforated membranes. Pectorals small, rounded. Ventrals none. Caudal gently convexly rounded. No produced fin-rays.

General colour dark smoky-grey, fairly uniform. A few very indistinct light milky patches above anal base.

Teeth dirty white, the middle of each tooth grey and its tip brownish-yellow. Eye blue with pale yellowish iris and surrounded by a whitish ring. Gill-opening and fins pale greenish-white on membranes and rays, except the caudal rays which are smoky.

Described from a specimen 270 mm. in standard length or 1 foot $0\frac{5}{8}$ in. overall.

*Locality.*—Trawled between Point Perpendicular and Wreck Bay, N.S.W., in 30 to 40 fathoms in November, 1941, by Mr. William Barnes aboard the "Barraconda."

New record for N.S. Wales.

# A BASIC LIST OF THE FRESH WATER MOLLUSCA OF AUSTRALIA.

By Tom Iredale.

*(Contribution from The Australian Museum, Sydney, N.S.W.)*

This was prepared as a necessary sequel to the Basic List of the Land Mollusca, which has appeared in this Journal. It was found that so little was known, and the problems so intricate that it was placed on one side, but recently the danger of Schistosomiasis has urged its publication. It is a very Basic List, as studies suggest many additions, and probably also many emendations. There is probably no group of which the members show so much variation, the causes of which are at present inexplicable. In Europe and America, where very intensive study has taken place, there seems little finality as to species and genera, so that our ignorance may be excusable.

Sixty years ago, E. A. Smith, of the British Museum, furnished the first list in the Journal of the Linnean Society of London (Zool., Vol. xvi., pp. 255-317, pls. v.-vii.). The paper was read on April 21, 1881, but not published until April 6, 1882. In the meanwhile, ignorant of their English friend's action, Tate and Brazier issued a Check List in the Linnean Society of New South Wales' Proceedings (Vol. vi., pp. 552-569), which appeared in December, 1881. The latter was purely a compilation without "critical remarks of our own," and consequently produced no novelties. In Smith's essay, on the other hand, many new species were introduced and figured, and a critical review as far as possible prepared. Ignorant of local conditions, and with little material, such an excellent list was prepared that no other has since appeared. Yet a number of papers has appeared in recent years dealing with local states by local workers, so that there is a large series of illustrations to refer to. Hedley reported upon the "Victorian species of *Bullinus*" (Rec. Austr. Mus., Vol. xii., pp. 1-8, pls. i.-ii., December 19th, 1917), and Gabriel has listed the whole of the fresh water mollusca of Victoria (Mem. Nat. Mus. Melb., No. 11, pp. 100-139, pls. i.-iii., November, 1939). May criticised the numerous species that had been described from Tasmania by those energetic workers, Tenison-Woods, Petterd and Johnston, in the Papers Proc. Roy. Soc. Tasm., 1920, pp. 65-75, pls. ix.-xii., September 14, 1920. [It may be here noted that to E. A. Smith, Tasmania was not Australia, and Tasmanian species were not included in his account.] Cotton and Godfrey listed the South Australian species (South Austr. Nat., Vol. xiii., pp. 156-165, pls. 2 and 3, August, 1932), and Cotton has since reviewed some members (Trans. Roy. Soc. South Austr., Vol. 66, pp. 75-82, pls. i.-ii., July 31, 1942), and also reported upon the Viviparidae of Australia, and suggests he will continue. I have to thank Mr. Cotton for study of a long series of South Australian forms, with the hope that we would together contribute an account, but pressure of other work has delayed that task, and I am very glad Mr. Cotton is doing it. I prepared an account of the Fresh Water Mussels of Australia, which has appeared in this Journal, Vol. viii., pp. 57-78, pls. iii.-vi., May 9, 1934. The present essay hopes to bring all these papers into review along with species from Northern Australia and Queensland not yet listed.

The first necessity is a knowledge of the river systems of Australia as these molluscs are more or less tied down to these factors. So far all the recent acquisitions have confirmed the broad lines Whitley and I laid down in a short paper, "The Fluvifaunulae of Australia" (South Aust. Nat., Vol.

xviii., pp. 64-68, April 30, 1938), including a map. The map requires a little re-drafting in a few details, but on the whole it shows the basis of our fresh water faunulae pretty well. In that place the Leichhardtian Fluvifaunula was that inhabiting the rivers of the Northern Territory from Port Essington eastwards and Queensland, west of Torres Straits. Unfortunately the dotted line showing these limits is drawn from Derby to the Roper River, a palpable and unforgivable error. The Greyian Fluvifaunula, inhabiting the rivers of the Dampierian Sub-Area is little known as yet, and here the dotted line on the map starts at Shark's Bay, which is correct, but finishes at the De Grey River, instead of continuing up to, at least, Wyndham. The Vlaminghian Fluvifaunula is that of the Leeuwinian Area, the south-west of Western Australia, while the Sturtian Fluvifaunula inhabits the rivers and lakes of the Centralian or Larapintine Area. The Mitchellian Fluvifaunula is that of the Darling, Murrumbidgee, Murray and their tributaries and the river captures of South Eastern Queensland. The Lessonian Fluvifaunula is restricted to the rivers of Eastern New South Wales, Victoria and North Tasmania, while the Tobinian Fluvifaunula is known only from the southern portion of the Maugean Sub-Area. The Krefftian Fluvifaunula practically occupies the rivers of the Oxleyan Sub-Area, while the Jardinean Fluvifaunula is named for the Torresian portion of the Solanderian Sub-Area. These names are preferable to State names as they really determine zoological areas, while two or three zoological areas may occur in one State. By observing these fluvifaunal limits possibility of error is much decreased, and we do not record named species for localities, wherein they could not occur, as, for instance, "Sydney and the Swan River," "St. Margarets, South Australia and Cardwell, North Queensland," etc., etc.

## Class Pelecypoda.

The bivalve molluscs of fresh water are mainly referable to three series, the so-called fresh water mussels and the small Corbiculids and peashells. The former were listed and illustrated in this Journal (Vol. viii., pp. 57-78, pls. iii.-vi., May 9, 1934), where full references were given. In the intervening years much additional material has been acquired, fully confirming the classification there proposed. To save space the details of the paper will not be here repeated, but the summary at the end is reprinted for convenience in connection with the following notes.

### Family Propehyridellidae.

As suggested this family may be polyphyletic, but until intensive research is undertaken on this group, the name may be tentatively utilised.

### Subfamily Velesunionae.

In this subfamily the beaks are smooth, and the shells vary in size from about 50 mm. to 170 mm. or over in length.

*Velesunio balonnensis* Conrad. Type locality, Balonne River, N.S.W., a tributary of the Darling River system. Richmond River provided a subspecies, *V. b. adjunctus,* and specimens from Rockhampton, Queensland, were also regarded as a subspecies, *V. b. intricatus.* These may prove to be distinct species.

*Velesunio danellii* Villa = *jeffreysianus* Lea, is the south Victorian species, but this appears to be living in the Irrigation Area of New South Wales.

*Velesunio shuttleworthi* Kuster = *vittatus* Lea = *moretonicus* Reeve = *legrandi* Petterd, lives only in the northern rivers of Tasmania, no mussels occurring in the southern portion of that island.

*Velesunio evansi* A. Adams and Angas, is the South Australian species.

*Westralunio ambiguus* Philippi is the Western Australian representative of the Eastern *Velesunio*. It was renamed *philippianus* by Kuster, and the type locality is King George's Sound, a subspecies being named *W. a. carteri* from the Perth district.

*Alathyria profuga* Gould, was named from the Hunter River, a coastal river, but the large species referred to the genus *Alathyria* are more common in the Darling River system, the species living there being named

*Alathyria jacksoni* Iredale, while a third species,

*Alathyria pertexta* Iredale, occurs in the mid and south Queensland rivers.

*Centralhyria stuarti* A. Adams and Angas, occurs in northern South Australia, while

*Centralhyria wilsonii* Lea, described from coastal mid-Queensland, apparently ranges across tropical Australia, a subspecies, *C. w. caurina*, being named from May River, north-west Australia.

*Centralhyria* (or better, *Aparcthyria*) *angasi* Sowerby, occurs northward of the preceding, the type locality being the Strangway River, a tributary of the Roper River, a subspecies, *C. a. subjecta*, being named from the "Membridge River."

*Centralhyria bednalli* Tate, was described from the River Adelaide, at the ford, Northern Territory, and is at present unrecognised nor figured.

*Hyridunio australis* Lamarck, is determined as a local Sydney species, with a subspecies, *H. a. orion*, from Victoria, and another, *H. a. drapeta*, from the Brisbane River, Queensland.

*Hyridunio renutus* Iredale, is a Gippsland, Victoria, species.

Subfamily LORTIELLINAE.

*Lortiella rugata* Sowerby, from the Victoria River, Northern Territory, and *Lortiella froggatti* Iredale, from the Lennard River, North-west Australia.

Subfamily PROPEHYRIDELLINAE.

*Rugoshyria depressa* Lamarck = *mutabilis* Lea = *paramattensis* Lea, from New South Wales, with three subspecies in the south, *R. d. monticola* from Mount Kosciusko, *R. d. vicinalis* from Gippsland, Victoria, and *R. d. sodalis* from Tasmania.

*R. interserta* Iredale, replaces this in mid-Queensland, and a different species, *R. aquilonalis* Iredale, lives in North Queensland (mayhap a distinct genus).

*R. cultelliformis* Conrad, occurs inland in northern New South Wales.

*Propehyridella nepeanensis* Conrad = *dorsuosus* Gould = *lessoni* Kuster, lives in mid-New South Wales, *P. n. opportuna* being a larger form in the north of the State, and *P. n. narracanensis* Cotton & Gabriel, replaces it in eastern Victoria.

*P. glenelgensis* Dennant, a very curious shell, occurs in western Victoria.

Subfamily CUCUMERUNIONAE.

*Cucumerunio novaehollandiae* Gray = *cucumoides* Lea = *cumingianus* Dunker, a magnificent shell, inhabits northern New South Wales and South Queensland. Since this appeared, Mr. Melbourne Ward, interested in fresh water crustacea, asked his correspondents to collect fresh water mussels at the same time, and he has presented a series to the Museum. These have proved very interesting, as they confirm all the propositions above cited. Thus from Deniliquin, N.S.W., on the Murray River system, the shells are *Velesunio evansi.* From Narrandera (Murrumbidgee River), New South Wales specimens of a large thick *Alathyria* simulating *profuga* rather than *jacksoni,* and from Condobolin (Lachlan River), N.S.W., large specimens like *jacksoni* are accompanied by shells like the Narrandera form, suggesting a distinct species.

From places on the Darling River system shells of *Velesunio* are of the *balonnensis* type, but similar specimens came from Charleville, Queensland, an unexpected locality, but the map showed that the Warrego River, a tributary of the Darling, reached to that locality.

However, from Wenlock Downs, Batavia River (flowing into Gulf), North Queensland, an *Aparcthyria* of small regular shape, black outside, blue internally, with long slender typical teeth. The shell measures 59 mm. by 37 mm. by 23 mm., smaller, more swollen, anterior end more pronounced than in *angasi,* and may be named *A. hemesa* sp. nov. Among aboriginal material from Cape York came large mussels (worked) in size recalling *Alathyria,* and specimens from Einasleigh River, North Queensland, provide the solution. The shell is large, measuring 120 mm. in length by 64 mm. in height and 46 mm. depth of conjoined valves. While similar to *Alathyria* the shell is notably winged, attenuate posteriorly, and has a distinct concentric sculpture, which develops frilling marginad, more strongly developed posteriorly. A larger specimen reaches 135 mm. by 75 mm. by 45 mm., the sculpture even stronger. The teeth are comparatively delicate, the pseudo cardinals small, elongate, decreasing with age, as also do the long slender laterals. The muscle scars are lightly impressed, the protractor pedis small elongate, the anterior p.p. fused.

This may be designated *Quaesithyria wardi* gen. et sp. nov., the type of the genus. A second species was collected by Dr. H. Flecker, in the Hodgkinson River North Queensland, and agrees generally, but is smaller, 90 mm. by 45 mm. by 25 mm., and differs in lacking the frilling, though concentric sculpture is present. In form, the wing is less elevated, and the ventral line is straight, and this may be called *Quaesithyria fleckeri* sp. nov.

Mr. Melbourne Ward also collected a series near Darwin, Northern Territory, showing slight differences in each locality. Thus, from Holmes Creek, 12 miles north-east of Darwin, two sets are seen, one from one pond being large, 75 mm. by 44 mm., thin, not much eroded, rather strongly winged, ventral border curved, while from another pool the shells are much smaller, 60 mm. by 37 mm., more solid, more eroded, not so much winged, and ventral border straight. From Bankier's Jungle Creek, Koolpinyal Station, 30 miles inland from Darwin, the shells are small, stout, eroded, the posterior side rather sharply truncate, thus giving it quite a different appearance from the preceding in form, and recalling the figure of the missing Membridge River form; it measures 48 mm. by 30 mm. From Howard Creek, on the same station, the shells are small, largest 55 mm. by 30 mm., but elongate, the posterior end not truncate, and looking quite

different. From Lake Deane, 40-45 miles from Darwin, large shells were found, 75 mm. by 44 mm., similar to the first one mentioned. I conclude these are all merely ecologic variations of the one species, which may be called *Aparcthyria inspecta* sp. nov., the type being the large Holmes Creek shell, as they all differ from *A. angasi* in their more pronounced winging.

Nearer Sydney, Elkington Allen has been studying these molluscs, and has collected some interesting species, finding very large *Propehyridella nepeanensis* in the Woronora River, exceeding the size of the Richmond River form, and at Dubbo he collected very large *Alathyria jacksoni,* reaching 170 mm. by 92 mm., thus confirming the early explorers, who reported "Mussels over six inches in length were met with in these rivers." This shows what a lot there is to be done in this group alone.

### Family GELOINIDAE.

This family has been commonly called Cyrenidae, the Lamarckian name *Cyrena* being used for the large subcircular brackish water black molluscs, but it has now been rated as a synonym of *Corbicula.* Tate and Brazier listed a dozen names, but Hedley only recognised two, one *Cyrena* and one *Batissa* in his Marine Mollusca of Queensland. None is really a fresh water mollusc, but specimens commonly occur in fresh water rivers, but only within the range of tidal influence. Thus the two listed by Hedley were abundant up the Daintree River at the Dairy Factory, where the water is absolutely fresh, while they also lived in the mangroves at Low Isles, where the water is always salt, and there appeared not the slightest difference in the shells. Though Deshayes described three species from Australia, and Prime, Mousson and Sowerby one each, Hedley lumped them all under the Cingalese name *coaxans* Gmelin. Prashad had used Solander's name *erosa,* in preference to Gmelin's name, but that is certainly incorrect. In the Portland Catalogue, p. 186, ante April 24, 1786, is printed—

"Lot 3961. Venus Erosa S., a very curious undescribed species of fresh water bivale (sic), with a black epidermis, and fine purple inside, the country unknown, very rare."

Humphrey, Museum Calonnianum, p. 59, May, 1797, added "Genus Capsa. 1089. Violacea. New South Wales. Venus Erosa Soland. Extremely scarce. M.P. 3961."

If this entry were to be accepted, it obviously refers to a *Batissa,* as no *Geloina* (= *Cyrena*) is purple inside, but pure white, while the *Batissa* is characterised by that coloration. Both the *Geloina* and *Batissa* occurred together at the Daintree River, which is not far from Cooktown, the only place in Queensland (= New South Wales in 1797), where Cook's party might have met with these molluscs.

### Family CORBICULIDAE.

This family includes all the small fresh water bivalves gregariously met with, and at present all the Australian species are referred to the one genus *Corbiculina,* but there appears to be evidence of more than one, but the matter cannot be discussed here.

### Genus CORBICULINA.

1903. *Corbiculina* Dall, Trans. Wagner Free Inst. Sci., Philad., Vol. iii., p. 1449, October. Orthotype, *Corbicula angasi* Prime.

CORBICULINA ANGASI.

1864. *Corbicula angasi* Prime, Journ. de Conch., Vol. xii., p. 151, pl. vii., fig. 6, April 1. River Murray, South Australia.

1877. *Corbicula rivina* Clessin, Syst. Conch. Cab. (Martini & Chemnitz), ed. Kuster, Bd. ix., Abth. iii., p. 139, pl. 25, figs. 3, 4. Murray River, Australia.

CORBICULINA AUSTRALIS.

1830. *Cyrena australis* Deshayes, Ency. Meth. Vers, Vol. ii., p. 50, sign G, ex Lesson. New Holland = Nepean River, N.S.W.

1831. *Cyclas nepeanensis* Lesson, Voy. Coquille, Zool., Vol. ii., p. 428; Atlas, Moll., pl. xiii., fig. 14. Nepean River, N.S.W. Refigd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 300, pl. vii., figs. 26-27, 1882.

CORBICULINA DEBILIS.

1850. *Cyrena debilis* Gould, Proc. Bost. Soc. Nat. Hist., Vol. iii., p. 293 (dated November), New Holland ? =. Figd. U.S. Expl. Exped., Vol. xii., p. 427, pl. xxxvi., fig. 529, a-b, 1852. = Hunter River, N.S.W.

1882. *Corbicula sublaevigata* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 304, pl. vii., figs. 30-31, April 6. Lochinvar (near Newcastle), Australia. (Dr. Sinclair, R.N.).

CORBICULINA FINKEANA, *sp. nov.*

1896. *Corbicula sublaevigata* Tate, Rep. Horn. Sci. Exped. Cent. Austr., pt. ii., Zool., p. 217, February. River Finke, Central Australia.

Subequilateral, anterior end shorter, pointed, posterior and well rounded. Sculpture weak but fairly regular grooving. Disagrees with Smith's figure and description of "Lochinvar" shell above cited.

CORBICULINA FABA.

1904. *Corbicula faba* Bullen, Proc. Malac. Soc. (Lond.), Vol. vi., p. 110, pl. vi., figs. 10-11, June 23. Richmond River, New South Wales.

CORBICULINA BARONIALIS.

1870. *Corbula baronialis* Prime, Ann. Lyc. Nat. Hist. New York, Vol. ix., p. 300, March; ex Amer. Journ. Conch., Vol. 5, pt. 2; appendix, p. 128, October 7, 1869, *nomen nudum*. Moreton Bay, Australia.

Not yet figured.

CORBICULINA MINOR.

1861. *Corbicula minor* Prime, Proc. Acad. Nat. Sci. Philad., 1861, p. 127, September 30. Hab. ? Figd. Ann. Lyc. Nat. Hist. New York, Vol. viii., p. 80, fig. 29, 1864. New Holland.

This name has been used for any small form, but should be rejected entirely, as the figure is exactly indeterminable without accurate locality.]

CORBICULINA PROLONGATA.

1861. *Corbicula prolongata* Prime, Journ. de Conch, Vol. ix., p. 356, October 1. Figd., Vol. x., p. 389, pl. xiv., fig. 6, October 1, 1862. Australia = Wide Bay, Queensland, fide Smith.

CORBICULINA OVALINA.

1855. *Corbicula ovalina* Deshayes, Cat. Bivalve Shells Brit. Mus., pt. ii., p.

229, May 12, 1855; Proc. Zool. Soc. (Lond.), 1854, p. 343, May 16, 1855. Port Essington, Australia. Figd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 299, pl. vii., figs. 24-25, 1882.

At the same place, p. 230, Deshayes described *C. semisulcata,* as from "Victoria River, New Holland," but Prime, and also Smith, stated the shells came from South America, and Smith described the succeeding species.

CORBICULINA DESHAYESII.

1882. *Corbicula deshayesii* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 303, pl. vii., figs. 28-29, April 6. Victoria River, North Australia.

CORBICULINA MUSSONI, *sp. nov.*

A large series of shells collected by Musson at Narrabri, Namoi River, was separated into sets and given various names, smallest, *minor,* oval ones, *ovalina,* others *nepeanensis,* but the whole series differs from *australis* in form, being comparatively deeper, less oval, ribbing coarser, and are nearer *angasi,* but have the ribs more distant than in that species. The type measures 25 mm. long by 19 mm. high.

CORBICULINA SEMARA, *sp. nov.*

Many specimens have been collected in North Queensland, which are all small, oval, and rather regularly distantly grooved, the type from the Burdekin River measuring 15 mm. long by 12 mm. high. Another series from further north are less oval, the ends less rounded, the hinge line more arched, and especially have close fine grooving. The type from the Barron River (above the Falls), North Queensland, may be called *C. aramita* sp. nov., the shell measuring 12 mm. long by 10 mm. high.

CORBICULINA PERMENA, *sp. nov.*

While attempting to include all local shells under *"nepeanensis"* there was much difficulty, and Yass specimens differed at sight, being equilateral with sloping sides, measuring 18 mm. by 15.5 mm. by 10 mm., and the sculpture was more defined and the ribs closer together. These should be nearer *angasi,* but the sculpture is finer, and the form is more trigonal.

CORBICULINA DESOLATA.

1887. *Corbicula desolata* Tate, Trans. Roy. Soc. South Austr., Vol. ix., p. 67, pl. iv., figs. 11 a-b., March. (Separates issued, ante December 29, 1886.) Cooper's Creek, Innamincka, Central Australia.

CORBICULINA MAROUBRA, *sp. nov.*

Mr. G. P. Whitley collected a strange valve on the sand at Maroubra, N.S.W., and later many, including freshly dead specimens, of a very distinct species. It is very trigonal, thick, with heavy concentric ribs, measuring 20 mm. long by 19 mm. high. It is covered with a very dark brown periostracum, and at every stage differs from any form of *australis.* It suggests that there may be more than one form of *Corbiculina,* as the hinge in this one is strongly arched, almost angulate, quite unlike the gentle slope of true *Corbiculina.*

CORBICULINA ESCULENTA, *sp. nov.*

Specimens from Armidale, north New South Wales, differed slightly from *australis,* but a series just received from Mrs. Consett Davis, collected at the Blue Hole, apparently reach a very large size, the type measuring 30

mm. by 22 mm. The anterior end is produced almost angulately, and the posterior is also produced, the ventral margin curved, and the sculpture regular fine grooving, the hinge line long, the teeth well spread, the cardinals very stout.

### Family SPHAERIIDAE.

The small bivalves referred to this family apparently constitute a study in themselves, as after a book had been written about the British species, seventeen in number, a few years later a long article was published explaining how to determine them. Analogically, it may take a century to discriminate the Australian forms. However, the extralimital experts have stated that our species are not referable to the original genera, and even suggested they may not belong to the family. The most we can do at present is to catalogue the species geographically, and hope some one will later undertake the elucidation of the group. European students separate two large groups, *Sphaerium* sensu latissimo, with two siphons, and *Pisidium*, sensu latissimo, with only one siphon. The shell characters differentiating each need careful criticism, though really the appearance is commonly sufficient to separate them.

### Genus SPHAERINOVA, *gen. nov.*

Type, *Sphaerium macgillivrayi* Smith.

The hinge is much weaker, the teeth disagreeing with those of the type of *Sphaerium*, the cardinals small, and the laterals delicate, recalling somewhat a degenerate *Pisidium* hinge line.

#### SPHAERINOVA MACGILLIVRAYI.

1882. *Sphaerium macgillivrayi* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 305, pl. vii., fig. 34, April 6. Penrith, New South Wales (Macgillivray).

#### SPHAERINOVA TATIARAE.

1938. *Sphaerium tatiarae* Cotton & Godfrey, Molluscs South Australia, Pt. I., Pelecypoda, p. 178, fig. 181 in text, March. Tatiara Creek, Bordertown, South Australia.

Gabriel has figured and described the Victorian representative (Memoirs. Nat. Mus. Melb., No. 11, p. 127, pl. iv., fig. 35, November, 1939) under the name *Sphaerium tasmanicum* Ten.-Woods, with which he synonymised *S. macgillivrayi*. As the Victorian shell is obviously neither of these distinct species, it may be called *Sphaerinova victoriana* sp. nov., Tarraville being the type locality. May separated the species from the Great Lake, Tasmania, as *macgillivrayi*, restricting *tasmanicum* to the low land southern species. May's illustration (Illus. Index Tasm. Shells, pl. ix., fig. 8, 1923) is unlike the northern shell, and is here named *Sphaerinova lacusedes* sp. nov. Specimens from Nundle, northern New South Wales, also differ from topotypes in their more elongate form, anteriorly produced, posteriorly truncate, growth lines obsolescent, and are separated as *Sphaerinova nundinalis* sp. nov., the type measuring 7.5 mm. by 5.5 mm.

#### SPHAERINOVA TASMANICA.

1876. *Cyclas tasmanica* Tenison-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 82, March 21, 1876. Swansea, east coast Tasmania. Figd. May, Papers Proc. Roy. Soc. Tasm., 1920, p. 68, pl. ix., fig. 1, September 14, 1920.

1879. *Calyculina tasmaniae* Clessin, Syst. Conch. Cab. (Martini & Chemnitz) ed. Kuster, Band ix., Abth. iii., p. 261, pl. 41, figs. 1-2. Tasmania.

SPHAERINOVA QUEENSLANDICA.

1882. *Sphaerium queenslandicum* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 305, pl. vii., fig. 33, April 6. Limestone Creek, Burdekin River, Queensland.

SPHAERINOVA TRANSLUCIDA.

1876. *Sphaerium translucidum* Sowerby, Conch. Icon. (Reeve), Vol. xx., pl. v., fig. 46. Palmtree Creek, Australia. Refigd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 305, pl. vii., fig. 32, April 6, 1882.

SPHAERINOVA PROBLEMATICA.

1939. *Sphaerium problematicum* Gabriel, Mem. Nat. Mus. Melb., No. 11, p. 128, pl. iv., figs. 36, a-b, November. Murray River, Victoria.

Genus AUSTRALPERA, *nov.*

Type, *Pisidium etheridgii* Smith.

The characteristic external ligament of *Pisidium* is missing here, and the teeth are so unlike that they have been suggested as of Lasaeid relationship, while the shell is fragile, unlike the northern forms.

AUSTRALPERA ETHERIDGII.

1882. *Pisidium etheridgii* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 306, pl. vii., fig. 35, April 6. Yau Yean (sic) Reservoir, Plenty District, Victoria.

The South Australian shells seem inseparable, though Cotton's figure looks different, but those from New South Wales are larger, deeper, the anterior end shorter, and the sculpture more pronounced, and may be named *A. bradena* sp. nov., the type from Braidwood, N.S.W., measuring 9 mm. long by 7 mm. high.

AUSTRALPERA TASMANICA.

1876. *Pisidium tasmanicum* Tenison-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 81, March 21, 1876. Brown's River, Tasmania. Figd. May, Papers Proc. Roy. Soc. Tasm., 1920, p. 68, pl. ix., fig. 3, September 14.

AUSTRALPERA (?) DULVERTONENSIS.

1876. *Pisidium dulvertonensis* Tenison-Woods, Papers, Proc. Roy. Soc. Tasm., 1875, p. 82, March 21, 1876. Lake Dulverton, Tasmania. Figd. May, Papers Proc. Roy. Soc. Tasm., 1920, p. 68, pl. ix., fig. 2, September 14 (type). Transferred to *Sphaerium,* May, Illus. Index Tasm. Shells, pl. ix., fig. 7, 1923.

Note:—There is something wrong here, as May's figure of "type" does not agree at all with Tenison-Woods' description.

AUSTRALPERA SEMEN.

1843. *Pisidium semen* Menke, Moll. Nov. Holl. Spec., p. 40, April. West Australia.

Note:—Hedley dredged a small shell, measuring 3 mm. by 2½ mm. from 35 feet, Blue Lake, Mount Kosciusko, recalling May's illustration of *tasmanica* above cited, but, of course, deeper, and with strong concentric ridges

and heavier teeth in the hinge. It is better referable to a new genus to be called *Glacipisum kosciusko* gen. and sp. nov.

Family Neritidae.

Smith reported "Genus *Neritina*. Of this genus, as far as I can ascertain, only two species undoubtedly live in fresh water, namely, *N. crepidularia* and *N. pulligera*. The former he recorded "Inlet next to Percival Bay, fresh water" (Dr. Richardson); "swamp two miles north of Cardwell, Queensland (Brazier)," while, for the latter, he accepted *N. pulligera* var. *sulcata* Ten.-Woods. "In the mountain streams of the Bellenden-Ker ranges, North Queensland." Nine other species were named as being recorded, but these are all rejected as marine, though possibly some may occur in fresh water under tidal influence. It would also be wise to reject the two named by Smith above as though specimens have been found in fresh water, these only occur under circumstances showing their marine association. Two species of so-called *"crepidularia"* occur in brackish and fresh water adjacent in Queensland, and the *sulcata* Ten.-Woods, was probably also collected in a similar place. Thus I collected a shell in a fresh water rill on a hillside running into the Daintree River, many miles from the mouth, but the river was still under tidal influence. So far no species has been found living away from rivers subject to tidal influence.

Family Viviparidae.

The members of this family have been recently listed by Cotton (Rec. South Austr. Mus., Vol. v., pp. 339-344, September 30, 1935, and also in the Vict. Nat., Vol. lii., p. 97, text fig., October, 1935), so there is little to comment on. Cotton introduced two new generic names, *Notopala* and *Centrapala,* but the famous Indian authority on fresh water molluscs, Prashad, had discussed "Recent and Fossil Viviparidae. A Study in Distribution, Evolution and Palaeogeography" (Mem. Indian Mus., Vol. viii., pp. 153-251, February, 1928). Therein Prashad suggested independent evolution of the Australian forms, and distinguished three groups (p. 178), thus "Vivipari Sublineata Group," including *sublineata* Conrad, *intermedia* Reeve, and *alisoni* Brazier; "Vivipari Ampullaroides Group," with *V. ampullaroides* Reeve, *waterhousei* Ad. & Ang., *kingi* Ad. & Ang., *tricinctus* Smith, and *dimidiatus* Smith; and the *"Larina"* group, an estuarine series, including the Cingalese *Robinsonia* and the Papuan *Glaucostracia.* Cotton proposed *Notopala,* with *hanleyi* Frauenfeld as type, for use for the whole series, except the lirate Centralian form, and *Larina.* Prashad would separate the northern series, the name *Notopala* belonging to the *sublineata* series. It may be as well to arrange our shells in that manner, and instead of the clumsy group serial name use a subgeneric name *Notopalena* nov., with *essingtonensis* Frauenfeld, as type. Although Prashad regarded *Larina* as an estuarine group, Hedley many years ago pointed out that it was truly a fresh water mollusc. *Robinsonia* does not appear a close ally, and *Glaucostracia,* though closer geographically, has also a distinct appearance.

Genus Notopala.

1935. *Notopala* Cotton, Rec. South Austr. Mus., Vol. v., p. 339, September 30. Orthotype, *Paludina hanleyi* Frauenfeld.

Notopala hanleyi.

1864. *Paludina hanleyi* Frauenfeld, Verhandl. k.k. zool. bot. Gesellsch. Wien., 1864, Bd. xiv., p. 612. New name for

1863. *Paludina intermedia* Reeve, Conch. Icon., Vol. xiv., pl. ix., sp. 57, April, ex Hanley MS. Hab.? Not *P. intermedia* Melleville, Ann. Sci. Geol. ii., 1843, p. 96 (C.D.S.).

1865. *Paludina (Vivipara) purpurea* Martens, Malak. Blätter, Vol. xii., p. 150, August ?. Australia = Murray River, December, 1865 (Krefft), see A.M.N.H., Ser. 3, Vol. xvi., p. 428.

1935. *Notopala hanleyi* Cotton, Vict. Naturalist, Vol. lii., p. 97, text fig., October.

NOTOPALA SUBLINEATA.

1850. *Paludina sublineata* Conrad, Proc. Acad. Nat. Sci. Philad., Vol. v., p. 11, February. Darling River, Australia. Figd. Amer. Journ. Conch., Vol. ii., p. 79, pl. i., fig. 8, January 1, 1866.

1865. *Paludina polita* Martens, Ann. Mag. Nat. Hist., Ser. 13, Vol. xvi., p. 256, October. Not *Vivipara polita* Frauenfeld, Verh. k.k. zool. bot. Ges. (Wien.), 1862, p. 1163. Balonne River.

1935. *Notopala gatliffi* Cotton, Vict. Naturalist, Vol. lii., p. 97, October. New name for *polita* Martens, preoccupied.

NOTOPALA ALISONI.

1879. *Vivipara alisoni* Brazier, Proc. Linn. Soc. N.S.W., Vol. iii., p. 221 (February). Diamantina River, Queensland.

Subgenus NOTOPALENA.

NOTOPALA ESSINGTONENSIS.

1862. *Paludina essingtonensis* Frauenfeld, Verh. k.k. zool. bot. Ges. (Wien.), 1862, p. 1162. Port Essington.

1863. *Paludina ampullaroides* Reeve, Conch. Icon., Vol. xiv., pl. vi., sp. 1, fig. 30, February, ex Hanley MS. Hab.?

1863. *Paludina australis* Reeve, Conch. Icon., Vol. xiv., pl. xi., sp. 71, April. Victoria River, North Australia (Dring). Not *Paludina australis* Orbigny, Mag. Zool., Vol. v., 1835, 30 (C.D.S.).

1865. *Paludina affinis* Martens, Ann. Mag. Nat. Hist., Ser. 3, Vol. xvi., p. 256, October 1. Fitzroy River and near Port Essington, North Australia. Not *Paludina affinis* Marcel de S., Journ. Phys., Vol. 87, 1818, p. 162 (C.D.S.).

1866. *Vivipara suprafasciata* Tryon, Amer. Journ. Conch., Vol. ii., p. 8, pl. ii., fig. 7, January 1. Tropical Australia.

NOTOPALA WATERHOUSII.

1864. *Vivipara waterhousii* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 414, April 20, 1864. Newcastle Waters, Arnheim's Land, North Australia. Figd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 261, pl. vii., fig. 14, 1882.

NOTOPALA BARRETTI.

1935. *Notopala barretti* Cotton, Vict. Naturalist, Vol. lii., p. 97, fig. 5, October. Innamincka, Cooper's Creek, South Australia. Figd. Sanger, American Naturalist, Vol. xvii., p. 1184, November, 1883, in text.

NOTOPALA KINGI.

1864. *Vivipara kingi* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p.

415, April 20, 1864. King's Ponds, Arnheim's Land. Figd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 264, pl. viii., fig. 15, 1882.

NOTOPALA TRICINCTA.

1882. *Vivipara tricincta* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 265, pl. vii., fig. 16, April 6. North Australia (J. R. Elsey).

NOTOPALA DIMIDIATA.

1882. *Vivipara dimidiata* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 265, pl. vii., fig. 17, April 6. Victoria River, North Australia (J. R. Elsey).

Probably these last three are based on normal variations only.

Genus CENTRAPALA.

1935. *Centrapala* Cotton, Rec. South Austr. Mus., Vol. v., p. 343, September 30. Orthotype, *Paludina lirata* Tate.

CENTRAPALA LIRATA.

1887. *Paludina lirata* Tate, Trans. Roy. Soc. South Aust., Vol. ix., p. 63, pl. iv., figs. 6 a-b, March (Seps. issued December 29, 1886). Cooper's Creek, Innamincka, Central Australia. Refigd. Cotton, at reference given above for *Centrapala*, figs. 19-20 in text.

Genus LARINA.

1855. *Larina* A. Adams, Proc. Zool. Soc. (Lond.), 1854, p. 41, January 10, 1855. Haplotype, *L. strangei* A. Adams. Not. *Larinus* Germar, Ins. spec. novae, I. 379, 1824 (Neave).

LARINA STRANGEI.

1855. *Larina strangei* A. Adams, Proc. Zool. Soc. (Lond.), 1854, p. 41, pl. xxvii., fig. 3, January 10, 1855. Moreton Bay, Queensland.

Probably the genus *Larina* should be renamed *Eularina* nov., but *Robinsonia* Neville, 1870, is undoubtedly invalidated by Grote, 1865 (Neave), and should be renamed, if this has not already taken place. Many years I wrote *Neclarina* in place, and perhaps this may come into use.

Family PALUDESTRINIDAE.

Comparatively recently, Thiele investigated some of these small fresh water molluscan forms, and built up a somewhat complex arrangement of families, subfamilies and "tribes." The "tribes" covered sufficiently distinct groups to be used in a more accurate grouping as families, but their limits seem too lax to be natural. From examination of the multitude of Australian and Tasmanian forms, it has been concluded that the only course for safety in determination is to use the smallest limits. It is well known that these fresh water molluscs show variation according to conditions, such as fast or slow water, acid or alkaline, about which we have, as yet, little data. Unfortunately this variation has been utilised to class together unrelated forms, and the tangle is not easy to unravel. The present account is merely an attempt to provide a basis for future work. Some of these small molluscs have been accused of carrying diseases, such as Schistosomiasis, and Sheep Fluke disease, but none of the many Australian forms has yet been accused. The reversion to *Bythinella* by Gabriel for our shells classed as *Potamopyrgus* is inexplicable, especially as Thiele has placed

these two genera in different groups. There can be no doubt that if our shells are not classed under *Potamopyrgus*, they must be placed in a new genus very closely allied, but not by any means can they be transferred to *Bythinella* or its vicinity.

Genus POTAMOPYRGUS.

1865. *Potamopyrgus* Stimpson, Amer. Journ. Conch., Vol. i., p. 53, February 15. Orthotype, *Amnicola corolla* Gould (New Zealand).

1891. *Huttonia* Johnston, Proc. Roy. Soc. Tasm., 1890, p. 90. New name for *Potamopyrgus* Hutton = Stimpson. Not *Huttonia* Cambridge, 1880, nor Kirk, 1882.

POTAMOPYRGUS NIGER.

1834. *Paludina nigra* Quoy & Gaimard, Voy. de l'Astrol, Zool., Vol. iii., p. 74, pl. 58, figs. 9-12. D'Entrecasteaux Channel, Tasmania.

1872. *Paludestrina legrandiana* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 698, May 2, 1872. New Norfolk, Tasmania. Figd. May, Papers Proc. Roy. Soc. Tasm., 1920, pl. xi., fig. 23.

1872. *Paludestrina wisemaniana* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 699, May 2, 1872. Hobart Town, Tasmania.

1876. *Bythinia unicarinata* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 76, March 21, 1876. Salmon Ponds, South Tasmania. Figd. May, loc. cit., p. 72, pl. xi., fig. 25.

1876. *Bythinia tasmanica* Ten.-Woods, loc. cit., p. 76, March 21, 1876. Tasmania. Figd. May, loc. cit., p. 72, pl. xi., fig. 26.

POTAMOPYRGUS PETTERDIANUS.

1875. *Amnicola petterdiana* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 19, April 27. Scottsdale, North Tasmania.

POTAMOPYRGUS LEGRANDI.

1876. *Bythinia legrandi* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 76, March 21, 1876. Brown's River, South Tasmania.

1879. *Bythinella exigua* Ten.-Woods, loc. cit., 1878, p. 71, February 24, 1879. New name for *legrandi* (the smallest Tasmanian species, 2 mm. x 1 mm.) on account of prior *legrandiana* Brazier. Not figured by May, Papers Proc. Roy. Soc. Tasm., 1920, pl. xi., fig. 24 (supposed type).

POTAMOPYRGUS BUCCINOIDES.

1834. *Paludina buccinoides* Quoy & Gaimard, Voy. de l'Astrol. Zool., Vol. iii., p. 175, pl. 58, figs. 13-15. Western Port, Victoria.

1878. *Bythinia victoriae* Tenison-Woods, Trans. Roy. Soc. Victoria, Vol. xiv., p. 65, March 14. Lake Connewarre. Figd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 270, pl. vii., fig. 20, 1882.

Genus RIVISESSOR, *nov.*

Type, *Hydrobia gunnii* Frauenfeld (auct.).

Differs from the preceding in form, in the operculum, and in minute details of the radula. If *Potamopyrgus* be not used, this name will be available, but this course is not recommended.

RIVISESSOR GUNNII.

1863. *Hydrobia gunnii* Frauenfeld, Verh. zool.-bot. Gesell. Wien., Vol. xiii., p. 1025. New Holland = Tasmania ex R. Gunn. Figd. id. ib., Vol. xv., p. 526, pl. 7, figs. —, 1865. Refigd. Hedley, Proc. Linn. Soc. N.S.W., 1913, p. 283, pl. 17, fig. 51.

1875. *Amnicola simsoniana* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 19, April 27. Brighton, Hobart (A. Simson). Figd. Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 72, pl. ii., fig. 5, 1889.

1876. *Bythinia pontvillensis* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 76, March 21, 1876. Brighton, Tasmania (A. Simson). Figd. May, loc. cit., 1920, p. 71, pl. xi., fig. 19.

RIVISESSOR TURBINATUS.

1889. *Hydrobia turbinata* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 77, pl. ii., fig. 3. River Styx, east coast Tasmania. Figd. May, loc. cit., 1920, pl. xii., fig. 30.

RIVISESSOR TASMANICUS.

1858. *Hydrobia tasmanica* Martens, Arch. Nat. (Wiegmann), Vol. 24, pt. i., p. 85, pl. v., fig. 12. Tasmania.

1865. *Amnicola diemense* Frauenfeld, Verh. Zool. Bot. Ges. Wien., Vol. xv., p. 529, pl. x., two figs. No locality = Tasmania.

1876. *Bythinia dulvertonensis* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 77, March 21, 1876. Lake Dulverton, Tasmania. Figd. Petterd, loc. cit., 1888, p. 71, pl. i., fig. 12, 1889. Refigd. May, loc. cit., 1920, p. 72, pl. xii., fig. 28.

1889. *Potamopyrgus woodsii* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 71, pl. i., fig. 12. South Esk River, N. Tasmania.

RIVISESSOR BROWNII.

1889. *Potamopyrgus brownii* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 72, pl. iii., fig. 14. St. Paul's River, north coast Tasmania. Figd. May, loc. cit., 1920, p. 71, pl. x., fig. 17.

RIVISESSOR PATTISONI.

1942. *Bythinella pattisoni* Cotton, Trans. Roy. Soc. South Austr., Vol. 66, p. 81, "fig. 1" = pl. i., figs. 5, 6, 7, July 31. River Torrens, South Australia.

Genus PUPIPHRYX, *nov.*

Type, *Bithynia dyeriana* Petterd.

The species of this group differ from the preceding in their smaller size, pupoid form, with the operculum paucispiral, the nucleus somewhat distant from the edge, not like that of *Potamopyrgus*.

PUPIPHRYX DYERIANA.

1879. *Bithynia dyeriana* Petterd, Journ. Conch. (Leeds), Vol. ii., p. 86, March. Long Bay, North Tasmania. Figd. May, Papers Proc. Roy. Soc. Tasm., 1920, p. 71, pl. x., fig. 18.

PUPIPHRYX SMITHII.

1889. *Potamopyrgus smithii* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p.

72, pl. i., fig. 10. Heazlewood River, N.W. Tasmania. Figd. May, loc. cit., p. 72, pl. xi., fig. 27.

PUPIPHRYX ELONGATA.

1920. *Potamopyrgus elongatus* May, Papers Proc. Roy. Soc. Tasm., 1920, p. 72, pl. xi., fig. 21, September 14. Apsley River, near Bicheno, east coast Tasmania.

PUPIPHRYX DUNROBINENSIS.

1876. *Bythinia dunrobinensis* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, fig. 77, March 21, 1876. Dunrobin, Ouse, Tasmania. Figd. May, loc. cit., p. 71, pl. xi., fig. 20.

PUPIPHRYX GRAMPIANENSIS.

1939. *Bythinella grampianensis* Gabriel, Mem. Nat. Mus. Melb., No. 11, p. 106, pl. i., fig. 5, November. Near Silver Band Falls, Grampians, Victoria.

PUPIPHRYX COOMA, *sp. nov.*

This shell is small, about 4½ whorls, regularly pupoid, mouth free, minute umbilical chink, pale brown, sutures impressed, whorls rounded, mouth oval, 2.5 mm. in length by 1.5 mm. in breadth. From Cooma, southern N.S.W. The first *Pupiphryx* from N.S.W.

Genus PHRANTELA, *nov.*

Type, *Potamopyrgus* (?) *marginata* Petterd.

Shell white, sutures margined, spire somewhat awl-shaped, recalls *Tatea* more than any other group, but nothing much like that, and may even not belong to this family.

PHRANTELA MARGINATA.

1889. *Potamopyrgus* (?) *marginata* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 73, pl. i., fig. 9. Heazlewood River, North-west Tasmania. Figd. May, loc. cit., 1920, p. 72, pl. xi., fig. 22.

Genus PETTERDIANA.

1895. *Petterdiana* Brazier, Papers Proc. Roy. Soc. Tasm., 1894-95, p. 105, August, 1896. New name for *Brazieria* Petterd. Orthotype, *Ampullaria tasmanica* Ten.-Woods.

1889. *Brazieria* Petterd, Papers Proc. Roy. Soc. Tasm., 188, p. 76. Haplotype, *Ampullaria tasmanica* Ten.-Woods. Not *Brazieria* Ancey, 1887.

1898. *Pseudampullaria* Ancey, Ann. Mus. d'Hist. Nat. Marseille, Vol. i., p. 148. New name for preceding.

1900. *Petterdiella* Pilsbry, Nautilus, Vol. xiii., p. 144, April. Error only for *Petterdiana*.

PETTERDIANA PALUDINELLA.

1857. *Littorina paludinella* Reeve, Conch. Icon., Vol. x., pl. xvi., sp. 84. Tasmania. Cf. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxviii., p. 283, 1913.

1877. *Ampullaria tasmanica* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1876, p. 117, February 27, 1877. Tasmania, probably = Arthur River, etc. North Coast. Figd. Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 76, pl. i., fig. 8. Refigd. May, id. ib., 1920, p. 73, pl. xii., fig. 35.

Genus BEDDOMENA, *nov.*

Type, *Beddomeia bellii* Petterd.

This name is introduced for the smaller perforate shells formerly in-

cluded in *Petterdiana,* which is a heavy imperforate shell; these are conical with rounded whorls, oval free mouth, spire as long as mouth, and operculum paucispiral.

BEDDOMENA BELLII.

1889. *Beddomeia bellii* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 75, pl. i., fig. 7. Heazlewood River, North-west Tasmania. Refigd. May, Papers Proc. Roy. Soc. Tasm., 1920, p. 73, pl. xii., fig. 31, September 14.

BEDDOMENA LODDERAE.

1889. *Beddomeia lodderae* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 75, pl. iii., fig. 1. Castra River, North Tasmania. Refigd. May, loc. cit., 1920, p. 73, pl. xii., fig. 34.

BEDDOMENA HULLII.

1889. *Beddomeia hullii* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 75, pl. i., fig. 8. Heazlewood River, N.W. Tasmania. Refigd. May, loc. cit., 1920, p. 73, pl. xii., fig. 32.

Genus TASMANIELLA.

1898. *Tasmaniella* Ancey, Ann. Mus. d'Hist. Nat. Marseille, Vol. i., p. 148. New name for

1889. *Beddomeia* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 73. Type, *Amnicola launcestonensis* Johnston. Not *Beddomea* Nevill, 1878 (Neave).

TASMANIELLA LAUNCESTONENSIS.

1879. *Amnicola launcestonensis* Johnston, Papers Proc. Roy. Soc. Tasm., 1878, p. 24, February 24, 1879. South Esk, North Tasmania. Figd. Petterd, loc. cit., 1888, p. 74, pl. i., fig. 2. Refigd. May, id. ib., 1920, p. 73, pl. xii., fig. 33.

TASMANIELLA TUMIDA.

1889. *Beddomeia launcestonensis* var. *tumida* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 74, pl. iii., fig. 11. The Great Lake, mid-Tasmania.

TASMANIELLA MINIMA.

1889. *Beddomeia launcestonensis* var. *minima* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 74, pl. i., fig. 3. Scottsdale, North Tasmania.

Genus VALVATASMA, *nov.*

Type, *Valvata tasmanica* Ten.-Woods.

The short spire, globose form and open umbilicus separate this at sight from any of the preceding, with which it has been associated through lack of a satisfactory location.

VALVATASMA TASMANICA.

1876. *Valvata tasmanica* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 82, add. note, March 21, 1876. Gould's County, North East Tasmania. Figd. Petterd, loc. cit., 1888, p. 75, pl. i., fig. 11. Refigd. May, id. ib., 1920, p. 73, pl. xii., fig. 36.

Genus JARDINELLA.

1938. *Jardinella* Iredale & Whitley, South Austr. Nat., Vol. xviii., p. 67, April 30. Orthotype, *Petterdiana thaanumi* Pilsbry.

This perforate shell is quite unlike the type of *Petterdiana,* and may have little relationship with any of the Tasmanian molluscs.

JARDINELLA THAANUMI.

1900. *Petterdiana thaanumi* Pilsbry, Nautilus, Vol. xiii., p. 144, April. Near Cairns, N. Queensland. Figd. Hedley, Proc. Linn. Soc. N.S.W., 1900, p. 727, pl. xlviii., fig. 11, May 20, 1901.

Genus POSTICOBIA, *nov.*

Type, *Hydrobia brazieri* Smith.

This cannot be placed in any genus on account of its form, strong peripheral keel and almost free oval mouth. The operculum is horny, paucispiral, the nucleus somewhat distant from the edge, and rather loosely wound.

POSTICOBIA BRAZIERI.

1882. *Hydrobia brazieri* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 269, pl. vii., fig. 21, April 6. South Grafton, Clarence River, New South Wales.

1884. *Amnicola positura* Petterd, Journ. Conch. (Leeds), Vol. iv., p. 159, January. Richmond River, New South Wales.

1889. *Amnicola carinata* Brazier, Journ. Conch. (Leeds), Vol. vi., p. 72, May 4. As synonym of preceding.

Many specimens from the Chichester Dam, Hunter River district, agree generally, but the keel is not pronounced on the last whorl. The shell is smaller, rarely exceeding 2 mm. in height, and nearly 2 mm. in breadth, and distinctly perforate. This may be called *P. chena* sp. nov.

Genus FLUVIDONA.

1937. *Fluvidona* Iredale, Austr. Zool., Vol. viii., p. 306, March 12. Haplotype, *Hydrobia petterdi* Smith.

FLUVIDONA PETTERDI.

1882. *Hydrobia petterdi* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 270, pl. vii., fig. 23, April 6. (Not July, 1881, as given in Austr. Zool. above cited.) Richmond River, New South Wales.

1884. *Bithynia richmondiana* Petterd, Journ. Conch. (Lond.), Vol. iv., p. 159, January. Richmond River, N.S.W. Figd. Hedley, P.L.S.N.S.W., 1904, pl. viii., fig. 7.

1892. *Pupa anodonta* Hedley and Musson, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. vi., p. 588, fig. in text, May 23. North Pine River, South Queensland.

Genus ANGROBIA, *nov.*

Type, *Hydrobia angasi* Smith.

Although Smith pointed out the peculiarities of this form, calling attention to the "clawed" operculum, a distinctive feature and foreign to *Bythinella,* Gabriel has even made the species a synonym of *buccinoides,* which he placed in *Bythinella.* Cotton has recently figured the operculum of his *Bythinella pattisoni,* which disagrees with this.

ANGROBIA ANGASI.

1882. *Hydrobia angasi* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 271, pl. vii., fig. 22, April 6. Compasely River, Victoria.

Genus TATEA.

1879. *Tatea* Tenison-Woods, Papers Proc. Roy. Soc. Tasm., 1878, p. 72, February 24, 1879. Haplotype, *Bythinia huonensis* Ten.-Woods.

TATEA HUONENSIS.

1876. *Bythinia huonensis* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 71, March 21. Huon River, South Tasmania. Figd. May, Illus. Index Tasm. Shells, pl. xxv., fig. 26, 1923.

TATEA RUFILABRIS.

1862. *Diala rufilabris* A. Adams, Ann. Mag. Nat. Hist., Ser. 3, Vol. x., p. 298, Oct. Port Lincoln, South Australia. Figd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 268, pl. vii., fig. 19, 1882. Refigd. Cotton, Trans. Roy. Soc. South Austr., Vol. 66, p. 81, pl. i., figs. 1, 2, 3, 4, 1942.

TATEA PARADISIACA.

1897. *Tatea paradisiaca* Pilsbry, Proc. Acad. Nat. Sci. Philad., 1897, p. 362, pl. ix., figs. 10-11, November 23. Eden, Twofold Bay, N.S.W.

TATEA KESTEVENI, *sp. nov.*

With Dr. H. L. Kesteven I collected numerous examples in the Myall Lakes of a very distinct species of *Tatea*. I have since found it in the Manly Lagoon, and herewith name it. It is much more slender than any other species, reaching over 5 mm. in length with only 1.5 mm. at broadest part, the spire attenuate, the whorls numbering at least eight, the colour brown, mouth complete, lip thickened, but not varicose. (Manly, N.S.W.)

TATEA BALLINA, *sp. nov.*

Here the species has reverted to a thick shell recalling *rufilabris*, but not as broad as *paradisiaca*. The shell has six whorls, the last whorl broad, the others rapidly narrowing, but nothing like the preceding. The shell measures 4.5 in length and 2 mm. in breadth. The outer surface of the operculum shows the nucleus more central than in the type with strong radiating growth lines. The type is from Ballina, northern New South Wales, and the species occurs on Stradbroke Island, South Queensland.

TATEA PREISSII.

1846. *Paludina preissii* Philippi, Abbild. Conch., Vol. ii., p. 137, pl. ii., fig. 12, October. (= *Paludina acuta* Menke, not Say). West Australia.

Family STENOTHYRIDAE.

Genus OBESITENA, *nov.*

Type, *Stenothyra australis* Hedley.

While the shell recalls *Stenothyra* it differs in its operculum, which is horny, not calcareous, paucispiral, with nucleus subcentral.

OBESITENA AUSTRALIS.

1901. *Stenothyra australis* Hedley, Proc. Linn. Soc. N.S.W., 1900, p. 724, pl. xlviii., fig. 10, May 20. Bowen, Queensland.

A large series from Nudgee, near Brisbane, shows the operculum fitting the mouth, as above, shell slightly narrower, spire a little longer, imperforate, and may be named *O. a. wildiana* subsp. nov. Another series picked

out of shell sand from Darwin, Northern Territory, shows a smaller, fatter shell, also imperforate, and this may be called *O. a. perdives* subsp. nov.

Family IRAVADIIDAE.

Genus PELLAMORA, *nov.*

Type, *Iravadia australis* Hedley.

Hedley described this species "from fresh water," without comparison with specimens of the Indian *Iravadia*. I cannot see any close relationship, but am leaving it in the family meanwhile. The shells are subcylindrical, spirally lirate, rounded whorls, aperture entire, outer lip varicose. Dead shells of more than one species are before me, and they are always recognisable by their translucent appearance. The apex is smooth and planate variced.

PELLAMORA AUSTRALIS.

1901. *Iravadia australis* Hedley, Proc. Linn. Soc. N.S.W., 1900, p. 727, pl. xlviii., fig. 12, May 20. "Fresh water," Bowen, Queensland.

PELLAMORA PROCERA, *sp. nov.*

Shell much larger, more elongate, imperforate, dead shell white, whorls four and a half, decollate, last whorl with eight strong lirae, longitudinal striae between, which do not bead the lirae. Length, 7 mm.; breadth, 3 mm. Almost a miniature is a small shell, measuring 2.5 mm. by 1.25 mm., sculpture and form similar, four adult whorls, a one and a half smooth planate protoconch, which may be called *P. laseroni,* after Cpl. J. Laseron, who collected the shell sand at Port Darwin from which these two species were picked out.

Family BITHYNIIDAE.

Genus GABBIA.

1865. *Gabbia* Tryon, Amer. Journ. Conch., Vol. i., p. 220, July 1. Haplotype, *G. australis* Tryon.

GABBIA AUSTRALIS.

1865. *Gabbia australis* Tryon, Amer. Journ. Conch., Vol. i., p. 220, pl. xxii., fig. 7, July 1. New South Wales.

1875. *Bithinia hyalina* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 9, April 27. Eastern Creek (Sydney), New South Wales.

GABBIA AFFINIS.

1882. *Bithinia affinis* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 267, ex Brazier MS., April 6. Burdekin River, North Queensland.

GABBIA CENTRALIA, *sp. nov.*

1896. *Bithinia australis* Tate, Rep. Horn. Sci. Exped., pt. ii., Zool., p. 210, February. Oodnadatta, Central Australia.

1896. *Bithinia australis* Hedley, id. ib., p. 220, figs. A.-B. in text.

As pointed out by Tate, the Centralian shell is larger.

GABBIA SMITHII.

1882. *Bithinia australis* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 267, pl. vii., fig. 18, April 6. Victoria River, North Australia.

1882. *Bithinia smithii* Tate, Trans. Roy. Soc. South Austr., Vol. v., p. 54, December. New name for *B. australis* Smith, not Tate & Brazier, 1881.

1887. *Bithinia tryoni* Smith, Journ. Conch. (Leeds), Vol. v., p. 236, November 12. New name for *B. australis* Smith.

Genus HYDROCOCCUS.

1928. *Hydrococcus* Thiele, Zool. Jahrb. (Jena), Syst. Bd. 55, p. 375, September 12. Haplotype, *H. graniformis* Thiele.

HYDROCOCCUS GRANIFORMIS.

1928. *Hydrococcus graniformis* Thiele, Zool. Jahrb. (Jena), Syst. Bd. 55, p. 375, fig. 30, September 12. West Australia. New name for

1843. *Paludina granum* Menke, Moll. Nov. Holl. Spec., p. 8, April 11. Banks of the Swan River, West Australia. Not *Paludina grana* Say, 1822 (Sherborn).

Family THIARIDAE.

This family includes the species formerly known as *Melania*, and it is here emphasised that *Oncomelania*, the mollusc accused in Japan of carrying Schistosomiasis, does not belong here.

Genus THIARA.

1798. *Thiara* Bolten, Mus. Bolten, pt. ii., p. 109, September. Haplotype, *Helix amarula* Linné.

1799. *Melania* Lamarck, Mem. Soc. d'Hist. Nat. (Paris), p. 75, May. Haplotype, *Helix amarula* Linné.

*Melacantha* Swainson, *Amarula* Sowerby, etc., are other synonyms.

THIARA AMARULOIDEA, *sp. nov.*

Shells from Cardwell, Queensland, were referred to the type of *Thiara amarula* Linné, a name used to cover most of the Indo-Pacific forms of *Thiara*. Smith observed that the local shell approximated to *cybele* Gould, from the Fijis, whose tubercles are "less numerous, sharper and longer" than those of the Amboina type. On the other hand, the Cardwell species, measuring 46 mm. by 28 mm., with two whorls remaining shows twenty or more short spines on the shoulder of the last whorl, and about fourteen on the preceding one.

Genus PLOTIOPSIS.

1874. *Plotiopsis* Brot., Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xxiv., p. 7. Orthotype, *Melania balonnensis* Conrad.

PLOTIOPSIS BALONNENSIS.

1850. *Melania balonnensis* Conrad, Proc. Acad. Nat. Sci. Philad., Vol. vi., p. 11, February. Balonne River, Australia. Figd. Am. Journ. Conch., Vol. ii., p. 80, pl. i., fig. 10, January 1, 1866.

1878. *Melania oncoides* Ten.-Woods, Proc. Linn. Soc. N.S.W., Vol. iii., p. 5, September. Bourke, River Darling, New South Wales.

PLOTIOPSIS TETRICA.

1850. *Melania tetrica* Conrad, Proc. Acad. Nat. Sci. Philad., Vol. v., p. 11, February. Rivers of South-east Australia = Murray River. Figd. Amer. Journ. Conch., Vol. ii., p. 80, pl. i., fig. 9, January 1, 1866.

1881. *Melania tatei* Brazier, Proc. Linn. Soc. N.S.W., Vol. vi., p. 551, December. New name only for *M. tetrica* Conrad.

1882. *Melania subsimilis* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 262, pl. v., fig. 13, April 6. Australia, J. Gould = Lower Murray River, South Australia, fide Cotton.

PLOTIOPSIS INCERTA.

1862. *Melania incerta* Brot, Matériaux fam. Melan., I., p. 52. New name for

1843. *Melania lirata* Menke, Moll. Nov. Holl. Spec., p. 9, April 11. Avon River, District York, Western Australia. Figd. Brot., Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. 24, p. 287, pl. 28, fig. 15, 1877.

PLOTIOPSIS AUSTRALIS.

1857. *Melania australis* Lea (Isaac & Henry), Proc. Zool. Soc. (Lond.), 1850, pl. 85, February 28, 1851. Victoria River, North Australia. Figd. Reeve, Conch. Icon., Vol. xii., pl. xiii., fig. 82, December, 1859.

1860. *Melania cerea* Brot., Revue Zool., 1860, p. 266, pl. 17, fig. 13, July. Hab. unknown.

1862. *Melania decussata* Brot, Matériaux fam. Melan., I., p. 55. New name for *M. australis* Lea.

PLOTIOPSIS SUBORNATA, *sp. nov.*

The coastal Queensland shell recalls the description of *subsimilis* Smith, being brightly coloured and generally of a smoother appearance, but it is larger and broader, up to 34 mm. by 14 mm. wide, and with more numerous longitudinals, the type coming from the Burdekin River, North Queensland.

Genus SERMYLASMA, *nov.*

Type, *Melania venustula* Brot.

This group is well characterised by the short form, longitudinal sculpture, with lirate base, mouth oval, anteriorly base almost canaliculate, outer lip thin.

SERMYLASMA VENUSTULA.

1877. *Melania venustula* Brot, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. 23, p. 331, pl. xxxiv., figs. 5-5a. Port Denison, Queensland.

SERMYLASMA PROGNATA, *nom. nov.*

1882. *Melania venustula* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 260, pl. v., fig. 10, April 6. Victoria River, North Australia (Elsey). Not of Brot as above.

SERMYLASMA RETRACTA, *sp. nov.*

Specimens from Lennard River, North-west Australia, are small, only 6 mm. long by 4 mm. broad, four whorls remaining, longitudinal ribs few, ten on last whorl, over-run by spiral lirae, basal lirae few and strong, and pale brown in colour, mouth subcanaliculate anteriorly.

SERMYLASMA ELSEYI.

1882. *Melania elseyi* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 261, pl. v., fig. 12, April. Australia (J. R. Elsey).

SERMYLASMA ONCA.

1864. *Melania* (*Melasma*) *onca* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 415, April 20, 1864. Adelaide River, Arnheim's Land. Figd. Brot, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xxiv., p. 330, pl. xxxiv., fig. 7, 1877.

SERMYLASMA CARBONATA.

1859. *Melania carbonata* Reeve, Conch. Icon., Vol. xii., pl. xiii., fig. 88, December. No locality. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 259, 1882, gives "Port Essington (J. B. Jukes and Gould)."

Genus STENOMELANIA.

1885. *Stenomelania* Fischer, Man. Conch., livr. viii., 701, January 29. Haplotype, *Melania aspirans* Hinds.

STENOMELANIA DENISONIENSIS.

1877. *Melania denisoniensis* Brot, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. 23, p. 234, pl. xxv., figs. 6 a-b. Port Denison, Queensland. Figd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 259, pl. v., figs. 4-8, 1882.

Smith's figures, given to show variation, were from various localities, and specimens from the Clarence River, N.S.W., are not so convex as the type, broader, larger, and may be subspecifically separated as *S. d. ultra* subsp. nov. On the other hand, Cardwell and further north the shells are tabulate, and agree with Smith's figure 5, and may be called *S. d. tacita* subsp. nov.

Genus RIPALANIA, *nov.*

Characterised by its smoothness, short, stout shape, recalling *Melanopsis*, but long oval mouth, nearly as long as decollated spire, is not canaliculate.

RIPALANIA QUEENSLANDICA.

1882. *Melania queenslandica* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 261, pl. v., fig. 11, April 6. Saltwater Creek, Cardwell, North Queensland.

Genus PSEUDOPOTAMIS.

1894. *Pseudopotamis* Martens, Denkschr. Ges. Jena, Vol. viii. (Zool. Forsch, Austr. (Semon), Band v., Moll.), p. 86, ex Brot MS. Type (here designated) *P. finschi* Martens.

PSEUDOPOTAMIS SUPRALIRATA.

1887. *Melania supralirata* Smith, Journ. Conch. (Leeds), Vol. v., p. 237, November 12. Prince of Wales Island, Torres Strait.

1894. *Pseudopotamis finschi* Martens, loc. cit., p. 87, pl. iv., fig. 4. Prince of Wales Island, Torres Strait.

PSEUDOPOTAMIS SEMONI.

1894. *Pseudopotamis semoni* Martens, Denkschr. Ges. Jena, Vol. viii., p. 87, pl. iv., fig. 6. Hammond Island, Torres Strait.

Family COXIELLIDAE.

The curious shells here placed have been referred to the neighbourhood

of *Truncatella* = *Acmea,* but this relationship is very obscure. Acmeid species are definitely marine, living on the coast line, whereas the Coxiellids live on the banks of salt lakes, even in the interior of Australia. The number of species is not yet known, but there may be half a dozen or more. Hedley wrote a note, "On a Thalassoid Element in the Australian Molluscan Fauna" (Vict. Naturalist, Vol. xl., pp. 75-77, August 9, 1923), drawing attention to their peculiarities, and advancing *filosa* Sowerby, 1838, as the earliest name, and also date of record of the group. But a much earlier note was from Rottnest Island, W. Australia, whence Peron records, "Bailly found two species of small shells: one a bivalve, the other a univalve, fairly similar to a *Melania* and red in colour on the shores of the salt lakes. The shores of most of these lakes were quite literally covered with these shells." Mitchell's later discovery of similar shells was on the banks of Mitre Lake, Victoria, over one hundred miles inland from the sea. It may be here noted that at first referred to *Truncatella,* it was later transferred to *Blanfordia,* then to *Pomatiopsis,* before being settled as *Coxiella.* At first glance the shells from the interior salt lakes did not belong to *Coxiella,* and *Coxielladda* was introduced, but a review of the species suggests that they do not even belong to the family, and may be more closely related to *Gabbia,* while there appears to be more species to be distinguished in many places. I note May did not include the species in his account of Tasmanian Fresh Water Mollusca, and he has been followed by Gabriel, on the grounds that they inhabit "salt water" lakes, but it seems impossible to place them amongst marine forms when they sometimes live hundreds of miles from the sea. A review of the material available indicates how much they have been misunderstood through this neglect by writers on fresh water and marine molluscs.

Genus COXIELLA.

1894. *Coxiella* Smith, Proc. Malac. Soc. (Lond.) ,Vol. i., p. 98, June. Haplotype, *Truncatella striatula* Menke.

COXIELLA STRIATULA.

1843. *Truncatella striatula* Menke, Moll. Nov. Holl. Spec., p. 9, April. Western Australia = Rottnest Island.

COXIELLA PYRRHOSTOMA.

1868. *Blanfordia pyrrhostoma* Cox, Mon. Austr. Austr. Land Shells, p. 95, pl. xv., figs. 14-14c, May. Shark's Bay, Western Australia.

COXIELLA STRIATA.

1842. *Truncatella striata* Reeve, Conch. Syst., Vol. ii. (3), p. 94, pl. 182, fig. 4, May, ex J. Sowerby MS. No locality. Mitre Lake, Victoria.

1838. *T(runcatella) filosa* Mitchell, Three Exped. East Austr., Vol. ii., p. 190, footnote ex J. Sowerby MS. Mitre Lake, Victoria. *Nomen nudum.*

1898. *Coxiella confusa* Smith, Proc. Malac. Soc., Vol. iii., p. 76, July. Adelaide, South Australia.

COXIELLA BADGERENSIS.

1879. *Pomatiopsis badgerensis* Johnston, Papers Proc. Roy. Soc. Tasm., 1878, p. 26, February 24, 1879. Fossil, Badger Island, Bass Strait. Figd. as recent species, May, Illus. Index Tasm. Shells, pl. xxvi., fig. 12, 1923.

Similar shells occur in Gippsland and Stawell, Victoria, but a series

from Port Phillip, Victoria, shows a very different form, the shell being long, narrow, the whorls flattened, six to ten whorls, measuring 8 mm. in length with only 2-2.5 mm. in breadth, the mouth not free, imperforate, operculum paucispiral. This may be called *Coxiella molesta* sp. nov. Another series from Port Fairy, Victoria, is comprised of shells with only five very rounded whorls, mouth free, umbilical chink present, different darker coloration, and measuring 9 mm. by 4 mm. This should be *confusa* or *striata*, if these be different as series here suggests.

### Genus Coxielladda.

1938. *Coxielladda* Iredale & Whitley, South Austr. Nat., Vol. xviii., p. 66, April 30, 1938. Orthotype, *Paludinella gilesi* Angas.

This genus should be transferred to the neighbourhood of *Gabbia*, even as Tate recognised. The shell is not truly decollate, only the tip eroded, while the whorls are few in number, rounded, the shell perforate, the operculum paucispiral, with the nucleus subcentral, and increasing concentrically. The coloration is also different from that of the *Coxiella* series.

### Coxielladda gilesi.

1877. *Paludinella gilesi* Angas, Proc. Zool. Soc. (Lond.), 1877, p. 70, pl. xxvi., fig. 2. Shore of Lake Eyre, South Australia.

1894. *Blandfordia stirlingi* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 196, November. Lake Callabonna, South Australia (subfossil).

### Coxielladda mammillata.

1894. *Blandfordia stirlingi* var. *mammillata* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 196, November. Murchison Goldfield, Western Australia.

This small squat shell of only three whorls is very unlike a *Coxiella*, especially as the apex is not truncate, but mammillate and persistent; operculum as in the preceding.

### Coxielladda exposita, *sp. nov.*

A large number of shells collected by Mr. E. Le G. Troughton at Cranbrook inland from Albany, W.A., consisted of two species, one a *Coxiella* similar to that collected at Rottnest Island by Mr. G. P. Whitley. The other was easily separated by its more rounded whorls, darker coloration and the presence of an operculum filling the aperture. The shell normally measured 6 mm. long by 3.25 mm. wide, the largest about 8 mm., three rounded whorls remaining, dark blackish brown, concentric striation, mouth oval, practically free, lip solid, three apical whorls sometimes present. The operculum was paucispiral, but with age it appeared concentric through the increase being all round, instead of one side only, as in normal paucispiral opercula.

## Family Lymnaeidae.

Although our species have commonly been referred to *Lymnaea*, that generic name has now been restricted to European species of *stagnalis* alliance, and none of our shells recalls this. The most noticeable group in Australia, and, be it noted, it does not occur in Tasmania, is that known under the name *Limnaea lessoni*, but which is a composite of many species. It is a thin, very globose, short spired shell, with the columella very strongly folded and is here named *Peplimnea*.

Genus PEPLIMNEA, *nov.*

Type, *Limnea lessoni* Deshayes.

PEPLIMNEA LESSONI.

1830. *Limnea lessoni* Deshayes, Mag. de Zool., 1830, 2 livr., pl. 16, figs. 1-2, dated June. New Holland (ex Lesson).

1831. *Lymnea lessonii* Lesson, Voy. Coquille, Zool., Vol. ii., pt. i., p. 330. River Macquarie at Bathurst, N.S.W.

1831. *Lymnaea lessonii* Lesson, Cent. Zool., pl. xliv.

1872. *Limnaea globosa* Sowerby, Conch. Icon. (Reeve), Vol. xviii., pl. xii., sp. 84, December. Australia.

[1872. *Limnaea brevicauda* Sowerby, loc. cit., pl. xv., fig. 105, December. Australia; is not Australian but Indian, fide Blanford and Smith.]

PEPLIMNEA PERLEVIS.

1850. *Amphipeplea perlevis* Conrad, Proc. Acad. Nat. Sci. Philad., Vol. v., p. 11, February. Salamanca and Balonne Rivers, N.S.W. Figd. Am. Journ. Conch., Vol. ii., p. 80, pl. i., fig. 5, January 1, 1866.

1872. *Limnaea cumingii* Sowerby, Conch. Icon. (Reeve), Vol. xviii., pl. vi., sp. 38, March. Australia.

PEPLIMNEA MELBOURNENSIS.

1857. *Amphipeplea melbournensis* Pfeiffer, Novit. Conch., p. 70, pl. xix., figs. 14-15. Near Melbourne, Australia.

PEPLIMNEA STRANGEI.

1854. *Amphipeplea strangei* Pfeiffer, Malak. Blätt., Vol. i., p. 64, dated April. Novit. Conch., Ser. i., p. 6, pl. ii., figs. 5-6, 1857. Moreton Bay, Queensland.

1886. *Amphipeplea queenslandica* Clessin, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth., xvii., p. 405, pl. 53, fig. 2. New name for

1869. *Amphipeplea iuvoluta* (sic) Schmeltz, Mus. Godeffroy, Cat., iv., p. 81, ex Mousson MS. B. (= Brisbane) and C. = Cape York. Type locality, Brisbane, Queensland.

PEPLIMNEA LILIMERA, *sp. nov.*

The North Queensland form has the spire very short, the body globose, pale translucent, very thin, columella strongly folded. The type is from the Burdekin River, measuring 19 mm. by 15 mm., and differs at sight from Rockhampton specimens, which have a prominent spire and less globose form. Two nomina nuda may be here cited

1873. *Limnaea australiana* Paetel, Cat. Conch. Samml., p. 115, as of Cox. Queensland.

1874. *Amphipeplea acuta* Schmeltz, Mus. Godeffroy, Cat. v., p. 89, February, ex Mousson MS. Bowen.

PEPLIMNEA VINOSA.

1864. *Amphipeplea vinosa* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 415, April 20, 1864. Adelaide River, North Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xviii., p. vi., fig. 37, March, 1872.

PEPLIMNEA VINOLENTA, *sp. nov.*

1896. *Limnaea vinosa* Tate, Rep. Horn. Sci. Exped. Centr. Austr., pt. ii., Zool., p. 211, February. Palm Creek, Darwent River, Centralia.

Differs in form, being more globose, with shorter spire, paler coloration from the northern true *vinosa*.

PEPLIMNEA PHILLIPSI.

1864. *Amphipeplea phillipsi* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 416, April 20, 1864. Arnheim's Land. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xviii., pl. vi., fig. 41, March, 1872.

1872. *Limnaea deshayesii* Sowerby, Conch. Icon. (Reeve), Vol. xviii., pl. xiv., fig. 95, December, ex Adams MS. Australia (fide Smith, obtained in North Australia (Cornet Creek)).

PEPLIMNEA ANGASI.

1872. *Limnaea angasi* Sowerby, Conch. Icon. (Reeve), Vol. xviii., pl. ii., fig. 12, March. Port Darwin, North Australia.

PEPLIMNEA CAURINA, *sp. nov.*

A series from the Lennard River, North-west Australia, "from lagoons," shows a thin translucent white shell, with a short acuminate spire, a very swollen body whorl, and strongly folded columella, measuring 15 mm. long by 11.5 mm. broad. Others from "water weeds in the river" itself are consistently smaller, less globose, and of a brownish colour, suggesting *vinosa*, but obviously only an ecologic variation.

Genus AUSTROPEPLEA.

1942. *Austropeplea* Cotton, Trans. Roy. Soc. South Austr., Vol. 66, p. 80, July 31. Orthotype, *Limnea papyracea* Tate = *aruntalis* C. & G.

AUSTROPEPLEA ARUNTALIS.

1938. *Lymnaea aruntalis* Cotton & Godfrey, Mal. Soc. South Austr., Publ. No. 1 (Syst. List. Gastrop. S.A.), p. 36, December 31. New name for

1880. *Limnaea papyracea* Tate, Trans. Roy. Soc. South Austr., Vol. iii., p. 103, pl. iv., figs. 5a-c., December. Penola, South Australia. Not *Limnaeus papyraceus* Spix, 1827 (Sherborn).

AUSTROPEPLEA HUONENSIS.

1876. *Limnaea huonensis* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 71, March 21, 1876. River Huon, South Tasmania. Figd. Petterd, loc. cit., 1888, p. 65, pl. 2, fig. 11.

[1876. *Limnaea hobartonensis* Ten.-Woods, loc. cit. Hobarton, Tasmania. Later referred to European *L. peregra*.]

AUSTROPEPLEA LAUNCESTONENSIS.

1876. *Limnaea launcestonensis* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 71, March 21, 1876. Launceston, North Tasmania.

Genus SIMLIMNEA, *nov.*

Type, *Limnaea brazieri* Smith.

A generic name is necessary for the series of small Limnaeids very

different from the preceding. The spire is short, acute, the body whorl large, but normal, not swollen, the columella not much folded, and inner lip notable, shell comparatively stout.

SIMLIMNEA BRAZIERI.

1882. *Limnaea brazieri* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 274, pl. v., fig. 15, April 6. Glebe Point, Sydney, N.S.W.

SIMLIMNEA GUNNII.

1889. *Limnoea gunnii* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 66, pl. 2, fig. 10, pl. 3, figs. 9-12. South Esk River, North Tasmania.

SIMLIMNEA VICTORIAE.

1882. *Limnaea victoriae* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 274, pl. v., fig. 16, April 6. Bairnsdale, Victoria.

SIMLIMNEA SUBAQUATILIS.

1880. *Limnaea subaquatilis* Tate, Trans. Proc. Roy. Soc. South Austr., Vol. iii., p. 103, pl. iv., figs. 6a-b, December. River Torrens, Adelaide, South Australia.

SIMLIMNEA NEGLECTA.

1889. *Limnaea subaquatilis* var. *neglecta* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 66, pl. 2, fig. 13, pl. 4, figs. 1-2. Launceston, north Tasmania.

[1880. *Succinea johnstoni* Tate, Trans. Proc. Roy. Soc. South Austr., Vol. iii., p. 103, December, ex Petterd MS. Tasmania.]

Note: There are two names on record as MS only.

1882. *Limnaea viridula* Tate, Trans. Roy. Soc. South Austr., Vol. iv., 1881, p. 76, January, 1882. Murndul, Hamilton, Victoria.

1896. *Limnaea venustula* Cherry, Proc. Roy. Soc. Vict., 1896, p. 183. Headwaters of the Wimmera, Victoria.

While the two following are regarded as referable to the European *L. peregra,* supposed to have been accidentally introduced.

1876. *Limnaea tasmanica* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 70, March 21, 1876. Hobart, South Tasmania.

1889. *Limnoea lutosa* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 67, pl. ii., fig. 13. Brighton, River Jordan, Tasmania.

GLACILIMNEA GELIDA, *gen. & sp. nov.*

A small, thin shell from 35 ft., Blue Lake, Mount Kosciusko, N.S.W., is thus named. The shell measures 4.5 mm. in length by 3.25 mm. in breadth, the spire very short, the apex planate, the last whorl slightly shouldered, the columella scarcely folded, the shell brown, with little calcification and showing strong regular longitudinal striation.

Family BULLINIDAE.

The economic importance of the molluscs of this family commands careful scrutiny of all the members in order that the blame may be attached to the right offender. It is unfortunate that these harmless creatures should be the carriers of parasites which cause serious trouble to mankind,

and his servants, the sheep. Unfortunately the earlier named forms are very difficult to determine as no exact locality was given. The species vary according to complex conditions not yet understood, so much so that specimens in any large series might be picked out mimicking other species. Apparently the species agree geographically, but in any locality there is ecologic variation which may vary year from year. Consequently it is impossible to determine a single specimen from unknown locality, and it would be wise to disallow all the names introduced without definite locality and thus stabilise the names to be used.

Genus LENAMERIA, *nov.*

Type, *Physa gibbosa* Gould.

These shells are sinistral, the spire generally shorter than the aperture, the columella folded, the mouth open. The radula is of the Lymneoid type, but the animal is different. On account of this character these species have been sometimes described as *Lymnaea*.

LENAMERIA GIBBOSA.

1847. *Physa gibbosa* Gould, Proc. Bost. Soc. Nat. Hist., Vol. ii., p. 214. Parramatta, New South Wales. Figd. U.S. Expl. Exped., Atlas, fig. 137, 1852.

[1844. *Physa ludwigii* Kuster, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth., 17, p. 21, pl. 3, figs. 14-16, ex Krauss MS. New Holland.]

[1882. *Physa grayi* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 277, pl. v., fig. 25, April 6. New name for *Physa novaehollandiae* "Gray," Animal Kingdom (Cuvier), ed. Griffith & Pidgeon, Vol. xii., Moll., pl. 27, fig. 4, dated 1833 (Index, p. 599, 1834).]

LENAMERIA RENOLA, *sp. nov.*

A series from Chichester Dam, Hunter River District, N.S.W., shows small thin sculptured shells, subshouldered as in *gibbosa*, spire short, body whorl oval, columella folded, sculptured with fine concentric striae and fine longitudinal threads. Length, 7.5 mm.; breadth, 4 mm.; length of aperture, 4.5 mm.; breadth, 3 mm.

LENAMERIA PECTOROSA.

[1822. *Physa n. Hollandica* Bowdich, Elem. Conch., expl. to pl. vi., fig. 13 (pref. November 8, 1821). No locality save in name.

1825. *Physa novaehollandiae* Blainville, Manual Malac., p. 450, refers to pl. xxxvii., fig. 3, issued December 28. Same figure as above.]

1826. *Physa novaehollandiae* Blainville, Dict. Sci. Nat. (Levrault), Vol. xl., p. 144, June 24 (Atlas, pl. 37, fig. 3), ex Lesson. Rivers of New Holland.

1831. *Physa novaehollandiae* Lesson, Voy. Coquille, Zool., Vol. ii., pt. i., p. 332, Atlas, pl. xvi., fig. 5. River Macquarie at Bathurst, New South Wales. ex *Physa australis* Lesson, Ann. Sci. Nat. (Paris), Ser. i., Vol. vi., p. 254, 1825, Nov. *Nomen nudum.*

[1842. *Physa marginata* Kuster, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth. 17, p. 10, pl. 2, figs. 1-2. New Holland.]

1850. *Physa pectorosa* Conrad, Proc. Acad. Nat. Sci. Philad., Vol. v., p. 11,

February. Bogan River, New South Wales. Figd. Amer. Journ. Conch., Vol. ii., p. 80, pl. i., fig. 6, 1866.

1882. *Physa lessoni* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 277, April 6. New name for *P. novaehollandiae* Lesson.

1886. *Physa kreftii* Clessin, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth. xvii., p. 370, pl. 54, fig. 12. Calvert's Creek, New South Wales.

1888. *Physa multistrigata* Cox, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. iii., p. 1254, December. ex Tate MS. *Nomen nudum.* Narrabri, N.S.W.

1889. *Physa multistrigata* Cooke, Proc. Zool. Soc. (Lond.), 1889, p. 139 (Radula).

LENAMERIA FUSIFORMIS.

1879. *Physa fusiformis* Nelson & Taylor, Journ. Conch. (Leeds), Vol. ii., p. 289, pl. i., fig. 9, October. Richmond River, N.S.W.

LENAMERIA DUPLICATA.

1874. *Physa duplicata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xii., sp. 100, November. Wide Bay, Australia.

LENAMERIA BREVISPIRA.

1917. *Isodora gibbosa* var. *brevispira* Odhner, Kungl. Svensk. Vet. Handl., Bd. 52, No. 16, p. 96, September 19. Atherton, North Queensland.

LENAMERIA SUBUNDATA.

1873. *Physa subundata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. viii., sp. 61, April. St. Margaret's, South Australia.

1874. *Physa pinguis* Sowerby, loc. cit., pl. xii., sp. 93, November. South Australia.

1874. *Physa bullata* Sowerby, loc. cit., pl. xii., sp. 97, November. South Australia. Not *Physa bullata* Potiez & Michaud, 1838.

LENAMERIA TENUISTRIATA.

1873. *Physa tenuistriata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. x., sp. 85, April. River Torrens, South Australia.

[1874. *Physa puncturata* Sowerby, loc. cit., pl. xi., sp. 91, November. Australia.]

1874. *Physa texturata* Sowerby, loc. cit., pl. xii., sp. 95, November. South Australia.

1878. *Physa arachnoidea* Ten.-Woods, Trans. Roy. Soc. Vict., Vol. xiv., p. 63. Mordialloc, Victoria. Figd. Hedley, Rec. Austr. Mus., Vol. xii., p. 3, pl. ii., fig. 15, December 19, 1917 (type).

1885. *Physa smithi* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xvii., p. 294, pl. 42, fig. 23. Murray River, Australia.

[1886. *Physa conica* Clessin, loc. cit., p. 360, pl. 51, fig. 3. South Australia.]

1886. *Physa waterhousei* Clessin, loc. cit., p. 361, pl. 51, fig. 6. South Australia.

1917. *Bullinus tenuistriatus* var. *confluens* Hedley, Rec. Austr. Mus., Vol. xii., p. 4, pl. i., figs. 9-10, December 19. Echuca, Victoria.

At this citation new figures are given of most of the above.

LENAMERIA SUBACUTA.

1941. *Amerianna subacuta* Cotton & Beasley, South Austr. Naturalist, Vol. 21, p. 17. River Torrens, South Australia. Figd. Cotton, Trans. Roy. Soc. South Austr., Vol. 66, p. 77, pl. ii., figs. 3-4, 1942.

LENAMERIA AUSTRALIANA.

1850. *Physa australiana* Conrad, Proc. Acad. Nat. Sci. Philad., Vol. 5, p. 11, February. Bogan River, New South Wales. Figd. Amer. Journ. Conch., Vol. ii., p. 81, pl. i., fig. 7, 1866.

LENAMERIA CONCINNA.

1864. *Physa concinna* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 417, April 20, 1864. Arnheim's Land, North Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. 5, sp. 35, February, 1873. Refigd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 251, pl. vi., figs. 13-14, 1882.

LENAMERIA OLIVACEA.

1864. *Physa olivacea* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 417, April 20, 1864. Arnheim's Land, North Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. v., sp. 34, February, 1873. Refigd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 286, pl. vi., fig. 15, 1882.

LENAMERIA PROTEUS.

1873. *Physa proteus* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. vi., sp. 43, February. West Australia.

LENAMERIA DISPAR.

1873. *Physa dispar* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. viii., sp. 66, April. Sydney, New South Wales.

LENAMERIA NITIDA.

1874. *Physa nitida* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xii., sp. 98, November. South-east Tasmania.

This is *gibbosa* May, not *gibbosa* Gould.

LENAMERIA VANDIEMENENSIS.

1873. *Physa vandiemenensis* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. viii., sp. 57, April. Van Diemen's Land.

1879. *Physa diemenensis* Johnston, Papers Proc. Roy. Soc. Tasm., 1878, p. 21, February 24, 1879. Lapsus only.

LENAMERIA BADIA.

1864. *Physa badia* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 416, April 20, 1864. Adelaide River, North Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. vii., fig. 51, February, 1873.

LENAMERIA GEORGIANA.

1832. *Physa georgiana* Quoy & Gaimard, Voy. de'l Astrol., Zool., Vol. ii., p. 207, pl. lviii., figs. 23-24. King George's Sound, S.W. Australia. Copied Smith, loc. cit., p. 277, pl. v., figs. 23-24, 1882.

1844. *Physa australis* Kuster, Syst. Conch. Cab. (Mart. & Chemn.), cont., Bd. I., Abth. 17, p. 9, pl. i., figs. 15-17, ex Koch MS. (*P. elongata* Menke, 1843, p. 8, not Say). West Australia.

1882. *Physa breviculmen* Smith. Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 290, pl. vi., fig. 26, April 6. King George's Sound, S.W. Australia. Refigd. Cotton, Trans. Roy. Soc. Sth. Austr., Vol. 66, pl. ii., figs. 9-10 (*"breviculum"*), 1942.

LENAMERIA QUOYI.

1882. *Physa quoyi* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 288, pl. vi., fig. 24, April 6. King George's Sound, South-west Australia.

LENAMERIA TENUILIRATA.

1882. *Physa tenuilirata* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 291, pl. vi., fig. 27, April 6. Swan River, Western Australia.

1930. *Isidora decorata* Thiele, Die Fauna Sudwest. Austr., Vol. v., p. 587, fig. 65. Brancaster, S.W. Australia.

LENAMERIA EXARATA.

1882. *Physa exarata* Smith, Journ. Linn. Soc. (Lond.), Vol. xvi., p. 292, pl. vi., fig. 28, April 6. "Depuch Island, Port Essington, N. Australia.

LENAMERIA EGREGIA.

1906. *Limnaea* (*Bulinus*) *egregia* Preston, Proc. Malac. Soc. (Lond.), Vol. viii., p. 36, fig. in text, March 9. North-west Australia.

LENAMERIA SISURNIA.

1918. *Bullinus sisurnius* Hedley, Proc. Roy. Geog. Soc. Austr. South Austr. Br., 1916-17, Moll., p. 20, pl. xli., figs. 5-7. Paterson Range, North-west Australia.

LENAMERIA PYRAMIDATA.

1873. *Physa pyramidata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. viii., sp. 62, April. Australia = Flinders Island, Bass Strait (Milligan), fide Smith.

1874. *Physa eburnea* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xi., sp. 89, figs. 89 a-b, November. Launceston, Tasmania.

LENAMERIA ATTENUATA.

1874. *Physa attenuata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xii., sp. 94, November. Dulverton Lake, mid-East Tasmania.

[1876. *Physa ciliata* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 75, March 21, 1876. Lake Dulverton, Tasmania. Figd. May, loc. cit., 1920, p. 70, pl. ix., fig. 6 (? type).]

LENAMERIA BRUNNIENSIS.

1874. *Physa brunniensis* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xii., sp. 99, November. Brunni Island, S. Tasmania.

LENAMERIA MAMILLATA.

1874. *Physa mamillata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xi., sp. 90, November. Brunni Island, Tasmania (Legrand).

LENAMERIA HUONENSIS.

1876. *Physa huonensis* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 74, March 21, 1876. Huon River, S. Tasmania.

1876. *Physa legrandi* Ten.-Woods, loc. cit. Richmond, Tasmania. Type figured May, op. cit., 1920, p. 70, pl. ix., fig. 7.

1876. *Physa tasmanica* Ten.-Woods, loc. cit. Inland streams. Type figured May, op. cit., 1920, p. 70, pl. ix., fig. 8.

1876. *Physa tasmanicola* Ten.-Woods, loc. cit., p. 75. Mount Murray, East Tasmania. Type figured May, op. cit., 1920, p. 70, pl. ix., fig. 9.

1876. *Physa huonicola* Ten.-Woods, loc. cit., p. 75. Upper Huon River, South Tasmania.

LENAMERIA YARRAENSIS.

1878. *Physa yarraensis* Ten.-Woods, Proc. Roy. Soc. Vict., Vol. xiv., p. 64. Upper Yarra, Victoria. Figd. Hedley, Rec. Aust. Mus., Vol. xvi., p. 5, pl. ii., fig. 16, 1917.

[1866. *Physa* (*Bulinus*) *acutispira* Tryon, Amer. Journ. Conch., Vol. ii., p. 9, pl. 2, fig. 10, January 1. Australia. Does not seem determinable.]

1882. *Physa etheridgii* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 288, pl. vi., fig. 25, April 6. Yan Yean Reservoir, Plenty District, Victoria.

LENAMERIA ADAMSIANA.

1874. *Aplexa adamsiana* Tapparone-Canefri, Mem. R. Accad. Sci. Torino, Ser. 2, Vol. xxviii. (Zool. Magenta), p. 207, pl. iii., fig. 3. Australia, ex Cox = Sydney, New South Wales.

LENAMERIA ACICULATA.

1873. *Physa aciculata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. viii., sp. 59, April. New South Wales.

LENAMERIA TORTUOSA.

1886. *Physa tortuosa* Clessin, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth. xvii., p. 360, pl. 51, fig. 1. Urara River, New South Wales.

1886. *Physa multispirata* Clessin, loc. cit., p. 361, pl. 51, fig. 4. Same locality.

1882. *Physa producta* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 286, pl. vi., fig. 21, April 6. South Grafton, Clarence River, N.S.W. Not *Physa producta* Mighels, 1845 (Sherborn).

Note:—Gabriel has recorded this species from Victoria, giving a figure of "*pyramidata*," which he has transferred to *tenuistriata*, which is of later publication, and has figured as "*tenuistriata* var. *pyramidata*," a very different shell! Cotton has also misfigured *pyramidata*. Compare May's figure and Sowerby's original one.

LENAMERIA BRISBANICA.

1879. *Physa brisbanica* Nelson & Taylor, Journ. Conch. (Leeds), Vol. ii., p. 288-89, pl. i., fig. 10, September-October. Brisbane River, Queensland.

LENAMERIA QUEENSLANDICA.

1882. *Physa queenslandica* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 287, pl. vi., fig. 23, April 6. Dawson River, Queensland.

LENAMERIA BEDDOMEI.

1879. *Physa beddomei* Nelson & Taylor, Journ. Conch. (Leeds), Vol. ii., p. 289, pl. i., fig. 8, October. Townsville, Queensland.

LENAMERIA GRACILENTA.

1882. *Physa gracilenta* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 285, pl. vi., fig. 20, April 6. Endeavour Creek or River, Queensland.

LENAMERIA LINCOLNENSIS.

1886. *Physa lincolnensis* Clessin, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth. xvii., p. 363, pl. 51, fig. 7. Port Lincoln, South Australia.

Genus GLYPTAMODA, *nov.*

Type, *Physa aliciae* Reeve.

This group is well defined by its slender form and prominent sculpture, the apex elevated, papilliform, the mouth large oval, the columella folded.

GLYPTAMODA ALICIAE.

1862. *Physa* (*Ameria*) *aliciae* Reeve, Proc. Zool. Soc. (Lond.), 1862, p. 106, fig. in text, June 1. Lower Murray River, South Australia.

1886. *Physa cingulata* Clessin, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth. xvii., p. 364, pl. 51, fig. 8. South Australia.

GLYPTAMODA KERSHAWI.

1878. *Physa kershawi* Ten.-Woods, Trans. Roy. Soc. Vict., Vol. xiv., p. 64, July 11. Upper Yarra, Victoria. Figd. Hedley, Rec. Austr. Mus., Vol. xii., p. 6, pl. ii., fig. 17, December 19, 1917.

1881. *Amplexa turrita* Tate, Proc. Linn. Soc. N.S.W., Vol. vi., p. 409, December. Lake Wendouree, Ballarat, Victoria. Figd. Hedley, Rec. Austr. Mus., Vol. xii., p. 6, pl. i., fig. 14, December 19, 1917.

1881. *Physa turriculata* Tate & Brazier, Proc. Linn. Soc. N.S.W., Vol. vi., p. 558, December. New name for preceding or error only. Not *Physa turriculata* Morelet, 1868.

Hitherto the peculiar form has been regarded as restricted to South Australia and Victoria, but it apparently has an extensive range, as a large series from Goulburn, New South Wales, is under review. These recall the typical *aliciae*, but some are even larger, with coarser sculpture, the ridges more distant, the shell measuring 15 mm. in length by 7 mm. in breadth, the aperture being 9 mm. in length by 4 mm. in breadth. The species may be named *Glyptamoda ellea* sp. nov.

GLYPTAMODA COSMETA, *sp. nov.*

A series of a small very delicate *Glyptamoda* was collected at Calala Lagoon, near Tamworth, northern New South Wales. The shell is small, elegant, measuring 7 mm. by 4 mm., very thin, brown, apex elevated, as figured by Hedley, about twenty major concentric lirae, with as many

minor ones, the interstices with fine radiating threads, forming a finely latticed appearance. The spire is very short, the mouth long and oval.

Genus TASMADORA, *nov.*

Type, *Physa aperta* Sowerby.

A curious isolated form having the appearance of an *Isidorella*, but with the columella strongly folded, the spire very short, less than half length of aperture.

TASMADORA APERTA.

1874. *Physa aperta* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. xi., sp. 88, November. Hamilton, Australia = Tasmania (Legrand).

Genus AMERIANNA.

1928. *Amerianna* Strand, Arch. für Nat. (Berlin), 29th Year, 1926, Abth. A, heft, 8, p. 63. New name for

1861. *Ameria* H. Adams, Proc. Zool. Soc. (Lond.), 1861, p. 143, September 16. Logotype, Cotton, 1942, *Physa truncata* H. Adams. Spelt *Armeria* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xvii., p. 295, 1885. Not *Ameria* Walker, List. Lep. B.M., pt. 2, p. 554, 1854.

AMERIANNA CARINATA.

1861. *Physa* (*Ameria*) *carinata* H. Adams, Proc. Zool. Soc. (Lond.), 1861, p. 143, September 16. Boyne River, Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. iii., sp. 18, February, 1873.

1861. *Physa* (*Ameria*) *truncata* H. Adams, loc. cit., p. 144. Calliope River, Australia. Figd. Sowerby, loc. cit., pl. iii., sp. 20. Not *Physa truncata*. Bourg., 1856.

1942. *Amerianna gabrieli* Cotton, Trans. Roy. Soc. South Austr., Vol. 66, p. 77, July 31. New name for *truncata*.

The two species are absolutely identical, and come from two rivers, adjacent, and with the same faunula. It is possible that the next is merely an ecological aberration, but is separable at present by its elevated apex, the others having the apex depressed. A specimen has been found in the Upper Clarence River, New South Wales.

AMERIANNA OBESULA, *nom. nov.*

1861. *Physa* (*Ameria*) *obesa* H. Adams, Proc. Zool. Soc. (Lond.), 1861, p. 144, September 16. Fitzroy River, Australia = Queensland. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. iii., sp. 24, February, 1873. Not *Physa obesa* De Kay, 1843.

Mr. H. Bernhard sent specimens from Yeppoon Lagoon with the tilted apex, and these seem distinct, but shells from the Burdekin River, further north, were figured by Sowerby as *truncata*.

AMERIANNA COMPAR, *sp. nov.*

Specimens from Lennard River, North-west Australia, are similar in shape to the Burdekin River shells, but differ in the flattened spire, which shows distinct concentric spiral striae; the height of the shell is 7 mm., the breadth 5.5 mm., the aperture 6.5 mm. by 3.5 mm., the shell very thin, colour fawn,

AMERIANNA REEVII.

1864. *Physa (Ameria) reevii* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 417, April 20, 1864. Arnheim's Land. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. vi., fig. 40, February, 1873.

AMERIANNA CUMINGII.

1861. *Physa (Ameria) cumingii* H. Adams, Proc. Zool. Soc. (Lond.), 1861, p. 144, September 16. Port Essington, Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. vi., sp. 44, February, 1873.

AMERIANNA BONUSHENRICUS.

1864. *Physa (Ameria) bonus-henricus* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 417, April 20, 1864. Arnheim's Land. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. v., sp. 38, February, 1873. Refigd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 293, pl. vi., fig. 29, 1882.

From Smith's account and figures this does not seem a typical *Amerianna*.

Genus OPPLETORA.

1938. *Oppletora* Iredale & Whitley, South Austr. Nat., Vol. xviii., p. 64, April 30. Haplotype, *Physopsis jukesii* H. Adams.

The truncate columella separates this at once from *Isidorella*.

OPPLETORA JUKESII.

1861. *Physopsis jukesii* H. Adams, Proc. Zool. Soc. (Lond.), 1861, p. 144, September 16. Port Essington, Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. ix., sp. 71, April, 1873.

Genus ISIDORELLA.

1896. *Isidorella* Tate, Rep. Horn Sci. Exped. Cent. Austr., pt. ii., Zool., p. 212, February. Orthotype, *Physa newcombi* A. Adams & Angas.

ISIDORELLA NEWCOMBI.

1864. *Physa newcombi* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 416, April 20, 1864. Ponds at Mount Margaret, Central Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. iii., sp. 21, February, 1873.

ISIDORELLA SUBINFLATA.

1874. *Physa subinflata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. i., sp. 5, fig. 6a (not fig. 5, fide Smith), November. South Australia.

1864. *Physa inflata* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1864, p. 39, June 24. Wakefield River, South Australia. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. i., sp. 4, November, 1874. Not *Physa inflata* Lea, Proc. Am. Phil. Soc., Vol. ii., p. 321, 1841.

1926. *Isidora newcombi hedleyi* Clench, Journ. Conch., Vol. xviii., p. 12, March. New name for preceding.

ISIDORELLA RUBIDA.

1882. *Aplexa rubida* Tate, Trans. Roy. Soc. South Austr., Vol. iv., 1881, p. 76, January, 1882, ex Southern Science Record, Vol. i., p. 136, August, 1881, *nom. nud.* Franklin Harbour, South Australia. Figd. Cotton &

Godfrey, South Austr. Nat., Vol. xiii., p. 160, pl. 2, fig. 7, "August" = September 30, 1932.

ISIDORELLA PILOSA.

1878. *Physa pilosa* Ten.-Woods, Trans. Roy. Soc. Vict., Vol. xiv., p. 63, July 11. (University Ponds), Melbourne, Victoria.

1878. *Physa crebriciliata* Ten.-Woods, loc. cit., p. 63. Caulfield, Victoria.

1886. *Physa ciliosa* Clessin, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth. xvii., p. 351, ex Martens MS. in synonymy.

1917. *Physa hirsuta* Hedley, Rec. Austr. Mus., Vol. xii., p. 7, pl. ii., fig. 21, December 19, ex Ten.-Woods MS., as types of *crebriciliata;* at the same place, fig. 19, the type of *pilosa* is figured.

ISIDORELLA BRAZIERI.

1882. *Physa brazieri* Smith. Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 286, pl. vi., fig. 22, April 6. Ashfield, near Sydney, N.S.W.

1882. *P. brazieri* var. *pallida,* id. ib. Chatsworth, N.S.W.

1886. *Physa contortula* Clessin, Syst. Conch. Cab. (Mart. & Chemnitz), ed. Kuster, Bd. I., Abth. xvii., p. 369, pl. 54, fig. 6. Australia.

ISIDORELLA MAJUSCULA, *nom. nov.*

1882. *Physa brazieri* var. *major* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 287, April 6. Burnett River, Queensland.

ISIDORELLA PHYSOPSIS.

1887. *Limnaea physopsis* Cooke, Journ. Conch. (Leeds), Vol. v., p. 243, pl. ii., figs. 1-4, November 12. Paroo Creek, River Darling, Australia.

ISIDORELLA FERRUGINEA.

1864. *Physa ferruginea* A. Adams & Angas, Proc. Zool. Soc. (Lond.), 1863, p. 416, April 20, 1864. Arnheim's Land. Figd. Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. iv., sp. 25, February, 1873.

[1866. *Physa (Isidora) hainesii* Tryon, Amer. Journ. Conch., Vol. ii., p. 9, pl. 2, fig. 9, January 1. Australia.]

1873. *Physa latilabiata* Sowerby, Conch. Icon. (Reeve), Vol. xix., pl. v., sp. 33, February. Victoria River, Northern Australia.

1886. *Physa schayeri* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xvii., p. 366, ex Troschel MS. as synonym. *P. schayeri* Paetel, Cat. Conch. Samml., p. 116, 1873, *nom. nud.,* "V.D.L." (where none of this group lives).

ISIDORELLA BRADSHAWI, *sp. nov.*

Many specimens collected by Mr. F. R. Bradshaw at Tambellup, South-western Australia, are well inflated, the spire medium, mouth free, umbilical chink present, sculpture of growth lines only, coloration brown. Height, 11.5 mm.; breadth, 11 mm.; height of aperture, 7.5 mm.; breadth, 6 mm.

ISIDORELLA MOOLA, *sp. nov.*

A series collected by Mr. K. H. Bennett at Moolah, west New South Wales, shows a species very distinct from *physopsis,* having an elevated spire, recalling more the *subinflata* style, brown in coloration, finely

reticulately sculptured, mouth free, small umbilical chink present. The shell measures 19 mm. in height, 13 mm. in breadth, the aperture 11 mm. by 8 mm.

ISIDORELLA MONTANA, *sp. nov.*

Many specimens collected at Jindabyne, 3,200 ft., Mount Kosciusko, New South Wales, recall *pilosa* Ten.-Woods, in their covering, showing a cancellate periostracum ruffed at the sutures, but differing by their produced spire. The shells reveals a slight cancellation also, but on the last whorl the growth lines dominate. The shell measures 17 mm. in height by 11 mm. in breadth, the aperture measuring 10 mm. by 8 mm.

Family PLANORBIDAE.

It is difficult to determine these small disc-like molluscs as in the latest very conservative British List, while only two genera are admitted, no fewer than six subgenera are admitted, and these are ranked higher by most other authorities. None of our species ranks with the large *cornea,* one of the types of *Planorbis,* but now the name has been allotted to a smaller shell. It is obvious that none of our forms is congeneric with either of the accepted *Planorbis,* so that we must introduce names for ourselves. There seems to be at least three recognisable series, a very small form with rounded whorls and small rounded mouth of southern range, which may be called *Pygmanisus, scottiana* Johnston being named as type. A second series also more common in the south is large, whorls still rounded, mouth oblique, but in the same plane almost free, typified by *tasmanicus* Ten.-Woods, and which is here called *Plananisus*; whilst the third of northern, as well as southern range, is strongly keeled peripherally, with the mouth oblique and discontinuous, the surface commonly spirally sculptured, and is the largest of the three. This is called *Glyptanisus,* and the type is *Glyptanisus ordessus* sp. nov., hereafter described. It may be that many other forms exist, as there has been little search for these small fresh water molluscs as yet.

PYGMANISUS SCOTTIANUS.

1879. *Planorbis scottiana* Johnston, Papers Proc. Roy. Soc. Tasm., 1878, p. 26, February 24, 1879. Launceston, Tasmania. Figd. May, op. cit., 1920, p. 70, pl. x., fig. 12.

The genus is apparently well distributed on the continent as, though Gabriel records only one locality in Victoria, it ranges as far north as Armidale in northern New South Wales.

PYGMANISUS LEONATUS, *sp. nov.*

Specimens have been collected at Canberra, Yass, and Goulburn, in southern New South Wales, and these differ from the Tasmanian species in smaller size, flatter spire and less developed sculpture. The shell measures 2 mm. in breadth by .75 mm. in height, sculpture of growth lines dominant. Shells from Cooma seem even less.

PYGMANISUS PELORIUS, *sp. nov.*

A different species occurs at Armidale, N.S.W., of fewer whorls, but still rounded, the mouth also rounded, the spire more sunken, the sculpture of growth lines only, the shell measuring 2 mm. in breadth by .5 mm. in height.

PLANANISUS TASMANICUS.

1876. *Planorbis tasmanicus* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 79, March 21, 1876. (Circular Head), Tasmania.

PLANANISUS MCCOYI.

1939. *Planorbis McCoyi* Gabriel, Mem. Nat. Mus. Melb., No. 11, p. 121, pl. iii., figs. 27, 27a, 27b, November, ex Ten.-Woods MS for Victorian shell described and figured as "*tasmanicus* Ten.-Woods."

PLANANISUS ISINGI.

1932. *Planorbis isingi* Cotton & Godfrey, South Austr. Nat., Vol. xiii., p. 162, pl. 3, figs. 9-10, August. Lake Alexandrina, South Australia.

Note:—*Planorbis obtusus* Sowerby, Conch. Icon. (Reeve), Vol. xx., pl. v., fig. 39, 1878, ex Deshayes MS, was described from Adelaide, South Australia. It does not appear to be an Australian shell, but in any case the name is invalid, being anticipated.

PLANANISUS MACQUARIENSIS.

1882. *Planorbis macquariensis* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 295, pl. vii., figs. 4-6, April 6. Macquarie River, New South Wales.

GLYPTANISUS MERIDIONALIS.

1875. *Planorbis meridionalis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 20, April 27. Ouse River, Tasmania.

1889. *Planorbis cathcarti* Petterd, Papers Proc. Roy. Soc. Tasm., 1888, p. 68, pl. i., figs. 4, 5, 6, in syonymy. Figd. May, Papers Proc. Roy. Soc. Tasm., 1920, p. 70, pl. x., fig. 11.

[1873. *Planorbis australianus* Paetel, Cat. Conch. Samm., p. 116, as of "Martyn." "Tasman." *Nomen nudum.*]

GLYPTANISUS ATKINSONI.

1879. *Planorbis atkinsoni* Johnston, Papers Proc. Roy. Soc. Tasm., 1878, p. 26, February 24, 1879. South Esk, Tasmania. Figd. May, op. cit., 1920, p. 70, pl. x., fig. 10.

GLYPTANISUS WATERHOUSEI.

1885. *Planorbis waterhousei* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xvii., p. 188, pl. 28, fig. 2. Clarence River, Australia = north New South Wales.

The shell figured by Gabriel (Mem. Nat. Mus. Melb., No. 11, p. 122, pl. iii., figs. 29a-b, November, 1939) from Portland, Victoria, under Clessin's name is certainly not this species, differing in the more rounded whorls, etc., and must be named *G. caroli* sp. nov.

GLYPTANISUS ORDESSUS, *sp. nov.*

A large series from the Chichester Dam, Hunter River district, shows a species of the strongly keeled series, the keel median, spire sunken, upper side of whorl round, lower side only subkeeled, sculptured, in addition to the fine growth lines, with distant concentric striae, measuring 3 mm. by 1 mm. in height.

GLYPTANISUS METAURUS, *sp. nov.*

Armidale, N.S.W., specimens differ in lack of concentric striation,

while the growth lines are very notable. The shell measures 3 mm. in breadth by 1 mm. in height, the medial keeling only prominent on the last whorl, the umbilicus wide, the mouth fairly large, oblique, and thin.

GLYPTANISUS GILBERTI.

1848. *Planorbis gilberti* Dunker, Proc. Zool. Soc. (Lond.), 1848, p. 40. New Holland (Gilbert). Figd. Sowerby, Conch. Icon. (Reeve), Vol. xx., pl. v., fig. 37, 1877. Refigd. Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 294, pl. vi., figs. 30-32, 1882.

This may be restricted to the Brisbane district, and specimens from Eidsvold, Queensland, be named *G. idenus* sp. nov., as they differ from Smith's account in their larger size, more descending mouth, more flattened base, less sunken spire, and finer sculpture. The shell measures 7 mm. in breadth by 2 mm. in height.

GLYPTANISUS BRAZIERI.

1885. *Planorbis brazieri* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth, xvii., p. 166, pl. 24, fig. 6. New name for

1882. *Planorbis fragilis* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 294, pl. vii., figs. 1-3, April 6, ex Brazier MS. Ipswich, Queensland. Not *Planorbis fragilis* Dunker, 1850.

GLYPTANISUS PLANISSIMUS.

1885. *Planorbis planissimus* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xvii., p. 165, pl. 24, fig. 7, ex Schmeltz, Mus. Godeffroy, Cat. iv., p. 69, 1869, *nom. nud.* Cape York, Queensland.

GLYPTANISUS DAEMELI.

1885. *Planorbis daemeli* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xvii., p. 189, pl. 28, fig. 6. Cape York, Queensland.

Specimens from Lilysmere Lagoon, Burdekin River, Queensland, are larger and flatter than *daemeli*, and in addition to a very fine concentric striation shows strongly marked growth ridges, giving the shell a distinctive striped appearance. The shell measures 7 mm. in breadth by 2 mm. in height. This species may be called *G. stabilis* sp. nov.

GLYPTANISUS ESSINGTONENSIS.

1882. *Planorbis essingtonensis* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 294, pl. vi., figs. 33-35, April 6. Port Essington, North Australia.

GLYPTANISUS HESPERUS, *sp. nov.*

Specimens from the Lennard River, North-west Australia, are smaller than the preceding, more tightly coiled, deeper, mouth smaller, strongly keeled medially, finely concentrically striate throughout, growth lines obsolete. The shell measures 4 mm. in breadth, 1.5 mm. in depth.

GLYPTANISUS CORANUS, *nom. nov.*

1896. *Planorbis fragilis* Tate, Rep. Horn. Sci. Exped., pt. ii., Zool., p. 216, pl. xix., fig. 23, February. Palm Creek, Central Australia. Not *P. fragilis* Smith, 1882.

GLYPTANISUS SPERANUS, *sp. nov.*

A series from Narrabri, Namoi River, N.S.W., shows a tightly coiled sunken apex, recalling *Segnitila* from above, strongly keeled medially, upper and lower surfaces somewhat subkeeled above and below, the concentric striation obscured by growth lines. Breadth, 5 mm.; height, 1.75 mm.

Genus SEGNITILA.

1938. *Segnitila* Cotton & Godfrey, Rec. South Austr. Mus., Vol. vi., p. 204, December 24. Orthotype, *Segmentina victoriae* Smith.

SEGNITILA VICTORIAE.

1882. *Segmentina victoriae* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 296, pl. vii., figs. 11-13, April 6. Victoria.

SEGNITILA AUSTRALIENSIS.

1882. *Segmentina australiensis* Smith, Journ. Linn. Soc. (Lond.), Vol. xvi., p. 296, pl. vii., figs. 7-10, April 6. Penrith, New South Wales.

SEGNITILA ALPHENA, *sp. nov.*

Specimens from Armidale, north N.S.W., are larger, with a narrower umbilicus and smaller mouth, and lack internal teeth. This seems to be the coastal form and is more like *victoriae* than the preceding, the umbilicus being only about one-fifth the width of the shell, measuring 1.1 mm. in a shell of 6 mm. width.

SEGNITILA OPPIDIA, *sp. nov.*

A smaller, more tightly wound species comes from Townsville, North Queensland, measuring 4 mm. in breadth by 1.5 mm. in depth, the umbilicus about one-fourth width, whorls five, very regularly coiled, last whorl not spreading, mouth fairly large.

SEGNITILA MENISCOIDES.

1882. *Planorbis meniscoides* Tate, Trans. Roy. Soc. South Austr., Vol. v., p. 53, December. Port Darwin, North Australia.

Genus GLACIDORBIS, *nov.*

A series of Planorbid collected by Mr. C. Hedley from 35 feet, Blue Lake, Mount Kosciusko, New South Wales, provides a distinct genus, the shell being small, thin, three whorled, evenly coiled, mouth round, free, umbilicus wide, spire sunken, no sculpture, save growth lines observed. Nearest *Pygmanisus*, but differing in the few whorls and greater depth to breadth.

GLACIDORBIS HEDLEYI, *sp. nov.*

The shell measures 2 mm. in breadth by 1 mm. in height, coloration fine rich brown.

Family ANCYLIDAE.

This family is probably unstable, as Bryant Walker has shown different groups, which even he, conservatively, regarded as of subfamily value. He would place some of our forms in connection with world-wide genera, not *Ancylus*, so that it will be better to use local names and prevent further confusion. The so-called "*Gundlachia*" seem to be aberrations, occurring under ecological conditions, as all the records appear to have been based on specimens from restricted localties. In order to keep this matter under

review, the two forms are kept separate in this List, but obviously our shells have nothing to do with the Cuban *Gundlachia,* whatever that may be.

Genus PETTANCYLUS, *nov.*

Type, *Ancylus tasmanicus* Ten.-Woods.

The distinction of the striate apex seems of little value phylogenetically, save in a local sense, and our southern *"Ancylus"* need not be classed with *Ferrissia* on that account.

PETTANCYLUS TASMANICUS.

1876. *Ancylus tasmanicus* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1875, p. 70, March 21, 1876. Hobart, Tasmania. Figd. May, loc. cit., 1920, p. 71, pl. x., figs. 15-16.

PETTANCYLUS MARIAE.

1902. *Ancylus mariae* Petterd, Papers Proc. Roy. Soc. Tasm., 1900-01, p. 1, June, 1902. Maria Island, South Tasmania. Figd. May, Illus. Index Tasm. Shells, pl. xli., fig. 21, 1923.

PETTANCYLUS AUSTRALICUS.

1880. *Ancylus australicus* Tate, Trans. Roy. Soc. South Austr., Vol. ii., p. 102, pl. iv., figs. 4a-b, December. River Torrens, Adelaide, S.A. Also misspelt *A. australis* B. Walker, Ancylidae Sth. Afr., p. 10, 1913.

PETTANCYLUS ASSIMILIS.

1884. *Aynclus* (sic) *assimilis* Petterd, Journ. Conch. (Leeds), Vol. iv., p. 159, January. Richmond River, N.S.W.

1884. *Ancylus oblonga* Petterd, id. ib., *nomen nudum.* Not *A. oblongus* Forbes & Hanley, 1853.

PETTANCYLUS SMITHI.

1890. *Ancylus smithi* Cox, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. iv., p. 658, pl. xix., figs. 1-3, February 3. Port Hacking River, National Park, Sydney, N.S.W.

PETTANCYLUS OCCIDENTALIS, *sp. nov.*

The Westralian Fresh Water Mollusca will prove as intriguing as the Land Mollusca as so little is known, and there seems to be numerous species. Mr. F. R. Bradshaw sent from Tambellup, S.W.A., a fine Ancylid, which is here named. Other specimens collected earlier at Rottnest Island by Mr. L. Glauert probably belong to another species, but these minute shells need intensive study. However, the Tambellup shell is distinctive, being 5 mm. in length, 3 mm. in width, and 2 mm. in height. The apex is situated at about one-fifth from the posterior margin, the long anterior slope being gently curved, the whole shell delicately radiately striate. The shape is a lengthened oval, posteriorly a little narrowed, the sides straight, almost parallel.

PETTANCYLUS IMPORTUNUS, *sp. nov.*

Specimens collected by Consett Davis at Dry River, Quaamaa, near Bermagui, New South Wales, are like *tasmanicus,* but larger, even more elevated, with the apex situated even further back, and as usual excentric. The shell is oval, the anterior slope long and curved, the posterior slope

steep and concave. There seems a little striation with the concentric growth lines well marked. The shell measures 3.5 mm. in length, 2.25 mm. in breadth, and 2 mm. in height.

PETTANCYLUS DEXTRENUS, *sp. nov.*

1882. *Ancylus australicus* Smith, Journ. Linn. Soc. (Lond.), Zool., Vol. xvi., p. 297, pl. vii., figs. 36-37, April 6. North Australia (collected during the Port Essington Expedition, October 14, 1844). Mis-recorded *A. australiensis* Martens, Zool. Rec., 1882, Moll., p. 83, 1883.

As shown in the figures this differs from the southern *australicus* Tate, in form, and especially in the position of the apex. It is possible it belongs to a different genus, along with the next species.

PETTANCYLUS EPENUS, *sp. nov.*

Specimens from the Barrier Ranges (Derby), North-west Australia, measure 4 mm. in length by 2.5 mm. in breadth, and 1.5 mm. in height, and are obliquely oval, with the apex excentric with a twist to the right. Odhner noted "Apex at posterior third, anterior slope more convex than Smith's figure, shell more depressed and apex to right."

PETTANCYLUS ENIGMA, *sp. nov.*

Vast numbers from the Chichester Dam, Hunter River district, show many small, rather stout conical shell, recalling *tasmanicus*, and many others larger, with more parallel sides, and many suggest a rest period, and continuation in the same mode, not opposed as in *"Gundlachia."* The adult measures 3 mm. by 2 mm. broad, is smaller, more oblong than *A. smithi*, and is finely radially striate throughout. The smaller shells seem more coarsely striate. A monographer might find many species of so-called *"Ancylus"* in this country, but they are difficult to collect owing to their small size and habitat.

Genus PROBLANCYLUS, *nov.*

Type, *Gundlachia petterdi* Hedley = *eremia* Cotton & Godfrey.

When Johnston introduced the Cuban genus *Gundlachia* into Tasmanian conchology, little was known about the group. There is not much more, although over half a century has passed. Hedley did not accept the view that *"Gundlachia"* was an ecological aberration of an Ancylid, but that may yet be proven. It is necessary to have a definite nomination in the meanwhile, so *Problancylus* is given for the southern capbearing Ancylid. Hedley gave good figures of the two Tasmanian species, and anatomical details of the South Australian species since named *eremia*. Though Bryant Walker regarded the radula of the Cuban *ancyliformis* as essentially similar to that of *Ferrissia*, and concluded that our Ancylids might be classed in *Ferrissia*, the Australasian radula formula appear very different. Thus Suter gives the formula of his *G. neozelanica* as 9 + 5 + 1 + 5 + 9, Hedley recorded the radula of *eremia* of South Australia as having 70 rows of 8 + 12 + 1 + 12 + 8, essentially different. As *woodsii*, classed as an *Ancylus*, is regarded as the young of *petterdi*, which was placed in *Gundlachia*, examination of the radula should solve the problem. It may be noted that Gabriel has recorded species of *Ancylus* as collected at every locality credited with *"Gundlachia,"* which is again suggestive.

PROBLANCYLUS PETTERDI.

1879. *Gundlachia petterdi* Johnston, Papers Proc. Roy. Soc. Tasm., 1878, p.

23, February 24, 1879 (Petterd Journ. Conch. (Leeds), Vol. i., p. 400, November, 1878, *nom. nud.*). First Basin, Launceston, Tasmania.

1879. *Ancylus woodsii* Johnston, loc. cit., p. 25. Figd. Hedley, Proc. Linn. Soc. N.S.W. (2), Vol. viii., pp. 505-514, pl. 24, figs. 1-3, June 5, 1894.

PROBLANCYLUS BEDDOMEI.

1888. *Gundlachia beddomei* Petterd, Papers Proc. Roy. Soc. Tasm., 1887, p. 41, pl. xliv.,. Brown's River Road, South Tasmania. Figd. Hedley, op. cit., pl. 24, figs. 4-6.

PROBLANCYLUS EREMIUS.

1938. *Gundlachia eremia* Cotton & Godfrey, Rec. South Austr. Mus., Vol. vi., p. 206, pl. xvii., figs. 2-3, December 24. Mount Lofty, South Australia. Figd. Hedley, op. cit., pl. 24, figs. 9-15.

Genus LEGRANDIA.

1879. *Legrandia* Legrand, Journ. Conch., Vol. ii., p. 95, March, ex Hanley MS. (*Legrandia* Legrand, 1872, as below, is a *nomen nudum*). Haplotype, *Ancylus cumingianus* Bourguignat.

1880. *Cumingia* Clessin, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xvii., p. 14, (recorded Z.R., 1880, Moll., p. 93). Haplotype, *Ancylus cumingianus* Bourguignat. Not *Cumingia* Sowerby, 1833.

1926. *Tasmancylus* Iredale, Nautilus, Vol. 39, p. 115. Orthotype, *A. cumingianus* Bourguignat. *Ancylastrum* Auct., not of Bourguignat, 1853.

LEGRANDIA CUMINGIANA.

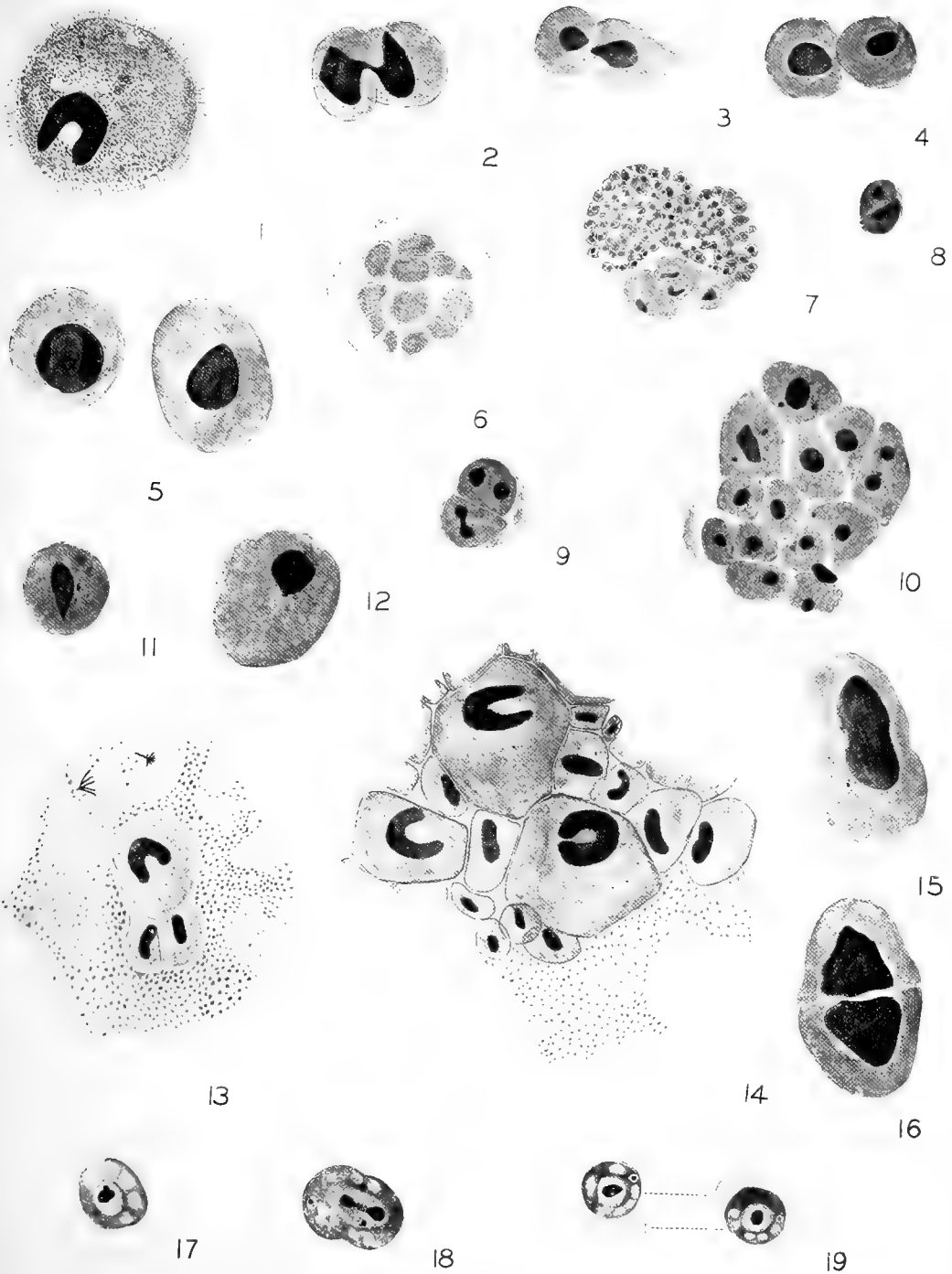
1854. *Ancylus cumingianus* Bourguignat, Proc. Zool. Soc. (Lond.), 1853, p. 91, pl. xxv., fig. 19, July 25, 1854 (ex Journ. de Conch., Vol. iv., p. 170, May 1, 1853, *nom. nud.*). Tasmania.

1872. *Legrandia maddocki* Legrand, Papers Proc. Roy. Soc. Tasm., 1871, p. 27, Report, ex Hanley MS. *Nomen nudum.*

LEGRANDIA IRVINAE.

1888. *Ancylus irvinoe* Petterd, Proc. Roy. Soc. Tasm., 1887, p. 40, pl. xliv. The Great Lake, Tasmania. Mis-spelt *A. vivinae* Zool. Rec., 1888, Moll., p. 66, 1889.

Perhaps each of the big lakes in Tasmania maintains its own special faunulae, as a specimen from Lake St. Clair, sent by Petterd, is ribbed as in the Great Lake species, but is much narrower and more elevated, measuring 12 mm. in length, 9 mm. in breadth, basally, the apex overhanging another millimetre, while the height is 8 mm. In order to induce investigation this is here called LEGRANDIA INSTIGATA, sp. nov.




ICHTHYOPHTHIRIUS MULTIFILIIS.

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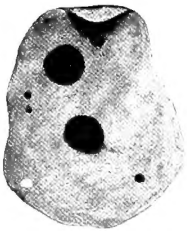

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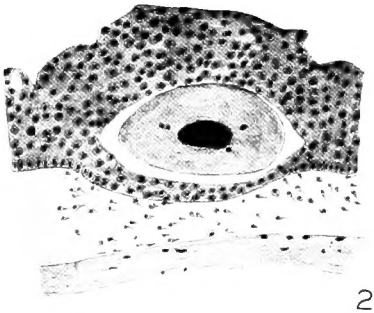

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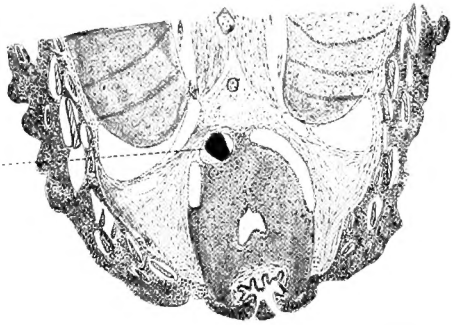


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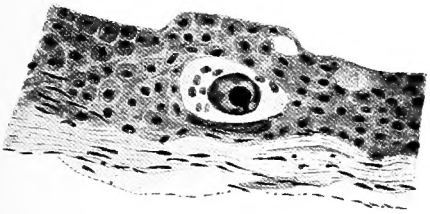

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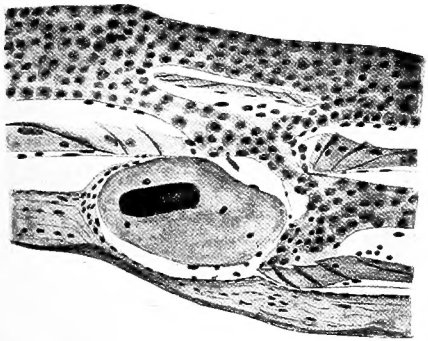

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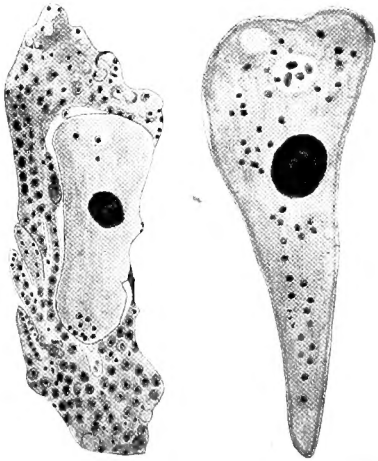

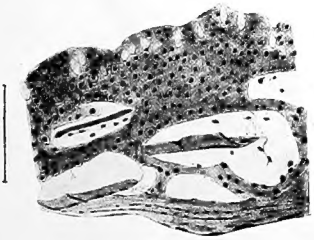

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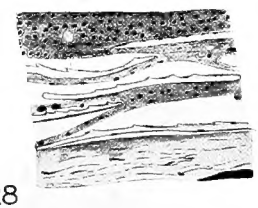

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ICHTHYOPHTHIRIUS MULTIFILIIS.

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