TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA

(INCORPORATED).

VOL. XXXII.

[WITH EIGHTEEN PLATES AND FORTY-TWO FIGURES IN THE TEXT.]

EDITED BY WALTER HOWCHIN, F.G.S.

PRICE, NINE SHILLINGS.

Adelaide:
W. C. RIGBY, 74, KING WILLIAM STREET.
DECEMBER, 1908.

Parcels for transmission to the Royal Society of South Australia from Europe and America should be addressed "per W. C. Rigby, care Messrs. Thos. Meadows & Co., 34, Milk Street, Cheapside, London."

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An Experimental Investigation of the Nature of the γ Rays.—No. 1.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide, and J. P. V. Madsen, D.Sc., Lecturer on Electrical Engineering.

[Received January 2, 1908; read May 5, 1908.]

In papers recently published in the "Proceedings of the Royal Society of South Australia" (May and June, 1907) and in the "Philosophical Magazine" (October, 1907) an attempt was made to show that the ether-pulse theory of γ and X-rays might prove to be incorrect after all, and that most of the known properties of these rays could be explained more simply and directly on the supposition that they were material and consisted of neutral pairs. The arguments were based on comparison of known phenomena with deductions from each of the two opposing hypotheses. At that time there did not seem to be any opportunity of appeal to a decisive experiment.

The object of this paper is to give a preliminary account of an investigation which appears to us to give a final answer as regards the γ rays, and to show that they are material in nature.

Secondary radiation, which is excited in an atom by a passing wave or pulse, must be distributed symmetrically with regard to a plane passing through the atom perpendicular to the direction of motion of the pulse. If we speak of the primary pulse as going forwards, the secondary radiation is just as likely to go backwards as forwards. This is a well-recognized principle. For example, J. J. Thomson divides the secondary radiation, due to γ rays, into two equal parts, which he supposes to move away symmetrically in opposite directions, and, for convenience of calculation, parallel to the direction of the primary rays (Cond. of Electricity through Gases, p. 406). Supposing, therefore, a pencil of γ rays to pass normally through a plate so thin that its absorption may be neglected, the secondary radiation should be exactly the same on the two sides of the plate—in amount, in quality, and in distribution; and it ought not to be possible to discover, by any comparison of the secondary radiations on the two sides, which is the face of entry and which of emergence.

Consider now the ionization-chamber represented in fig. 1. The two ends are closed by plates, of which A and A' are alike; so also are B and B'. The substance of A and A' is different to that of B and B'. The nature of the side walls is immaterial. A pencil of γ rays passes along the axis of the chamber, which is represented by a dotted line. The ionization current within the chamber is measured as usual by inserting a high potential electrode connected to an electroscope.

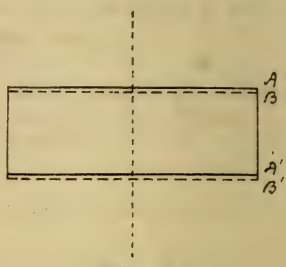

Fig. 1.

When the plates A and B are inverted, there is a change in the amount of the current; so also when A' and B' are inverted. By an extension of the principle already stated, it ought not to be possible, on the ether-pulse theory, to discover which way the rays are going, up or down in the figure, by comparing the consequence of inverting A and B with that of inverting A' and B'.

As a matter of fact, the direction can be discovered with ease; the more easily the greater the difference between the atomic weights of A and B.

For example, in one experiment of ours the chamber was of cylindrical form, 3 inches high and 10 inches diameter. The plates used were of aluminium and lead. The thickness of each plate was a little less than 2 mm. Inversion of the top plates A and B made a difference in favour of Al of less than 1 per cent., *i.e.*, the current was slightly larger when Al was next the chamber. On the other hand, inversion of the bottom plates made a difference of 44 per cent. in favour of Pb, *i.e.*, the current was 44 per cent. larger when the Pb was on top. The details are shown in the figure. Allowance was made for all radiation other than that which proceeded down the conical opening in the lead block.

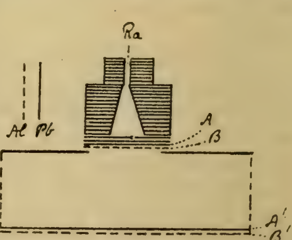

Fig. 2.

It may be well to point out that this effect cannot be ascribed to any complication due to secondary or tertiary rays. No doubt the radiation in the chamber is very complex; but the fact is immaterial. Provided that the chamber is symmetrical in the first place, then the secondaries must be symmetrical also if the ether-pulse theory is correct, and therefore the tertiaries and so on. Nor is it necessary to consider whether the secondary radiations are β rays or scattered γ rays. Also, it must be remembered that the secondary radiations which enter the chamber have their origin almost entirely in a very few millimetres of material bordering on the chamber. Therefore, the γ rays are in almost exactly the same condition, both as to quality and as to quantity, when they excite secondary radiations from the top plate as they enter the chamber, and secondary radiations from the bottom plate as they leave.

The details of the experiment may be varied greatly; but in all the cases we have tried the want of symmetry is obvious. In fig. 3 are shown the details of one other case, in which carbon and lead were the materials used, and the form of the

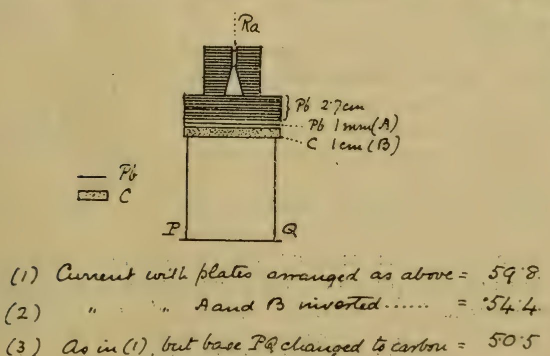

Fig. 3.

chamber was different. It seems unnecessary to give more, because, in the first place, the experiments are easy to repeat; and in the second place, the complete quantitative analysis of the figures depends on several factors, the influence of which is imperfectly understood, such as the previous screening of the rays, the form of the chamber, and the respective parts played by the original γ rays, cathode rays, and secondary γ rays, if any such exist. The experiments, as they stand, show how far away is that symmetry which the ether-pulse theory demands. It seems to us that there is no escape from the conclusion that the γ rays are not ether pulses.

Let us, therefore, proceed to consider the hypothesis that the γ rays are material. In the paper already mentioned, it was argued that they might well consist of neutral pairs, liable to be broken up on encountering atoms or parts of atoms; and that the secondary cathode radiations might be the negative particles thus set free. Let us suppose, provisionally, that the particles, when set free, move at first in the direction of the γ stream, but are subsequently scattered in the usual manner of β rays. [It is here that the absence of symmetry arises. On the pulse theory the particles should go equally backwards and forwards; indeed, if they were ejected by atomic explosions, the result of energy accumulated from passing pulses, as suggested by J. J. Thomson in the case of X-rays, they would move equally in all directions.]

Wigger gives a table (Jahrbuch der Radioaktivität, Bd. ii., p. 431) showing that the γ rays are absorbed according to a density law pretty strictly, except for small thicknesses of substances of large atomio weight.

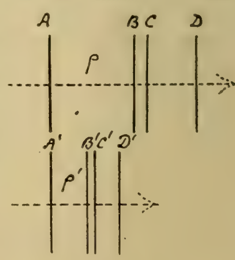

Fig. 4.

Assume this law to hold good, and also assume for the present that the absorption of β rays follows the density law. The latter is only roughly true, of course; but we may deal with quantities in a broad fashion first, and make the proper amendments afterwards. We can now compare the quantities of cathode radiation which should emerge from the far sides of two plates of different densities ρ and ρ'. Let these be represented by AD and $A'D'$ in the figure, and let BC and $B'C'$ be corresponding strata of equal weight: in fact, let $AB/A'B' = BC/B'C' = CD/C'D' = \rho'/\rho$. Let the plates be crossed by equal pencils of γ rays, as shown in the figure. A certain quantity of γ radiation is absorbed in crossing BC. In the language of our present hypothesis we should say that a certain number of γ particles are stripped of their positives, and the negative remainders go on. An equal number of negatives are set free in $B'C'$ because the two strata are of equal weight. Of those set free in BC only a certain number emerge from the face D, because of the absorption of the plate CD. Since CD and $C'D'$ are of equal weight, a similar absorption occurs in the case of the particles set free in $B'C'$. Thus the same number emerge from each plate. Integrating for all effective strata, the whole cathode radiations emerging from the two plates are equal.

We thus find that if the absorption of β and γ rays both followed the density law, the secondary cathode radiation on the far side of a plate—we may call it the "emergence" radiation—would be the same for all materials. There should be no such relation between the amount of the radiation and the atomic weight of the plate, as various observers have shown to be true for the secondary cathode radiation of "incidence," a relation which is closely parallel to that found in the case of β rays.

Experiment is in agreement with this theory, for it shows that no such relation exists in respect to the emergence radiations; in marked contrast to what happens in the case of the radiations from the front sides of plates of various materials, the incidence radiations.

It is true that the emergence radiations are not all equal, but this is to be expected, because (1) the amount of secondary cathode radiation depends, as Kleeman has shown, on the previous screening of the γ rays; (2) the β rays are not absorbed strictly according to a density law; (3) the γ rays also depart from this law. We have made no serious attempt as yet to disentangle the effects of these various disturbing factors. In fact, the task promises to be long and intricate, for it will be necessary to find out how much of the ionization in the chamber is due to each class of rays; to discover the law of distribution of the radiations in space, so that the form of the chamber may be allowed for, if necessary; to find out the nature of the departures from the density law of those β and γ rays which are in question; and so on. Nevertheless, the results are satisfactory, so far as we have gone. The amount of emergence radiation is found to depend on the previous screening of the rays. In one case the inversion of a C, Pb pair of plates from C, Pb to Pb, C, altered the current in the ratio 1 : 1·11 when the rays had been previously screened by Pb; but in the ratio 1 : ·96 when the screen was changed to C. Again, when the rays had previously passed through an iron screen, the inversion Pb Fe to Fe Pb changed the current in the proportion 1 : 1·12, but when a lead screen was substituted for an iron one the change was 1 : 1·04. In illustration of the effect of the second disturbing factor mentioned above, we have found that, other things being equal, the substances of small atomic weight give the most secondary radiation, in a general way; and it may be no coincidence that in some cases we have found Sn and Fe to give surprisingly small amounts. This is in agreement with what is to be expected, for it is clear, on consideration of the argument already given, that the greater the β ray absorption of a substance in proportion to its density, the less "emergence" radiation should issue from it. Some observers have found Sn and Fe to possess exceptional absorbing powers. We do not wish, however, to lay any stress upon these last observations, some of which we may not have interpreted correctly; but we mention them in order to show that the inequalities that are found to exist between the emergence radiations of various substances promise to be reducible to order as soon as the difficulties of interpretation have been surmounted.

Let us now consider the cathode radiations on the front sides of the plates. Of the cathode particles set free in BC and moving at first in the direction of the γ rays, a certain proportion, say p, is returned by what is beyond. These move towards the face A, and a certain number of them succeed in reaching it and emerging therefrom. In the case of the other plate the proportion returned is p'. The absorption in $B'A'$ is the same as in BA, because the weights are the same. Comparing the two plates, stratum by stratum, we find that the "incidence" radiation of one plate is to the incidence radiation of the other plate as p to p'. Now p and p' are the well-known constants of the β rays.

When a stream of γ rays is allowed to fall upon a plate the cathode radiation which issues from the place of incidence must be divisible into two parts. One consists of scattered β particles derived from the stream of such particles which was travelling with the γ rays before incidence, and which was formed during the previous transit of the screens employed, solid, liquid, or gaseous. This part is scattered to an extent which depends on the atomic weight of the plate, according to the usual law of β particles. The other part is originated in the plate itself in the manner just described, and the amount of it is also regulated according to the β ray law. When, therefore, observers have measured the secondary radiation, due to γ rays, and have found a law corresponding to that for β rays, the reason of the correspondence has been that they really were measuring the secondary radiation due to β rays. Properly speaking, the secondary radiation, produced by γ rays, or, rather, *from* γ rays, is proportional to the density of the substance traversed (*cf.* Wigger's table), and this is only another form of the law of absorption of γ rays.

The relative importance of the two parts of the incidence radiation just mentioned must depend on the circumstances of the experiment.(1) The researches of Kleeman (Phil. Mag., Nov., 1907) show very well how the second part, which is influenced by previous screening, modifies the effect of the

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(1) In a recent letter addressed by one of us to "Nature," too great a preponderance was assigned to the first part under all circumstances.

first part, which is not so influenced, but which follows the law of β rays strictly.

It is easy to show, by comparing corresponding strata at the front and back of one plate, that the incidence radiation should be somewhat less than p times the transmitted radiation. Somewhat less, because the cathode radiation, which is turned back, is scattered and softened in the process.

To sum up:—On the ether-pulse theory we ought to find perfect symmetry in the secondary radiations from the two sides of a plate. But experiment shows nothing of the kind.

On the material or neutral-pair theory, the "incidence" radiations should follow the β ray law. This is known to be the case. The emergence radiations should not follow the β ray law, and experiment shows that they do not. If the density law held for both β and γ rays, and if the γ rays were homogeneous, the emergence radiations should all be equal. As already explained, experiment shows that the observed inequalities give promise of ready explanation, on the ground that no one of these suppositions is quite true.

It is, perhaps, better not to extend the preliminary account of these experiments by any lengthy discussion of the issues arising from them. Many points that invite consideration have been discussed already in the papers first referred to. Moreover our own further experiments are incomplete, and their full interpretation is not yet certain. We will, therefore, confine ourselves to one or two questions which seem of special interest. The X-rays resemble the γ rays so closely that it is practically inconceivable that the two radiations should be essentially different. The secondary cathode radiations, which are set free when X-rays impinge on any material, must therefore have been part of the X-ray stream, and must start their independent existence by moving on in the line of the X-ray motion. Their velocity is much smaller than that of the secondary cathode rays due to γ rays, and they are much more readily scattered. It may still remain an open question whether or no the X-ray stream contains ether pulses. Perhaps their existence must be supposed in order to explain the velocity experiment of Marx, and the diffraction experiment of Haga and Windt. Possibly they are also required in order to explain Barkla's polarization experiments: but we do not think that the experiment described by Barkla in "Nature" (October 31, 1907) is in any way decisive.

It seems proper to consider a possibility that the negative particle, when it moves on in the original line of motion of the pair from which it came, retains also its original velocity. It is a striking fact that the cathode particle, due to the γ rays, has the same speed, very nearly, as the β particle issuing from the original radioactive material. And it looks quite unlike a coincidence that similar comparisons can be made in the case of the X-rays. The secondary cathode radiations due to these rays have velocities which, at the least, are of the same order as the velocities of the cathode particles in the X-ray bulb. If we examine the table given by Innes (Proc. Roy. Soc., Aug. 2, 1907, p. 461), and if we may be allowed to adopt an interpretation differing somewhat from the author's, but more natural, it seems to us, in view of the conclusions of this paper, we find that the velocities of the electrons emitted by all the metals are practically the same, zinc being an exception, because it is unable to break up the hardest rays. We find that the velocities range from about 6×10^9 to $7 \cdot 5 \times 10^9$ for soft rays, and 6×10^9 to 8×10^9 for hard rays. Remembering that bundles of X-rays are very heterogeneous, the natural conclusion seems to be that the softest rays give the slowest speeds, and that the velocity of the secondary rays increases with the hardness of the X-rays from which they are derived.(2) Now the hardness of the rays grows with the speed of the cathode particles in the bulb. Is it then possible that the cathode particle is first set in motion by the electromotive force in the bulb, strikes the anticathode, and picks up a positive there, becomes neutral, and is now called an X-ray, is subsequently stripped of the positive, and becomes a secondary cathode particle, the identity of the negative remaining the same throughout, and its speed invariable, or nearly so? The difficulty comes in when we try to consider the part played by the mass of the positive. Probably it becomes necessary to consider it as small compared to the mass of the negative. In many ways such a supposition would fit in very well. We should then understand why the positive is so hard to isolate: also a radioactive atom, in ejecting a γ particle would not lose appreciably in weight. Lilienfeld believes he has found the positive electron to be less massive than the negative. (Deutsch. Phys. Gesell. Verh., 9, 7, April 15, 1907.)

And, again, may not the β and γ forms be interchangeable at times? A γ particle, which had been stripped of its positive, and become a secondary cathode, or β ray, would be lost to measurement as a γ ray; and we should thus have an explanation of how the γ rays are "absorbed," and why the absorption follows an exponential law. And in the same way, if a β particle picked up a positive, it would disappear from view as a β particle, it would be "absorbed."

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(2) By independent experiment, Bestelmeyer (Ann. d. Phys., xxii., p. 429, 1907) and Cooksey (Amer. Jour. of Science, Oct., 1907) arrive at the same conclusion.

Although we have made a few experiments with magnetic fields, we have not yet come to any conclusions as to whether or no there are γ pairs which have become loosened in the attachment of positive to negative, forming a softer and more ionizing radiation. Their existence might be suspected since there is an analogous effect in the case of X-rays; and probably they would be found more at the back of the penetrated plate than in front of it.

A few further experimental illustrations are shown diagrammatically in Figs. 5-7, with the explanations attached.

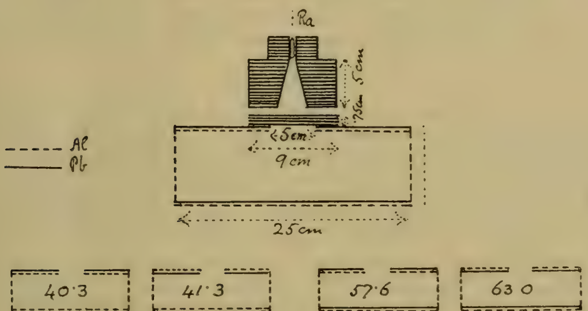


Fig. 5.

The upper figure shows the general arrangement. The lower figures are diagrammatic, and show the currents for different arrangements of the Pb and Al at the bottom of the chamber, and at the top, with the exception of the plate through which the γ rays enter. Inverting the top plates makes little difference where the upper of the two plates at the bottom is Al, but an appreciable difference when it is Pb, because in the latter case a good deal of secondary radiation is thrown upwards by the Pb, and there is a tertiary from the top plate.

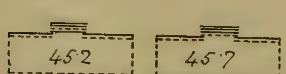
The same, when the conical opening is completely filled by a Pb stopper:—

12·6	12·6	17·7	18·3

The differences show the effects of those rays only which do not pass through the Pb stopper:—

27·7	28·7	39·9	44·7

———



The same, with Pb stopper inserted :-

14·1 14·7

Fig. 6.

These show the effect of inverting that portion only of the top plate where the γ rays enter. Three Pb plates = ·55 cm., Al plate = ·16 cm.

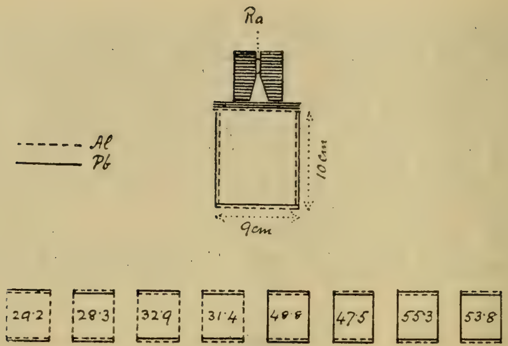


Fig. 7.

The upper figure shows the general arrangement. The wall of the cylindrical vessel was of brass; a Pb or an Al lining could be inserted as shown. The lower figures are diagrammatic, and show the currents for different arrangements of Pb and Al at top, bottom, and sides. Inversion of the plates, *through* which the γ rays pass into the chamber, makes little difference; but there is a great alteration if the material is changed on which the γ rays fall, or the emergence radiation from the top plate. The base is of less importance than in fig. 5; but the sides of more importance. This should clearly be so, for geometrical reasons.

When the conical opening was filled by a Pb stopper, the currents were all reduced considerably, but retained the same proportions pretty nearly.

On the other hand, when a small pencil of β rays was admitted through a hole in the centre of the top plate, a change of the material of the bottom became more effective, and of the sides less effective than before; but this difference became smaller when thin Al sheets were so placed as to scatter the β rays on their entry into the chamber.

In conclusion, we should like to add that Wigger was the first, so far as we know, to show clearly that the secondary radiation of Al, on the far side of the plate, might be greater than that of Pb. A comparison of the emergence radiations of different metals was made by Dawes (Phys. Rev., xx., p. 182), who showed that they did not follow the law of the incidence radiations. The same effect was indicated in the experiments of Eve (Phil. Mag., Dec., 1904). We have little doubt that the interesting experiment of Mackenzie (Phil. Mag., July, 1907) is to be explained on the lines indicated in this paper. In fact, it is clear that this is the case in a broad sense; but it is difficult to give a complete explanation until the laws are so completely worked out that they can be applied to the interpretation of experiments, which are really very complicated, although at first sight they may seem to be simple.

DESCRIPTION OF A NEW SPECIES OF ORCHID.

By R. S. ROGERS, M.A., M.D.

[Read November 5, 1907.]

Prasophyllum occidentale, sp. nov.

Plant.—A somewhat dwarfed species, varying from 5 to 8 in. in height; the fistula in the sheath placed high up, sometimes immediately below the spike. Leaf-lamina greatly exceeding the spike, extending in my smallest specimen $4\frac{3}{4}$ in. beyond the fistula, and in my tallest 6 in. beyond this point. The spike not crowded, consisting of from ten to fourteen green flowers.

Flowers.—Lateral sepals about 3 lines long, slightly bidentate, united except in their distal fourth. Dorsal sepal somewhat shorter ($2\frac{1}{2}$ lines), erect, acuminate, concave. Lateral petals narrow-lanceolate, very slightly shorter than dorsal sepal.

Labellum.—Sessile, about 2 lines long, reflexed about the middle, tip acuminate; membranous portion fairly wide and slightly crenulated, callous part continues a short distance beyond the bend; does not protrude between the free tips of sepals.

Column.—Middle lobe quadrangular. Lateral appendages about same height as rostellum; unequally lobed, the smaller one being given off about middle of appendage. Stigmatic plate speckled in my specimens.

I found this orchid growing close to the shore at Streaky Bay on September 26, 1907. Only four specimens were collected, and three of these were seeding, so that it should be looked for at the beginning of the month.

It bears a superficial resemblance to the Western Australian form, *P. macrostachyum*, from which, however, it may be distinguished by its relatively long and narrow petals, by the extent to which its lateral sepals cohere, and by the great length of its leaf-lamina.

There is no recorded member of the genus in this State with which it is likely to be confused, unless it be *P. fuscum*. In this species the lateral sepals are free, whereas in the new form they are connate, a feature which at once makes the diagnosis easy.

The Ionization Remaining in Gases after Removal from the Influence of the Ionizing Agent.

By J. P. V. Madsen, D.Sc., B.E.

[Read April 7, 1908.]

Introduction.

In a paper by Professor Bragg and Mr. Kleeman,(1) a theory of initial recombination was advanced to explain the cause of the lack of saturation in gases exposed to the action of the α particles of radium. The effect was found to be due to the immediate action between a parent molecule and the electron which was ejected from it as a result of the ionizing influence of the α particle. It was shown that it was easy to reconcile with this theory the result of an experiment described by Professor Rutherford,(2) which suggested that it is easier to obtain the saturation current in a gas when the gas is quickly removed from the influence of the ionizing agent before testing. Rutherford's experiment would, of course, indicate that the process of initial recombination would be completed in a very short time after a molecule had been ionized. However, as explained in a later paper by Professor Bragg,(3) it was not essential to the theory of initial recombination that the process should be completed within any set time, in which case many important considerations would result.

The author undertook the repetition of Rutherford's experiment, and the non-success of some preliminary attempts led to the further suggestion that for a certain length of time it was conceivable that the positive and negative ions might remain in a state of incomplete combination, their final recombination being precipitated by some change of conditions. The existence of such partially combined pairs of ions would help to explain much of the mechanism of phosphorescence, and would appear to have some connection with the clusters described by J. B. B. Burke,(4) which were the product of ionization, and gave rise under some conditions to phosphorescent glow, contained energy, and yet were not electrified.

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(1) Trans. Roy. Soc., S.A., vol. xxix., 1905.

(2) Phil. Mag., vol. 47, p. 158.

(3) Phil. Mag., May, 1906.

(4) Phil. Mag., vol. i., p. 342, 1901.

Again, in some experiments described by C. D. Child [5] upon the arc through mercury vapour, clusters very similar in nature to those described by Burke are met with, and their behaviour was only explained on the hypothesis that recombinations between positive and negative ions were not always complete or stable, and that the clusters so formed were, under suitable conditions, readily broken up, giving rise to ionization.

It may not be out of place at this point to remark that the nucleus of such clusters might possibly be formed either by the partial recombination of a positive and a negative ion which have each had time to become attached to neutral molecules of the gas or by the immediate partial recombination of a parent molecule and the electron ejected from it by the process of ionization.

Just as this paper was near completion the results of an investigation by Von Erich Barkow [6] came to hand, in which the existence of neutral pairs of ions, evidently produced in the former manner, offers a ready explanation of the effects observed.

It was, however, more with the idea of finding out whether a cluster is formed in the latter way that the work of this present paper was carried out. When two oppositely charged ions, approaching each other, are at a distance apart "r" (in the present case "r" is of the order of the molecular free path), the particles will revolve in closed orbits around each other, if the kinetic energy due to their relative motion is less than $\frac{e^2}{r}$ (e being the charge on an ion). An electrical field will tend to disturb this motion, and it is one of the purposes of the present paper to decide whether some such state of semi-combination can persist for an appreciable time, and a separation of the ion be eventually effected by an electrical field, or by a field conjointly with other causes.

Returning to the experiment described by Rutherford, little detail information is given in regard to the apparatus used. It is stated that instead of measuring the current with the uranium oxide covering one electrode, the air which had passed over the uranium was forced between two concentric cylinders between which the electromotive force was acting. It seemed probable that the apparatus described by him earlier in the same paper (p. 144) had been used, in which air, after passing through cotton wool and over the uranium surface, was forced through a wire gauze, and then between

(5) Phys. Rev., vol. xxii., pp. 221-231, April, 1906.

(6) Annalen der Physik, p. 317, No. 7, 1907.

two cylinders of 2·8 and 1·6 cms. diameter respectively, a potential difference of 32 volts between the cylinders being found sufficient to completely remove all the ions from the gas. The distance of the gauze from the central electrode and the size of gauze used are not definitely stated. It will be

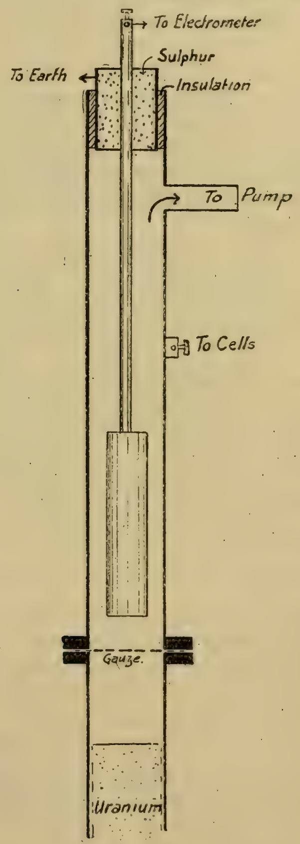

Fig. 1.

shown in the present paper that the form of the saturation curve obtained in such an apparatus depends largely upon these two latter factors, as well as upon the potential difference between the cylinders, and also their size.

In attacking the question of the ionization in gases after their removal from the action of the ionizing agent, two direct methods suggest themselves. In the first place, ionized gas may, as in Rutherford's experiment, be blown into a chamber in which the ions are to be collected by an electric field. In this case care must be taken to enable the ions to be passed rapidly into a uniform electric field, so as not to subject them at first to a weaker field.

To pass the ionized gas through a fine gauze as Rutherford did would appear the most convenient method to adopt in such a case, although, as will be shown later, it by no means, in all cases, approaches the ideal condition.

In the second method, the ionizing agent may be allowed to act upon the gas which is enclosed in a suitable ionization chamber, and then either the chamber or, what is usually more convenient, the ionizing agent may be removed before the electromotive force is applied between the electrodes.

Both these methods have been used in the present investigation.

Since the shape of the ionization curve obtained in the presence of the ionizing agent is found (7) to depend upon the effects of both general and initial recombination, it is important, no matter which of the above methods is used, in comparing the saturation curves with and without the presence of the ionizing agent, to eliminate the effects of general recombination. Also, diffusion of the ions to conducting surfaces would produce many of the effects which one might expect to be shown by clusters which could be separated by a sufficiently intense field.

§ 1.

The Action of Gauzes.

The first experiments were carried out with an apparatus as shown in fig. 1. Air was used in these experiments, and after passing through a plug of cotton wool was drawn by a water-pump, with suitable pressure regulator, at a speed of 10 cms. per second, over the surface of uranium oxide. Thence it passed through a gauze and between two cylindrical electrodes of 2 cms. and 4 cms. diameter respectively. The outer electrode was connected to a set of small accumulators, the other terminal of the cells being connected to earth. The central electrode was 10 cms. in length, and was supported in a sulphur plug, which in turn was protected by an earthed ring. By suitable keys the central electrode could be connected either to the electrometer or to earth. A Thompson Quadrant Electrometer was used, giving a deflection of 75 scale divisions per volt.

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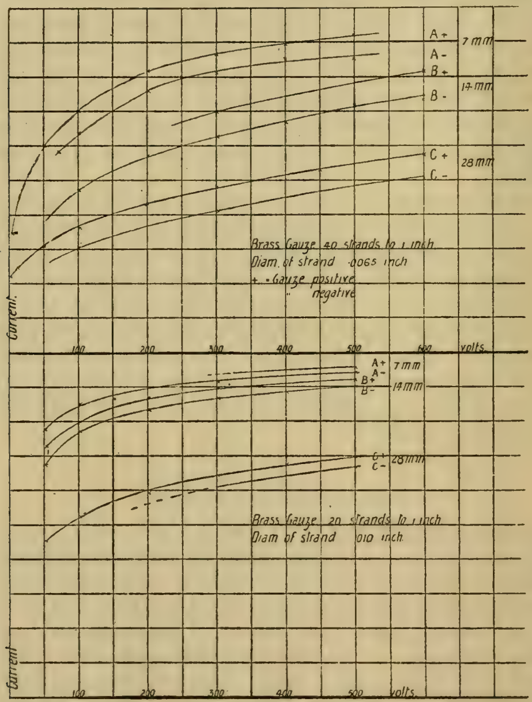
(7) Bragg and Kleeman, Trans. Roy. Soc., S.A., vol. xxix., 1905.

As a similar form of apparatus has been frequently employed where the introduction of a gauze suggested a ready means of localizing the field which was to be used for collecting the ions which were blown along a tube—as, for example, in the experiments of Townsend [8] upon diffusion of ions and [9] in experiments upon the ions which are produced from flames, etc.—it is of some additional interest to know what effects may arise from the introduction of such a gauze. A short account will therefore be given of some preliminary ex-



Figs. 2 and 3.

periments in which the size and nature of the gauze and the distance between the central electrode and the gauze were varied.

The curves, fig. 2, show the results of experiments with a brass gauze having 40 strands to the inch, two sets of wires being interlaced at right angles to each other, each wire

(8) Phil. Trans. Roy. Soc., cxcii., A 1900, pp. 129-158.

(9) Langevin and Block, Comptes Rendus, cxxxix., 1904, p. 792.

being of ·0065 inches diameter. The curves ($A+$), ($B+$), (C+), show the relation between the potential difference of the electrodes, and the corresponding electrometer deflections per 0·5 minute for distances of 7, 14, and 28 mm. between the gauze and the flat end of the central cylindrical electrode, the gauze being positive to the central electrode. The curves ($A-$), ($B-$), ($C-$), are corresponding curves obtained when the gauze was negative. Fig. 3 shows similar curves using a brass guaze with 20 strands to the inch, each wire being ·010 in. in diameter.

Table A.

Material.	Strands per in.	Diameter of Wires, in.	Deflection for 400 volts. / Deflection for 50 volts.
Brass × ...	20	·010	1·4
Brass × ...	11	·0185	1·25
Brass × ...	14	·015	1·33
Brass × ...	40	·007	1·7
Iron × ...	14	·013	1·25
Iron × ...	21	·016	1·34
Galv. Iron ×	14	·0135	1·26
Copper ‖ ...	16	·013	1·14
Copper ‖ ...	32	·013	1·5

× Represents crossed wire-mesh gauzes.
‖ Represents parallel wire gauzes.

A large number of other gauzes were similarly tested, including some which were built in the form of grids, with one set only of straight wires arranged parallel to each other. As figs. 2 and 3 are, however, typical, the results obtained with some of the other gauzes are given in Table A in terms of the deflections per 0·5 minute at potential differences of 400 and 50 volts respectively between the cylinders with the central electrode in all cases 28 mm. from the gauze. The state of the surface of the gauze was found to have little effect, even when the gauze was wetted, and in the case of iron allowed to rust slightly.

At intervals during each set of experiments the draught was stopped and a reading taken of the amount of ionization which entered the chamber independently of the draught. No special precautions were taken to dry the air, and on one or two occasions the amount of ionization produced by the uranium showed changes which were apparently due to slight dampness of the uranium surface. This accounted for the reduction in the amount of ionization which was observed on such occasions, as the path of the α particles through the gas would be slightly reduced.

It will be observed in both figs. 2 and 3 that there is no very close approach to saturation, although the approach is much closer in fig. 3 than in fig. 2, even when large potential differences are applied between the electrodes. The results with the gauze positive are in all cases larger than with the gauze negative. Also, the number of ions reaching the central electrode in a given time decreases for any given value of potential difference between the cylinders, as the distance

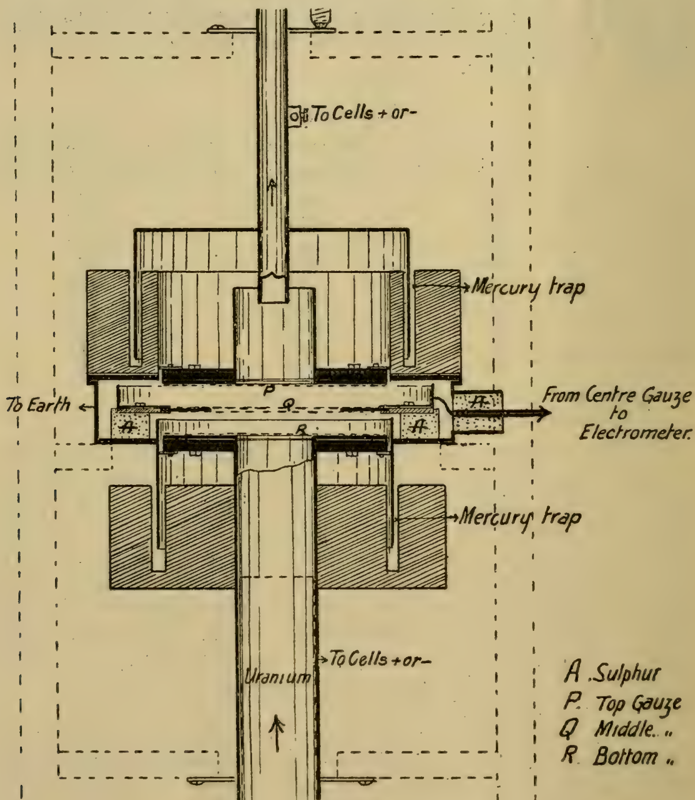


Fig. 4.

between the gauze and the end of the central electrode is increased. When, therefore, even very large potential differences are maintained between the electrodes, the number of ions which reach the central electrode in a given time may give a very false measurement of the number of ions which actually reach the gauze in that time.

It appears from the curves that it is the strength of field in the immediate neighbourhood of the gauze and not so much the actual difference of potential between the inner and outer cylinders that determines the number of ions received by the central electrode. As in the experiments so far described, this field was by no means uniform, it was decided to re-design the apparatus so as to provide for this condition.

An apparatus as shown in fig. 4 was constructed, having three gauzes set parallel to each other with their planes at right angles to the axis of the tube. The central gauze, to which the electrometer was connected, consisted of a brass gauze with 20 strands to the inch, each wire being ·01 in. in

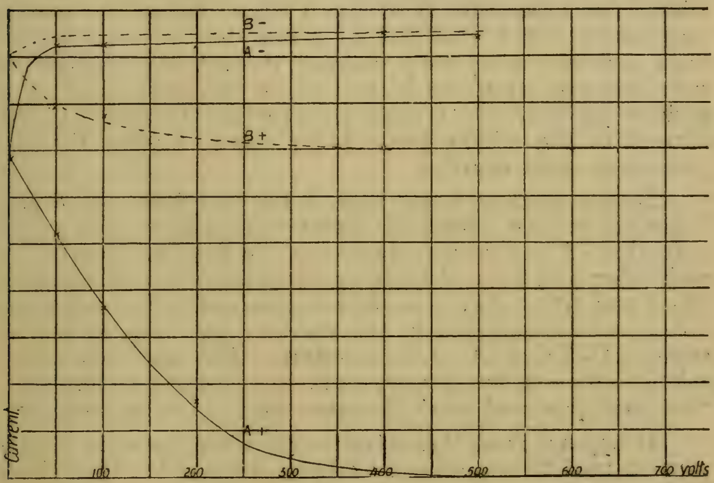


Fig. 5.

diameter, soldered to a thin metal ring and carefully attached to a ring of sulphur in such a way as to allow the air to pass only through the gauze. Earthed metal rings, as shown in the diagram, were found necessary to protect the sulphur from the direct influence of the high-potential plates. On each side of this middle gauze were arranged gauzes which could be easily replaced, and so that their distance from the middle gauze could be varied. In the first set of experiments these gauzes were of brass with 40 strands to the inch, the distance between the top and middle gauzes being 6·5 mm., that between the bottom and middle gauzes 7·5 mm.

In fig. 5, curve ($A -$), is shown the effect of varying the potential applied to the top gauze, always, however, keeping it negative, while maintaining the bottom gauze at a negative potential of 41 volts. A draught of 10 cms. per second was maintained as in the earlier experiments. It will be seen from the curve, that with 50 volts applied to the top gauze, a much larger current passes to the middle electrode than when the top gauze is connected to earth; but that further increases in the potential of the top gauze cause very little further increase in the current. Curve ($A+$), in the same figure, shows how the current varies when the bottom gauze is still maintained at a potential of -41 volts, but with the potential of the top gauze varied through a range of positive values. With the bottom gauze at -41 volts, and the top gauze at $+500$, practically no current passed to the middle electrode—that is to say, a large number of negative ions which would otherwise be drawn to the middle electrode are now completely dragged through it. Similar results occurred when the bottom gauze was maintained at a positive potential of 41 volts, the greatest diminution in the current to the middle gauze being observed when the top gauze was made negative.

To prevent any interaction of the two fields above and below the middle screen, the gauze was replaced by a screen consisting of two gauzes, similar to the first, set parallel to each other and at a distance apart equal to 2 mm. Curves ($B-$) and ($B+$), fig. 5, were then obtained by following out the procedure described in the previous test, from which the curves ($A-$) and ($A+$) were derived. The same type of result is obtained, but greatly reduced. Single gauzes with finer mesh produced much the same effect as the double gauze.

It appears from these results that when the wider single gauze is used for the central electrode, some of the ions which it should apparently stop are blown completely through it, and more the wider the gauze; but that these are collected by the gauze when the field in the top chamber drives them with sufficient force against the draught. If, then, the top gauze be of the same sign as the bottom gauze, any field in the top chamber greater than about 100 volts per cm. ensures practically all the ions being caught by the middle electrode. In subsequent experiments the top chamber was always so arranged, and the screen of two gauzes was used as the central electrode.

The strength of field in the lower chamber was varied and corresponding currents measured. Curves were obtained for depths of bottom chamber, 7·5 mm., 11·5 mm., and 23·5 mm., respectively. The capacity was determined by an auxiliary condenser in each case, and after correcting the readings for the slight alterations in capacity produced by the change in position of the gauzes, the curves for the different width chambers were found to practically coincide for all except very weak fields.

When, therefore, the bottom gauze is negative, we may conclude that for fields stronger than 50 volts per cm. very few, if any, positive ions penetrate far into the bottom chamber through the lower gauze; otherwise, effects due to recombination in that chamber should have been observed clearly when the depth of the lower chamber was varied. The smaller values of current, obtained when the bottom gauze was negative and the top positive, were due to the action of the field in the top chamber, more particularly its arrangement in the immediate vicinity of the wires of the middle gauze.

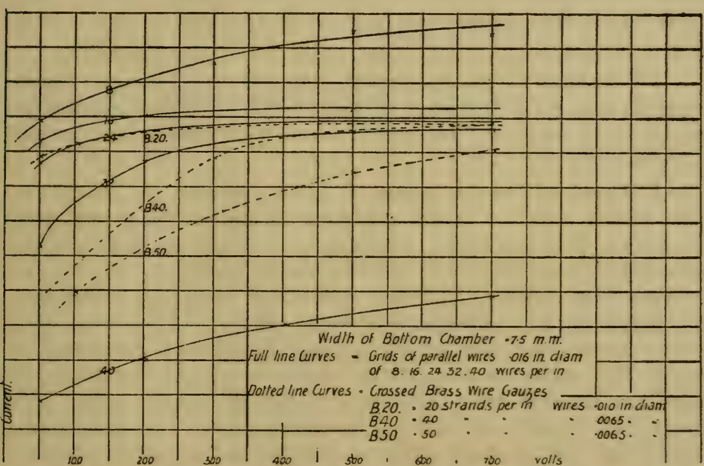


Fig. 6.

In fig. 6 are shown the results obtained with different gauzes for the bottom electrode, and varying fields applied to the lower chamber; the field in the top chamber being maintained, in all experiments, at 100 volts per cm., arranged in such a direction as to prevent the escape of the ions through the middle gauze. The depth of the lower chamber was 11 mm.; the dotted curves are for bottom gauzes of crossed strands of 50, 40, and 20 meshes to the inch respectively. The full line curves are for bottom gauzes made of copper-wire ·016 in. in diameter, set parallel, and equidistant from each other, and of 8, 16, 24, 32, and 40 wires to the inch respectively.

The crossed gauzes give results falling very well into line with those from the paralled wire grid, in which the smaller the mesh the harder it was to obtain saturation. It is notable that with all the intermediate gauzes an approach is shown to the same value of maximum current as the field strength is increased. With very fine gauzes very intense fields would seem necessary to drag all the ions through the gauze, while with gauzes much broader than about 16 to the inch ions are apparently readily drawn from distances considerably below the gauze.

All the curves given were obtained from results of experiments in which the bottom gauze was positive. When it is made negative, and the top gauze also negative, very little difference is found in curves for strong fields: with weak fields the values obtained with the gauze positive are as a rule slightly higher than with the gauze negative.

Of numerous gauzes tested, the 20 to the inch crossed brass gauze, with diameter of strand ·01 in., gave the nearest approach to an early saturation, and was used in subsequent experiments.

Rutherford, in his paper already referred to, has shown that gauzes exert a large influence in discharging ions from gas blown through them; he finds that the effect depends, apparently, upon the ratio of the space occupied by the air between the meshes, and the extent of metal in the gauze. As, however, his experiments were performed with a field acting upon one side of the gauze, it seemed necessary to repeat the experiments with no field acting on the gauze, as from the experiments described above it would seem that under this condition the discharging power of the gauze should be even greater than as determined by Rutherford.

The experiment was arranged so that gauzes could be set parallel to and ·5 cm. below the bottom gauze of the chamber used in the previous experiments. A field of 300 volts per cm. was applied to the lower side of the electrometer gauze and 100 volts per cm. above it, thus preventing ions from escaping through the electrometer gauze. Readings of the current were taken with and without the gauze which was to be tested, in position. The ratio of these two readings was taken as a measure of the discharging power of the gauze.

In fig. 7 are plotted the results for parallel grids corresponding to Table B. There appears a certain value of the ratio—air to metal surface—below which the discharging power rises very rapidly. This effect is similar to that which would result from considering the gauze as a limiting

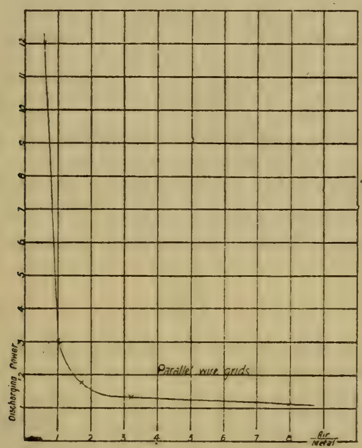


Fig. 7.

TABLE B.

Discharging Powers of Gauzes.

Material.	Strands per inch.	Diam. of Wires, in inches.	Distance between Wires, in inches.	Air. / Metal.	Discharging Power.
Copper ‖ ...	8	·016	·127	8·0	1·1
Copper ‖ ...	16	·016	·050	3·2	1·3
Copper ‖ ...	24	·016	·027	1·7	1·75
Copper ‖ ...	32	·016	·016	1·0	3·0
Copper ‖ ...	40	·016	·010	·6	12·0
Copper ‖ ...	16	·013	·054	3·8	1·25
Copper ‖ ...	32	013	·020	1·4	2·12
Brass × ...	11	·0185	·072	1·0	1·35
Brass × ...	15	·0155	·051	1·0	1·5
Iron × ...	14	·013	·058	1·3	1·5
Iron × ...	17	·010	·05	2·6	1·45
Iron × ...	17	·013	·046	1·18	1·8
Iron × ...	20	·018	·032	·7	2·7
Brass × ...	20	·010	·04	1·2	1·65
Brass × ...	25	·0095	·03	1·1	2·5
Iron × ...	26	·0245	·0245	·6	3·85
Brass × ...	40	·007	·018	1·1	5·45
Copper × ...	120	·0025	·037	1·2	49·0

× Represents crossed mesh gauzes.
‖ Represents parallel wire grids.

case of a set of parallel tubes of small diameter as used by Townsend in his experiment upon the diffusion of ions.

Comparing these results with those of fig. 6, it is seen that, taking for comparison the brass gauze of 40 meshes per inch, each wire, ·007 in. diameter, and the brass gauze of 20 meshes per inch, each wire ·010 in. diameter; although their discharging powers are as 5·45 to 1·65, nevertheless with a field of 700 volts per cm., applied to their upper surfaces, exactly the same number of ions are drawn through each. Again, twice the number of ions are drawn through the parallel wire gauze having 24 strands to the inch, as through the similar wire gauze having 40 strands per inch—when a field of about 1,060 volts to the cm. is applied in each case—although their discharging powers are respectively 1·75 and 12.

§ 2.

Returning to the result shown in fig. 5. It has so far been assumed that the effects observed were due solely to the intensity and distribution of the field around the wires of the middle electrode. A question, however, suggests itself as to whether the whole, or only part, of the diminution in current which is observed when the fields on either side of the middle gauze are in the same direction is due to the withdrawal of ions from the lower chamber; for when the two fields are opposed in direction no ions cross the top chamber, while when the fields are in the same direction, some apparently do cross it.

It seemed conceivable that there still might be something akin to partially combined sets of ions which, although unaffected by the weaker field of the lower chamber, produced ionization in the top chamber under the influence, not merely of an intense field, but as the result of ions moving in an intense field, through clusters such as have been already suggested. This would also explain the lack of saturation shown in the curves of fig. 6.

An experiment was performed in an independent apparatus. Two ionization chambers, provided with aluminium windows, through which Rontgen rays could pass, were balanced electrically against each other. Through the one was drawn air which had been just previously subjected to the influence of either radium or uranium, the ionization having been subsequently removed by a weak field; through the other chamber a supply of air was drawn at the same speed. No alteration in the balance could be observed.

Again, a ring of copper-wire was made active by exposure to thorium emanation, and placed on the upper surface of the middle gauze. Readings were taken—*(a)* With the copper ring active, and air which had previously passed over the uranium surface drawn through the chamber. *(b)* With the ring active, but the uranium removed, and still using the draught. *(c)* With air passed over the uranium surface after the activity of the ring had disappeared. The results showed that the amount of ionization produced by the copper ring in air was the same as in the air which had just previously passed under the influence of uranium.

Again, had the want of saturation, shown in the curves of fig. 6, been due to the presence of clusters, or partially combined pairs of ions, an alteration of the shape of these curves might have been expected if the number of ions was reduced without altering the number of clusters. No alteration in the shape of the curves could, however, be detected when the uranium was moved some distance further from the gauze, or even when the ionization was still further reduced by placing along the axis of the tube leading to the gauze a wire maintained at a few volts difference of potential from its surroundings.

Recently a paper by M. de Broglie [9a] has appeared, in which tests similar to those just described have been performed upon the gases coming from flames. His results are in agreement with the foregoing in so far that no clusters are found when water vapour is not present.

Having found no support to the cluster theory, we must look to diffusion for an explanation of the curves in fig. 6. The distortion of the field in the immediate neighbourhood of the wires of the middle gauze and its penetration through the wider gauzes have accounted for the results shown in fig. 5. The came cause, in gradually preventing diffusion of the ions to the lower side of the bottom gauze, will explain the difference in shape of the ionization curves obtained with broad- and with narrow-mesh gauzes, also the approach, in many cases, to the same final value of current, as the field strength is increased.

One difficulty which arises in the foregoing explanation is that while the field exerts its influence through the air spaces of the bottom gauze, if the gauze be positively electrified, negative ions will, of course, be more readily drawn to the lower surfaces and sides of the wires of the gauze than if the gauze were uncharged; and positive ions should, apparently, be similarly repelled with a force which depends upon the strength of the field. Now, it is known [10] that when a

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[9a] Le Radium, tome iv., No. 7, July, 1907.

[10] J. J. Thomson, Elements of Electricity and Magnetism.

positively charged body of small size is brought very close to a body of much larger dimensions similarly charged, the repulsion which normally exists reduces in value to zero and changes to an attraction when the small charged body is brought within a certain critical distance of the surface, this distance depending upon the charges on the small body and the surface, respectively, and on the curvature of the surfaces. This seems to offer the explanation of the marked difference which exists in the shapes of the ionization curves obtained with broad- and with narrow-mesh gauze, as the field strength is varied; for in the case considered positive ions are blown by the current of air against the lower gauze surface, which is but weakly electrified when the field in the chamber above is weak. As the field in the chamber is increased the fringe, which passes through the gauze, is strengthened, and the force which is exerted upon the positive ions by the draught is not sufficient to bring them to within the critical distance of the lower surface of the gauze to cause attraction. As the positive ions in air are larger and more massive than the negative, it is to be expected, when the lower gauze is negative, that for a given field in the chamber above, less negative ions would be received by the electrometer gauze than in the corresponding case where the bottom gauze is positive. This, we have seen, does occur when the field is weak. Since, when a strong enough field is applied, the same maximum value of current is obtained, whether the bottom gauze be positive or negative, and also for a large range of gauzes exposing very different amounts of surface, the most natural conclusion is that under such circumstances all the ions of one sign which reach the lower surface of the gauze are drawn through the gauze without loss in number and are then collected by the central electrode.

§ 3.

It has been shown by Bragg and Kleeman that the lack of saturation in a mixture of air and ethyl-chloride is considerably greater than for air. Their theory of initial recombination explains this difference, and one of the objects in view at the commencement of the present experiment was to decide whether such an effect persisted for a time after the act of ionization by an α particle had been completed.

As the results so far obtained show the difficulty there exists in eliminating the effects of diffusion when the ions are blown through gauzes, a comparative test between the behaviour of such a vapour as ethyl-chloride and air seemed as much as could at the time be safely derived.

It was arranged to pass a mixture of ethyl-chloride with a small proportion of air from one gasometer through the gauze chambers which have been described in fig. 4 to a second gasometer. A gauze was inserted, and enabled the draught to be carefully adjusted during each observation. Readings were taken with the lower gauze at potentials of 50 and 600 volts respectively. The depth of the chamber was 11 mm. The mean value of the ratio of the readings with the fields of 555 volts per cm. and 45 volts per cm. was found to be the same for the mixture of ethyl-chloride and air as it was for air only, its value being 1·05. Nitrous oxide was similarly tested, and gave a similar result. The velocity of the gas through the chamber was, in these experiments, about 5 cm. per second. The uranium was 5 cm. below the bottom gauze, so that approximately two seconds elapsed before the products of ionization from the centre of the uranium cylinder reached the gauze. Change in velocity of the draught was found to have no appreciable effect upon the result. The experiment indicates that air, ethyl-chloride, and nitrous oxide, although giving distinctly different ionization curves when the ionization is measured in the presence and during the influence of the ionizing agent, show no difference in behaviour from each other when the ionization is collected from them after their removal for a period of two seconds or more from the influence of the ionizing agent.

§ 4.

It was now deemed advisable to make use of the second method of experiment, as mentioned in the introduction.

The general arrangement of the experiment was such as to allow the α radiation from radium to act for some little time upon the gas to be experimented upon, this being enclosed in a suitable ionization-chamber, and both electrodes meanwhile being connected to earth. A lead screen was quickly interposed between the radium and the chamber; the electrometer electrode was simultaneously disconnected from earth, and a strong field immediately applied between the electrodes. The field was left on for a time, sufficient to ensure all the ions to reach the electrodes. It was then removed, and the charge, which had been collected on the insulated electrode, was measured by a quadrant electrometer. The radium bromide was held in a small metal cup placed at A (fig. 8) some little distance below the floor of the ionization-chamber B. This chamber consisted of a brass case connected to earth; in its floor was cut a circular opening of 1·2 cm. diameter. The hole was covered by a thin sheet of mica, F, which rendered the case gas-tight, but was thin enough to enable the α radiation to penetrate between the

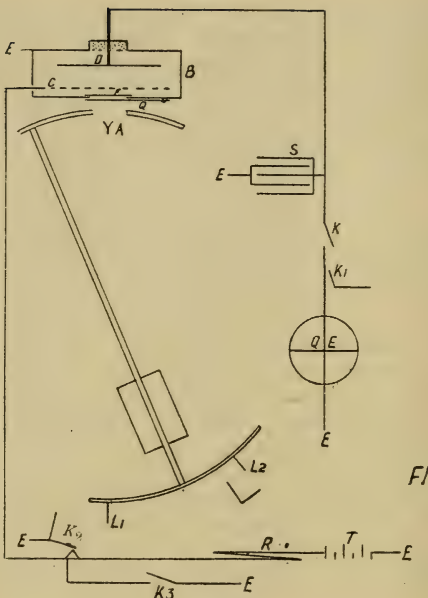

Fig. 8.

electrodes. For introducing gas to the chamber a metal plug was provided, which could be screwed into the opening below the mica, and while air was being exhausted from the chamber a small screw, operated from the outside, enabled a by-pass to be opened between the space on either side of the mica sheet. The lower electrode, *C*, consisted of a brass gauze insulated from the case, attachment to it being made from the outside by an insulated wire. The upper electrode, *D*, consisted of a brass plate 8 cm. diameter, supported by a rod passing through sulphur insulation and being connected to one set of plates of a sliding condenser as in the experiments of Langevin.(11)

An aluminium semaphore, *G*, enabled the α rays to be entirely shut off, when necessary, during the swing of the pendulum without reducing to any great extent the β and γ radiation which entered the chamber. A plate of lead, *H*, about 2 mm. thick, attached to the pendulum, was arranged so as to swing between the radium and the opening in the ionization-chamber. In this lead plate was cut a hole 1·5 cm. square, and the amplitude of swing was such that the α rays

(11) Ann. de Chim. and Phys., 7me ser., tome 28-39, 1903.

could pass into the chamber only for a short period during the motion of the pendulum. The pendulum at the same time operated a contact K_2 by means of the pin L_1, and this operation connected the electrode, C, to a high potential derived from the small accumulator cells, T, joined in series with a high resistance, R. Prior to the movement of the pendulum these cells were connected to earth through the key, K_2. A second pin, L_2, attached to the pendulum, operated another key in such a way as to complete an auxiliary circuit which released a second pendulum at a definite instant. This second pendulum, after an interval of 1.25 sec., operated a second relay, which connected the electrode, C, to earth by means of the key, K_3.

The pins, L_1 and L_2, could be set in any position upon the pendulum, and by this means the field between the electrodes, C and D, could be applied at any definite instant during the swing of the pendulum, and removed after always the same lapse of time, viz., 1.25 sec. With the range of field strength employed, this time was sufficient to allow for the collection of all the ions which had been produced by the α particles crossing the chamber.

The distance between the electrodes, C and D, was adjustable. To make the effects of ordinary recombination small it was advisable to keep the distance between C and D small, but as this decreased the volume of gas which could be ionized, it was found necessary to work with a distance between the electrodes of 1·8 cm.

To perform an experiment, the pendulum, having been drawn to one side and held by means of a catch, the lead plate, H, was set so as to screen the chamber from the radium, the keys, K, K_1, K_2, being closed, make contact to earth, the key K_3, being left open. The second pendulum was drawn aside and held in position by a clutch. The condenser was closed. By means of electromagnets the main pendulum is released, and at the same time the key K raised. The pin, L, is set so that the gauze, C, is not electrified until the lead screen, H, again shuts off the radium; L_1 and L_2 then strike their keys respectively at the same instant; C is thus electrified, and the second pendulum set swinging. The first pendulum is caught at the end of its swing. When the second pendulum has accomplished its swing it causes the key, K_3, to be closed, and the gauze C is thereby connected to earth.

A constant interval of 4 sec. was now allowed before opening the condenser, S—this for each reading—and at the end of that time the electrometer was disconnected from earth by K, and the key, K, closed. The charge communicated to the electrometer was measured in terms of the first and second swings by the formula deduced by Langevin, i.e., $\theta = \frac{\epsilon^1 + m\epsilon}{1+m}$ where θ is the charge communicated to the electrometer, and ϵ and ϵ^1 are the first and second swings, and m a factor which in this case had a value of ·65. Even with the sliding condenser it was not possible to eliminate small effects due to rise of potential in the system, D, when the gauze, C, was electrified.

To make sure that this effect as well as leakage was eliminated by subtracting readings with the semaphore on and off a separate experiment was performed. The pin, L, was set so that the field was on all the time the chamber was exposed to the a radiations. Results of experiments with the semaphore on and off were subtracted. The curve obtained showed close agreement with that obtained with the pendulum removed (and the saturation curve obtained in the ordinary manner) and formed a valuable check upon the reliability of the whole apparatus.

In this form of experiment ordinary recombination is not eliminated, and to allow for it we must consider the arrangement of the ions in the chamber, as they cross it under the influence of the field. As shown by Langevin, if in the first place the ions be assumed to be uniformly distributed

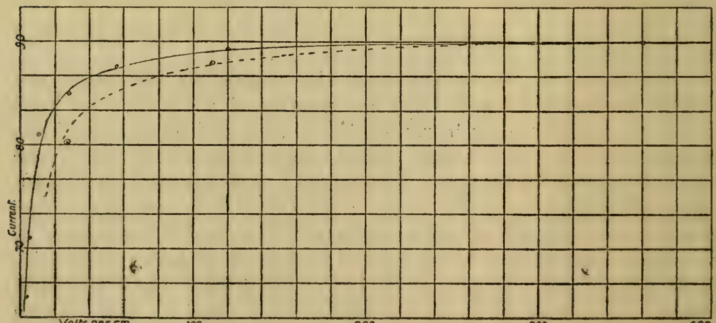

Fig. 9.

and the velocity of the positive and negative be v cm. per sec. under unit $P.D.$ (per. cm.), the time taken for an ion to move across the chamber from electrode to electrode $= \frac{L}{v}$ where L is the distance between electrodes. If time be reckoned from the instant the field is applied, after an interval of time $\frac{L}{2v}$ recombination will have ceased. The number of ions lost by recombination in crossing the chamber will be $\alpha \int_0^{\frac{L}{2v}} l\, n^2\, dt$ where N is the density of the ions in the space of length, l, at a time, t, from the start:

$$\alpha \int_0^{\frac{L}{2v}} (L - 2vt) \left(\frac{N}{1 + N\alpha t}\right)^2 dt = NL - \frac{2v}{\alpha} \log_e \left(1 + \frac{N\alpha t}{2v}\right)$$

Hence a curve can be plotted as in fig. 9, showing the relation between field strength and the number of ions which reach the electrode starting with a given initial density.

In fig. 9 the full line curve is drawn according to the formula which has just been deduced, the value of N being determined in the usual way from a knowledge of the value of the saturation current, the capacity of the system, and the dimensions of the ionization chamber. The value of the N was $5 \cdot 10^6$ ions per cub. cm. The circles show the results of experiments upon air, and it will be seen that they fall very nearly upon the theoretically determined curve, showing that ordinary recombination is sufficient to account for the observed effects. However, it is necessary to show that the effect due to initial recombination was large enough to be detected had it been present.

Using for comparison currents at field strengths of 390 and 80 volts per cm., it will be seen from the curves given by Bragg and Kleeman, in their paper upon "Initial Recombination," that between these values of field strength a very considerable percentage of initial recombination is observable when the ions are collected in the presence of the ionizing agent; but the exact amount depends upon the speed of the α particles producing the ionization. By removing the pendulum and obtaining saturation curves in the ordinary manner with the apparatus used in the foregoing, it was found that after allowing for the effect of ordinary recombination there remained between these values of field strength a rise of about 5 per cent., due to the effects of initial recombination. This amount was such as could have been readily detected in the pendulum experiments.

As the time which elapsed between the stopping of the action of the ionizing agent and applying the field in these experiments was 1-20th sec., it appears then that no evidence can be obtained from the experiments of the non-completion of the act of initial recombination in air within a period of 1-20th sec. after the act of ionization.

Similar experiments were next performed upon ethyl-chloride. The experimental results are shown on the dotted diagram by (o); again it is seen that ordinary recombination accounts for the results.

By a separate set of experiments, as previously described, it was found that between the values of field strength 390 and 80 volts per cm. a rise of 9 per cent. was to be expected from the pendulum experiments in the case of ethyl-chloride, if the effects of initial recombination had been present. This, again, was of such a magnitude that it should have been readily detected.

In the cases, therefore, of air and ethyl-chloride, which both show large effects due to initial recombination when the ions are collected by a field during the action of the ionizing agent, no such effect can be observed when the field is applied as soon as 1-20th sec. after the act of ionization is performed; the act of initial recombination being fully completed within this period.

§ 5.

Having now shown that effects of initial recombination do not last an appreciable time, it seemed possible, by means of the apparatus described in fig. 4, to obtain an independent verification of the theory of initial recombination. For since the arrangement of the gauze in that apparatus made it possible to obtain a measure of the number of ions which reach the lower gauze in any given time, it was to be expected, if the ionizing agent were placed, first, above the lower gauze, and directly in the ionization chamber; and, secondly, just below that gauze, with a current of gas carrying the ions into the chamber; that, after making proper allowances for the effect of ordinary recombination in the latter case, the current obtained in the first case should be much greater than in the second.

For the purpose of obtaining a steady draught, and at the same time to work under any pressure with different gases, the apparatus of fig. 4 was slightly modified. The tubes were placed horizontally, and the gas was circulated by means of a piston moving in a long cylinder, the ends of which communicated to corresponding tubes leading from the ionization chamber. The piston could be moved at a very uniform speed by means of a suitably geared electro-motor. The ionizing agent consisted of a small quantity of radium, enclosed in a lead cell. A V-shaped slit 1·2 cm. deep, with parallel faces ·75 mm. apart, restricted the α rays to a fan-shaped space on emerging from the cell. The cell was placed so that the slit was in a plane perpendicular to the axis of the ionization chamber, and a small sliding door cut in what has been so far called the lower gauze of the chamber enabled the cell to be introduced when necessary. The air was carried across the radium cell and through the ionization chamber with a velocity of 7 cm. per sec. A thin aluminium sheet, sufficient to stop all the α particles, could be moved over the slit when required, and the difference between the readings without and with this sheet over the slit gave a measure of the ionization produced by the α particles.

In a particular experiment with a piece of tinfoil covering the radium, equivalent to about 1·5 cm. of air at atmospheric pressure, and working under a pressure of two atmospheres, the saturation current with the radium in the ionization chamber corresponded to a deflection of 80 scale divisions in 10 sec. With the radium 8 mm. from the gauze, and with a draught of 7 cm. per sec., the current was 53 scale divisions per 10 sec. Thus the loss of ions in the first ·115 sec. after the ionization was produced = 34 per cent. By increasing the pressure and determining the saturation current with the radium placed directly in the ionization chamber it was possible to determine the greatest density of ionization which had been produced in the previous experiment. An increase of pressure equivalent to a shortening of the range of the α particles by ·34 mm. gave a decrease in current corresponding to 3·0 scale divisions per second.

The section at the opening of the slit was ·08 cm. × 1 cm., the capacity of the system 125 cm., and the electrometer gave a deflection of 340·0 scale divisions per volt. Thus, $4{\cdot}1 \times 10^8$ ions are produced per cub. cm. per second just beyond the slit. The greatest density produced, therefore, in the air as it is blown across the slit is $4{\cdot}7 \times 10^6$ ions per cub. cm. Now, if we suppose all the ionization to be of this same density, the number of ions which will disappear by ordinary recombination in the period ·115 sec. is 36 per cent. The actual number as found was 34 per cent.; it is, therefore, seen that to account for the 34 per cent. difference in ionization which has occurred after ·115 sec., if we are to suppose it due entirely to ordinary recombination, a value equal to that of the maximum density must be assumed for the whole of the ionization. Now it is clear, not only from the geometry of the beam of radiation which is used, but also from the fact that the ionization proceeding from a small heap of radium bromide decreases with the distance from the radium, that the density of ionization in the beam must reach values very much smaller than the maximum. Since the loss due to recombination depends upon the square of the density, the experiment described indicates the existence (in addition to general) of a process of initial recombination, which is completed within a very short period after the act of ionization.

Summary.

Experiments upon ionized gas blown through gauzes are in agreement with the theory of Bragg and Kleeman, that there exists an initial recombination between a molecule ionized by α rays and the ejected electron or electrons.

Two methods of experiments described show no trace of such effect when the gas is examined 1-10th—1-20th of a second after the act of ionization.

Initial recombination is thus to be considered initial in respect to time.

The action of gauzes, electrified or unelectrified, upon ionized gases blown through them is to be explained by the aid of the theory of diffusion.

An arrangement of gauzes as herein described allows of the removal by an electric field of all the ions of one sign from a very defined region in a tube along which the ions are carried by a current of gas.

The ionization produced in air by Röntgen rays or by a wire made active by exposure to thorium emanation is the same in air which has just previously passed under the influence of uranium radiation as in air not so treated.

In conclusion, I wish to express my indebtedness and sincere thanks to Professor Bragg for suggesting these experiments, and for much advice and help during their progress.

University of Adelaide, 1907.

An Experimental Investigation of the Nature of γ Rays.—No. 2.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide; and J. P. V. Madsen, D.Sc., Lecturer on Electrical Engineering.

[Read May 4, 1908: a preliminary summary was given on April 7.]

In a previous paper (Trans. Roy. Soc. of S.A., 1908, p. 1) we have given a preliminary account of an investigation of the properties of the secondary radiation due to γ rays, and discussed the evidence thus afforded as to the nature of the rays. The first section of the present paper contains an account of further experiments, and the second a list of the properties of the secondary radiation, derived in part from the work of other observers, and in part from our own. In the third we have tried to show that the properties are readily explained if the γ rays are supposed to be material, but are not easily to be reconciled with the ether-pulse hypothesis.

§ I.

In the former paper we showed that on the neutral-pair hypothesis the connection between the amount of secondary β radiation emitted from the front side of a plate struck by γ rays and the atomic weight of the material of the plate should be approximately the same as for the β rays. It is, of course, known that this is actually the case. Also, we showed that the β radiation emitted from the other side of the plate, the side from which the γ rays emerge, should be the same for all substances, provided three things were true, viz.: —

(1) The γ rays were homogeneous;
(2) The γ rays were absorbed according to a simple density law;
(3) The β rays were also absorbed according to such a law.

If these laws did not hold, and to the extent to which they did not hold, the "emergence" radiation would not be the same for all substances.

The experimental evidence which we submitted showed that the emergence radiation was not connected with the atomic weight of the material by the same law as that which held for the incidence radiation and for β rays: that it was much more nearly the same for all substances, and that such differences as existed (*e.g.*, carbon generally gave more than lead) appeared to be proper, in view of the conditions stated above. As the results we had obtained seemed to be sufficient to give a criterion between the material and the ether-pulse theories, we thought it right to publish the details of the work as far as we had carried it.

We have now made a more thorough investigation of the nature and amount of emergence radiation. We believe that we are in a position to connect together all the effects attendant on the absorption of the γ rays, and the consequent production of β rays, to a first approximation at least. Included in these effects are some which have come to light during this work, the neutral-pair theory having led us to their discovery.

It is not a very easy thing to obtain an exact measure of the emergence radiation. When a stream of γ rays is shot into an ionization-chamber through a plate forming one of the chamber walls, a very large proportion of the ionization produced is actually due to the emergence rays of the plate. But if the plate is taken away, the place of these rays is supplied, to a varying extent, by secondary rays, made in the air or emergent from the last substance traversed by the rays. A normal stream of γ rays always contains β rays; if these are stopped by a screen, fresh β rays emerge from the other side of the screen. It is impossible, therefore, to measure the emergence rays by subtracting the value of the current when the above-mentioned plate is not in position from the value when it forms part of the chamber wall. Such an operation might conceivably show a negative emergence radiation.

It is, in fact, necessary to remove the β rays from the stream of γ rays by some means which is more effective than a screen. A powerful magnetic field can considerably purify the γ-ray stream for a short distance along the path. Owing to the action of the air, β rays will reappear again in measurable amount after the rays have traversed a few centimetres; nevertheless, we have found the method to be fairly satisfactory so far, and will doubtless be able to improve it when better information is available for the calculation of the remaining errors. The method has already been employed by G. Kucera (Bulletin International de l'Académie des Sciences de Bohême, 1905), but it was finally abandoned. because the magnetic lines of induction penetrated the ionization-chamber, and affected the paths of the secondary β rays, and therefore the magnitude of the current. We therefore placed a thick iron screen (2·5 cm.) between the magnet and the chamber; the γ rays passed through a hole in the iron.

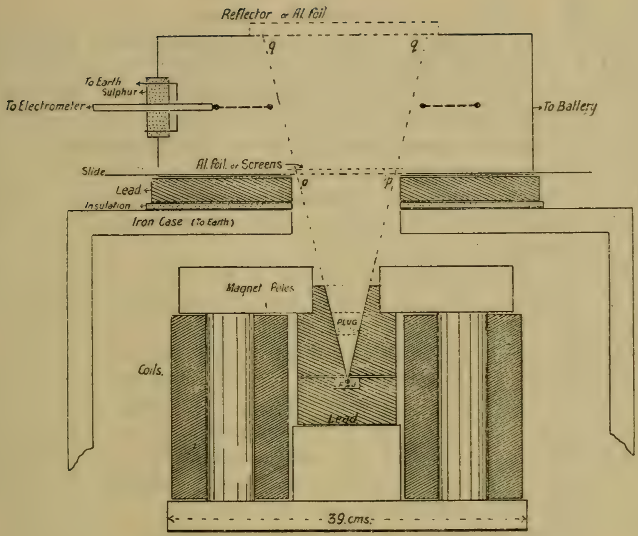

Fig. 1.

This quite satisfied the purpose for which it was intended, and we were therefore provided with the means of testing the effects of a γ stream fairly free from β rays. We used a magnetic field of about 2,500 units. The details and dimensions of the apparatus are shown in fig. 1. The radium was placed at the bottom of a conical hole made in a massive lead block. Plugs of various materials and different thicknesses were turned to fit exactly in the hole. The screens were brought to the position p,p by means of a sliding frame, which passed through an opening in the side wall of the ionization-chamber. This was done to avoid the necessity of opening up the chamber, an operation which often makes readings unsteady for a short time. The electrode consisted of two concentric circles of thick copper-wire, connected by short crosspieces, as shown. The chamber itself was kept at 400 volts. The radium was a fine specimen, which Dr. Herman Lawrence, of Melbourne, was so very kind as to lend us. It was contained, when we received it, in a small brass vessel covered with mica, over which a little wax had been run. Being very anxious to avoid any trace of emanation escaping into our apparatus, and at the same time to run no risk of injuring the specimen, we covered it still further with asbestos, placed the whole in a thin brass vessel, just big enough to hold it, and soldered down the lid. Thus the radium was at all times sufficiently screened to cut out most of the normal β rays, and, indeed, some of the soft γ rays as well. The Dolezalek electrometer was fitted with a fine quartz fibre: one volt moved the scale-image through four metres. The zero was fairly steady, and consecutive readings generally agreed to three per cent.; the differences were by no means wholly due to the electrometer. As appears to be usual in the measurement of such small currents, we were somewhat troubled by unaccountable disturbances, but on most days these were not enough to interfere with the general results.

Having set up the apparatus in this way, we proceeded first to compare the incidence and emergence radiation of various substances. This was done by the measurement of the current under three different arrangements:—

(a) When those parts of the top and bottom walls of the chamber through which the γ rays passed were made of the thinnest Al foil *(p,p* and *q,q,* in the figure);

(b) When a plate of the substance, of proper thickness, was so placed at *p,p* that the rays passed through it into the chamber;

(c) When a plate of the same substance was made to form part of the top wall, at *q,q,* so that the γ rays struck it after crossing the chamber.

We took $b-a$ as a measurement of the emergence radiation, $c-a$ as a measurement of the incident. Some results which we obtained in this way are contained in the following table, in which the numbers refer to the movement of the scale in 30 seconds, $10=1$ mm.:—

TABLE.

Comparison of emergence and incidence radiations.

	Soft γ rays.		Hard γ rays.	
	Incidence.	Emergence.	Incidence.	Emergence.
C	170	2280	58	1150
Al	280	1810	120	795
S	340	1575	154	685
Fe	487	1350	163	560
Cu	558	—	202	523
Zn	618	1160	224	485
Sn	1051	1170	333	303
Pb	1723	2001	497	470

The figures here given show the very large want of symmetry between the radiations on the two sides of a plate. Our previous experiments proved the existence of this want of symmetry; but it is now shown more clearly and satisfactorily.

The results still require correction before they can be considered accurate. It will be clear that $b-a$, the emergence radiation, is too small in all cases, because the screen, when placed on the bottom of the chamber, stops a certain amount of β radiation, which is made in the air just underneath the plate, and is out of reach of the magnet, as well as some fast β radiation which comes from lower down, and is strong enough to escape from the magnetic field. This is reckoned in a, but not in b; so that on this account all the emergence radiations are too small by a certain constant amount. We have not yet succeeded in determining this constant with any accuracy. We believe it to be mainly due to the fast β rays, which emerge with hard γ rays from the upper surfaces of the magnet poles, of the lead block, and of the plug. It cannot be much less when the plug is removed, and must therefore be of more relative importance to the results for hard rays than for soft, since the total observed effects are smaller in the former case. Its magnitude is, perhaps, indicated with some accuracy by the fact that when a lead plug of 3 cm. thickness was used the emergence radiation of tellurium seemed to be nearly zero: the substance had stopped almost as much as it generated. It can easily be seen from what follows that tellurium should probably have less emergence radiation than any other substance, yet it ought to approach half the value for carbon; and this would imply that the value of the constant was about 300 for the hard rays, and perhaps rather more for the soft. On the other hand, $c-a$, the incidence radiation, is too large, because the plate that is placed on top of the chamber at q,q not only gives rise to the incidence radiation to be measured, but also turns back to a greater or less extent the β rays striking it from below. This effect increases with the atomic weight, and must be of some importance in the case or Sn and Pb. As it is clear that these corrections will increase the want of symmetry, already obvious enough, and as we are hardly in a position as yet to make the corrections with accuracy, and as we hope to diminish our experimental errors in the future, we have for the present left these figures uncorrected.

In the first of these papers we showed that the incidence radiation should be somewhat less than p times the emergence radiation where p is the reflection constant of the substance in question for β rays. The above table does indeed show that the ratio of the two radiations increases with the atomic weight, and therefore with p; but the quantitative comparison appears poor. But it is to be remembered that (1) corrections yet to be made will alter the figures somewhat, making, for example, the emergence radiation of Pb greater, and the incidence radiation smaller; (2) the quantity p is somewhat indefinite. It is true that McClelland has made careful measurements of p for various substances; so also has H. W. Schmidt; and the two sets of results do not agree very well. This is not to be wondered at, for the quality of the secondary radiation due to β rays is different to that of the incident, and depends on the nature of the reflector. For instance, there is some very soft radiation, of which half is absorbed in 25 cm. of air. The experimental value of p will therefore depend on how close the ionization-chamber which receives the secondary radiation is placed to the reflecting-surface. It will be largest if the surface is actually within the chamber; and this is effectively the case in these present experiments.

Again, the incidence radiation should be *somewhat less than* p times the emergence radiation; and the words italicized should apply specially to the case of the lighter atoms. Referring back to the argument of our previous paper, it was there pointed out that the cathode radiation, which originated in any layer of the plate and was turned back, was scattered and softened in the process. In determinations of p this effect causes the result to be too high, because slow β rays produce more ions per cm. than fast ones. At the same time, such rays contribute less to the incidence radiation than they would have done if they had possessed the same penetrative powers as the β rays which go on and emerge from the plate. This applies particularly to the lighter atoms, for it is in their case that this scattering and softening effect is so pronounced. (Quality of secondary radiation due to β rays. Trans. Roy. Soc. of S.A., Oct., 1907, p. 300.) This seems a reasonable explanation of the very large differences between the emergence and incidence radiations of the lighter atoms.

It is interesting to observe that the figures for the incidence radiations were obtained by the use of a stream of γ rays fairly free from β rays. So far as we can discover, this condition has not been realized previously. When we have successfully applied the corrections described above, the results should be of considerable interest.

Having carried these experiments sufficiently far to show clearly the want of symmetry between the secondary radiations on the two sides of the plate, we put them aside for the time, in order to compare the emergence radiations of plates of different substances. At the beginning of this paper it was stated that emergence radiations would be the same for all substances, if we could arrange to have (1) homogeneity of the γ rays; (2) a density law of absorption for the γ rays; (3) a density law of absorption for the β rays. All these conditions cannot be realized; but we can go a long way towards satisfying the first two. Wigger has shown that rays which have passed through 2·8 cm. of lead are then absorbed by different substances according to a density law simply: they do not recognize atomic groupings. We may safely assume that the first condition is then effectively realized also. We therefore placed a lead plug (1·61 cm. in thickness) in the conical opening (see fig. 1), and hoped to find that the emergence radiation, which we then proceeded to measure, would depend only on the absorption of the β rays. For according to our theory equal quantities of γ rays would be converted into β rays in equal weights of different substances; and the subsequent emergence of these β rays into the ionization-chamber would be governed only by their ability to penetrate the layers intervening between their place of origin and the chamber. It is, perhaps, important to observe that we are implicitly making another assumption, viz., that the β rays originating in different substances have the same speed. On the material theory of the γ rays the assumption is natural; it is justified by the general nature of our results, and by special experiments to be described later.

Since the absorption of β rays by substances of small atomic weight is much less than in the case of the large atomic

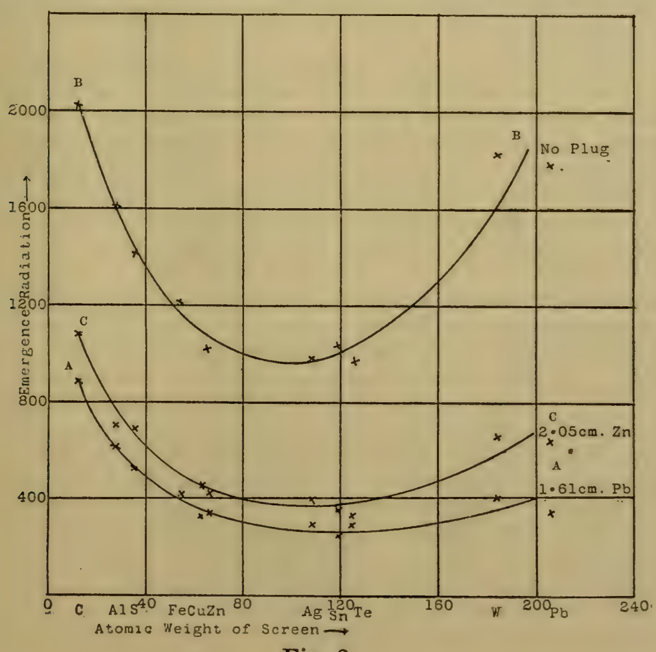

Fig. 2.

weight, weight for weight of screen; or, in the usual phraseology, since λ/ρ is smaller for light atoms than for heavy atoms, we expected the emergence radiations of C and Al to be much greater than those of, say, W and Pb. Fig. 2 shows that this expectation was realized; the results are shown graphically along the curve *AA*.

The representative points do not lie closely on a smooth curve. To some extent, no doubt, this is due to experimental error, for the measured quantities are very small. But we are inclined to think that the departures from regularity are to some extent real. We hope to settle this point partly by improving our apparatus, and so attaining greater accuracy of measurement, and partly by obtaining better knowledge of the corrections to be applied to the observations. For our present purpose, it is enough to draw a smooth curve such as *AA*, and to ignore the variations from it.

The figure shows a rapid decrease in the emergence radiations as we proceed from C to Te. There is then a small rise to W and Pb. This is easily explained, and exemplifies a very important feature of the problem. We must remember, not only that λ/ρ is fairly constant for the heavy atoms, but also that the lead screen did not completely remove the soft rays; in other words, that the pencil of γ rays was not quite homogeneous.

This will be clearly understood by comparing the curve *AA* with the curve *BB*, which represents the results we obtained when the lead plug was removed and the γ rays had passed through only the wall of the vessel containing the radium before entering the chamber. There was therefore a quantity of soft radiation in the stream of γ rays; the effect was to increase considerably the emergence radiation of Pb and W relatively to that of the other substances. This was as it should have been. We know that hard γ rays pay no attention to atomic structure, but that soft rays distinguish between atoms of different weight. In the table given by Wigger (Jahrbuch der Radioaktivität, 1905, p. 432) the values of λ/ρ for thin sheets of Pb and Zn are ·068 and ·039 respectively; but when the rays have been hardened by passing through 2·8 cm. of lead, each co-efficient has become nearly ·02. Thus, the hard rays treat lead and zinc alike, but softer rays are more absorbed by the former than the latter, weight for weight. When a stream of γ rays is passed through a lead plate, the soft rays are rapidly converted into β rays. Consequently, a thin lead plate produces a large quantity of emergence radiation, due principally to the slow β rays produced by the soft γ rays. The effect is further discussed later on in the paper. But this is rapidly used up; consequently, the radiation measured on the far side of a lead plate is relatively large when the plate is thin, and falls off more quickly at first than it does subsequently, the plate being gradually thickened. The logarithmic curve of Pb has a rapid initial fall, as several observers have shown. But there is a difference in the case of Al or any substance of small atomic weight. The soft γ rays give rise to much less secondary radiation, and, moreover, they are not used up so fast. Both these causes operate to make the logarithmic absorption curve of Al more nearly a straight line, as is actually the case.

It appears that a screen of any material absorbs the soft rays faster than the hard. Consequently, for example, a zinc screen or a lead screen may be used indifferently in order to reduce the ratio of the emergence radiation of lead to that of zinc. But a screen of large atomic weight acts more rapidly. If the screens of lead and zinc are chosen of such thicknesses that they absorb hard rays to an equal extent, then the former absorbs more of the soft rays than the latter. The curve CC (fig. 2) shows the results which were obtained when a zinc plug of 2·05 cm. thickness was placed in the conical opening. In both CC and AA the value for Sn is a little too small; we were not aware at the time that our Sn plate

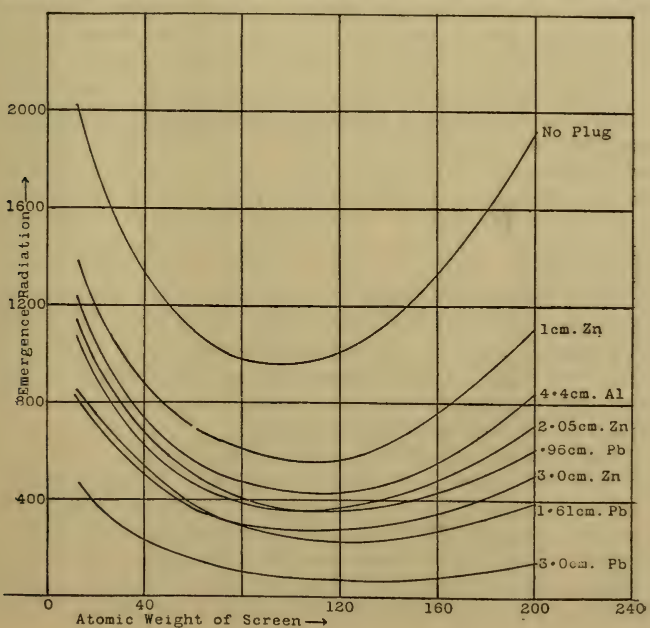

Fig. 3.

was rather too thin. In fig. 3 are drawn several curves, each showing the result of using some particular plug. In order to avoid confusion the representative points are not marked. The effect under discussion is clearly seen on comparing, for example, the curve for 1·61 cm. of Pb with that for 3 cm. of Zn. Kleeman was the first to show that the distinction made by the γ rays between different atoms in regard to the amount of secondary radiation produced by them could be modified by screening (Phil. Mag., Nov., 1907). Our results agree with his to this extent, but they do not show any true selective absorption, such as he supposes.

We may add that when using a different specimen of radium, with which we were able to allow the γ rays to act with a minimum of previous screening, the emergence radiation of Pb was greater than that of C. It would appear probable that with very soft rays other atoms lighter than Pb would surpass C in the same way, and that it is quite conceivable that the emergence radiations should increase with the atomic weight throughout the whole range. In a letter to "Nature" (April 2, 1908, p. 509) Cooksey shows that in the case of X-rays the emergence radiations are greater than the incident, thus proving the parallel to our own results in the case of γ rays. He also finds that the emergence radiation increases with the atomic weight. This is the opposite to what we have found true of the γ rays in most cases; but it is clear that it can be quite in accord with our theory.

When the screen through which the γ rays pass on their way into the chamber is gradually increased in thickness, the emergence radiation rises rapidly to a maximum, and then slowly decreases. The rise is due to increasing β radiation from the thickening screen; the decrease to the absorption of the γ rays by the screen. There is a maximum when the two effects balance. This was clearly shown by Wigger (*loc. cit.*, p. 429). If we determine the thickness which gives half the maximum value, we obtain an easy and fairly accurate measure of the penetration of the secondary β rays. It is easily shown that this particular thickness is also that which would absorb half the equally penetrating radiation from a radioactive layer, assuming an exponential law, which it is permissible to do with sufficient accuracy.

The results are shown graphically in figs. 4 to 8. In each case the curve *A* represents the result of an experiment in which the lead plug, 1·61 cm. in thickness, was used to screen the γ rays. The curve *B* shows the result with the plug removed. From each curve can be determined the thickness of screen, which gives half the full value of the emergence radiation; the points are marked on the diagrams. The re-

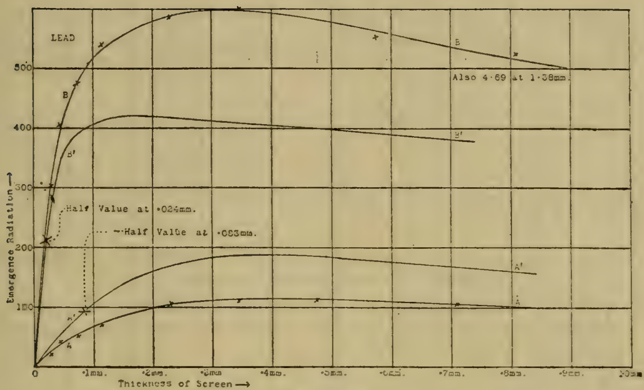

Fig 4.

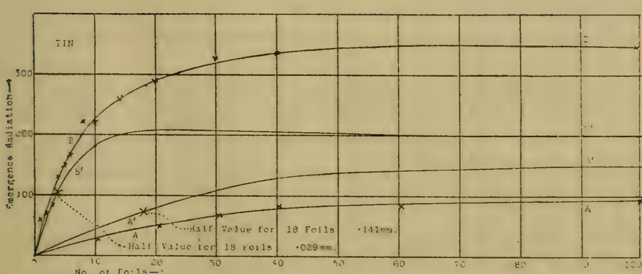

Fig. 5.

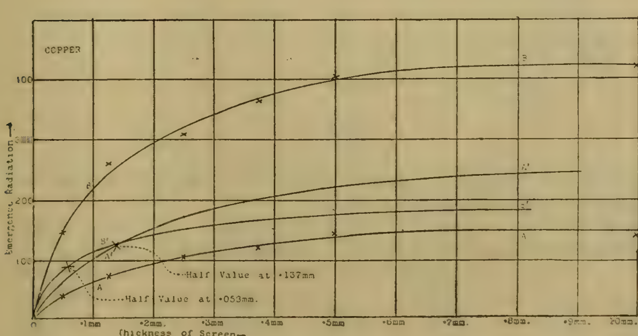

Fig. 6.

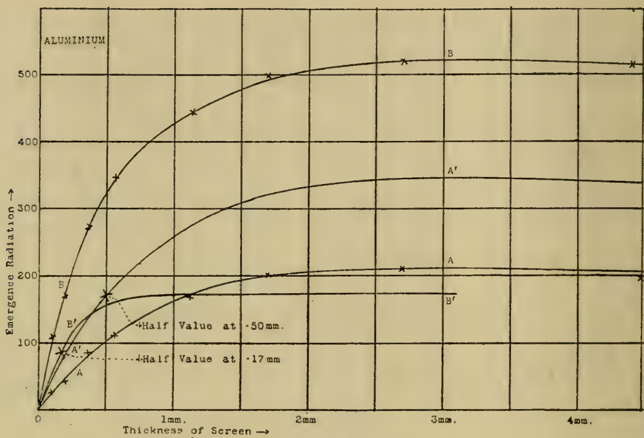

Fig. 7.

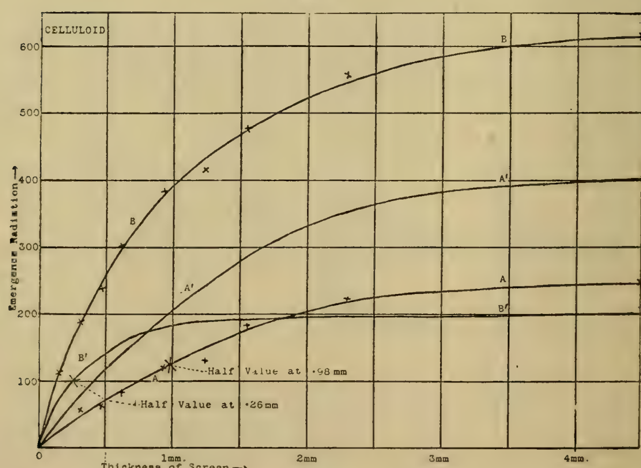

Fig. 8.

sults for the hard rays are collected and shown in the second column of the following table:—

I. Substance.	II. Thickness of Screen to give half-value in mm.	III. λ Calculated from II., in cm^{-1}	IV. λ for β rays. (McClelland and Hackett).
Lead	·083 ...	84 ...	93
Tin	·141 ...	50 ...	52
Copper ...	·137 ...	51 ...	55
Aluminium ...	·50 ...	14 ...	14
Celluloid ...	·98 ...	— ...	—

The third column shows the values of λ calculated from the results in the second column. The fourth column shows the values of λ for the primary β rays of radium, as given by McClelland and Hackett. (Trans. Roy. Soc. Dub., March 22, 1907, p. 49.) A comparison of the two last columns shows clearly that the secondary β rays excited by the γ rays possess nearly the same velocity, no matter in what substance they are excited, and that this velocity is the same as that of the primary β rays. Only hard γ rays have been used to excite the β rays in these experiments, while the values of McClelland and Hackett refer to β rays of ordinary heterogeneity. It is scarcely possible in the present state of knowledge to estimate what allowance should be made for this difference, but it is clear that the main conclusion cannot be affected by it. The value of λ varies rapidly with the speed of the β particle, and there is room for considerable alteration of the values in the table without any important alteration in the associated speed. Nor does much error arise from neglect of the correction discussed above, which makes the emergence radiations too small. The various curves of figs. 4 to 8 should really run a little way past the point taken as origin of co-ordinates.

If we consider the corresponding values for the soft rays, or rather, soft together with hard rays, we find, as expected, that the β rays which they produce are of a much less penetrating character. Also, the difference between the curves A and B is most marked in the case of lead and tin, a result which is in agreement with what has gone before. For these metals the thicknesses of screen required to give half the full emergence radiation are ·030 mm. and ·048 mm. respectively, which may be compared with the values ·083 and ·141 obtained when hard rays were used. The amount of soft radiation is so large that we may consider the effect of the hard radiation mixed with it as a correction to be allowed for. The effect of the hard radiation which has been passed through the plug, 1·61 cm. of lead, is, of course, shown by the curve A. It is a little difficult to say precisely what it would have been if the rays had not gone through the plug, since the absorption co-efficient for γ rays varies so much with the hardness. From ·8 cm. Pb to 1·25 cm. Pb, the value of λ is given by McClelland as ·44 cm.$^{-1}$; from 2·8 cm. Pb onwards Wigger gives ·241 cm.$^{-1}$. We have taken a value between these, towards the harder side, and drawn the curve A' for each metal, derived from A by increasing the ordinates of A by two-thirds, a factor calculated from the absorption co-efficient chosen. Subtracting A' from B, we obtain B', a curve which may be taken as representing approximately the behaviour of soft γ rays alone. The form of the curve for both Pb and Sn seems to suggest that the operation has been a success. The half-values are now ·024 and ·029 respectively. Thus the β rays due to these soft γ rays have only one-quarter the penetration of those derived from the harder γ rays. Possibly we have here an association with the facts stated by H. W. Schmidt (Ann. der Phys., Bd. 21, p. 654), viz., that the β rays emitted by RaC consist of two groups, of which one has four times the penetration of the other. The thickness of Al screen necessary to reduce the harder set to half-value was ·53, which agrees with the ·50 given in the table above; for the softer rays the value was ·131, nearly a quarter of the other. If there are two main groups of β rays we should certainly expect to find two corresponding groups of γ rays. Kleeman has also argued in the same direction, though for different reasons.

As will be seen from figs. 6 to 8 we have made the same attempt to sort the soft from the hard rays in respect to Cu, Al, and celluloid as in the case of Pb and Sn. The proportion of soft γ rays converted into β rays is now much less relatively. The results for soft rays are therefore of less accuracy, and depend appreciably on the allowance made for the hard rays. Nevertheless, they are of considerable interest. They show clearly the difference between the effects of hard and soft rays, and the varying proportion of soft to hard from substance to substance.

It may be gathered from consideration of all these curves that secondary γ rays play a very small part in ionizing the air within the chamber. If there were any appreciable amount of it we should expect a gradual rise long after the effect of the secondary β rays had reached its maximum value.

§ II.

We may now give a short summary of the results of this and our previous paper:—

(1) When γ radiation is diminished in quantity in consequence of its passage through matter, β radiation appears in its place, moving at the outset in the original direction of the γ radiation, and subsequently undergoing scattering in the ordinary manner of β rays.

(2) The speed and penetration of the β radiation thus produced increase with the penetration of the γ radiation to which it is due.

(3) The speed of the β radiation does not depend on the nature or condition of the atom in which it arises.

(4) In the case of radium the speed of the β radiation

produced is nearly equal to the speed of the β rays emitted by radium itself. In the case of uranium, thorium, and actinium there are indications that the law holds good also, but no exact measurements have yet been made.

(5) When very hard γ rays traverse matter the absorption and the consequent production of β rays are almost independent of the atomic structure of the matter, and a density law follows. Softer rays are affected by atomic structure, in that the heavier atoms are more absorbent than the lighter, weight for weight; and the softer the rays are the more prominent this effect becomes.

(6) If there are secondary γ rays, the ionization which they produce is negligible compared with that produced by the secondary β radiation, at least within a moderate distance (say 100 cm. of air) of the radiator.

§ III.

Various hypotheses have been suggested as to the mode in which the secondary β radiation is produced by the interaction of the γ (or X-) ray and the atom. It is convenient to divide them into three classes, and to consider to what extent each class is able to furnish an explanation of the properties set out in the summary just given.

To the first class belong those hypotheses which suppose both the energy and the material of the β radiation to be furnished by the atom alone; the γ ray is a pulse which merely pulls the trigger. In its most recent form this idea is put forward by W. Wien (Göttingen Nachrichten, 1907, p. 598).

Secondly, it may be supposed that the energy of the β radiation comes from the γ ray, but the material from the atom. The γ ray is a bundle of electric energy, possessing mass, which impinges on the atom and drives out the electron before it. This is the view now held by J. J. Thomson (Camb. Phil. Soc. Proc., vol. xiv., pt. iv., p. 417).

Thirdly, both the energy and the material of the β ray may be supposed to be derived from the γ ray. The latter is not a pulse but a neutral pair, positive and negative; in passing through some atom the bonds are dissolved, and the negative flies on. (Trans. Roy. Soc. of S.A., May, 1907; Phil. Mag., Oct., 1907.)

Consider first the theory which considers that the whole of the energy of the expelled electron comes from the internal energy of the atom. It is to be supposed that the pulse as it widens finds an atom here and there which is in an explosive condition, and that in some unknown way it precipitates a catastrophe. There is, of course, one point which is immediately cleared up by such a hypothesis, viz., that the speed of the expelled electron is independent of the intensity or quantity of the primary radiation. But here we stop short, for we have also to explain why the speed of the electron is *not* independent of the quality of the primary radiation. Why should the speed be great when the primary γ rays are hard, and small when they are soft? Why should the velocity of the shot depend on the way in which the trigger is pulled? We might get out of the difficulty by supposing an atom to be like a battery which contained a number of different kinds of guns, and that the pulses were selective, each pulling the trigger of its own particular gun. But even if we have presumed some highly artificial arrangement of this kind, we have greater difficulties still to face. How is it that the pulses always find the guns pointing in the direction in which they are travelling themselves, so that the motion of the shot is a continuation of their own line of flight? For if the speed of the electron is independent of the strength of the pulse, then, so to speak, the touch on the trigger must be very light indeed, and can have nothing to do with the laying of the gun. We might perhaps suppose that there were guns in the battery pointing in all directions, and that the pulse only fired the one which pointed in that direction in which it was travelling itself; but this would require a special atomic structure to meet the case, and it would be out of all proportion to frame such a hypothesis to explain the observed effect. Nor do our difficulties end here. For if the expulsion of the electron is the result of an atomic disintegration, should we not expect the velocity of the electron to vary from atom to atom, as it does in the case of the radio-active substances? It is inconceivable that the explosion of a light atom should result in the expulsion of an electron with exactly the same speed as in the case of the heavy atom. And, further, assuming the same hypothesis, how can the production of β rays, in the case of the hard γ rays, be absolutely independent of atomic structure in all respects whatever?

Thus, after its first small success, the theory breaks down at every point. It is true that Wien makes a tentative application of a theory of Planck, viz., that energy emitted from atoms is divided into definite units, the size of which is inversely proportional to the associate wave length. He thence deduces the law $v^2\lambda = \text{constant}$, where v is the velocity of the ejected electron, and λ the thickness of the X-ray pulse which he is considering. He thus passes by the need of explaining certain of the difficulties just discussed, and arrives at a formula from which the second and third properties in the above summary may be derived. Even then his theory fails to explain the first and fourth properties. It seems to us to be clear that the application of Planck's theory is not justified. And, generally, we conclude that the energy of the secondary β ray does not come from the atom.

We now come to the second case. In this there is no suggestion of trigger action; the energy of the β radiation is supposed to be entirely derived from that of the ether pulses. As already mentioned, this theory has lately been maintained by J. J. Thomson (Proc. Camb. Phil. Soc., vol. xiv., pt. iv., p. 417). It is also discussed by N. R. Campbell ("Modern Electrical Theory"). Since an ether pulse of the orthodox form spreads its energy over wider and wider surfaces as it radiates from its origin, and since the energy of the ejected secondary particle is immensely greater than can be imparted to it during the passage of the weak, and always weakening, pulse, it becomes a necessity on this hypothesis to concentrate the energy of the pulse along radial lines, having their centre at the place where the primary cathode particle is suddenly stopped or accelerated. Thomson speaks of "bundles of energy" occupying only a very small portion of the wave-front, the rest of the front being blank. Of course this at once suggests explanations of some of the difficulties of the γ and X-rays, such as the ionization of only a few of the atoms swept over by the wave, and the absence of relation between the velocity of the secondary electron, on the one hand, and, on the other, the intensity of the radiation and the nature of the atom. Also, it makes provision for a concentration of momentum. This theory, however, postulates a very special and complicated structure of the ether. And, in the second place, it does not even then offer an explanation of all the phenomena.

If a "bundle of energy" provides the energy with which the secondary cathode particle leaves the atom, then the energy-content of the bundle must be greater than the energy of the particle. If, on the other hand, as in the case of the X-rays, the energy of the bundle is derived from that of the arrested cathode particle, the former must be less than the latter. Now, it seems quite clear that the energy of the secondary electron is at least nearly as great as that of the primary cathode particle. For in the case of the X-rays the velocity of the secondary electron is nearly 10^{10}, and is therefore much the same as that of the cathode rays in the bulb. And we have shown above, in the analogous case of γ rays, that the velocity of the secondary β ray, produced by the γ ray, is practically the same as that of the primary β ray, which issues with the γ ray. We must, therefore, conclude on this hypothesis that the energies of the primary electron, the bundle, and the secondary electron are all equal. The whole of the energy of the cathode particle in the X-ray tube is converted into one energy bundle. This darts away from the anticathode, and sooner or later causes the ejection of an electron from some atom which it traverses, handing over to the electron the whole of its own store of energy. Replace the bundle of energy by a neutral pair, and the whole affair seems simple enough. But surely the complications of the ether structure increase the more closely we examine the process under which rapidly moving electrons in the X-ray tube disappear, and similar electrons, moving at the same rate, appear elsewhere, if we are to consider that the only links between them are little bundles of energy moving with the speed of light.

It might be said, perhaps, that one bundle contains the energy of several arrested electrons; but in that case we should have bundles of all sizes and secondary electrons of all speeds: or that several bundles might pile up their energies in one atom until there was enough for the ejection of one secondary electron; but then we should return to the difficulty of explaining why the speed is independent of the nature of the atom.

A cathode particle cannot give all its energy to a pulse unless its arrest is brought about in a very sudden and special way. The thickness of the pulse must not be greater than the diameter of the electron or corpuscle ("Cond. of Elect.," p. 660). If the pulse is thicker than this, only a proportional fraction of the energy of the cathode particle can be converted into the energy of the pulse. Now it is generally believed that the phenomena of the X-rays require a pulse many thousands of times as thick as the diameter of an electron. It does not seem possible to reconcile these opposite requirements.

The bundle must be excessively small. If it is larger than an atom, or even than an electron, the whole of its energy cannot be given up to one electron on which it impinges. There would not be time for the energy to move in from the outskirts of the bundle to the place where it is being transformed into the motion of the electron. It must not expand or contract its borders as it moves, or else its effect will vary as it travels.

The difficulties of this theory are exactly those which would naturally arise in the attempt to transfer the properties of a material particle to an immaterial disturbance.

Let us now consider the third form of hypothesis, according to which both the energy and the material of the secondary electron are derived from the primary ray. In our previous paper on this subject, and in papers on "The Properties and Natures of Various Electric Radiations" (Trans. Roy. Soc. of S.A., May and June, 1907; Phil. Mag., Oct., 1907), it was shown that the hypothesis offered a reasonable explanation of all the phenomena known to date. It is only necessary now to show to what extent it fits with the properties of the γ rays enumerated in § II. of this paper. We will take the properties in turn.

As regards (1) we have simply to suppose that the negative and positive, passing united into an atom, are separated if they happen to traverse a very strong field anywhere therein; the negative flies on and the positive becomes ineffective.

The second property is also an obvious consequence of the hypothesis. The faster the γ particle is moving the greater the initial speed of the negative.

The third is readily explainable: the electric field of the atom merely dissolves the bonds that connect the pair. It is not able to affect the speed of the negative set free.

The fourth may be taken to imply that the radio-active atom (say RaC) ejects electrons at certain speeds, some of which start off in company with a positive counterpart, some without. The former constitute the γ rays, the latter the β rays. When the γ rays break up, the negatives so produced have the same speed as the primary β rays.

The fifth would show that there are stronger fields inside heavy atoms than light ones, and that the chance of separation of a pair increases with (a) the strength of the field, (b) the time taken to cross it.

This is all the explanation that is necessary. We can at least claim that it is much simpler and more complete than any explanation which the ether-pulse theory seems likely to afford, even in its latest form.

It is true that the neutral - pair hypothesis requires the existence of a positive counterpart to the negative electron. In a previous paper it was suggested that this might be an α particle; the results of this paper seem rather to suggest that its mass is only small, and that it may really be a positive electron. Now the positive electron has hitherto been received with little favour; but the argument has been not so much against its existence as against its presence in metals in a free state. The latter is not at all necessary to our hypothesis. We require only that the positive shall exist, that it can be torn from its attachment and carried away by a passing negative electron, and, again, that it can be left behind in some atom which the pair subsequently traverses.

The recent determination by Cooksey of the want of symmetry between the emergence and incidence radiations due to X-rays is the last experiment required to show that all the properties in the summary of § II. are true for X-rays as well as for γ rays, *mutatis mutandis.* All the properties except the first have been already shown to be true (see our first paper on this subject). The complete parallelism between X- and γ rays stands out more strongly than ever.

In conclusion, there is one aspect of the problem which seems to invite a little further consideration. The characteristics of the secondary β ray are independent, as we have seen, of the nature of the atom in which it arises, and depend only on the nature of the γ ray to which it is due. This is all the more remarkable when we consider that the characteristics of primary β rays are peculiarly dependent on the nature of the atoms whence they emerge, and are absolutely independent of physical agencies acting from without. In the one case, that of secondary β radiation, we can determine that a given material shall emit β rays of definite speed and direction, and can carry out our determination by the use of suitable agencies and dispositions. In the other case, that of primary β radiation, the whole process is completely beyond our control. It is one example of this contrast that the radio-active substances do not emit secondary radiations to an abnormal extent. It is clear that there is a sharp line of distinction between the emission of an electron from an atom as a primary β ray, and the emergence of an electron from an atom as a secondary β ray. On our hypothesis the origin of the distinction is simply that in the former case the electron was part of the atom which ejected it; in the latter case, it was no part of the atom: it came in with the exciting ray. All the experimental evidence accords with this view. We come very close to the complete realization of an anticipation made twelve months ago (Trans. Roy. Soc. of S.A., May 7, 1907, pp. 84, 85), "All secondary radiation, other than the δ rays, seems to be in general a rough reflection or scattering of the primary . . . The only cases in which a secondary radiation appears, that is neither δ radiation nor reflected primary rays, are those in which β rays are produced at the impact of X- or γ rays, and in which X-rays are produced by cathode rays. . . . It may well be that further research will bring these cases into better agreement with the rest." On the neutral-pair hypothesis the exceptions mentioned here practically disappear. There remains a broad generalization, which, with all the faults natural to its kind, seems to us to be applicable to every case of which we have knowledge, and to be an important principle of the theory of secondary radiation.

New Australian Lepidoptera of the Families Noctuidæ and Pyralidæ.

By A. Jefferis Turner, M.D., F.E.S.,
Brisbane.

[Read April 7, 1908.]

Family NOCTUIDÆ.

Subfamily AGARISTINÆ.

Argyrolepidia æthrias, n. sp.

(*Æthria*, the sky.)

♂, 39 mm. Head blackish, a pair of spots on crown and sides of face yellowish-white. Palpi yellowish-white, terminal joint, and a spot on external surface of second joint before apex, blackish. Antennæ blackish. Thorax blackish with some whitish scales; posterior edge and two longitudinal lines on patagia yellowish-white. Abdomen grey; tuft, except on dorsum, and under-surface orange. Legs blackish, irrorated, and tarsi annulated with white; anterior coxæ yellowish-white; middle tibiæ orange on external surface. Forewings triangular, costa moderately arched, apex rounded, termen bowed, slightly oblique; blackish; basal area strigulated and spotted with greenish-white; a squarish greenish-white spot on dorsum before middle; succeeded by a small spot, constricted in middle, beyond mid-dorsum; a small bluish-white spot in cell; an outwardly-oblique yellowish-white spot from costa beyond middle, constricted beneath costa; beyond and beneath this a larger spot of the same colour, divided posteriorly into three obtuse teeth; a subterminal series of pale-blue spots; cilia blackish, on apex and tornus white. Hindwings with termen rounded, irregularly dentate; blackish; a large triangular basal area pale metallic blue; cilia white.

This attractive species is nearest *A. novæ-hiberniæ*, Bdv.

Type in Coll. Turner.

N.Q., Cape York; one specimen.

Section AGROTINÆ.

Proteuxoa loxosema, n. sp.

(*Loxosemos*, obliquely marked.)

♂ ♀, 35-40 mm. Head, palpi, and thorax dark-reddish-brown. Antennæ fuscous, towards bases whitish; in ♂ minutely ciliated ($\frac{1}{5}$) with slightly longer bristles. Abdomen pale fuscous. Legs grey, mixed with whitish and brownish.

Forewings elongate-oblong, costa nearly straight, apex rounded, termen rounded beneath; dark-reddish-brown; veins obscurely marked by fuscous and pale-grey irroration; orbicular represented by a minute white dot, reniform by an outwardly oblique, rather irregularly shaped, white bar; a dark oblique subterminal shade, sometimes outlined with whitish, nearly straight, but with small subcostal tooth; beyond this ground colour is paler; cilia dark-grey, mixed with pale-grey. Hindwings with termen rounded, slightly wavy; pale-fuscous; cilia whitish, with a fuscous median line.

Type in Coll. Drake.

V., Leopold, Gisborne, Beaconsfield, in March and April; four specimens received from Dr. Drake and Mr. G. Lyell.

Proteuxoa spodias, n. sp.

(*Spodos*, ashes.)

♂, 34 mm. Head, palpi, and thorax whitish-grey. Antennæ pale-grey; in ♂ minutely ciliated ($\frac{1}{5}$), with slightly longer bristles. Abdomen pale-grey. Legs whitish. Forewings elongate, costa straight, except close to base and apex, apex rounded, termen rounded beneath; whitish-grey; orbicular and reniform faintly indicated in darker grey; a barely perceptible line of grey dots parallel to termen, midway between that and reniform; cilia pale-grey. Hindwings with termen rounded, somewhat wavy; pale-grey; cilia whitish, with a grey median line at apex.

Type in Coll. Drake.

V., Black Rock, near Melbourne, in March; one specimen received from Dr. Drake.

Section HADENINÆ.

Cirphis orthomita, n. sp.

(*Orthomitos*, with straight threads.)

♂ ♀, 38 mm. Head, palpi, and thorax whitish-ochreous. Antennæ pale-fuscous, towards base whitish-ochreous; in ♂ serrate with moderate cilia (1) arranged in fascicles. Abdomen with dense lateral tufts; whitish-ochreous. Legs whitish-ochreous; three terminal tarsal joints dark-fuscous. Forewings elongate, costa slightly arched, apex rounded, termen rounded beneath; whitish-ochreous; a slender blackish line from base along fold to $\frac{1}{3}$; a shorter, similar line immediately above submedian in posterior part of cell, extending slightly beyond cell; a terminal series of blackish dots between veins; cilia whitish-ochreous, apices barred with dark-fuscous. Hindwings with termen rounded, sinuate; grey; some fuscous terminal dots; cilia ochreous-whitish.

Type in Coll. Lyell.

V., Leopold, in April; two specimens received from Mr. G Lyell.

Section CUCULLIANÆ.

Eumichtis mesophæa.

(*Mesophaios*, dusky in the middle.)

Eumichtis mesophæa, Hmps., Cat. Lep. Phal. VI., p. 343.

♂, 32-34 mm. Head and palpi brown-fuscous. Antennæ fuscous; in ♂ simple with short ciliations ($\frac{1}{2}$). Thorax with a bifid posterior crest; brown-fuscous, an inwardly oblique whitish streak on each patagium. Abdomen with two or three dorsal crests and dense lateral tufts; fuscous. Legs brown-fuscous, tarsi annulated with whitish. Forewings not elongate, costa scarcely arched, apex rounded, termen crenulate, rounded beneath; brown-fuscous; markings dark-fuscous; seven short costal strigulæ between base and $\frac{3}{4}$; three minute whitish costal dots on apical $\frac{1}{4}$; a triangular spot above $\frac{1}{4}$ dorsum; an irregular discal blotch narrower towards dorsum, much expanded towards costa, including orbicular and reniform as transversely elongate, medially constricted, pale areas; posterior edge of reniform outlined with ferruginous; a dentate subterminal line mixed with ferruginous; a fine interrupted terminal line; cilia fuscous, base pale ferruginous. Hindwings with termen rounded, obtusely dentate; fuscous; cilia ochreous-whitish with a fuscous median line not reaching tornus.

Type in Coll. Drake.

V., Beaconsfield, in January; two specimens.

Section ACRONYCTINÆ.

Prometopus poliophracta, n. sp.

(*Poliophraktos*, grey-bordered.)

♂, 32-34 mm. Head grey; upper half of face dark-fuscous. Palpi whitish; basal $\frac{2}{3}$ of external surface dark-fuscous. Antennæ fuscous, towards base whitish; in ♂ serrate and shortly ciliated ($\frac{1}{2}$) in tufts. Thorax whitish-grey; bases of tegulæ fuscous. Abdomen pale-grey. Legs whitish, irrorated with dark-fuscous; tarsi fuscous, with whitish annulations. Forewings elongate, costa slightly arched near extremities, apex rounded, termen rounded beneath; whitish-grey, with scattered fuscous scales; lines dark-fuscous; an incomplete line near base; a strongly dentate line, partly double, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; some brownish suffusion basal to this line; a circular brownish dot edged with dark-fuscous representing orbicular; reniform represented by a short transverse brownish streak, to the posterior edge of which is closely applied a crescentic whitish streak, edged posteriorly with dark-fuscous; a fine dentate posterior transverse line; some dark-fuscous suffusion in mid-disc and again beyond posterior line, the latter containing some blackish streaks and brownish scales, and forming a sharp wavy subterminal edge; terminal area whitish-grey; a fine fuscous terminal line; cilia grey, with a fine basal brownish line. Hindwings with termen rounded, slightly sinuate; grey; cilia white with a grey antemedian line, on apex and dorsum grey.

Type in Coll. Drake.

V., Black Rock, near Melbourne, in March; two specimens.

Caradrina cryphæa, n. sp.

(*Kruphaios*, hidden.)

♂ ♀, 32-36 mm. Head and thorax fuscous or brownish-fuscous. Palpi dark-fuscous, apex of second joint more or less whitish. Antennæ pale-fuscous; in ♂ serrate and shortly ciliated ($\frac{1}{2}$). Abdomen grey, sometimes mixed with whitish-ochreous. Legs fuscous, tarsi annulated with whitish; posterior, femora, and tibiæ clothed with long whitish hairs. Forewings elongate, costa scarcely arched, apex rounded, termen rounded beneath; whitish-grey, with some brownish suffusion, especially towards termen, or grey mixed with ochreous-whitish; basal line obsolete, represented by two fuscous dots on costa; a fine dentate transverse line at $\frac{1}{4}$, sometimes double; orbicular obsolete, sometimes a transverse fuscous median shade, from mid-costa obliquely outwards, then bent inwards and again bent to dorsum beyond middle; reniform faintly indicated by a brownish or pale-ochreous suffused spot; a finely dentate postmedian line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, succeeded by some dark streaks on veins; a dark subterminal shade sharply defined posteriorly; a terminal series of indistinct dark-fuscous dots, sometimes obsolete; cilia concolorous. Hindwings with termen rounded; whitish, towards termen suffused with fuscous; cilia fuscous at apex, becoming whitish towards tornus.

Type in Coll. Lyell.

V., Gisborne, Castlemaine, and Murtoa, in March and April; a series received from Mr. G. Lyell.

Caradrina leucosticta, n. sp.

(*Leucostiktos*, white-spotted.)

♀, 26-28 mm. Head and thorax brown; lower edge of face ochreous-whitish. Palpi dark-fuscous; terminal joint and apex of second joint ochreous-whitish, with a few fuscous scales. Antennæ fuscous. Abdomen brown-whitish, irrorated with brown. Legs fuscous, irrorated, and tarsi annulated, with ochreous-whitish; posterior pair paler. Forewings elongate-oblong, costa straight, apex rounded, termen rounded beneath; brown with a few scattered whitish and dark-fuscous scales; a fine transverse, rather wavy dark-fuscous line at $\frac{1}{3}$; a white spot at $\frac{2}{3}$, representing reniform, sometimes preceded by a similar spot representing orbicular; immediately succeeded by an interrupted dark-fuscous transverse line; a terminal series of white dots; cilia brown mixed with fuscous. Hindwings with termen rounded; ochreous-whitish; cilia ochreous-whitish.

Type in Coll. Drake.

V., Black Rock, near Melbourne; three specimens.

Caradrina melanographa, n. sp.

(*Melanographos*, inscribed with black.)

♂, 27-29 mm. Head and thorax whitish-ochreous, irrorated with fuscous. Palpi dark-fuscous; apex of second joint whitish; terminal joint whitish, with a few dark-fuscous scales. Antennæ dark-fuscous; in ♂ shortly ciliated ($\frac{1}{2}$). Abdomen ochreous-whitish, irrorated with pale fuscous. Legs dark-fuscous, tibiæ and tarsi annulated with ochreous-whitish; posterior pair mostly ochreous-whitish. Forewings elongate-oblong, costa straight, slightly arched near base and apex, apex rounded, termen rounded beneath; ochreous-whitish, irrorated with brownish-fuscous; a blackish line from costa near base, not reaching dorsum; a white, black-edged dot in disc at $\frac{1}{6}$; a dentate transverse blackish line at $\frac{1}{4}$; a second white black-edged dot at $\frac{1}{3}$; five or six fuscous dots on apical half of costa; a fine blackish dentate line from $\frac{2}{3}$ costa, bent outwards in disc, to $\frac{2}{3}$ dorsum; a dark subterminal shade, twice dentate; a terminal series of black dots; cilia pale-fuscous. Hindwings with termen rounded; whitish, with fuscous suffusion; a crescentic fuscous mark at end of cell; a fine fuscous terminal line; cilia whitish. Ab. Forewings suffused with dark-fuscous, white discal dots sometimes obsolete, subterminal shade edged by an ochreous-whitish line.

Type in Coll. Drake.

V., Black Rock, near Melbourne; four specimens, including two of the dark form.

Caradrina amathodes, n. sp.

(*Amathodes*, sandy.)

♂ ♀, 34 mm. Head and thorax pale-ochreous. Palpi dark-fuscous, terminal joint and apical third of second joint ochreous-whitish. Abdomen ochreous-whitish. Legs pale-ochreous; tarsi fuscous, with ochreous-whitish annulations. Forewings elongate, costa slightly arched near base, then straight, apex rounded, termen rounded beneath; pale-ochreous; a dark-fuscous dot on costa near base; another at $\frac{1}{3}$, in a line with one at mid-disc, and another above dorsum at $\frac{1}{3}$; a dot on costa beyond middle, from which proceeds a row of fine dots obliquely outwards, then curved downwards to $\frac{3}{4}$ dorsum; orbicular obsolete, reniform represented by a faint crescentic fuscous streak; a darker subterminal shade, sharply outlined posteriorly, with a subcostal tooth; a fine, interrupted fuscous terminal line; cilia pale-ochreous. Hindwings with termen rounded; whitish-ochreous; cilia whitish-ochreous.

Type in Coll. Drake.

V., Black Rock, near Melbourne, in February; two specimens.

Caradrina nycteris, n. sp.

(*Nukteris*, a night-bird.)

♀, 32 mm. Head, thorax, palpi, and antennæ fuscous. Abdomen fuscous, irrorated with whitish. Legs fuscous, irrorated, and tarsi annulated with whitish; posterior pair mostly whitish. Forewings elongate-oblong, posteriorly dilated, costa scarcely arched, apex rounded, termen somewhat obliquely rounded; fuscous, with some paler scales; an indistinct dark-fuscous dentate line from $\frac{1}{5}$ costa to $\frac{1}{3}$ dorsum; orbicular indicated by a minute whitish dot; reniform obscure, dark-fuscous; a very indistinct outwardly-curved pale line at $\frac{2}{3}$; an irregular interrupted pale subterminal line preceded by a darker shade of fuscous; a terminal series of minute whitish dots; cilia fuscous. Hindwings with termen rounded, somewhat sinuate beneath apex; fuscous; cilia fuscous.

Type in Coll. Turner.

N.S.W., Emu Plains, near Sydney; one specimen received from Mr. G. A. Waterhouse.

Caradrina basisticha, n. sp.

(*Basisteikos*, with basal streak.)

♂, 28 mm. Head pale brownish-ochreous. Palpi dark-fuscous, apex and internal surface pale brownish-ochreous. Antennæ fuscous; in ♂ serrate with short ciliations ($\frac{1}{3}$). Thorax pale brownish-ochreous mixed with fuscous. Abdomen whitish-ochreous, irrorated with pale-fuscous. Legs fuscous irrorated, and tarsi annulated with whitish-ochreous; posterior pair mostly whitish-ochreous. Forewings elongate-oblong, costa straight except near base and apex, apex rounded, termen rounded, scarcely oblique; brownish irrorated with fuscous; a fine dark-fuscous streak from base along fold to ⅓; orbicular and reniform indicated by pale spots with darker outlines; indications of dark-fuscous streaks along veins toward termen, ending in terminal dots; cilia brownish-fuscous. Hindwings with termen rounded, somewhat wavy beneath apex; whitish, towards apex and termen suffused with fuscous; cilia whitish with a fuscous line near bases.

The type is not in the best condition; it is somewhat similar to *C. acallis*, Turn., but a browner insect, and readily distinguishable by the basal streak on forewings.

Type in Coll. Turner.

Q., Brisbane, in October; one specimen.

Genus Elesma.

Elesma, Wlk., Brit. Mus. Cat. xxxii., p. 608.
Amaloptila, Turn., Tr.R.S.S.A., 1903, p. 6.

This genus appears to have real affinity with the *Nolinæ*.

Elesma subglauca.

Elesma subglauca, Wlk., Brit. Mus. Cat. xxxii., p. 608.
Amaloptila triorbis, Turn., Tr.R.S.S.A., 1903, p. 6.

N.S.W., Newcastle. V., Beaconsfield.

Genus Epicyrtica, *nov.*

(*Epikurtikos*, hump-backed.)

Frons with a rounded, horny projection, covered with scales. Tongue very small. Palpi slender, porrect, hairy, not reaching beyond frontal projection. Antennæ in ♂ simple, minutely ciliated. Thorax with a dense rounded posterior crest. Abdomen smooth. Forewings with 2 from ⅞, 3 from angle, 2, 3, and 4 well separated at bases, 6 from upper angle of cell, 7, 8, 9 stalked, 10 connected by a bar with 7, 8, 9. Hindwings with 3 and 4 stalked, 5 imperfectly developed from middle of discocellulars, 6 and 7 stalked, 8 anastomizing with 7 near base.

The affinities of this genus are uncertain.

Epicyrtica lathridia, n. sp.

(*Lathridios*, stealthy, secret.)

♂, 22 mm. Head, palpi, thorax, and abdomen grey mixed with fuscous and whitish. Antennæ grey-whitish; in ♂ with short ciliations (½). Legs fuscous irrorated, and tarsi annulated, with whitish; posterior pair mostly whitish. Forewings elongate-triangular, costa gently arched, apex rounded, termen obliquely rounded; grey; markings dark-fuscous; a distinct line near base, angled beneath costa; a fine line from ⅙ costa to ⅓ dorsum, irregularly dentate; an incomplete circle in disc before middle; an irregularly dentate line from mid-costa to $\frac{2}{3}$ dorsum; three roughly parallel lines from terminal third of costa, converging towards tornus; an interrupted terminal line; cilia grey, apices whitish. Hindwings with termen somewhat sinuate; whitish irrorated with grey; indistinct grey median and postmedian lines; a dark-grey terminal line, obsolete towards tornus; cilia whitish.

Type in Coll. Lyell.

V., Leopold, near Melbourne, in April; one specimen.

Section ACONTIANÆ.

Genus Acachmena, *nov.*

(*Akachmenos*, sharp; in allusion to the thoracic crest.)

Frons flat. Tongue well developed. Palpi ascending; second joint with a strong triangular anterior tuft; terminal joint short, obtuse. Antennæ in ♂ (unknown). Thorax with a sharp, elongate keel-like posterior crest. Abdomen with dorsal crests on first two segments. Forewings with 7, 8, 9 stalked, 10 connected by a bar with 8 + 9 beyond 7. Hindwings with 3 and 4 separate, 5 from mid-way between 4 and middle of cell, 6 and 7 separate.

Acachmena œnocrossa, n. sp.

(*Oinokrossos*, with vinous border.)

♀, 20 mm. Head, palpi, and thorax whitish-red with some reddish-purple irroration. Antennæ fuscous, towards base whitish-red. Abdomen whitish; crests whitish-red. Legs whitish; anterior pair reddish. Forewings triangular, costa straight, slightly arched towards base and apex, apex pointed, termen nearly straight, oblique; whitish-red with sparsely-scattered fuscous-purple scales; two very fine purplish lines, one median, the second at $\frac{3}{4}$; a reddish dot on costa at origin of second line; cilia reddish-purple, apices whitish. Hindwings with termen rounded; whitish, towards termen suffused with pale-fuscous; cilia whitish.

Type in Coll. Turner.

N.Q., Kuranda, in March; one specimen received from Mr. F. P. Dodd.

Genus Alypophanes, *nov.*

(*Alypophanes*, of cheerful appearance.)

Frons rounded, somewhat protuberant. Tongue well developed. Palpi moderate, slender, smooth-scaled, ascending, not reaching vertex; second joint moderate; terminal joint short, tolerably acute. Antennæ in ♂ simple, minutely ciliated. Thorax and abdomen smooth. Legs with outer tibial spurs half length of inner or less. Forewings with a slender bar-like retinaculum in ♂; 7, 8, 9 stalked, 10 free, no areole. Hindwings with 3 and 4 stalked, 5 from mid-way between 4 and middle of cell, 6 and 7 stalked.

ALYPOPHANES IRIDOCOSMA, n. sp.

(*Iridokosmos*, variegated.)

♂ ♀, 18-20 mm. Head rosy; face pale-yellow. Palpi ochreous-whitish. Antennæ whitish; in ♂ with minute ciliations ($\frac{1}{4}$). Thorax rosy, apices of tegulæ and patagia grey. Abdomen grey with some rosy scales; a conspicuous snow-white spot on dorsum of second segment with a lateral rosy spot on each side of it; tuft pale-ochreous. Legs whitish; anterior tibiæ and tarsi fuscous. Forewings elongate-triangular, costa nearly straight for $\frac{2}{3}$, then moderately arched, apex rounded, termen bowed, oblique; ochreous-yellow; a grey spot containing some rosy scales at base; a somewhat quadrangular grey blotch on costa before middle, extending to near dorsum, indented on dorsal aspect, containing a rosy central spot; a large grey terminal blotch reaching to tornus and on costa nearly to apex, its costal edge rosy; leaving a narrow streak of ground colour on apical part of termen; cilia ochreous-yellow. Hindwings with termen rounded; ochreous-yellow; a short median crimson streak from base; a large grey blotch containing some rosy suffusion occupying whole of dorsal and terminal areas, except edge of termen, acutely indented by ground colour in mid-disc; cilia ochreous-yellow, on dorsum grey.

Type in Coll. Turner.

N.Q., Kuranda, in October, April, and May; five specimens received from Mr. F. P. Dodd.

Section NOCTUINÆ.

OPHIDERES PYROCRANA, n. sp.

(*Purokranos*, with fiery head.)

♂, 64 mm. Head iridescent purple, posterior edge reddish-brown. Palpi, second joint iridescent purple, internal surface ochreous; terminal joint long ($\frac{2}{5}$ second), and dilated before apex, fuscous, an iridescent blue spot on subapical dilation on internal and external surfaces, extreme apex pale-ochreous. Antennæ fuscous; in ♂ naked. Thorax reddish-brown with some purplish reflections anteriorly. Abdomen deep yellow, terminal joint fuscous. Legs ochreous, tarsi and apices of tibiæ fuscous, anterior tibiæ densely hairy, above fuscous, towards base reddish-brown, with a pale-ochreous median spot, beneath ochreous. Forewings triangular, costa strongly arched, apex tolerably acute, termen scarcely bowed, oblique, dorsum with a strong antemedian tooth; dark-greenish; a darker line from $\frac{1}{3}$ costa to $\frac{1}{4}$ dorsum succeeded by a bluish-purple iridescent suffusion; an irregularly pentagonal darker discal spot; a postmedian line from $\frac{3}{4}$ costa to mid-dorsum, preceded by a bluish-purple iridescent suffusion; a similar but less marked suffusion along termen; cilia concolorous. Hindwings with termen rounded; deep-yellow; a blackish terminal band, very broad at apex, narrowing to a point at tornus; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

Ischyja cyanopasta, n. sp.

(*Kuanopastos*, sprinkled with bluish.)

♂, 64 mm. Head, palpi, thorax, and abdomen dark-fuscous, very sparsely irrorated with white specks. Antennæ dark-fuscous; in ♂ shortly laminate ($\frac{1}{2}$) with terminal bristles ($\frac{1}{2}$). Legs dark-fuscous, tibiæ densely hairy; posterior tibiæ and tarsi beset with long hairs of paler fuscous with sparse whitish specks, a white spot at base of tibiæ. Forewings triangular, costa straight, arched towards apex, apex round-pointed, termen bowed, oblique; fuscous with bluish-white irroration, sparse in disc, dense towards termen; a dark transverse line, slightly wavy, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, preceded by a brownish line; a dark circular orbicular spot beyond first line and a larger similar reniform spot, both pale-margined; a line similar to preceding from lower edge of reniform to $\frac{3}{4}$ dorsum; a third dark line with brown edges from $\frac{5}{6}$ costa obliquely outwards nearly to termen, then dentate and parallel to termen, meeting second line on dorsum; a circular pale-ochreous spot interrupts third line above dorsum; a triangular dark fuscous apical area beyond third line; cilia concolorous. Hindwings with termen twice angled; fuscous; terminal area, except towards costa, with bluish-white irroration and traversed by a dark-fuscous brown-edged line, which becomes double towards tornus; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

Section ERASTRIANÆ.

Genus Auchmophanes, *nov.*

(*Auchmophanes*, squalid-looking.)

Frons loosely scaled. Tongue well developed. Palpi thickly scaled, recurved, considerably exceeding vertex; second joint curved, not reaching vertex; terminal joint rather short, acute. Antennæ in ♂ (unknown). Thorax and abdomen smooth. Posterior tibiæ with outer spurs not much more than half length of inner spurs. Forewings with 2, 3, 4 well separated and equidistant at origin, 4 from angle, 7, 8, 9, 10 stalked, 7 only short-stalked. Hindwings with 3 from slightly above angle of cell, 4 and 5 stalked, 6 and 7 connate.

AUCHMOPHANES OCHROSPILA, n. sp.

(*Okrospilos*, pale-spotted.)

♀, 27 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-fuscous. Legs pale-ochreous mixed with grey. Forewings triangular, costa gently arched, apex rounded, termen rounded beneath; ochreous-fuscous; whitish dots on costa at $\frac{1}{8}$, $\frac{1}{4}$, and $\frac{2}{3}$; from the last of these a fine irregularly dentate fuscous line proceeds to $\frac{2}{3}$ dorsum; three small circular whitish discal spots in disc, the first at $\frac{1}{4}$, the second and third arranged transversely before middle; a terminal series of fuscous dots; cilia concolorous. Hindwings with termen much rounded; as forewings, but without white spots.

Type (in poor condition) in Coll. Lyell.

N.Q., Mulgrave River, near Cairns, in July; one specimen.

NAARDA XANTHONEPHRA, n. sp.

(*Xanthonephros*, with yellow kidneys—*i.e.*, reniform spots.)

♂, 25 mm. Head and palpi dark-fuscous. Antennæ fuscous; in ♂ with fairly long ciliations ($1\frac{1}{2}$), and longer bristles (2). Thorax fuscous. Abdomen paler fuscous. Legs fuscous; anterior coxæ, femora, and tibiæ densely hairy except on external surface, which is covered by smooth shining whitish scales. Forewings elongate-triangular, costa distinctly concave in basal $\frac{3}{4}$, apex rounded, termen bowed, oblique; pale-fuscous, darker towards base and costa; suffused darker fuscous transverse lines; first near base; second at $\frac{1}{4}$, preceded by a small roundish ochreous subcostal spot; reniform oval, indented posteriorly, ochreous with two dark-fuscous contained dots arranged transversely; third line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, sigmoid; a faint-whitish subterminal line, deeply waved; a terminal series of black dots between veins; cilia fuscous-whitish. Hindwings much broader than forewings, termen rounded; colour and markings as forewings, but without ochreous spots.

Type in Coll. Lyell.

N.Q., Kuranda, in March; two specimens received from Mr. F. P. Dodd, of which one is in my collection.

Corgatha poecilota, n. sp.

(*Poikilotos*, variegated.)

♂, 20-22 mm. Head and palpi reddish-brown. Antennæ whitish-ochreous; in ♂ shortly ciliated ($\frac{2}{3}$) with a few longer bristles. Thorax pale ochreous-grey. Abdomen pale-purple, towards base pale ochreous-grey. Legs ochreous-fuscous; femora reddish. Forewings triangular, costa scarcely arched, apex rounded, termen with a large obtuse submedian projection; pale purplish-grey, towards costa whitish-grey; costal edge ochreous, interrupted by fuscous; a broad ochreous-fuscous line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, angled beneath costa; three or four dots of same colour representing median discal spot; a fine pale line suffusedly bordered with ochreous-fuscous from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, bent first outwardly then inwardly; some ochreous-fuscous suffusion towards termen; a subterminal series of blackish dots; cilia purple-reddish, apices white, on apex and projection apices fuscous. Hindwings with termen nearly straight; pale purplish-grey suffused with ochreous-fuscous; extreme base and base of costa whitish-ochreous; a reddish band from base of dorsum to apex, interrupted by a large white spot containing two or three blackish scales; cilia purple-reddish, apices white.

Type in Coll. Lyell.

N.Q., Kuranda, in October and April; two specimens received from Mr. F. P. Dodd, of which one is in my collection.

Corgatha loxomita, n. sp.

(*Loxomitos*, with oblique thread.)

♀, 28 mm. Head, palpi, antennæ, thorax, and abdomen whitish-grey. Legs whitish with some fuscous irroration; tarsi fuscous. Forewings elongate-oval, costa strongly arched, apex acute, termen excised beneath apex, dentate on vein 4, oblique; whitish-grey irrorated with grey; a fine wavy grey transverse line from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum; a well-marked, straight, oblique, grey line from immediately beneath $\frac{5}{6}$ costa to $\frac{2}{3}$ dorsum; an ill-defined pale-reddish transversely-oval discal spot containing two grey dots; a subterminal series of grey dots; cilia whitish mixed with grey and brown. Hindwings with termen slightly angled on vein 4; colour and markings as forewings, but without antemedian line and discal spot.

Allied to *C. excisa*, Hmps.

Type in Coll. Turner.

N.Q., Kuranda, in October; one specimen received from Mr. F. P. Dodd.

MALIATTHA FERRUGINA, n. sp.

(*Ferruginus*, rusty.)

♂, 18 mm. Head and palpi reddish-brown. Antennæ grey, towards bases brownish; in ♂ very shortly ciliated ($\frac{1}{3}$). Thorax reddish-brown mixed with white. Abdomen whitish with some fuscous suffusion; basal crest reddish-brown. Legs fuscous; tarsi annulated with ochreous-fuscous; posterior legs whitish. Forewings triangular, costa moderately arched, apex rounded, termen bowed, oblique; whitish with some fuscous and reddish-brown irroration; a broad reddish-brown median fascia; its anterior edge fuscous, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; posterior edge fuscous from costa beyond middle, forming a strong, rounded posterior projection, then somewhat concave to $\frac{3}{4}$ dorsum; in median band at base of projection is a transversely oval white spot containing a pair of fuscous dots arranged transversely; a narrow reddish-brown terminal band preceded by a waved white line; cilia fuscous-whitish. Hindwings with termen rounded; pale-fuscous; cilia pale-fuscous with a whitish basal line.

Type in Coll. Turner.

N.Q., Kuranda, in January; one specimen received from Mr. F. P. Dodd.

ZETHES HÆMACTA, n. sp.

(*Hæmaktos*, blood-stained.)

♂, 22 mm. Head, palpi, and antennæ whitish-ochreous mixed with dark reddish-brown; antennæ grey towards apices, ciliations in ♂ very short ($\frac{1}{4}$) with longer bristles (1). Thorax dark reddish-brown. Abdomen grey mixed with whitish. Legs whitish with some fuscous irroration; anterior and middle tarsi dark-fuscous with whitish annulations. Forewings triangular, costa strongly arched near base, then straight to near apex, apex rounded-rectangular, termen rather wavy, with a strong tolerably acute median projection on vein 4; grey-whitish with some scattered reddish-brown scales; a parallel-sided rather strongly outwardly curved dark reddish-brown fascia near base; a similarly coloured blotch on costa at $\frac{2}{3}$, dilated below, reaching to mid-disc; a pale line from costa at $\frac{3}{5}$ obliquely outwards, traversing costal blotch, then bent inwards to $\frac{2}{3}$ dorsum; a subterminal series of dark reddish-brown dots; cilia grey-whitish with some reddish-brown scales. Hindwings with termen strongly dentate; grey-whitish with some reddish-brown scales; a pale median transverse line; a subterminal series of dark reddish-brown dots, that at tornus much larger than the rest; cilia grey-whitish.

I refer *conscripta*, Luc., to the same genus.

Type in Coll. Turner.

N.Q., Kuranda, in April; one specimen received from Mr. F. P. Dodd.

Zethes cyrtogramma, n. sp.

(*Curtogrammos*, with curved marking.)

♂, 38 mm. Head, pale ochreous-grey. Palpi ochreous-whitish, second joint irrorated throughout, and terminal joint before apex, with purplish-fuscous. Antennæ whitish-ochreous; in ♂ with minute ciliations ($\frac{1}{3}$) and short bristles (1). Thorax purplish-grey; collar pale ochreous-grey. Abdomen whitish mixed with purple-grey. Legs whitish-ochreous; anterior and middle tarsi purple-fuscous annulated with whitish-ochreous. Forewings triangular, costa nearly straight, apex acute, termen crenulate, acutely angled on vein 4; purplish-grey with a few dark-fuscous scales; a pale, dark-bordered outwardly-curved, transverse line near base preceded on costa by a fuscous spot; a faint, slender, dentate, median, fuscous, transverse line; a dark-fuscous dot in disc before, and another beyond, median line; a pale-ochreous line, doubly edged with fuscous, from $\frac{2}{3}$ costa very obliquely outwards, forming an obtuse projection, then sharply bent to end on $\frac{2}{3}$ dorsum, its angle sometimes joined to termen by a fuscous suffusion; a subterminal series of blackish dots on veins, preceded by a fine dentate line; cilia whitish, on angle sometimes fuscous. Hindwings with termen crenulate, acutely angled on vein 4; colour and markings as forewings; postmedian line similar but straight, basal line not developed.

Type in Coll. Turner.

N.Q., Kuranda, in January and May; two specimens received from Mr. F. P. Dodd.

Zethes adoxopis, n. sp.

(*Adoxopis*, obscure-looking.)

♂ ♀, 32-34 mm. Head, palpi, and thorax pale brownish-grey. Antennæ whitish-ochreous with some fuscous scales; in ♂ with minute ciliations ($\frac{1}{5}$) and moderate bristles (1). Abdomen whitish-grey irrorated with brown-fuscous. Legs whitish irrorated with fuscous; tarsi fuscous annulated with whitish. Forewings triangular, costa straight, gently arched near base and apex, apex acute, termen crenulate, angled on vein 4; pale brownish-grey; costa with some whitish suffusion; a whitish triangular spot on costa at $\frac{2}{3}$; a darker interrupted transverse line at $\frac{1}{4}$; a fine, acutely-dentate, fuscous line from $\frac{2}{3}$ costa through whitish spot to $\frac{3}{4}$ dorsum; some fuscous dots on veins representing subterminal line; a fine grey terminal line; cilia brown-whitish. Hindwings with termen wavy, dentate on veins 4 and 7; colour and markings as forewings, but postmedian dentate line succeeded by a suffused fuscous band, and this again by a reddish-brown irregularly-shaped spot in mid-disc.

Type in Coll. Turner.

N.Q., Kuranda, in October and March; two specimens received from Mr. F. P. Dodd.

ERASTROIDES MOLYBDOPASTA, n. sp.

(*Molubdopastos*, lead-besprinkled.)

♂ ♀, 17-21 mm. Head, thorax, and abdomen whitish, faintly greenish-tinged, irrorated with fuscous scales which present a leaden-metallic lustre; face fuscous. Palpi rather short ($1\frac{1}{2}$), porrect, terminal joint very short and concealed; fuscous. Antennæ grey; in ♀ whitish with fuscous annulations; in ♂ serrate, with moderate ciliations ($1\frac{1}{2}$) in tufts. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; whitish, faintly greenish-tinged, irrorated with fuscous scales showing a leaden-metallic lustre; these dark scales tend to form transverse lines; antemedian at $\frac{1}{3}$; postmedian at $\frac{2}{3}$, anteriorly suffused, posteriorly well defined, with a median bidentate projection; subterminal indistinct; four white dots on apical $\frac{1}{4}$ of costa; cilia whitish with fuscous bars and a median fuscous line. Hindwings rather elongate, termen rounded; colour and markings as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in October: two specimens received from Mr. F. P. Dodd.

Genus SYNTHACA, *nov.*

(*Synthakos*, sitting together.)

Frons rounded. Tongue present. Palpi moderately long, porrect; second joint dilated with roughly-spreading scales above and beneath; terminal joint short, smooth, obtuse. Antennæ in ♂ with moderately long even ciliations, and a longer bristle on each joint. Thorax smooth. Abdomen with a dorsal crest on basal segment. Forewings with 7, 8, 9 stalked, 10 connected by a bar with 8 + 9 opposite origin of 7. Hindwings with 3 and 4 connate, 5 from mid-way between lower angle and middle of cell, 6 and 7 connate.

Differs from *Erastria* in the palpi and ♂ antennæ. The species described below has a general resemblance to *Rivula susialis*, Wlk.

SYNTHACA GILVICEPS, n. sp.

(*Gilviceps*, with yellowish head.)

♂, 18 mm. Head and palpi pale-ochreous. Antennæ pale-fuscous, towards base ochreous-tinged; in ♂ with moderately long (2), even ciliations and longer (3) bristles. Thorax ochreous-whitish; collar pale-ochreous. Abdomen ochreous-whitish irrorated with pale-fuscous. Legs pale-ochreous mixed with pale-fuscous. Forewings triangular, costa nearly straight, apex rounded, termen bowed, oblique; whitish with fuscous irroration; costal edge tinged with ochreous; an outwardly-curved fuscous line, tinged with ochreous, from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum, interrupted in disc; a similar but broader line from $\frac{3}{5}$ costa to mid-dorsum, obtusely angled outwards in disc; a finer, nearly straight, fuscous line from before apex to before tornus; an interrupted fuscous terminal line; cilia whitish mixed with fuscous. Hindwings with termen rounded; very pale fuscous; terminal line and cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in February; one specimen received from Mr. F. P. Dodd.

MICRAESCHUS PROLECTUS, n. sp.

(*Prolektos*, chosen, preferred.)

♂ ♀, 20-23 mm. Head white; face and palpi brown. Antennæ white; in ♂ with a double row of short pectinations ($\frac{2}{3}$). Thorax grey with a small reddish-fuscous posterior spot. Abdomen grey with some reddish-ochreous scales. Legs ochreous-whitish. Forewings triangular, costa straight, apex round-pointed, termen sinuate beneath apex, then strongly bowed, oblique; pale-grey with a few scattered dark-fuscous scales; a purple-fuscous streak on costa from near base to near apex, interrupted towards apex by three whitish-ochreous dots; a large postmedian purple-fuscous blotch, traversed by a pale line, extending from costa $\frac{2}{3}$ across disc; a purple-fuscous terminal line; cilia orange-ochreous. Hindwings with termen rounded; pale-grey; a pale-reddish suffused median band containing a series of white dots, best developed towards dorsum; terminal line and cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in October; two specimens received from Mr. F. P. Dodd.

RIVULA ÆNICTOPIS, n. sp.

(*Æniktopis*, of obscure appearance.)

♂ ♀, 15-16 mm. Head, palpi, thorax, and abdomen ochreous-whitish. Antennæ pale-fuscous; in ♂ shortly ciliated ($\frac{2}{3}$). Legs ochreous-whitish; middle tibiæ of ♂ elongate and with a crest of long scales on dorsal surface. Forewings triangular, costa slightly arched, apex rounded, termen bowed, oblique; ochreous-whitish: a series of whitish dots with darker interspaces on costa, mostly in posterior half; a fine linear transverse mark representing discal dot; a fine ochreous terminal line containing minute blackish dots on veins; cilia fuscous. Hindwings with termen rounded, slightly indented above middle; whitish: a slight fuscous suffusion on termen; cilia fuscous, on tornus and dorsum whitish.

Allied to *R. ommatopis*, Meyr., but much paler and discal spot of forewing much smaller and linear.

Type in Coll. Turner.

N.Q., Kuranda, Geraldton, Townsville, in October, November, March, and April.

RIVULA CRASSIPES, n. sp.

(*Crassipes*, with thickened feet.)

♂, 19 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-whitish; antennal ciliations in ♂ moderate ($1\frac{1}{2}$). Legs ochreous-whitish; middle tibiæ in ♂ elongate, hairy, thickened on dorsal surface with long hairs, which end in a dense fuscous tuft at distal extremity, first tarsal joint also hairy on dorsal surface; posterior tibiæ and first tarsal joint hairy on dorsal surface, the hairs on former forming a distinct tuft before middle. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique, dorsum fringed with long hairs towards base; ochreous-whitish; two or three small fuscous dots representing antemedian line; a pair of dark-fuscous dots arranged transversely and succeeded by some fuscous scales in disc beyond middle; a double series of faintly-marked fuscous dots representing postmedian line, from $\frac{5}{6}$ costa, sigmoid, and bent in to $\frac{2}{3}$ dorsum; a whitish line close to termen, termen narrowly ochreous-fuscous with minute blackish dots on veins; cilia pale-fuscous. Hindwings with termen rounded; pale-fuscous; cilia pale-fuscous.

Easily recognized by the ♂ middle tibiæ.

Type in Coll. Turner.

N.Q., Kuranda, in April; one specimen received from Mr. F. P. Dodd.

ANACHROSTIS ZONOPHORA, n. sp.

(*Zonophoros*, banded.)

♂, 14 mm. Head grey-whitish. Palpi fuscous. Antennæ grey; in ♂ serrate and moderately ciliated (1) in tufts. Thorax ochreous-whitish. Abdomen grey. Legs fuscous; posterior pair whitish. Forewings triangular, costa slightly arched, apex rounded, termen bowed, oblique; ochreous-whitish with scattered fuscous scales more numerous towards termen, markings fuscous; a triangular spot on costa from base to $\frac{1}{6}$; an irregularly dentate line from $\frac{1}{3}$ costa to $\frac{1}{4}$ dorsum, a similar line from mid-costa to mid-dorsum, the included space wholly fuscous towards costa, elsewhere irrorated with fuscous; a fine, acutely-dentate, whitish subterminal line; preceded by an irregular dark-fuscous subapical spot; cilia fuscous, obscurely barred with grey-whitish. Hindwings with termen rounded; grey; cilia grey.

Type in Coll. Turner.

N.Q., Kuranda, in September and April; two specimens received from Mr. F. P. Dodd.

Anachrostis placospila, n. sp.

(*Plakospilos*, broad-spotted.)

♂ ♀, 14-16 mm. Head, palpi, thorax, and abdomen white with a few fuscous and brownish scales more numerous in ♀. Antennæ whitish; in ♂ serrate with rather long cilia (2) in tufts. Legs whitish with fuscous irroration. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; white with some fuscous-brown irroration, more so in ♀; markings fuscous-brown; a spot on base of costa; a small triangular spot on $\frac{1}{4}$ costa; a large quadrangular spot on costa beyond middle; several irregularly-distributed dots in terminal part of disc; an interrupted terminal line; cilia whitish with some fuscous scales. Hindwings with termen rounded; whitish suffused with pale-fuscous, in ♀ fuscous; terminal line and cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in August and October; two specimens received from Mr. F. P. Dodd, of which the ♀ is in Coll. Lyell.

Section HYPENINÆ.

Panilla microsticta, n. sp.

(*Microstiktos*, with small spots.)

♂, 32-35 mm. ♀, 28 mm. Head and palpi fuscous mixed with ochreous-whitish. Antennæ fuscous; towards base in ♂ ochreous-whitish with a tuft of scales from anterior surface of basal joint; in ♂ simple, with a double row of tufts of rather long cilia ($1\frac{1}{2}$). Thorax and abdomen fuscous mixed with ochreous-whitish. Legs fuscous, anterior and middle tarsi annulated with ochreous-whitish; in ♂ with a dense tuft of hairs from anterior coxæ, and anterior femora and posterior tibiæ clothed with long hairs. Forewings triangular, costa straight, arched towards apex, apex rounded, termen crenate, bowed, oblique; fuscous irregularly mixed with ochreous-whitish; orbicular small, roundish, reniform larger, posteriorly indented, both fuscous, reniform with paler centre; an ill-defined, somewhat dentate, fuscous line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum, succeeded by a row of minute whitish dots on veins, variably developed, scarcely traceable in ♀; a terminal series of short longitudinal fuscous streaks between veins, running into a fuscous terminal line; cilia fuscous obscurely barred with ochreous-fuscous. Hindwings with termen rounded, crenate; colour and markings as forewings.

Type in Coll. Turner.

N.Q., Cairns; Kuranda; in April and May (Dodd); three specimens.

Panilla umbrifera, n. sp.

(*Umbriferus*, shaded.)

♂ ♀, 21-23 mm. Head reddish-brown mixed with whitish. Palpi fuscous mixed with reddish-brown and whitish. Antennæ fuscous, beneath ochreous-whitish; in ♂ with a tuft of hairs from upper and posterior aspect of basal joint, slightly dentate towards apex, moderately and evenly ciliated ($1\frac{1}{4}$), with longer bristles. Thorax reddish-brown mixed with whitish and dark-fuscous; a small whitish posterior tuft. Abdomen reddish-brown mixed with dark-fuscous and whitish; dorsal tufts on second and third segments. Legs ochreous-whitish; anterior and middle tibiæ dark-fuscous anteriorly; anterior and middle tarsi dark-fuscous with ochreous-whitish annulations; in ♂ with tufts of very long hairs, partly ochreous-whitish, partly dark-fuscous, from anterior coxæ and femora. Forewings triangular, costa straight, slightly arched towards apex, apex rounded, termen bowed, oblique, crenate; whitish mixed with reddish-brown; markings dark-fuscous mixed with reddish-brown; a basal fascia; a fascia at $\frac{1}{3}$, angled beneath costa; a large triangular spot on costa at $\frac{2}{3}$ from which a slender process extends obliquely outwards to mid-disc; a fine fuscous looped terminal line; cilia purplish with some fuscous scales. Hindwings with termen rounded, crenate; colour and markings as forewings, but without basal fascia and costal triangle, the latter replaced by a fine transverse postmedian line.

Type in Coll. Turner.

N.Q., Kuranda, in April and May; four specimens received from Mr. F. P. Dodd.

Genus Corethrobela, *nov.*

(*Korethrobelos*, with brush-like palpi.)

Head rough-haired, frons rounded. Tongue well developed. Palpi ascending, recurved; second joint ascending, reaching vertex, rough-haired, with a tuft of hairs posteriorly towards apex; terminal joint recurved, long, acute, in ♂ with loose-spreading hairs in front and behind, in ♀ with a tuft of long hairs on posterior surface only. Antennæ in ♂ with minute ciliations and a short bristle on each segment. Thorax smooth; in ♂ with a lateral expansile tuft of long hairs beneath from near origin of hindwings. Abdomen smooth. Coxæ and femora densely rough-haired, especially in ♂. Forewings with 7, 8, 9, 10 stalked, no areole; in ♂ with an elongate scaleless ribbed patch in posterior end of cell beneath, and a dense crest on upper surface on costal edge of posterior part of cell. Hindwings with 3 from well before lower angle of cell, 4 from angle, 5 closely approximated to 4 at origin, 6 and 7 connate, 8 anastomozing with cell to $\frac{1}{4}$; in ♂ with a pecten of long hairs on upper surface on median vein.

Allied to *Nodaria*, Gn., of which it appears to be a development.

CORETHROBELA MELANOPHAES, n. sp.

(*Melanophaes*, dark.)

♂ ♀, 38 mm. Head, palpi, thorax, and abdomen dark-fuscous. Antennæ fuscous; in ♂ with short ciliations ($\frac{1}{2}$) and longer bristles ($1\frac{1}{2}$). Legs fuscous mixed with ochreous-whitish. Forewings broadly triangular, apex rounded-rectangular, termen rounded beneath; dark-fuscous; a white dot in cell at $\frac{1}{6}$; a reddish-ochreous spot, finely outlined with black, beyond cell at $\frac{2}{3}$; in ♀ a few scattered whitish scales, of which some indicate a subterminal line; cilia fuscous-whitish. Hindwings with termen rounded; blackish in ♂, dark-fuscous in ♀; cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in April and May; two specimens received from Mr. F. P. Dodd.

NODARIA NYCTICHROA, n. sp.

(*Nuktichroos*, dark.)

♀, 24 mm. Head, palpi, antennæ, thorax, and abdomen fuscous. Palpi very long, ascending, second joint exceeding vertex, posterior aspect clothed with long scales, which extend to apex. Antennæ in ♀ with minute ciliations and moderately long bristles (2). Legs fuscous irrorated with whitish. Forewings triangular, costa moderately arched, apex acute, termen bowed, oblique; fuscous; median area darker, its anterior edge at $\frac{1}{3}$, concave; its posterior edge from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, irregularly dentate; cilia fuscous. Hindwings with termen rounded; fuscous; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

Genus ANOMOPHLEBIA, *nov.*

(*Anomophlebios*, with unusual neuration.)

Frons with an acute anteriorly-directed tuft of scales. Tongue well developed. Palpi long, porrect; second joint long, much thickened with loose scales, especially beneath; terminal joint short, somewhat thickened with scales which extend to apex. Antennæ in ♂ with a double row of long pectinations. Thorax with a posterior crest. Abdomen smooth. Forewings in ♂ with a large fovea in cell, and another between cell and costa; areole present, 8, 9, 10, 11 stalked from areole, 10 and 11 arising by a common stalk from 8 long before 7. Hindwings with 3 and 4 stalked, 5 from middle of cell, 6 and 7 stalked.

The anomalous neuration is perhaps correlated with the presence of a fovea in the forewing and confined to the ♂.

ANOMOPHLEBIA FURTIVA, n. sp.

(*Furtivus*, concealed, inconspicuous.)

♂, 24 mm. Head, thorax and abdomen pale-brownish. Palpi pale-brownish irrorated with dark-fuscous. Antennæ brown-whitish; in ♂ with very long (12) slender pectinations extending nearly to apex. Legs brownish with some fuscous irroration. Forewings triangular, costa gently arched towards base and apex, apex rounded, termen bowed, oblique; cell occupied by a foveal depression, and space between cell and costa by a second similar depression, both thinly scaled especially on under surface; pale-brownish; fuscous dots on costa at $\frac{1}{4}$ and middle; a strongly sigmoid postmedian line indicated by several fuscous dots on disc at $\frac{2}{3}$ beyond cell, several beneath end of cell before middle of disc, and one on dorsum at $\frac{2}{3}$; some inconspicuous fuscous terminal dots; cilia pale-brownish. Hindwings with termen rounded; brown-whitish; cilia whitish.

Type in Coll. Turner.

N.Q., Kuranda, in October; one specimen received from Mr. F. P. Dodd.

OLULIS SUBROSEA, n. sp.

(*Subroseus*, somewhat rosy.)

♀, 30 mm. Head, palpi, antennæ, and thorax ochreous-whitish. Palpi very long, ascending; second joint much exceeding vertex; terminal joint $\frac{2}{3}$ second, slender, acute. Abdomen ochreous-whitish with some rosy suffusion. Legs ochreous-whitish. Forewings elongate-triangular, costa nearly straight except near base and apex, apex acute, termen excised beneath apex, acutely dentate on vein 4, thence oblique; ochreous-whitish; some scattered fuscous scales which form obscure markings; indications of antemedian, postmedian, and subterminal lines; a pale-centred median discal spot; a series of dots on veins close to but not on termen; cilia ochreous-whitish. Hindwings bowed on vein 3, wavy between this and apex rounded towards tornus; whitish suffused with rosy.

Type (wasted) in Coll. Turner.

N.Q., Kuranda, in March; one specimen received from Mr. F. P. Dodd.

CHUSARIS RHODIAS, n. sp.

(*Rhodon*, a rose.)

♂, 21-24 mm. Head, palpi, and thorax fuscous-whitish, with a few dark-fuscous scales. Antennæ fuscous, towards bases whitish; in ♂ shortly ciliated ($\frac{2}{3}$). Abdomen ochreous-whitish densely irrorated, except basal segment and apical tuft, with pinkish. Legs ochreous-whitish; anterior pair irrorated with pinkish; anterior and middle tarsi irrorated with dark-fuscous. Forewings triangular, costa moderately arched, apex rectangular, termen strongly bowed, sinuate beneath apex, somewhat crenulate; ochreous-whitish sparsely irrorated with fuscous and pinkish scales; with tufts of raised scales, which are mostly dark-fuscous; several in basal area; five or six forming a line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; two arranged transversely in mid-disc; a series forming a sinuate line from just before apex to just before tornus; a subterminal series of pinkish-fuscous dots; cilia ochreous-whitish, apices pinkish. Hindwings with termen rounded; deep pink; traces of some fuscous subterminal dots near apex; cilia ochreous-whitish mixed with pinkish, the former preponderating towards tornus.

Type in Coll. Turner.

N.Q., Kuranda, in October; two specimens received from Mr. F. P. Dodd, of which one is in Coll. Lyell.

BLEPTINA PANTŒA, n. sp.

(*Pantoios*, of all kinds, variable.)

♂ ♀, 30 mm. Head pale-brownish. Palpi long and dilated with scales, in ♂ strongly recurved, second joint much exceeding vertex; brownish mixed with fuscous. Antennæ pale-brownish; in ♂ with a strong tuft of scales on upper surface beyond middle. Thorax and abdomen brownish. Legs whitish-ochreous mixed with fuscous-brown. Forewings triangular, costa straight, strongly arched before apex, apex acute, termen bowed, oblique; in ♂ with a much enlarged costal fold on under-surface, extending from base to $\frac{2}{3}$ costa and nearly half across disc; pale-brownish with some fuscous-brown irroration; an oblique darker shade, sometimes followed by a pale shade from costa beyond middle to dorsum before middle; a reddish-brown or dark-fuscous reniform spot, indented posteriorly, immediately beyond this; sometimes a series of fine fuscous dots representing postmedian line, from $\frac{2}{3}$ costa, at first curved outwards, then inwards to mid-dorsum; another series of dots represents subterminal line, in this line below costa is a short linear dark-fuscous lunule, edged posteriorly by a pale line; a terminal series of dark-fuscous dots; cilia fuscous, apices whitish barred with fuscous. Hindwings with termen scarcely rounded; colour and markings as forewings but without discal spot and lunule.

Type in Coll. Turner.

N.Q., Kuranda, in March, April, and July; three specimens received from Mr. Dodd, of which one is in Coll. Lyell.

Catada apoblepta, n. sp.

(*Apobleptos*, conspicuous.)

♂, 40 mm. Head reddish-ochreous; face and palpi fuscous; the latter extremely elongate (8). Antennæ fuscous; in ♂ with tufts of long cilia (3) in basal half, but towards apex cilia are short. Thorax brownish; collar reddish-ochreous. Abdomen ochreous-yellow; apical segments fuscous. Legs whitish; anterior pair suffused with fuscous. Forewings triangular, costa straight, arched before apex, apex rounded, termen obliquely rounded; fuscous; a bluish-white line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, outwardly curved; a similar line from midcosta, sinuate first outwardly then inwardly to mid-dorsum; between median line and base ground-colour is reddish-brown; a dark-fuscous dot in cell between lines; three fine parallel bluish-white lines the first on disco-cellular, the other two immediately posterior; a large whitish subapical blotch; [extreme apex broken, cilia abraded]. Hindwings with termen rounded; ochreous-yellow; a blackish terminal band, very wide at apex, narrowing to tornus; [cilia abraded].

Type in Coll. Turner. Though in poor condition, this is a striking and unmistakable species.

N.Q., Kuranda, in April; one specimen received from Mr. F. P. Dodd.

Genus Hypobleta, nov.

(*Hupobletos*, spurious counterfeit.)

Frons flat with a few projecting scales. Tongue well-developed. Palpi moderate, slender, porrect; second joint rather long, thickened with scales on upper surface towards apex; terminal joint short, somewhat down-curved, tolerably pointed. Antennæ in ♂ with short ciliations and rather longer bristles. Thorax and abdomen not crested. Anterior coxæ, femora, and tibiæ clothed with long hairs in ♂. Forewings with 7, 8, 9 stalked, 10 connected by a bar with 8 + 9 opposite 7. Hindwings with 3 and 4 short-stalked, 5 from midway between 4 and middle of cell, 6 and 7 connate.

Allied to *Hypenagonia*, Hmps. (Moths Ind. iii., p. 100). The following species might on superficial appearance be referred to the Sterrhinæ (Geometridæ).

Hypobleta cymæa, n. sp.

(*Kumaios*, wavy.)

♂ ♀, 20-22 mm. Head, thorax, and abdomen whitish or grey-whitish with some scattered dark-fuscous scales. Palpi whitish, towards base dark-fuscous. Antennæ whitish with some dark-fuscous scales towards base; in ♂ with very short ciliations (½) and rather longer, bristles (1). Legs whitish; anterior pair fuscous. Forewings rather elongate-triangular, costa straight to near apex, apex round-pointed, termen bowed, oblique, crenulate; whitish or grey-whitish, with a few scattered dark-fuscous scales; fine, indistinct, dentate postmedian and subterminal lines; a dark-fuscous subcostal dot at ¼, sometimes followed by similar dots in a line between this and termen; a terminal series of blackish dots; cilia whitish or grey-whitish. Hindwings with termen rounded, flattened towards tornus, dentate; colour and markings as forewings, but with some dark-fuscous suffusion at tornus.

Type in Coll. Turner.

N.Q., Kuranda, in March and April; two specimens received from Mr. F. P. Dodd.

Arrade percnopis, n. sp.

(*Perknopis*, of dusky appearance.)

♂, 21-23 mm. Head, palpi, antennæ, and thorax brown-fuscous. Antennæ in ♂ with short ciliations (⅔). Abdomen brown-fuscous, paler towards base; some raised scales on dorsum of penultimate segment. Legs brown-fuscous; posterior pair paler; fore-tibiæ in ♂ dilated with scales at apices. Forewings elongate-triangular, costa slightly concave in basal ⅔, then gently arched, apex tolerably pointed, termen straight, oblique, not crenulate, at most slightly wavy, dorsum with a triangular scale-tuft at ⅔; dark-brown; four minute whitish dots on apical fourth of costa; an interrupted dark-fuscous terminal line; cilia brown. Hindwings with termen rounded; pale-grey; cilia pale-grey.

Var. a.—Forewings with a darker basal patch sharply limited by a very oblique line from $\frac{1}{3}$ costa towards, but not reaching, tornus.

Type in Coll. Turner.

N.Q., Kuranda, in February and March; two specimens received from Mr. F. P. Dodd.

ESTHLODORA CYANOSPILA, n. sp.

(*Kuanospilos*, with bluish spots.)

♂, 16 mm. Head, palpi, thorax, and abdomen whitish-grey with a few scattered dark-fuscous scales. Antennæ whitish-grey; in ♂ simple, with moderate ciliations (1). Legs whitish-grey tinged with reddish; tarsi grey. Forewings triangular, costa straight almost to apex, then arched, apex acute, termen with an acute dentate projection on vein 4; whitish-grey, with some scattered brownish and fuscous scales; a suffused reddish spot on base of dorsum, more or less developed, sometimes reduced to a few scales; a straight fuscous line from $\frac{2}{5}$ costa to $\frac{2}{5}$ dorsum, sometimes faint, sometimes strongly developed; a pair of dark-fuscous discal dots arranged transversely immediately beyond this line; a whitish dentate subterminal line edged posteriorly with dark scales, more or less developed, sometimes pure white towards costa; a reddish-fuscous terminal line, thickened between veins; cilia reddish-fuscous, bases ochreous. Hindwings with termen nearly straight towards apex, slightly dentate on veins 2, 3, 4, deeply incised at tornus; reddish-fuscous, towards costa whitish-grey; a number of bluish-white spots; first and largest in mid-disc before middle, a median transverse series more or less confluent, and a double series before termen; cilia reddish-fuscous. Under side reddish-fuscous; forewing except towards costa and termen ochreous with reddish irroration.

Type in Coll. Turner.

N.Q., Kuranda, in March and May; two specimens received from Mr. F. P. Dodd.

Family PYRALIDÆ.

Subfamily PYRAUSTINÆ.

This group is very largely represented on the North Queensland coast, as is the case in all the tropical regions of the Eastern Hemisphere. Many of the species have a very extensive range, and the synonymy is thereby complicated. The classification of the genera is a task which, after having paid some attention to the subject, I prefer not to undertake at the present time. I include in this group the Hydrocampinæ and Scoparianæ of Hampson. The former, as he defines it, I do not regard as in any sense a natural group, and the character on which it is based, the stalking of vein 10 of the forewings, is not I think even of generic value. This vein is usually closely oppressed to 8 + 9, and may arise separately, or be partly fused with the latter in closely allied species, and sometimes both kinds of structure may be found in different individuals of the same species.

Genus Elachypteryx, *nov.*

(*Elachupterux*, tiny-winged.)

Frons rounded. Tongue present. Palpi upturned, slender, not reaching vertex; terminal joint slender, acute. Maxillary palpi very short, filiform. Antennæ of ♂ ciliated, with angular projections at joints. Posterior tibial spurs long and nearly equal. Forewings with 4 and 5 coincident, 8, 9, 10 stalked, 11 absent. Hindwings with 5 absent.

The neuration is difficult to make out on the type specimen, but I think this will be found correct.

Elachypteryx erebenna, n. sp.

(*Erebennos*, dark, gloomy.)

♂, 9 mm. Head, palpi, antennæ, thorax, and abdomen fuscous. Legs fuscous, tarsi and inferior surface whitish. Forewings elongate-triangular, costa gently arched, apex rounded, termen strongly indented at ⅓ and again near tornus; fuscous mixed with whitish; cilia fuscous, on apex and indentations whitish. Hindwings with termen strongly indented beneath apex; fuscous mixed with whitish; a terminal series of four black spots edged with silvery scales; cilia fuscous, apices whitish.

Type in Coll. Turner.

Q., Brisbane, in May; one specimen.

Genus Nannomorpha, *nov.*

(*Nannomorphos*, dwarfish.)

Face flat. Tongue obsolete. Palpi moderate, ascending; second joint tufted anteriorly; terminal joint moderate, with loose projecting scales. Maxilliary palpi strongly dilated with scales at apex. Antennæ with triangular thickenings at joints towards apex. [Legs broken.] Forewings with veins 4 and 5 stalked, 6 absent, 10 separate. Hindwings normal.

Allied to *Nymphula*, differing in the absence of tongue and neuration of forewings.

Nannomorpha alychnopa, n. sp.

(*Aluchnopos*, without brilliance, dull.)

♀, 11 mm. Head, palpi, thorax, and abdomen fuscous with some whitish scales. Antennæ ochreous-whitish with blackish annulations. Anterior legs ochreous-whitish suffused with fuscous; [middle and posterior pairs broken]. Forewings elongate-triangular, costa nearly straight, apex rounded, termen indented beneath apex, thence obliquely rounded; whitish densely irrorated with fuscous; some pale dots on costa; a transverse dentate pale line at $\frac{1}{4}$, with a dark-fuscous median dot on its posterior edge; a dark-fuscous median discal dot; a second pale transverse line at $\frac{4}{5}$; cilia whitish, a median line and apices fuscous. Hindwings with termen rounded, indented beneath apex; colour and markings as forewings.

Type in Coll. Turner.

Q., Eumundi, near Nambour, in December, one specimen.

Genus Eristena.

Eristena, Warr., A.M.N.H. (6), xvii., p. 150. Hmps., Tr. E.S., 1897, p. 136.

Eristena melanolitha, n. sp.

(*Melanolithos*, black-jewelled.)

♂, 18 mm. Head, palpi, and thorax fuscous. Antennæ, abdomen, and legs ochreous-whitish. Forewings elongate-triangular, costa nearly straight, apex rounded, termen obliquely rounded; fuscous-whitish with fuscous irroration; a roundish median fuscous spot; a fine fuscous subterminal line; cilia fuscous-whitish. Hindwings with termen rounded; whitish, a fine postmedian fuscous line not reaching costa and dorsum; a similar subterminal line only developed opposite median third of termen, on which are three black dots, intersected by tooth-like processes from this line; cilia whitish.

Type in Coll. Turner.

Q., Stradbroke Island; one specimen.

Genus Bæoptila, *nov.*

(*Baioptilos*, with little wings.)

Frons flat. Tongue well-developed. Labial palpi moderate, cylindrical, slightly ascending; terminal joint long, tolerably acute. Antennal joints triangularly dilated at apex; ciliations in ♂ minute. Forewings with 8 and 9 stalked, 10 separate but closely applied to 8 + 9, 11 absent. Hindwings with 7 anastomosing with 8.

Differs from *Nymphula* in the absence of vein 11 of forewings. It is probably related to *Musotima*, but I should like further material for examination.

Bæoptila selenias, n. sp.

(*Selene*, the moon; in allusion to the crescentic markings.)

♂, 8½ mm. Head, antennæ, thorax, and abdomen fuscous. Palpi whitish with three fuscous annulations. Legs white. Forewings triangular, costa moderately arched, termen scarcely bowed, oblique, strongly indented at $\frac{1}{4}$ from apex; fuscous; a white spot on costa before middle, continuous with a white crescentic discal mark, its concavity outwards; a white crescentic line from $\frac{3}{4}$ costa to mid-disc, its concavity inwards; a short oblique white subapical streak; a dark-fuscous terminal line interrupted at indentation; cilia whitish, on apex and mid-termen dark-fuscous. Hindwings with termen rounded, indented beneath apex; colour as forewings but without white markings.

This obscure species is one of the smallest of the Pyralidæ.

Type in Coll. Lyell.

N.Q., Kuranda, in March; one specimen received from Mr. F. P. Dodd.

Genus Aræomorpha, *nov.*

(*Araiomorphos*, slenderly formed.)

Frons rounded. Tongue well developed. Palpi upturned, reaching vertex; second joint with loose speading hairs towards base; terminal joint long, slender, acute. Maxillary palpi short, rather stout, not dilated. Antennæ of ♂ simple, shortly ciliated. Legs long and slender; spurs nearly equal. Forewings with 3 and 4 stalked, or less commonly connate; 8, 9, 10 stalked. Hindwings with 4 absent (coincident with 5), 6 and 7 stalked.

The stalking of 3 and 4 of the forewings though characteristic is not always present.

Aræomorpha atmota, n. sp.

(*Atmotos*, smoky.)

♂ ♀, 14-19 mm. Head, palpi, antennæ, thorax, and abdomen fuscous. Legs fuscous, beneath whitish. Forewings narrow-elongate, posteriorly dilated, costa gently arched, apex rounded, termen obliquely rounded; pale-fuscous, markings darker fuscous; suffused spots at base of costa and dorsum; similar spots beneath costa at $\frac{1}{4}$ and middle; a pale sigmoid line from $\frac{3}{4}$ costa to mid-dorsum; an indistinct subterminal line; cilia grey, apices whitish. Hindwings with termen rounded; whitish, towards termen greyish; cilia greyish.

The description of *Nymphula diplopa*, Low., resembles this species, but it should be structurally different.

Type in Coll. Turner.

N.Q., Kuranda, in October. Q., Brisbane, from September to April. Abundant on the river bank, resting on plants, etc., at the edge of the water. Probably the larvæ are aquatic.

NYMPHULA ARISTODORA, n. sp.

(*Aristos*, best; *doron*, a gift.)

♂, 10-12 mm. Head whitish. Palpi dark-fuscous; apices whitish. Antennæ ochreous-whitish. Thorax and abdomen whitish mixed with ochreous. Legs whitish annulated with fuscous; anterior pair mostly fuscous. Forewings elongate-triangular, costa scarcely arched, apex rounded, termen obliquely rounded, slightly indented at $\frac{1}{3}$ from costa; white mixed with ochreous and fuscous; costa suffused with fuscous as far as middle; a median fuscous and ochreous fascia from before mid-costa, broadening in disc, to mid-dorsum; beyond this is an ochreous fascia interrupted in middle, giving off below interruption a process towards mid-termen; a fine wavy dark-fuscous line from $\frac{3}{4}$ costa to mid-disc; an ochreous-fuscous subapical costal blotch; a terminal ochreous fascia anteriorly edged with fuscous; cilia whitish with a fuscous basal line. Hindwings with termen strongly indented at $\frac{1}{3}$; a fuscous line from middle of dorsum not reaching costa, preceded by an ochreous suffusion; a dark-fuscous median fascia broadly dilated in disc; followed by a broad ochreous fascia; terminal fascia and cilia as forewings.

Type in Coll. Turner.

Q., Brisbane, in April and May; taken abundantly in one locality on the edge of a waterhole.

NYMPHULA EPIMOCHLA, n. sp.

(*Epimochlos*, marked with a bar.)

♂, 18 mm. Head, palpi, and antennæ ochreous-whitish. Thorax and abdomen pale ochreous-fuscous. Legs ochreous-whitish; anterior pair infuscated. Forewings elongate-triangular, costa nearly straight, apex rounded, termen obliquely rounded; vein 10 stalked with $8+9$; pale ochreous-fuscous mixed with whitish; a fine white subterminal line; cilia ochreous-whitish, bases barred with fuscous. Hindwings with termen rounded; white; a narrow median and broad postmedian fuscous fascia; an ochreous-fuscous terminal fascia edged anteriorly with fuscous; cilia ochreous-fuscous with four or five blackish basal dots towards apex of wing.

Type in Coll. Turner.

Q., Brisbane, in January; one specimen. There are also two specimens in the British Museum.

CATACLYSTA PSATHYRODES, n. sp.

(*Psathurodes*, of fragile appearance.)

♂, 12 mm. Head white. Palpi white; basal half of terminal joint fuscous externally. Antennæ grey; in ♂

with angular projections at joints and short ciliations ($\frac{1}{2}$). Thorax fuscous; patagia white. Abdomen white irrorated with fuscous. Legs white; anterior pair fuscous, tarsi white with fuscous annulations. Forewings elongate-triangular, costa gently arched, apex pointed, termen slightly sigmoid, slightly oblique; white, with dark-fuscous and ochreous-brown scales; costal edge fuscous; a short blackish longitudinal streak from base; a blackish line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; a triangular ochreous-brown suffusion on dorsum beyond middle, edged above with blackish scales; a fine black circle in disc at $\frac{3}{4}$ connected by ochreous-brown suffusions with costa at $\frac{2}{3}$ and $\frac{5}{6}$, and with tornus; a fuscous terminal line; cilia white with a few fuscous scales. Hindwings with termen rounded, scarcely indented beneath apex; white; irregular blackish suffusions before and beyond middle; a pale ochreous subterminal band; terminal line and cilia as forewings.

Type in Coll. Turner.

Q., Stradbroke Island, in January; one specimen.

Genus Hylebatis, *nov.*

(*Hulebates*, haunting the forest.)

Frons flat. Tongue well-developed. Palpi moderate, porrect, triangularly dilated with hairs, terminal joint concealed. Maxilliary palpi strongly dilated at apices. Antennæ with triangular projections at joints; in ♂ with rather long cilia. Posterior tibiæ with inner median spur long, outer $\frac{1}{2}$, inner distal spur moderate, outer $\frac{2}{3}$. Forewings with 8 and 9 stalked, 10 closely approximated to $8+9$. Hindwings normal.

Allied to *Nymphula* but with different palpi.

Hylebatis scintillifera, n. sp.

(*Scintillifer*, sparkling.)

♂ ♀, 12-16 mm. Head pale ochreous-fuscous. Palpi whitish; external surface fuscous. Antennæ ochreous-whitish; ciliations in ♂ $1\frac{1}{2}$. Thorax ochreous-whitish. Abdomen pale ochreous-fuscous, apices of segments whitish. Legs ochreous-whitish; anterior tibiæ and tarsi annulated with blackish. Forewings elongate-triangular, costa nearly straight, apex rounded, termen rounded, oblique; whitish suffused and irrorated with ochreous-fuscous; a strongly outwardly-curved fuscous transverse sub-basal line, and a similar slightly curved line at $\frac{1}{3}$; a median fuscous pale-centred discal dot; a third line from $\frac{4}{5}$ costa to termen, then looped to beneath discal dot, where it forms a second loop, ending in dorsum beyond middle, after describing a sharp externally directed angle near dorsum; the costal portion of this line is bounded by a clear white line on either side; a subapical ochreous-fuscous blotch bounded posteriorly by a white line; a broad streak of metallic brassy scales above tornus; an ochreous-fuscous terminal line; cilia whitish mixed with fuscous, with a dark-fuscous basal line. Hindwings with termen deeply indented beneath apex; colour as forewings; towards costa whitish; a triangular basal darker blotch on dorsum; a median dark line from dorsum not reaching costa; an ochreous line opposite middle third of termen, succeeded by a black line containing several white dots; and this by a terminal line of brilliant brassy metallic scales; cilia as forewings but whitish towards tornus.

Type in Coll. Turner.

Q., Eumundi, near Nambour, and Mount Tambourine, in November, December, and March; common in damp places in the tropical forest growth.

MUSOTIMA LEPTORRHODA, n. sp.

(*Leptorrhodos*, faintly rosy.)

♂ ♀, 10-11 mm. Head, thorax, and abdomen pinkish-white; in ♀ fuscous. Palpi dark-fuscous, annulated with whitish. Antennæ ochreous-whitish; in ♀ fuscous. Legs white. Forewings triangular, costa moderately arched, apex tolerably rectangular, termen deeply indented beneath apex, then rounded, scarcely oblique; pale-pinkish with fuscous transverse lines; in ♀ almost wholly suffused with fuscous; three lines before $\frac{1}{3}$; a linear median discal mark, preceded on costa by a white dot, preceded and followed by a fuscous dot; an incomplete line from $\frac{2}{3}$ dorsum not reaching mid-disc; a fine dentate line at $\frac{5}{6}$, succeeded on costa by a slender triangular white spot; apical area above indentation ochreous, containing a leaden-metallic spot, with a blackish dot on its posterior edge; beneath indentation a subterminal series of blackish dots; cilia fuscous. Hindwings with termen slightly incised beneath apex; colour and markings as forewings, but without costal and apical markings.

Type in Coll. Turner.

N.Q., Kuranda, in May; two specimens received from Mr. F. P. Dodd.

Genus COSMOPHYLLA, *nov.*

(*Kosmophullos*, neat-winged.)

Frons flat. Tongue present. Labial palpi moderate, somewhat up-curved; second joint moderately scaled; terminal joint cylindrical, ascending, obtuse. Maxillary palpi well developed, dilated with scales at apex. Antennal joints triangularly dilated with scales at apices; ciliations in ♂ minute. [Posterior legs broken.] Forewings with 4 and 5 short-stalked, 8 and 9 stalked, 10 separate, but closely applied for some distance to 8+9. Hindwings with 3 from angle, 4 and 5 stalked, 7 anastomosing with 8 nearly to apex.

Cosmophylla oxygramma, n. sp.

(*Oxugrammos*, with sharply-angled markings.)

♂, 21-22 mm. Head white, with two posterior fuscous spots. Palpi pale-fuscous, internal surface white. Antennæ fuscous; in ♂ very minutely ciliated. Thorax white; bases of tegulæ, bases and apices of patagia, and a pair of dorsal spots fuscous. Abdomen grey, irrorated with white, more so towards base and apex. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen bowed, oblique; white; markings fuscous, tinged with ferruginous; a narrow costal streak to apex; subcostal, median, and dorsal longitudinal streaks from near base, terminating in an oblique bar from beneath $\frac{3}{5}$ costa to $\frac{2}{5}$ dorsum; fine streaks along subcostal veins to costa, but not reaching termen, the latter streaks join at extremities forming very acute dentations; an inwardly-curved fascia from apex, sharply dentate on both margins, broadening beneath to occupy nearly $\frac{1}{2}$ dorsum; a broad terminal line including some white scales; cilia white, faintly barred with fuscous. Hindwings with termen rounded; white; some pale-fuscous scales on veins; a faint fuscous line at $\frac{5}{6}$, another near termen, and a third on termen, all obsolete towards tornus; cilia white.

Type in Coll. Drake.

V., Beaconsfield, in October and December; two specimens, of which one is in my collection.

Voliba leptomorpha, n. sp.

(*Leptomorphos*, slightly-built.)

♀, 11 mm. Head and antennæ ochreous-whitish. Palpi ochreous-whitish, mixed with fuscous. Thorax whitish, anteriorly fuscous-tinged. Abdomen whitish. Legs fuscous, annulated with whitish; posterior pair whitish. Forewings elongate-triangular, costa slightly arched, apex rounded, termen obliquely rounded; ochreous-whitish; markings fuscous; a basal fascia, expanded on costa; a transverse straight linear fascia at $\frac{1}{3}$; a discal dot beneath $\frac{2}{5}$ costa; a larger discal dot beneath $\frac{3}{5}$ costa; a postmedian line from $\frac{3}{4}$ costa, bent inwards to touch lower extremity of posterior dot, and then to $\frac{2}{3}$ dorsum; from upper bend it gives off a process to tornus; cilia whitish. Hindwings with termen rounded; whitish; a slight pale-fuscous suffusion on mid-termen; cilia whitish.

Whiter than *V. scoparialis,* the forewings with clearly defined markings and two discal dots, of which the anterior is free.

Type in Coll. Turner.

N.Q., Townsville, in October; one specimen received from Mr. F. P. Dodd.

Voliba pycnosticta, n. sp.

(*Puknostiktos,* thickly-spotted.)

♂, 12 mm. Head, palpi, and antennæ dark-fuscous. Thorax dark-fuscous, posteriorly whitish. Abdomen whitish, posteriorly greyish. Legs fuscous with whitish annulations. Forewings elongate, posteriorly dilated, costa gently arched, apex rounded, termen obliquely rounded; whitish, markings fuscous, suffused; a basal patch; a transverse fascia at $\frac{1}{4}$; another in middle, dilated on costa; a spot on costa at $\frac{3}{4}$, giving rise to a dentate line to tornus; some fuscous suffusion on termen; cilia grey-whitish. Hindwings ovate-lanceolate; whitish, with some grey suffusion; cilia whitish.

The head and markings on forewings are darker than in *V. scoparialis,* and the latter are conspicuously dilated on costa.

Type in Coll. Turner.

Q., Burpengary, near Brisbane, in April; one specimen.

Voliba asphyctopa, n. sp.

(*Asphuktopos,* feeble-looking.)

♂, 10 mm. Head and antennæ ochreous-whitish. Palpi ochreous-whitish, mixed with fuscous. Thorax and abdomen whitish. Legs whitish; anterior, tibiæ, and tarsi fuscous, with whitish annulations. Forewings narrow-elongate, slightly dilated posteriorly, costa slightly arched, apex rounded, termen obliquely rounded; whitish; markings fuscous, distinct; an obscure basal patch; a narrow transverse fascia at $\frac{1}{3}$, succeeded by a subcostal dot; a larger discal dot at $\frac{2}{3}$; a fine dentate line from $\frac{3}{4}$ costa, bent inwards to touch discal dot, then curved in a right angle to $\frac{4}{5}$ dorsum; a dot above tornus close to termen; cilia whitish. Hindwings ovate-lanceolate; whitish; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in October; one specimen received from Mr. F. P. Dodd.

VOLIBA PSAMMOESSA, n. sp.

(*Psammoeis*, sandy.)

♂, 12-13 mm. Head, thorax, palpi, and antennæ pale ochreous-fuscous. Abdomen whitish, bases of segments dark-fuscous, tuft pale-ochreous. Legs ochreous-whitish, annulated with fuscous; anterior pair fuscous, annulated with ochreous-whitish. Forewings elongate - triangular, costa slightly arched, apex rounded, termen very obliquely rounded; whitish, finely irrorated with ochreous-fuscous; markings dark-fuscous; a dot on base of costa, a fine transverse fascia at $\frac{1}{4}$; a pale-centred discal ring beyond middle, connected by a fine dentate line with $\frac{4}{5}$ dorsum; a line from $\frac{3}{4}$ costa, at first straight, then describing a small outward curve, and ending above tornus; a fine terminal line not reaching tornus; cilia ochreous-whitish. Hindwings ovate; whitish; towards apex a pale-fuscous suffusion, containing an obscure fuscous line; a short dark-fuscous streak from tornus; cilia whitish.

Type in Coll. Turner.

Q., Adavale, in April; two specimens.

ENTEPHRIA CISSOPHORA, n. sp.

(*Kissophoros*, wearing ivy.)

♂, 18-21 mm. Head white, crown greenish-tinged. Palpi and antennæ whitish. Thorax whitish. Abdomen grey, apices of segments whitish, tuft pale-ochreous. Legs white. Forewings elongate-triangular, costa straight, except near base and apex, apex rounded, termen nearly straight, oblique; grey with purplish reflections, semi-translucent; a large triangular pale-green blotch, extending on costa from $\frac{1}{6}$ to middle, its apex above $\frac{1}{3}$ dorsum, anterior margin straight, posterior straight to lower margin of cell, then strongly waved to apex of blotch; two small oblong pale-green blotches on costa, between this and apex, and a similar streak broad at apex and narrowing on termen, sometimes interrupted, not reaching tornus; cilia white, bases grey. Hindwings with termen rounded; whitish-grey, darker towards mid-termen; cilia as forewings, but wholly white towards tornus and on dorsum.

In the form of the palpi and the elongate genital tuft of the ♂ this species corresponds closely with *Entephria meritalis*, Wlk.

Type in Coll. Turner.

N.Q., Kuranda and Townsville, in January; three specimens received from Mr. F. P. Dodd.

Nacoleia glageropa, n. sp.

(*Glageropos*, milky-looking.)

♂, 22 mm. Head white. Palpi fuscous, base, anterior, and internal surfaces white. Antennæ fuscous; in ♂ thickened and broadly laminate, slightly thicker and obtusely angled in middle, angled again at $\frac{3}{4}$ with a tuft of scales on angle. Thorax and abdomen fuscous, mixed with white. Legs white, annulated with pale-fuscous; anterior pair fuscous, annulated with whitish. Forewings elongate-triangular, costa slightly concave in basal $\frac{2}{3}$, convex in terminal third, apex round-pointed, termen bowed, oblique; fuscous mixed with white, which forms ill-defined blotches near base, on subcostal area, and at tornus; lines fuscous; an outwardly-curved line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; a white discal spot before middle confluent with subcostal suffusion; a line from $\frac{3}{4}$ costa towards tornus, abruptly bent inwards above tornus, and then downwards to $\frac{2}{3}$ dorsum; cilia fuscous, at tornus whitish. Hindwings with termen slightly sinuate; fuscous; whitish towards base, and beneath basal $\frac{2}{3}$ of costa; fuscous lines lost in ground-colour, but edged posteriorly with white; cilia pale-fuscous, towards tornus white, with a darker basal line.

Also allied to *N. rhoeonalis*, but readily distinguished by the whitish blotches.

Type in Coll. Turner.

N.Q., Kuranda, in September; one specimen received from Mr. F. P. Dodd.

Nacoleia oncophragma, n. sp.

(*Onkophragmos*, with bent margin.)

♂ ♀, 22-25 mm. Head and thorax fuscous, with some whitish scales. Palpi fuscous, internal surface and base white. Antennæ fuscous; in ♂ thickened and broadly laminate, slightly thicker and obtusely angled in middle, angled again at $\frac{3}{4}$, with a tuft of scales on angle. Abdomen fuscous, with some white scales on terminal segments. Legs white, with pale-fuscous annulations. Forewings elongate-triangular, costa with basal $\frac{2}{3}$ slightly concave, terminal third strongly convex, apex round-pointed, termen sinuate, oblique; fuscous, tinged with ochreous, more so on costa; lines darker-fuscous, obscure; a transverse line at $\frac{1}{4}$; a square pale-ochreous subcostal spot before middle; a finely dentate line from $\frac{4}{5}$ costa towards tornus, abruptly bent inwards above tornus, and again downwards to $\frac{2}{3}$ dorsum; cilia fuscous, on tornus ochreous-whitish. Hindwings with termen sinuate; fuscous, towards base sometimes whitish; an outwardly-curved fuscous line from $\frac{1}{5}$ costa to $\frac{3}{4}$ dorsum; a finely dentate line from $\frac{2}{3}$ costa not reaching dorsum; cilia whitish, with a fuscous basal line, absent towards costa.

Closely allied to *N. rhoeonalis*, Wlk. (=*murcalis*, Wlk.), from which it differs in the strongly sinuate costa of forewings, the more ochreous coloration, absence of second discal spot, and absence of lines in cilia of forewings.

Type in Coll. Turner.

Q., Brisbane, Killarney, and Bunya Mountains, in October and December; three specimens.

NACOLEIA ALINCIA, n. sp.

(*Alinkios*, similar.)

♂ ♀, 20 mm. Head fuscous, mixed with whitish. Palpi fuscous, basal half sharply whitish. Antennæ fuscous; in ♂ with moderate ciliations (1), bent beyond middle, and with a small posterior tuft of hairs immediately before bend. Thorax fuscous, with a few whitish scales. Abdomen fuscous, with a broad whitish basal band. Legs whitish, barred with fuscous. Forewings triangular, costa slightly sinuate, apex rounded, termen slightly rounded, oblique; vein 10 separate; whitish generally suffused with fuscous, especially towards costa; a fuscous fascia near base, succeeded by a fine transverse line at $\frac{1}{5}$; fuscous dots in disc at $\frac{1}{3}$ and middle; two fuscous dots on apical $\frac{1}{4}$ of costa, from the second proceeds an inwardly oblique, slightly dentate line, strongly bent outwards in disc, and again inwards, ending on $\frac{2}{3}$ dorsum; cilia fuscous, with a darker basal line. Hindwings as forewings, but without basal lines, and with only one discal spot, postmedian line interrupted in middle.

Very closely allied to *N. amphidecalis*, but forewings without clear whitish median band, and cilia not barred with whitish.

Type in Coll. Turner.

N.Q., Townsville, in January; two specimens received from Mr. F. P. Dodd.

Genus GLYCYTHYMA, *nov.*

(*Glukuthumos*, delightful.)

Frons rounded. Tongue well developed. Palpi moderate, upturned, not reaching vertex; second joint moderate, terminal joint short, slender, acute. Maxillary palpi minute, not dilated. Antennæ in ♂ minutely ciliated, not thickened, not bent, not tufted. Tibiæ with outer spurs about $\frac{1}{2}$ length of inner. Forewings with 7 well separated from 8, 9, to which 10 is approximated. Hindwings normal.

Allied to *Nacoleia*, Wlk., from which it is distinguished by the simple antennæ of the ♂, and the more slender and acute terminal joint of the palpi.

Type *Semioceros chrysorycta*, Meyr.

Glycythyma chrysorycta.

Semioceros chrysorycta, Meyr., Tr. E.S., 1884, p. 320.

N.Q., Dank Island and Townsville, in January. Q., Duaringa, Brisbane, in March.

Glycythyma thymedes, n. sp.

(*Thumedes*, well-pleasing.)

♂ ♀. Head and thorax yellow. Palpi yellow, apex fuscous. Antennæ ochreous-fuscous. Abdomen ochreous-yellow. Legs whitish-ochreous. Forewings elongate-triangular, costa straight, apex rounded, termen bowed, oblique; yellow; markings dark-fuscous, clearly defined; a line from costa near base, not reaching dorsum; a line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, curved outwards in middle; a dot beneath $\frac{1}{3}$ costa, sometimes absent; a second reniform costal dot beyond middle, sometimes yellow-centred; a line from $\frac{4}{5}$ costa, describing a sigmoid curve more or less strongly, and touching or nearly so lower end of reniform spot, ending on $\frac{2}{3}$ dorsum; a terminal line, thickened into a triangular spot above middle: cilia fuscous, sometimes barred with whitish. Hindwings with termen rounded; yellow; a fuscous line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum, sometimes interrupted in disc; a fuscous suffusion at apex; cilia as forewings.

Readily distinguished from the preceding by the presence of only a single line on hindwings.

Type in Coll. Turner.

N.Q., Townsville, in April; two specimens.

Genus Eurybela, *nov.*

(*Eurubelos*, with broad weapons, *i.e.*, palpi.)

Frons rounded. Tongue well developed. Palpi rather large, curved upwards, not reaching vertex; second joint covered with dense long hairs, forming an anteriorly directed dense tuft at apex; terminal joint short, concealed in hairs of second joint. Maxillary palpi well developed, not dilated at apex. Antennæ in ♂ minutely ciliated. Outer tarsal spurs half inner. Forewings with 3, 4, 5, approximated at base, 7 straight and well separated from 8, 9, to which 10 is closely approximated. Hindwings with 3, 4, 5, approximated at base, 6, 7 stalked, 7 anastomosing with 8.

Characterized mainly by the palpi, which do not appear to correspond to any described genus.

EURYBELA SCOTOPIS, n. sp.

(*Skotopis*, dark-looking.)

♂, 25 mm. Head, palpi, antennæ, thorax, and abdomen dark-fuscous. Legs fuscous, annulated with whitish. Forewings elongate-triangular, costa nearly straight except towards apex, apex rounded, termen bowed, oblique; fuscous, mixed with ochreous-whitish; markings dark-fuscous; an outwardly-curved, somewhat suffused, transverse line at $\frac{1}{3}$; a pale-centred discal spot beneath mid-costa; a dentate line from $\frac{4}{5}$ costa towards tornus, posteriorly edged with ochreous-whitish, above tornus abruptly bent inwards, and then continued to $\frac{2}{3}$ dorsum; cilia fuscous, with a basal series of whitish spots. Hindwings with termen rounded; fuscous; an indistinct darker line, its median portion finely dentate and produced to near termen; cilia as forewings.

Type in Coll. Turner.

N.Q., Kuranda, in May; two specimens received from Mr. F. P. Dodd.

SYLEPTA CHRYSAMPYX, n. sp.

(*Krusampux*, with frontlet of gold.)

♀, 23 mm. Head orange-ochreous; face fuscous. Palpi with terminal joint very small; orange-ochreous, some fuscous scales on anterior and posterior edge. Antennæ grey. Thorax slaty-grey. Abdomen slaty-grey; tuft ochreous. Legs ochreous; anterior coxæ, apices of femora, and tibiæ, and terminal tarsal joints grey. Forewings elongate-triangular, costa straight to near apex, there strongly bowed, apex rounded, termen bowed, oblique; slaty-grey; a transversely elongate, oval, whitish spot on costa at $\frac{4}{5}$; cilia slaty-grey. Hindwings with termen gently rounded; slaty-grey; cilia concolorous.

Type in Coll. Lyell.

N.Q., Kuranda, in May; one specimen received from Mr. F. P. Dodd.

SYLEPTA AGENETA, n. sp.

(*Agenetos*, low-born, plebeian.)

♀, 24 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-fuscous. Legs whitish; anterior pair fuscous. Forewings triangular, costa straight, apical fourth moderately arched, apex round-pointed, termen bowed, oblique; ochreous-fuscous; lines fuscous, obscure; a transverse line at $\frac{1}{5}$; a faint linear discal dot before middle; a line from $\frac{2}{3}$ costa, at first straight and parallel to termen, then bent outwards at a right angle in mid-disc, then parallel to termen for a short distance, again bent rectangularly, first inwards, and then outwards to end on $\frac{3}{5}$ dorsum; cilia fuscous. Hindwings with termen rounded; fuscous, with an ochreous tinge; a postmedian fuscous line produced towards termen in mid-third, forming an obtuse process like that of forewing; cilia fuscous.

Type in Coll. Turner.

N.Q., Cardwell, in August; one specimen.

SYLEPTA PHRICOSTICHA, n. sp.

(*Phrikostichos*, with rippled lines.)

♂ ♀, 32 mm. Head, palpi, antennæ, thorax, and abdomen brown; thorax sometimes reddish-brown; antennal ciliations in ♂ $\frac{2}{3}$. Legs brown-whitish; posterior tibiæ with outer spurs less than $\frac{1}{2}$ inner; posterior femora and tibiæ in ♂ densely fringed with long hairs on upper surface. Forewings triangular, costa straight for $\frac{2}{3}$, then moderately arched, apex acute, termen slightly sinuate, oblique; brown, sometimes reddish-brown; markings fuscous; an obscure slender transverse line at $\frac{1}{6}$; a subcostal dot at $\frac{1}{3}$; and two dots placed transversely beneath mid-costa; a slender acutely dentate line from $\frac{3}{4}$ costa across disc, below middle bent abruptly inwards to beneath median dots, and then downwards to dorsum just beyond middle; a terminal series of minute dots on veins; cilia whitish, bases fuscous. Hindwings with termen rounded; colour as forewings, but paler towards base; one or two dots representing basal line; an acutely dentate postmedian line, its median third produced towards termen; terminal dots and cilia as forewings. Underside pale-brownish, postmedian fuscous, dentate line very distinct, subcostal fuscous dots at $\frac{1}{4}$, that on hindwing larger, with a smaller dot between it and base.

Type in Coll. Turner.

Q., Brisbane; two specimens.

PAGYDA CALLIPONA, n. sp.

(*Kalliponos*, beautifully wrought.)

♂ ♀, 18-20 mm. Head whitish. Palpi whitish, mixed with fuscous and ochreous. Antennæ ochreous-whitish. Thorax whitish, mixed with ochreous. Abdomen ochreous; apices of segments whitish. Legs whitish. Forewings elongate-triangular, costa straight for $\frac{3}{4}$, then gently arched, apex round-pointed, termen sinuate, oblique; ochreous-orange, with three whitish-ochreous fasciæ: first linear from $\frac{1}{6}$ costa to $\frac{1}{4}$ dorsum: second broad from $\frac{1}{3}$ costa, narrowing in disc, not reaching dorsum: third also incomplete, broad, from costa beyond middle, dilated in disc; a fine whitish interrupted line from $\frac{3}{4}$ costa, describing a sigmoid curve to $\frac{3}{4}$ dorsum; a second similar line from costa between this and apex to mid-termen, and continued along termen to tornus; cilia whitish.

Hindwings with termen rounded, slightly sinuate beneath apex; whitish-ochreous, thinly scaled, and partly translucent; an orange-ochreous, outwardly-curved fascia, edged with fuscous and constricted in middle at $\frac{1}{3}$; a similar fascia at $\frac{2}{3}$, broadly interrupted in middle; an orange-ochreous terminal suffusion confluent with second fascia towards tornus; a subterminal line of whitish dots from costa joining a similar terminal line before middle; cilia whitish, mixed with orange-ochreous.

Type in Coll. Turner.

N.Q., Kuranda, in September and December; two specimens received from Mr. F. P. Dodd.

Agathodes paliscia, n. sp.

(*Paliskios*, dusky.)

♂ ♀, 28-34 mm. Head, palpi, and antennæ ochreous-grey. Thorax grey, with purple reflections; a small posterior crest of brownish-fuscous scales. Abdomen whitish suffused with grey; tuft in ♂ dark-grey. Legs white. Forewings narrow-elongate, gradually dilated posteriorly; costa straight to near apex, then arched, apex rounded, termen obliquely rounded, dorsum slightly sinuate; pale-grey, with purple reflections, and some dark-ochreous irroration, especially towards dorsum; a pale linear discal mark at $\frac{2}{3}$, succeeded by a dark-ochreous suffusion; a pale line from $\frac{5}{6}$ costa obliquely outwards nearly to termen, then bent and finely dentate to $\frac{3}{4}$ dorsum; disc beyond this dark-ochreous; a fine white interrupted terminal line; cilia dark-ochreous. Hindwings more than twice breadth of forewings, termen scarcely rounded, in ♀ sinuate beneath apex; thin-scaled and semi-translucent, pale-grey, towards base whitish; cilia white, with a grey basal line.

Type in Coll. Turner.

N.Q., Townsville, in February; two specimens received from Mr. F. P. Dodd.

Pygospila hyalotypa, n. sp.

(*Hualotupos*, with transparent markings.)

♂, 46 mm. Head grey; sides of face whitish. Palpi with second joint very broad, rounded anteriorly; grey; base of second joint sharply whitish. Antennæ grey. Thorax grey with some whitish scales. Abdomen grey. Legs whitish; tibiæ and tarsi annulated with pale-grey. Forewings triangular, costa straight to near apex, there strongly bowed, apex rounded, termen slightly bowed, oblique, dorsum sinuate; fuscous-grey, with purple lustre; spots translucent, free from scales; a dot below cell near base, and another in cell towards base; a quadrangular spot in cell at $\frac{1}{3}$, and another oval spot on dorsal side of it below cell; a quadrangular spot beneath $\frac{3}{5}$ costa, bisected by vein 6; a smaller spot obliquely below this bisected by vein 4; cilia fuscous. Hindwings with termen sinuate; vein 8 in ♂ bowed and clothed beneath with long scales; colour and cilia as forewings; one translucent spot only, towards base on dorsal side of cell, elongate-ovoid, narrower towards base.

Type in Coll. Lyell.

N.Q., Kuranda; one specimen, received from Mr. F. P. Dodd. Mulgrave River, near Cairns, in December; one specimen.

Archernis eucosma, n. sp.

(*Eukosmos*, well-adorned.)

♂ ♀, 31-32 mm. Head pale-grey, face white except for a pale-grey superior spot. Palpi fuscous, inner-surface and base white. Antennæ pale-grey. Thorax and abdomen pale-grey. Legs white; anterior femora and distal $\frac{2}{3}$ of tibiæ dark-fuscous on internal surface. Forewings triangular, costa straight for $\frac{3}{4}$, then rather strongly arched, apex rounded, termen bowed, oblique; pale-grey; a blackish crescentic median discal spot; a fine fuscous line from $\frac{3}{4}$ costa, wavy, outwardly curved, towards dorsum bent inwards, and then downwards to $\frac{3}{4}$ dorsum; an elongate suffused white spot on posterior edge of this line beneath costa, and a smaller similar spot above dorsum; cilia whitish barred with fuscous. Hindwings with termen rounded; pale-grey; discal spot rather large, blackish, angular; a postmedian fuscous line bent outwards towards termen in middle third; a fuscous terminal line; cilia white, bases barred with fuscous.

Type in Coll. Turner.

N.Q., Townsville, in February; two specimens received from Mr. F. P. Dodd.

Archernis leucocosma, n. sp.

(*Leukokosmos*, with white ornament.)

♂ ♀, 22-26 mm. Head greyish-brown, face white. Palpi $3\frac{1}{2}$; fuscous-brown, base white. Antennæ greyish-brown. Thorax and abdomen greyish-brown. Legs white; anterior femora and tibiæ fuscous on internal surface. Forewings triangular, costa straight for $\frac{3}{4}$, then arched, apex round-pointed, termen bowed, oblique; greyish-brown; a fine fuscous transverse line at $\frac{1}{5}$; a snow-white median discal spot, edged anteriorly with fuscous; a fine fuscous wavy line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum, edged posteriorly with white in costal portion; cilia fuscous, apices white except opposite mid-termen. Hindwings with termen rounded; greyish-brown; a snow-white discal spot edged anteriorly with fuscous; a fuscous postmedian line, edged posteriorly with white throughout, and produced towards termen in middle; cilia white with a basal fuscous line.

Type in Coll. Turner.

N.Q., Kuranda, in October and May; two specimens received from Mr. F. P. Dodd.

Archernis metriodes, n. sp.

(*Metriodes*, of ordinary appearance.)

♂, 29 mm. Head pale-brown, face white. Palpi 2; fuscous-brown, base white. Antennæ pale-brown. Thorax and abdomen pale-brown. Legs white; internal surface and anterior femora and tibiæ fuscous. Forewings triangular, costa straight for $\frac{3}{4}$, then arched, apex round-pointed, termen bowed, oblique; pale-brown; basal line obsolete; a linear crescentic fuscous median discal mark; a fine wavy fuscous line from $\frac{2}{3}$ costa towards tornus, abruptly bent inwards in disc and then downwards to $\frac{2}{5}$ dorsum; cilia brown-whitish with a fuscous basal line. Hindwings with termen rounded; as forewings but discal mark straight, postmedian line with middle third produced towards termen and dentate.

Type in Coll. Turner.

N.Q., Townsville, in March; one specimen received from Mr. F. P. Dodd.

Metasia polytima, n. sp.

(*Polutimos*, much-esteemed.)

♂, 14-15 mm. Head ochreous-whitish, face fuscous. Palpi 3; fuscous, beneath white. Antennæ whitish with incomplete fuscous annulations; ciliations in ♂ $\frac{2}{3}$. Thorax pale-reddish. Abdomen pale-reddish; apical segments fuscous. Legs whitish with some fuscous suffusion; anterior pair mostly fuscous. Forewings triangular, costa straight, slightly indented at $\frac{2}{3}$ and thence gently arched, apex rounded, termen bowed, oblique; pale-reddish; a broad dark-fuscous costal streak to $\frac{2}{3}$; a fine fuscous transverse line at $\frac{1}{3}$; a pale discal spot outlined with fuscous and connected by a fine fuscous line with dorsum beyond middle; a wavy dark-fuscous line from $\frac{3}{4}$ costa to before tornus; disc beyond this suffused with fuscous; a dark-fuscous terminal line; cilia fuscous with whitish bases and a darker median line. Hindwings with termen rounded, distinctly indented towards apex; colour, antemedian, postmedian and terminal lines, and cilia as forewings.

Type in Coll. Turner.

N.Q., Townsville, in September; two specimens.

Metasia dactyliota, n. sp.

(*Daktuliotos*, ringed; in allusion to discal spot of forewings.)

♀, 16 mm. Head and antennæ pale-fuscous. Palpi $1\frac{3}{4}$; fuscous-whitish. Thorax ochreous-whitish mixed with fuscous. Abdomen whitish, bases of segments broadly fuscous. Legs fuscous annulated with whitish. Forewings elongate-triangular, costa slightly arched, apex rounded, termen bowed, oblique; ochreous-whitish irrorated with fuscous; markings fuscous; a broadly suffused sub-basal line; an irregularly dentate transverse line at $\frac{1}{5}$; a similar line from mid-costa to $\frac{2}{3}$ termen, bifurcating to enclose a small whitish discal spot; a third similar line from $\frac{2}{3}$ costa to tornus; two fuscous dots on costa between this and apex; a fuscous terminal line; cilia whitish, bases ochreous-whitish mixed with pale-fuscous. Hindwings with termen rounded; whitish with some fuscous irroration; a fuscous transverse line from tornus, lost in mid-disc; a similar incomplete line from termen beyond tornus; an apical fuscous suffusion; cilia as forewings, but at tornus wholly whitish.

Type in Coll. Turner.

N.Q., Townsville, in August; one specimen received from Mr. F. P. Dodd.

Metasia diplophragma, n. sp.

(*Diplophragmos*, with double margin.)

♀, 14 mm. Head white. Palpi $3\frac{1}{2}$; external surface pale-fuscous. Antennæ grey. Thorax whitish-ochreous. Abdomen whitish-ochreous, bases of segments fuscous. Legs whitish-ochreous; apices of anterior tibiæ fuscous. Forewings elongate-triangular, costa nearly straight, apex rounded, termen bowed, strongly oblique; whitish-ochreous; markings fuscous, distinct; some fuscous suffusion at base; an outwardly curved line from $\frac{1}{4}$ costa to $\frac{2}{5}$ termen; an obliquely elongate median discal spot; a sinuate line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, succeeded by some fuscous irroration; a fuscous terminal line; cilia whitish with a fuscous basal line. Hindwings with termen slightly sinuate; colour, terminal line, and cilia as forewings; broadly suffused fuscous lines at $\frac{1}{3}$ and before termen, the latter not reaching dorsum, both not reaching costa.

Type in Coll. Turner.

N.Q., Townsville, in November; one specimen received from Mr. F. P. Dodd.

Metasia nyctichroa, n. sp.

(*Nuktichroos*, dusky.)

♂, 14 mm. Head fuscous. Palpi $2\frac{1}{4}$; fuscous, whitish beneath. Antennæ fuscous; ciliations in ♂ $\frac{1}{2}$. Thorax and abdomen fuscous. Legs whitish-ochreous; anterior pair mostly fuscous. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen bowed, oblique; ochreous-whitish densely irrorated with fuscous; markings obscure; a pale oblong spot in disc at $\frac{2}{3}$; an ill-defined line from $\frac{3}{4}$ costa towards tornus, bent inwards above tornus and again downwards to $\frac{2}{3}$ dorsum; cilia whitish mixed with fuscous. Hindwings with termen sinuate; pale-ochreous with fuscous irroration; a short line from $\frac{2}{3}$ dorsum not reaching mid-disc; cilia as forewings.

Type in Coll. Turner

Q., Killarney, in October; one specimen.

Metasia typhodes, n. sp.

(*Tuphodes*, smoky.)

♂, 16 mm. Head ochreous. Palpi $2\frac{1}{4}$; ochreous. Antennæ fuscous; ciliations in ♂ extremely short. Thorax and abdomen fuscous. Legs whitish. Forewings triangular, costa slightly arched, apex round-pointed, termen bowed, oblique; fuscous with darker lines; a straight transverse line at $\frac{1}{4}$; a minute dark median discal dot; a line from $\frac{3}{4}$ costa towards tornus, bent inwards in disc and again downwards to $\frac{2}{3}$ dorsum; cilia fuscous. Hindwings with termen rounded; colour as forewings; a single transverse darker line from tornus to $\frac{2}{3}$ costa.

The yellowish head contrasting with the uniformly dusky wings should be sufficient for the recognition of this species.

Type in Coll. Turner.

Q., Brisbane and Toowoomba; two specimens.

Metasia adoxodes, n. sp.

(*Adoxodes*, obscure.)

♂, 15 mm. Head fuscous with white irroration; face fuscous. Palpi 2; fuscous, base partly white. Antennæ fuscous; ciliations in ♂ extremely short. Thorax white with dense fuscous irroration. Abdomen grey, at base ochreous-tinged. Legs white; anterior and middle pairs with dense fuscous irroration. Forewings elongate-triangular, costa slightly arched, apex rounded, termen slightly bowed, oblique; white, densely irrorated with fuscous throughout; markings dark-fuscous; a dot near base; a transverse line at $\frac{1}{6}$; a subcostal dot at $\frac{1}{3}$; a transverse linear median discal mark; a line from $\frac{5}{6}$ costa towards tornus, bent inwards in mid-disc to beneath discal mark, and then downwards to $\frac{3}{4}$ dorsum; a suffused terminal line; cilia whitish with a fuscous line near bases. Hindwings with termen rounded; grey, towards base paler; cilia whitish with a grey basal line.

Type in Coll. Turner.

Q., Brisbane, in January; one specimen.

METASIA TROPHŒSSA, n. sp.

(*Trophoeis*, stout, large.)

♂, 22 mm. Head ochreous-whitish; face fuscous. Palpi $1\frac{1}{2}$; fuscous, base whitish. Antennæ pale-fuscous; in ♂ with moderately long ciliations ($1\frac{1}{2}$). Thorax fuscous. Abdomen whitish-ochreous with a few fuscous scales; three terminal segments dark-fuscous on dorsum. Legs dark-fuscous annulated with whitish. Forewings elongate-triangular, costa straight for $\frac{3}{4}$, then moderately arched; apex round-pointed, termen bowed, oblique; ochreous-whitish with much fuscous irroration; markings fuscous, suffused; a transverse line near base and another at $\frac{1}{4}$; a median discal spot; a line from $\frac{4}{5}$ costa towards tornus, bent inwards beneath discal spot, and again downwards to $\frac{3}{4}$ dorsum; a terminal series of dots; cilia grey with a darker basal line. Hindwings with termen rounded; ochreous-yellow; a broad dark-fuscous terminal band, broadest on costa, narrowing to tornus; cilia as forewings.

Type in Coll. Turner.

Q., Toowoomba, in April; one specimen.

ISOCENTRIS ERROMENA, n. sp.

(*Erromenos*, stout.)

♂, 39 mm. Head orange-ochreous. Palpi dark-fuscous; base and a broad median ring ochreous. Antennæ dark-fuscous; ciliations in ♂ $\frac{1}{2}$. Thorax dark-fuscous; tegulæ and a posterior spot orange-ochreous. Abdomen ochreous; bases of first, second, sixth, and seventh segments, and whole of eighth segment except apex dark-fuscous. Legs dark-fuscous; inner half of anterior coxæ ochreous. Forewings triangular, costa sinuate, apex rounded, termen bowed, oblique; dark-fuscous, markings orange-ochreous; a small spot at base of costa, and another on mid-base; a large quadrangular spot before middle, larger towards dorsum, unequally divided by a fine fuscous line on median vein; a rounded spot at $\frac{2}{3}$, nearer costa than dorsum; cilia fuscous, apices pale-ochreous. Hindwings with termen rounded, slightly sinuate; orange-ochreous; an antemedian spot and a broad terminal band dark-fuscous; cilia as forewings.

Type in Coll. Lyell.

N.Q., Cooktown (?); one specimen.

Genus Cœlobathra, *nov.*

(*Koilobathros*, with hollowed base.)

Head with slight rounded prominence. Palpi porrect; second joint slightly ascending, terminal joint bent forward, well developed. Maxillary palpi filiform. Antennæ of ♂ minutely ciliated. Posterior tibiæ of ♂ with outer middle spur rudimentary, outer end-spur $\frac{1}{2}$ inner. Forewings of ♂ with large fovea on upper surface near base, frenulum and retinaculum well developed, costal portion of hindwings expanded near base to cover under-surface of fovea; vein 10 separate. Hindwings with 5 approximated at base to 4, 7 anastomosing with 8 to near apex.

A peculiar genus. The partial obsolescence of posterior tibial spurs recalls *Phlyctænia*, but the long anastomosis of vein 7 of hindwings, together with the fovea on forewings of ♂, remove it from that genus.

Cœlobathra eucrines.

(*Eukrines*, clear, distinct.)

♂, 13 mm. Head, palpi, antennæ, thorax, and abdomen ochreous-yellow. Legs whitish-ochreous. Forewings triangular, costa nearly straight, apex rounded, termen bowed oblique; bright ochreous-yellow; markings blackish; a dot beneath $\frac{1}{3}$ costa, another on $\frac{1}{3}$ dorsum, and a third between and slightly anterior to these, on edge of fovea; a discal dot at $\frac{2}{3}$; posterior line distinct, from $\frac{5}{6}$ costa, bent first outwards, then strongly inwards to beneath discal dot, and rectangularly to $\frac{2}{3}$ dorsum; [cilia abraded]. Hindwings with termen rounded; grey; paler towards base; cilia whitish-ochreous.

Type (somewhat worn) in Coll. Lyell.

N.A., Port Darwin, in March; one specimen.

Pyrausta diplosticta, n. sp.

(*Diplostiktos*, doubly-spotted.)

♀, 22-26 mm. Head, palpi, antennæ, thorax, and abdomen brownish-grey. Legs whitish; anterior pair grey. Forewings triangular, costa straight, terminal fourth rounded, apex round-pointed, termen bowed, oblique; pale brownish-grey; a clear white median subcostal spot, edged with some darker scales; a similar spot narrower and twice constricted at $\frac{3}{4}$; cilia grey. Hindwings with termen rounded, slightly sinuate; median vein with a few loose hairs; ochreous-whitish with some brownish-grey irroration; an antemedian dot, and a subterminal band of the same colour; cilia grey.

Type in Coll. Lyell.

V., Lorne, in December and March; three specimens received from Mr. G. Lyell.

Pyrausta apocrypha, n. sp.

(*Apokruphos*, hidden, obscure.)

♀, 32 mm. Head pale-brownish. Palpi $1\frac{1}{2}$; pale-brownish, base white. Antennæ whitish. Thorax pale-brownish. Abdomen brown-whitish. Legs whitish. Forewings rather elongate-triangular, costa straight for $\frac{2}{3}$, then arched, apex round-pointed, termen scarcely bowed, oblique; pale-brownish without markings, except traces of a suffused, slightly darker, oblique, postmedian line; cilia brown-whitish. Hindwings with termen rounded; brown-whitish; a very indistinct, suffused, postmedian line; cilia whitish.

Type in Coll. Turner.

Q., Brisbane, in March; one specimen.

Genus Otiophora, *nov.*

(*Otiophoros*, bearing little ears; in allusion to fovea on forewing.)

Head flat and oblique. Tongue well developed. Palpi moderate, porrect; terminal joint short, obtuse. Maxillary palpi well-developed, not dilated. Antennæ in ♂ minutely ciliated. Posterior tibiæ with outer spurs $\frac{1}{2}$ inner. Forewing of ♂ with a large auricular fovea near base on upper surface between subcostal vein and dorsum, bounded dorsally by a steep ridge; vein 10 separate. Hindwings with vein 7 anastomosing with 8 to nearly apex.

Type *Pionea leucura*, Low.

Otiophora leucura.

Pionea leucura, Low., Tr. R.S.S.A., 1903, p. 67.

This species is not "white-tailed," as the name would imply.

N.Q., Townsville. Q., Brisbane.

Otiophora clavifera.

Pionea clavifera, Hmps., P.Z.S., 1889, p. 241.

N.Q., Kuranda, Townsville (Dodd).

Genus Noorda.

In this genus, as I understand it, vein 10 may be either separate or stalked with 8 + 9. It includes the species referred by Sir Geo. Hampson to *Clupeosoma* and *Hemiscopis*. In fact, *N. polalis (polusalis)*, Wlk., is specifically closely allied to *N. suffusalis*, Wlk., and to *nyctopa*, described below. The genus is a very natural one, characterised by the form of the labial and maxillary palpi.

Noorda nyctopa, n. sp.

(*Nuktopos*, dark, gloomy.)

♂ ♀, 18-22 mm. Head ochreous-fuscous. Palpi 4; fuscous. Antennæ fuscous; ciliations in ♂ minute. Thorax fuscous. Abdomen fuscous, posteriorly fuscous-whitish. Legs ochreous-whitish; anterior femora and middle tibiæ fuscous; anterior tibiæ and tarsi white. Forewings triangular, costa at first straight, then rather strongly arched, apex rounded, termen bowed, oblique; 10 separate; fuscous with a dull-purple lustre; an ochreous-fuscous line, slightly outwardly-curved, at $\frac{1}{5}$; a similar but broader line; its anterior edge suffused, from $\frac{3}{5}$ costa obliquely outwards, obtusely bent beneath costa and curved inwards to $\frac{3}{5}$ dorsum; terminal area fuscous-whitish; a fuscous terminal line; cilia fuscous. Hindwings with termen rounded; fuscous-whitish; median area fuscous-purple, crossed by an ochreous-fuscous postmedian line, which is more obscurely continued to tornus; a fuscous terminal line; cilia fuscous, on costa, tornus, and dorsum fuscous-whitish.

Pyrausta violacea, Luc. (P.L.S.N.S.W., 1892, p. 263), may be based on a confusion of this species with the allied *suffusalis*, Wlk., but the description plainly applies to the latter.

Type in Coll. Turner.

Q., Sandgate, near Brisbane; Southport; from October to February; the larvæ abundant on *Wikstroemia indica*.

Noorda rhodopa, n. sp.

(*Rhodopos*, rosy.)

♀, 20 mm. Head whitish-ochreous. Palpi 4; whitish-ochreous mixed with fuscous. [Antennæ broken.] Thorax pale-rosy. Abdomen whitish-ochreous. Legs whitish. Forewings elongate-triangular, costa gently arched, apex round-pointed, termen nearly straight, oblique; 10 separate; pale-rosy; lines fuscous; an outwardly-curved transverse line at $\frac{2}{5}$; a finely dentate sinuate line from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum; cilia whitish, bases pale-rosy. Hindwings with termen rounded; ochreous-whitish, thinly scaled, translucent; cilia whitish.

This species must not be confused with *Noorda rhodea*, Low., which I have from Townsville.

Type in Coll. Turner.

N.Q., Thursday Island; one specimen.

Noorda psarochroa, n. sp.

(*Psarochroos*, ashen-grey.)

♀, 27 mm. Head, antennæ, and thorax grey. Palpi 4; grey, shortly white at base. Abdomen grey. Legs grey-whitish; anterior pair grey. Forewings elongate-triangular, costa gently arched, apex rounded, termen bowed, oblique; whitish densely irrorated with grey; markings fuscous; a fine transverse line at $\frac{1}{4}$, produced outwards in centre; a median discal dot; a line from $\frac{3}{4}$ costa to tornus, indented inwards above middle; an interrupted terminal line; cilia grey-whitish with a grey line near base. Hindwings with termen rounded; whitish; some grey suffusion towards termen; cilia whitish with a grey line near base.

Type in Coll. Turner.

N.Q., Townsville, in March; one specimen received from Mr. F. P. Dodd.

Noorda eutacta, n. sp.

♂, 13 mm. Head and thorax whitish-ochreous. Palpi 3; whitish-ochreous with a few darker scales. Antennæ whitish-ochreous; in ♂ thickened and minutely ciliated. Abdomen whitish-ochreous, towards base and apex whitish. Legs whitish; apex of posterior tibiæ fuscous. Forewings triangular, costa straight for $\frac{3}{4}$, arched towards apex, apex acute, slightly produced, termen sinuate, oblique; whitish-ochreous with some brownish-ochreous suffusion, median area paler; some dark-fuscous scales on costal edge; a broad dark-fuscous transverse line containing some whitish scales at $\frac{2}{5}$; a crescentic median brownish-ochreous discal mark; a dark-fuscous line from $\frac{3}{4}$ costa, at first outwardly oblique, then curved parallel to termen, ending on $\frac{3}{4}$ dorsum; a fine dark-fuscous terminal line; cilia brownish-ochreous. Hindwings with termen rounded, slightly indented above middle, whitish; a faint fuscous subterminal line; cilia whitish.

Type in Coll. Turner.

N.Q., Townsville, in January; one specimen received from Mr. F. P. Dodd.

Myriostephes citrochroa, n. sp.

♀, 13 mm. Head, palpi, antennæ, and thorax yellow. Abdomen whitish. Legs pale-yellow. Forewings elongate-triangular, costa straight to near apex, then slightly arched, apex rounded, termen straight, oblique; yellow; markings and some scattered irroration brownish; an oblique ill-defined line from $\frac{1}{6}$ costa to $\frac{1}{3}$ dorsum; a suffused squarish spot on costa before middle; a suffused spot on costa at $\frac{3}{4}$, reaching mid-disc and enclosing two small yellow spots, in this are two darker parallel inwardly oblique lines connected by a cross bar between the two spots, like the letter H; a broad suffused subterminal line, and a few dark scales on termen; cilia pale yellow. Hindwings with termen strongly sinuate; whitish; on termen grey-whitish; cilia whitish.

Type in Coll. Turner.

Q., Brisbane; one specimen.

Myriostephes crocobapta, n. sp.

♀, 14 mm. Head, thorax, and abdomen orange-reddish. Palpi $2\frac{1}{4}$; brown, beneath white. Antennæ brownish-fuscous. Legs brown-whitish. Forewings triangular, costa straight to near apex, apex round-pointed, termen straight, oblique; orange-reddish; markings fuscous; a streak along costa to $\frac{3}{4}$; a fine dentate transverse line at $\frac{1}{4}$; an oval median discal spot; a fine slightly dentate line at $\frac{4}{5}$ parallel to termen; disc between this and termen suffused with fuscous; cilia fuscous. Hindwings with termen slightly sinuate; colour lines and cilia as forewings; terminal fuscous band not extending to postmedian line and narrowing to mid-termen.

Type in Coll. Turner.

N.Q., Townsville, in March; one specimen received from Mr. F. P. Dodd.

Eclipsiodes homora, n. sp.

(*Homoros*, similar.)

♂, 16 mm. Head, palpi, antennæ, and thorax fuscous. Abdomen ochreous. Legs grey with whitish-ochreous irroration; posterior pair except tarsi whitish-ochreous. Forewings elongate-triangular, costa nearly straight, apex rounded, termen obliquely rounded; fuscous, with dark-fuscous lines; first line indistinct, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, obsolete on margins; a subcostal dot at $\frac{1}{3}$; posterior line from beneath $\frac{2}{3}$ costa bent inwards rectangularly and again downwards to $\frac{2}{3}$ dorsum; discal dot linear, joining posterior line at second angle; a suffused whitish spot on dorsum before posterior line; cilia fuscous. Hindwings with termen rounded, sinuate beneath apex; ochreous-yellow; a broad fuscous terminal band; cilia fuscous.

Closely allied to *E. crypsixantha*, Meyr.

Type in Coll. Lyell.

N.W.A., Roebourne; one specimen.

ECLIPSIODES DAPSILIS, n. sp.

(*Dapsiles*, abundant, plentiful.)

♂ ♀, 18-20 mm. Head fuscous. Palpi 5; fuscous irrorated with whitish. Antennæ fuscous; ciliations in ♂ $\frac{1}{2}$. Thorax fuscous irrorated with white. Abdomen grey-whitish irrorated with dark-grey. Legs fuscous, irrorated with white; posterior pair mostly white. Forewings triangular, costa straight except at extremities, apex rounded, termen bowed, oblique; white irrorated with fuscous; an incomplete double dark-fuscous line at $\frac{1}{4}$; a reniform postmedian fuscous discal spot, outlined with dark-fuscous; a small fuscous spot on costa at $\frac{4}{5}$, giving rise to a fine dentate line to $\frac{2}{3}$ dorsum; shortly beyond this a broad oblique fuscous streak from apex to dorsum, near but not touching termen; edged anteriorly with dark-fuscous; an interrupted dark-fuscous terminal line; cilia fuscous with a white median line. Hindwings with termen rounded; grey, towards base paler; cilia grey.

Type in Coll. Turner.

Q., Toowoomba and Warwick, a series in March.

ECLIPSIODES ICELOMORPHA, n. sp.

(*Eikelomorphos*, of similar form.)

♂, 22 mm. Head, palpi, and thorax grey, mixed with dark-fuscous. Antennæ dark-fuscous; in ♂ shortly pectinate (1). Legs dark-fuscous irrorated, and tarsi annulated with grey-whitish; posterior pair grey-whitish. Forewings triangular, costa nearly straight, apex rounded, termen slightly bowed, slightly oblique; grey irrorated with whitish-grey, and with dark-fuscous; a slightly wavy dark-fuscous transverse line at $\frac{1}{4}$; an annular dark-fuscous, pale-centred, posteriorly indented discal spot beneath mid-costa; a very fine dentate dark-fuscous line from $\frac{3}{4}$ costa to before tornus; a dark-fuscous apical suffusion continued along termen; cilia dark-grey, apices partly whitish. Hindwings with termen rounded; fuscous with suffused darker median and subterminal lines; cilia dark-grey.

Very similar to *Eclipsiodes drosera*, but immediately distinguished by the pectinated antennæ.

Type in Coll. Turner.

W.A., Albany, in January; one specimen.

ECLIPSIODES PAMMICTA, n. sp.

(*Pammiktos*, mixed.)

♂, 18-19 mm. Head pale-ochreous. Palpi 3; dark-fuscous; base white. Antennæ dark-fuscous, ciliations in ♂ extremely short. Thorax dark-fuscous; apex of patagia and a few scattered scales whitish-ochreous. Abdomen fuscous, apices of segments and tuft whitish-ochreous. Legs dark-fuscous irrorated and annulated with whitish-ochreous; posterior pair mostly whitish-ochreous. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; ochreous-whitish, markings dark-fuscous; a basal patch; a broad transverse fascia before $\frac{1}{4}$; a broad fascia from mid-costa to tornus; a fine dentate line from $\frac{3}{4}$ costa bent inwards into fascia in disc, and continued beyond fascia to mid-dorsum; a broad streak from apex parallel to termen as far as mid-disc; a terminal series of dots; cilia whitish-ochreous barred with fuscous. Hindwings with termen rounded; dark-grey; cilia whitish-ochreous with a broad grey line near base.

Type in Coll. Turner.

N.Q., Kuranda, in October and May; three specimens received from Mr. F. P. Dodd.

ECLIPSIODES MELIPHYRTA, n. sp.

(*Meliphurtos*, mixed with honey.)

♂, 18-20 mm. Head white, a central spot on crown and whole of face dark-fuscous. Palpi 2; dark-fuscous, base white. Antennæ ochreous-whitish with incomplete dark-fuscous annulations; ciliations in ♂ $\frac{1}{4}$. Forewings triangular, costa scarcely arched, apex rounded, termen bowed, oblique; white irrorated and suffused with dark-fuscous; a basal suffusion, succeeded by an interrupted dark-fuscous transverse line at $\frac{1}{4}$; a suffused squarish spot on mid-costa; a sinuate line of dots from $\frac{3}{4}$ costa to $\frac{3}{5}$ dorsum; a large apical and a smaller tornal suffusion connected anteriorly leaving an irregularly-outlined white spot near termen above tornus; cilia pale-ochreous with a dark-fuscous line near base. Hindwings with termen rounded; pale-ochreous; some fuscous suffusion towards termen; cilia pale-ochreous with a fine fuscous line at $\frac{1}{3}$.

Type in Coll. Turner.

Q., Toowoomba, in September; two specimens.

SCOPARIA CHAROPŒA, n. sp.

♂, 16 mm. Head fuscous with a few white scales on crown. Palpi, $2\frac{1}{4}$; fuscous, at base white. Antennæ fuscous; ciliations in ♂ $\frac{1}{4}$. Thorax white, anterior margin and extreme apex fuscous. Abdomen whitish. Legs fuscous, annulated with white; posterior pair white. Forewings elongate, costa slightly arched, apex rounded, termen straight, oblique; white; a dark-fuscous spot on base of costa including a white costal dot; disc before median band irregularly suffused with pale-fuscous tinged with yellowish; a dark-fuscous median band, its anterior edge sharply defined, concave, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, its posterior edge very ill-defined, and encroached on by white above middle, containing two dark dots representing orbicular and claviform; a median dark-fuscous discal dot; a dark-fuscous line, somewhat bent outwards, from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum, giving off anteriorly a short broad line (representing the reniform) about middle, which bifurcates, the branches being very short, one directed towards base, the other towards costa; a pale-fuscous band succeeds this line, separated from it by white dots on costa and dorsum; an irregular dark-fuscous subterminal line, thickened in middle, obsolete towards costa; a fine fuscous terminal line, connected with preceding on veins, not reaching tornus; cilia white, with a median series of fuscous dots. Hindwings $1\frac{1}{2}$; termen slightly sinuate; white, tinged with grey towards termen; cilia white.

Nearest *S. epicryma* and *S. exhibitalis*. This genus is poorly represented in Queensland.

Type in Coll. Turner.

Q., Killarney, in October; two specimens, of which one is in Coll. Meyrick.

Subfamily TINEODINÆ.

A small group characterized by vein 5 of the hindwings arising from the middle of the cell, not approximated to 4 at origin. It consists probably of the scattered remnants of a group which may once have been much more largely developed. To it I refer the genera *Oxychirota*, Meyr.; *Cœnoloba*, Wlsm.; *Tineodes*, Gn.; and *Simæthistis*, Hmps., of which the first three are Australian, the last Indian. The first two are so peculiar that they might be treated as two separate subfamilies, if that were worth while.

Tineodes phœnicea, n. sp.

(*Phoinikeos*, purple.)

♀, 17 mm. Head whitish-ochreous. Palpi 4; whitish-ochreous. Antennæ whitish. Thorax and abdomen whitish-ochreous; the latter with a broad pale-fuscous dorsal band near base. Legs brownish-fuscous; posterior pair whitish above. Forewings elongate-triangular, costa straight to near apex, then arched, apex acute, slightly produced, termen sinuate, oblique; whitish-ochreous, markings brown-purple; a dark dot at $\frac{1}{4}$, longitudinally elongate; another at middle, narrow and transversely elongate; some scattered irroration in dorsal part of disc; a broad suffused discal blotch beyond middle, triangular with apex towards dorsum; a broad terminal band interrupted by some white scales beneath apex, separated from preceding suffusion by a whitish line, and containing two subterminal whitish spots near tornus; cilia brown-purple several times interrupted by whitish, apices whitish on upper half of termen and at tornus. Hindwings elongate, apex rounded, termen gently rounded; brown-purple; a patch of darker scales at base of dorsum; dorsal edge dark, but interrupted by a whitish spot above tornus; cilia brown-purple several times interrupted by whitish.

Type in Coll. Turner.

Q., Brisbane; one specimen received from Mr. R. Illidge.

TINEODES OXYPRORA, n. sp.

(*Oxuproros*, sharp-prowed.)

♂, 17-18 mm. Head fuscous. Palpi 4; fuscous, Antennæ $1\frac{1}{4}$; fuscous; in ♂ with long ciliations (4). Thorax pale-fuscous. Abdomen fuscous-whitish; tuft ochreous-whitish preceded by a dark-fuscous dorsal bar. Legs fuscous; posterior pair whitish. Forewings elongate-triangular, costa sinuate, slightly excavated in middle, strongly arched in posterior $\frac{1}{4}$, apex acute, slightly produced, termen nearly straight, oblique; ochreous-whitish, with fuscous suffusion and irroration; whole of costa suffused with fuscous; a transverse fuscous mark near base; an inwardly oblique straight fuscous line from mid-costa to $\frac{1}{3}$ dorsum, between which and base the disc is suffused with pale-fuscous; a median transverse fuscous discal mark; an incomplete fuscous line from $\frac{3}{4}$ costa towards tornus; a terminal series of dark-fuscous dots on veins; cilia ochreous-whitish, at apex and tornus fuscous, and interruptedly fuscous on costa. Hindwings with rounded apex, termen slightly excavated; whitish; a transverse fuscous fascia before middle; a broad fuscous terminal band; an interrupted dark-fuscous terminal line; cilia fuscous.

Type in Coll. Turner.

N.Q., Kuranda, in August; one specimen (Dodd). Q, Brisbane; one specimen (Illidge).

TINEODES HOLOPHÆA, n. sp.

(*Holophaios*, wholly dusky.)

♂, 19 mm. Head and palpi fuscous. Antennæ fuscous; ciliations in ♂ $1\frac{1}{2}$. Thorax and abdomen fuscous with dull purple reflections; apices of abdominal segments more or less whitish; tuft ochreous-whitish. Legs pale fuscous; tarsi annulated with whitish; posterior pair except tarsi whitish. Forewings elongate-triangular, costa straight to $\frac{3}{4}$, then strongly bowed, apex acute, termen doubly sinuate, strongly oblique; fuscous with dull purple reflections; markings obscure, ochreous-brown; a line from $\frac{1}{4}$ costa to $\frac{2}{5}$ termen; a linear median discal mark preceded by a whitish area; a posterior line from beneath $\frac{3}{4}$ costa, sinuate, to $\frac{3}{4}$ dorsum; a fine terminal line; cilia fuscous barred with ochreous-whitish. Hindwings with apex rather pointed, termen slightly excavated; colour as forewings; cilia fuscous.

Type in Coll. Lyell.

N.Q., Kuranda, in November; one specimen received from Mr. F. P. Dodd.

NEW AUSTRALIAN LEPIDOPTERA.—No. XXV.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read August 4, 1908.]

NOCTUIDÆ.

AGROTINÆ.

*Meliceptria flavitincta, n. sp.

♀, 34 mm. Head, palpi, thorax, and abdomen pale yellow. Legs pale yellow tinged with fuscous. Forewings elongate, moderate, costa gently arched, termen rounded oblique; pale yellow, with dark fuscous, moderately thick, markings: a short basal fascia; a strongly waved fascia from costa at $\frac{1}{3}$ to dorsum at $\frac{1}{3}$, with an elongate projection outwards below middle; a moderately large round discal spot; a transverse fascia, somewhat waved, from costa just beyond middle, reaching only half across wing; a waved fascia from just beyond last fascia, from beneath costa to dorsum at $\frac{3}{4}$ strongly bowed on upper half; a transverse fascia beyond this and parallel, more or less broken into spots and becoming obsolete in middle; a row of spots along termen; cilia pale yellow with fuscous spots at extremities of veins. Hindwings with termen rounded; pale yellow; a broad fuscous band along termen; cilia pale yellow.

Derby, Western Australia. One specimen (without date).

Proteuxoa euglypta, n. sp.

♀, 34 mm. Head, palpi, antennæ, and thorax brownish-fuscous, mixed with whitish, thorax with a narrow transverse anterior whitish band, anteriorly edged with a fine line of black; a short transverse blackish bar above middle of thorax, and two more or less quadrate spots on posterior half, upper largest, patagia broadly white, with a fine fuscous anterior line. Legs fuscous, sprinkled with white, tibiæ and tarsi banded with white. Forewings elongate-moderate, costa straight, termen rounded, faintly waved; ochreous-fuscous, with whitish markings, finely edged with black; a spot at base; a strongly waved moderately thick transverse fascia, from costa near base, reaching more than half across wing; a tridentate oblique fascia from costa at $\frac{1}{5}$ to $\frac{1}{3}$ dorsum, connected with previous fascia in middle by a short

* The names preceded by an asterisk were kindly suggested by Sir G. Hampson, to whom I am indebted for considerable help in determining many species.

bar; orbicular, ovoid, large, with a black central spot; reniform large, both portions black centred, a round spot between dorsum and orbicular; a short oblique mark just above reniform; a row of lunate marks forming a moderate fascia, from costa at $\frac{3}{5}$ to dorsum at $\frac{2}{3}$, curved outwards in middle; a somewhat suffused subterminal line, from costa at apex, where it is broadest to anal angle, slightly indented in middle; a row of small posteriorly black-edged lunate marks along termen; cilia fuscous, mixed with white. Hindwings with termen unevenly waved; pale whitish-ochreous; a moderately broad dull fuscous transverse fascia, from $\frac{4}{5}$ to dorsum at $\frac{3}{4}$, broader on lower half and suffusedly continued narrowly along dorsum to base; a parallel fascia just beyond, from costa at $\frac{5}{6}$ to anal angle; a fine fuscous line along termen; cilia grey-whitish.

Bolivar, South Australia. One specimen; in April.

PROTEUXOA DELOPTIS, n. sp.

♀, 36 mm. Head, palpi (antennæ broken), legs, and thorax dark ochreous-fuscous, minutely mixed with black and whitish scales; markings white, obscurely indicated; a short fascia at base; a waved fascia from $\frac{1}{4}$ of costa to $\frac{1}{4}$ dorsum, very obscure on lower half; orbicular and reniform well developed, edged with blackish, and with a black central spot in each; a spot on costa above reniform; four other small spots on costa between this and apex; a waved line from beneath costa at $\frac{3}{4}$ to dorsum at $\frac{4}{5}$, anteriorly edged with blackish; a suffused whitish subterminal line; a row of black spots along termen, anteriorly edged with whitish; cilia dark fuscous, mixed with whitish. Hindwings with termen unevenly waved; whitish; a fuscous suffusion at apex; a fine line along termen; cilia grey-whitish.

Dundas, Western Australia. One specimen, in November.

ACRONYCTINÆ.

PROMETOPUS METANEURA, n. sp.

♂ ♀, 25-28 mm. Head reddish fuscous, palpi and antennæ fuscous. Legs, thorax, and abdomen grey-whitish, thorax with anterior narrow ferruginous band. Forewings elongate, moderate, costa nearly straight, termen rounded oblique; dull grey-whitish irregularly mixed with darker fuscous and sparsely and suffusedly mixed with orange reddish scales; a short red streak along fold, from base to $\frac{1}{4}$; orbicular and reniform red, both more or less centred with whitish, posterior half of reniform sometimes wholly whitish; 3 fuscous equidistant costal spots near base, at $\frac{1}{5}$ and $\frac{1}{3}$ respectively; a curved series of fuscous dots from costa at $\frac{3}{4}$

to dorsum at $\frac{3}{4}$; a dull reddish fuscous shade beyond throughout, limited by a waved tridentate line; space between this and termen pale ochreous-reddish; a black line along termen, interrupted and forming spots; cilia dull fuscous reddish. Hindwings fuscous, basal area whitish; an obscure fuscous discal spot, line along termen as in forewings; cilia silvery-white, fuscous around apex.

Broken Hill, New South Wales; Adelaide, South Australia. Several specimens; in March, April, and November.

LYMANTRIADÆ.

Colussa psammochroa, n. sp.

♂, 54 mm. Head, palpi, thorax, and abdomen ochreous-grey, strongly mixed with ferruginous-fuscous, last three abdominal segments fuscous. Antennæ whitish, pectinations 10, fuscous. Legs ochreous-grey. Forewings elongate, triangular, costa nearly straight, termen gently bowed, very faintly waved; pale ochreous-whitish, with fuscous markings; a rather broad, curved fascia from costa at $\frac{1}{3}$ to $\frac{1}{3}$ of dorsum, edged anteriorly by a line of blackish and having on its posterior edge a black-edged spot in cell; a moderate black elliptic ring in end of cell, centred with ground colour; a second fascia, slightly broader than first, from costa at $\frac{4}{5}$ to dorsum at $\frac{4}{5}$, anteriorly edged by a waved line, which is separated from fascia by a narrow line of ground colour; posterior edge of fascia waved, and limited by a waved black line throughout; cilia greyish-ochreous. Hindwings pale greyish-ochreous, basal hairs dense, ochreous; a suffused fuscous discal spot; second fascia as in forewings, but much paler, becoming distinct on posterior edge only, underside of wings as above, markings of upper side reproduced; discal spots strongly reproduced; hindwings with two black, white centred discal spots at $\frac{1}{6}$ and before middle, first smaller. In the neighbourhood of *ocellata*, Walk.

Cockburn, South Australia. One specimen; at light.

PSYCHIDÆ.

Oiketicus aristocosma, n. sp.

♂, 60 mm. Head and face bright orange. Thorax and abdomen black, patagia orange, thorax beneath orange, abdominal segments broadly orange, excepting first segment which is black. Antennæ black, pectinations at greatest length 10, on apical half 1. Legs black. Forewings very elongate, costa nearly straight, termen very oblique, continuous with dorsum; velvety black, all veins outlined in whitish; cilia dark-fuscous. Hindwings very small, somewhat isosceliform; apex bluntly prominent, termen rather strongly sinuate; anal angle produced; colour, markings, and cilia as in forewings. Case:—Fusiform. Yellowish-ochreous internally, externally thickly covered with very fine needle-like pieces of grass, and ornamented with the portions of (? *Juncus*) stems, placed indiscriminately throughout, but always with sharp point directed forward, generally about 25 mm. long and fairly conspicuous. These being shorter towards the terminal portion of case. Length of entire cocoon, 8½ inches; breadth, at greatest, 1¾ inches. This magnificent creature is probably the largest *Psychid* yet discovered. The nearest approach to it for size is *Eumeta maxima*, Butl. (53 mm.), from the Duke of York Island. The present species is closely allied to *O. elongatus*, but is very different in the imago and formation of cocoon. If any intermediate forms are discovered it may possibly prove to be a geographical form of that species, yet I scarcely think so. Larva unknown.

Kuranda, Queensland. One specimen, from Mr. F. P Dodd; bred in January.

PLUTORECTIS THERMACULA, n. sp.

♂, 22 mm. Head, thorax, and abdomen black. Antennæ and legs fuscous, antennal pectinations at greatest length 8. Forewings elongate, moderate, costa gently arched, termen hardly rounded oblique; 4 and 5 stalked; 8 and 9 stalked; 7 separate from 8; dark fuscous; a dull ochreous spot, resting on vein 1 in middle; cilia black. Hindwings with termen rounded; 4 and 5 long stalked; 6 and 7 remote; dark fuscous, lighter than forewings and somewhat bronzy-tinged; cilia dark fuscous. Distinct by its black colouring and ochreous spot on forewings.

Kuranda, Queensland. One specimen; bred by Mr. F. P. Dodd in January. A second specimen from Cooktown (E. A. Olive) is apparently the same, but being abraded admits of some doubt.

Case:—Cylindrical, tapering, thickly ornamented with short thick pieces of stems of *Eucalyptus sp.*, ranging in length from 5 to 15 mm., those at the lower portion being much shorter and the other gradually increasing in size until the maximum is reached at the anterior portion, which is generally attached to the food plant. The ornamentations are placed indiscriminately, but when viewed vertically the case has a triangular appearance, with the pieces of stem protruding at intervals. The extreme height of case is 17 mm.; the apex, which is ornamented with small pieces of *Phyllodia*, is about 5 mm. and the base about 15 mm. in diameter. Larva unknown.

GEOMETRINA.

MONOCTENIADÆ.

Monoctenia niphosema, n. sp.

♀, 50 mm. Head and palpi dull reddish-carmine, palpi beneath fuscous tinged, antennæ ochreous, pectinations 1. Thorax dull ochreous-carmine, becoming strongly suffused with carmine on anterior half. Abdomen grey, mixed with dull purple laterally and beneath. Legs ochreous, anterior coxæ dull carmine. Forewings elongate moderate, costa slightly arched on basal third, slightly sinuate beyond middle, termen rather strongly bowed, oblique, slightly sinuate beneath apex, apex somewhat produced; dull ochreous-carmine, median third strongly suffused with carmine; costal edge narrowly carmine throughout; a well-defined snow-white spot in cell at $\frac{1}{4}$ from base, faintly edged with fuscous; a large dull fuscous spot in posterior extremity of cell; dusted with whitish ochreous scales; a transverse fuscous line, slightly curved outwards, from about $\frac{3}{4}$ of costa to $\frac{3}{4}$ of dorsum; a row of fuscous dots, considerably beyond but parallel to line; cilia carmine tinged with fuscous. Hindwings with termen moderately rounded; greyish-ochreous, broadly tinged with fuscous-purple along termen; cilia dull purplish.

Perth, Western Australia. One specimen; in November.

Dichromodes (?) triglypta, n. sp.

(?♀) 28 mm. Head, palpi, and thorax fuscous. (Antennæ broken.) Abdomen ochreous. Legs fuscous. Forewings elongate, triangular, costa nearly straight, termen oblique; brownish-ochreous; a thick erect black line from dorsum at $\frac{1}{3}$ towards costa but hardly reaching it; an irregularly waved moderately thick black line from costa at about $\frac{2}{3}$ to dorsum at about $\frac{2}{3}$, with a sinuation outwards in middle, edged posteriorly by its own width of clear white and anteriorly by its own width of light ferruginous; space between this and erect line suffused with dull ferruginous; a well-defined clear white line from costa at $\frac{5}{6}$ to anal angle, with a strong sinuation inwards just above middle, where it becomes thicker, strongly sinuate above and below this, edged anteriorly by a thick dark fuscous shade throughout; a row of fine white dots along termen; cilia ochreous-fuscous. Hindwings with termen rounded; pale ochreous-whitish; faint fuscous discal dot; two parallel pale fuscous waved lines, from costa at $\frac{2}{3}$ and $\frac{3}{4}$ respectively, reaching dorsum at $\frac{2}{3}$ and $\frac{3}{4}$ respectively; cilia pale ochreous.

Doubtfully referable to *Dichromodes*, the head being in bad condition; it is a pretty and distinct insect.

Dundas, Western Australia. One specimen; in November.

TORTRICINA.

TORTRICIDÆ.

Capua petrochroa, n. sp.

♂, 18 mm. Head, palpi, antennæ, and thorax pale ochreous-yellow, thorax anteriorly fuscous tinged. Legs pale ochreous-whitish. Forewings moderate, costa gently arched, termen rather oblique; pale ochreous-yellow; costal edge shortly strigulated with fuscous; outer edge of basal patch fuscous, with a paler projection in middle; groundcolour between this and base deeper ochreous-yellow; median patch yellowish fuscous, moderately distinct, very oblique, anterior edge well defined, posterior edge suffused into general groundcolour, from middle of costa nearly to dorsum at anal angle; a moderate fuscous triangular costal patch at $\frac{3}{4}$; 3 transverse series of pale yellowish-fuscous spots from costa between triangular patch and apex, reaching more or less across wing, first one becoming very clear on median portion; cilia pale ochreous-yellow, mixed with darker. Hindwings and cilia pale whitish-ochreous.

Birchip, Victoria. One specimen; in November.

Capua ceramica, n. sp.

♂, 20 mm. Head, palpi, antennæ, and thorax reddish-fuscous, palpi internally whitish. Abdomen grey. Legs greyish mixed with fuscous. Forewings moderate, costa gently arched, termen oblique, hardly bowed; reddish fuscous, irrorated with rows of transverse fuscous dots; basal and median patches not indicated; a dull fuscous suffused spot on upper edge of cell, at about middle; a similar but larger spot at posterior end of cell, the transverse rows of dots towards termen become more or less confluent, and appear as suffused streaks; cilia greyish, with fuscous and ferruginous spots. Hindwings grey, strigulated throughout with transverse rows of fuscous dots; cilia grey.

Monbulk, Victoria. One specimen; taken in September.

Capua oxygona, n. sp.

♀, 16 mm. Head, thorax, antennæ, and abdomen fuscous. Palpi and legs ochreous-white, legs fuscous tinged. Forewings elongate, moderate, costa rather strongly arched, termen oblique; light ochreous-fuscous; costa shortly strigulated with fuscous; basal patch obsolete; anterior edge of median patch moderately defined, very oblique, from costa before middle to dorsum above anal angle; slightly sinuate on upper half, curved on lower half; whole of wing beyond this fuscous; posterior edge of median band very irregular and gradually merged into groundcolour; a moderate reddish fuscous patch on middle of termen; cilia ochreous, with a reddish fuscous spot opposite spot on termen. Hindwings fuscous; cilia grey, with a fuscous basal line.

Cooktown, Queensland. One specimen; taken in November.

CONCHYLIDÆ.

Paramorpha perileuca, n. sp.

♂, 14 mm. Head and thorax white. Palpi very long, white, sharply dark fuscous beneath. Antennæ and legs grey-whitish. Abdomen silvery grey, darker beneath. Forewings elongate, moderate, costa hardly arched, termen obliquely rounded; cinereous-grey-whitish, with numerous blackish scales throughout forming a fine irroration; markings blackish, costal edge nearly blackish from base to middle, beneath which is an elongate streak of clear whitish; two spots, obliquely placed near base; a spot below fold at $\frac{1}{4}$, another on fold at $\frac{1}{3}$, and a third midway above and between; two others larger and more distinct, transversely placed, at end of cell; two or three obscure spots along lower edge of whitish streak, sometimes absent; an ochreous fuscous suffusion in cell; four equidistant, short, oblique costal streaks, between $\frac{3}{5}$ and apex; a more or less interrupted line along termen; cilia whitish with fuscous median and subterminal lines. Hindwings thinly scaled; grey-whitish; cilia as in forewings. The smallest species of the genus.

Melbourne, Victoria. One specimen; in March. I have seen two others from Castlemaine, Victoria.

TINEINA.

XYLORYCTIDÆ.

Xylorycta argyrota, n. sp.

♂, 16 mm.; ♀, 20 mm. Head, palpi, antennæ, and thorax silvery-whitish, palpi internally whitish. Abdomen greyish ochreous, beneath broadly banded with fuscous. Legs silvery-whitish, posterior pair ochreous. Forewings elongate, moderate, costa gently arched, termen obliquely rounded; silvery-whitish, almost white in some specimens; a moderately clear white costal streak, from base to $\frac{3}{4}$, posteriorly attenuated; veins towards termen obscurely outlined with pale fuscous; cilia whitish, faintly ochreous tinged. Hindwings grey; cilia pale greyish-ochreous.

Henley Beach, South Australia. Fifteen specimens; in March and November. Bred from stems of *Juncus sp.* The larva form ball-shaped masses of grey flocculent down on the seed heads; sometimes there are three of these masses on one stem, in others they are formed at the base of the stem, and there become much larger.

CRYPTOPHAGA LASIOCOSMA, n. sp.

♀, 54 mm. Head, palpi, antennæ, thorax, legs, and abdomen snow-white, antennæ fuscous on terminal $\frac{2}{3}$, thorax ochreous anteriorly, abdomen with reddish segmental margins, first segment broadly banded with orange ochreous. Tarsi banded with black. Forewings elongate, moderate, costa gently arched, termen rounded, oblique, 2 from $\frac{2}{3}$; shining snow white; markings black, a spot near base; a larger one in cell at $\frac{2}{5}$, and another on fold in middle; one or two black scales near tornus; cilia shining snow white. Hindwings and cilia shining snow white.

Kuranda, Queensland. One specimen, from Mr. F. P. Dodd; bred in December.

Nearest *Argyrias*, Turn., but differs in the discal dots, *clear* white hindwings, etc.

AGRIOPHARA PLATYSCIA, n. sp.

♀, 36 mm. Head, palpi, antennæ, and thorax, ashy-grey-whitish, palpi beneath white. Abdomen grey. Legs grey. Forewings elongate, moderate, costa arched rather strongly, termen obliquely rounded; ashy-grey-whitish; a broad, more or less interrupted longitudinal shade, from base to apex, containing several short narrow blackish elongate streaks, those towards termen (where shade is darker) being especially prominent; extreme costal edge whitish, from before middle to apex; cilia ashy-grey-whitish. Hindwings and cilia light greyish-fuscous. Easily known by the thick longitudinal streak.

Tasmania. One specimen; probably in November.

ŒCOPHORIDÆ.

GUESTIA EURYBAPTA, n. sp.

♂, 26 mm. Head, palpi, and thorax reddish-ochreous. Antennæ fuscous. Abdomen ochreous, segmental margins silvery-grey. Legs fuscous, middle and posterior tibiæ and tarsi banded with reddish-ochreous, posterior pair ochreous. Forewings elongate moderate, costa gently arched, termen rounded, apex rounded; reddish-ochreous, irrorated with darker; a short dark fuscous streak along fold, from near base to $\frac{1}{5}$, slightly curved upwards at posterior extremity; a suffused fuscous elongate streak at $\frac{1}{3}$ above middle; indications of a similar streak on fold slightly before; an obscure leaden-fuscous suffused spot above anal angle, with a small fuscous mark above on upper edge, groundcolour between paler ochreous and spot-like; a curved series of semi-confluent fuscous dots, from costa at $\frac{5}{6}$ to dorsum above anal angle, not indented; a row of reddish elongate spots along termen; cilia reddish-ochreous, darker at base, becoming greyish-ochreous on terminal third. Hindwings pale ochreous-grey; cilia pale greyish-ochreous, becoming ochreous at base.

Closely allied to *Paradelpha*, Low., but immediately separated by the ochreous-grey hindwings.

Broken Hill, New South Wales. Four specimens (all ♂); taken in April.

TINEIDÆ.

Eudrymopa cyanoleuca, n. sp.

♂, 20 mm. Head, palpi, and thorax dull bluish-white. Antennæ fuscous, serrated. Abdomen greyish. Legs grey, more or less infuscated. Forewings elongate, moderate; costa gently arched in middle; termen obliquely rounded; dull bluish-white, with some scattered fuscous and chocolate dots; costal area slightly tinged with fuscous; a narrow chocolate fascia, slightly curved outwards from costa at $\frac{1}{3}$ to dorsum at $\frac{1}{3}$; a chocolate apical patch; cilia bluish-white, mixed with fuscous, and with a chocolate spot at apex. Hindwings with termen somewhat pointed; pale fuscous; cilia fuscous grey.

Gisborne, Victoria. One specimen (*Lyell*). Mr. Lyell bred this species; larva green, forming a slight silky cocoon beneath the bark of *Eucalyptus sp.*

Scardia inconcisella, Wlk.

I have recently had occasion to examine the structure of several specimens of this species, and as they present some peculiarities I record them. The *Tineidæ* seldom maintain the true or normal characters throughout. In the forewings of one specimen before me vein 4 is present, 7 and 8 are stalked (portion of 8 absent). In another, 7 and 8 are present, but not stalked, and 4 is absent; and another, 7, 8, and 9 form a point, but not stalked, and 4 is absent.

ELACHISTIDÆ.

Elachista leucophasa, n. sp.

♀, 10 mm. Head, palpi, thorax, antennæ, abdomen, and legs white. Forewings lanceolate; white, strewn with minute fuscous scales throughout, except along costa, which is narrowly white; two rather obscure, pale fuscous streaks, one along fold from base to about middle, the other along lower edge of cell; cilia white, rather thickly mixed with fuscous. Hindwings narrow-lanceolate; grey; cilia pale ochreous grey.

Semaphore, South Australia. One specimen, in September.

E. (?) METALLIFERA, n. sp.

♂ ♀, 8-10 mm. Head bronzy-ochreous, palpi orange, terminal joint fuscous. Thorax fuscous, beneath metallic-orange. Antennæ fuscous, basal joint dull yellow. Abdomen coppery-fuscous. Legs orange, banded with fuscous. Forewings ovate-lanceolate, slightly dilated posteriorly; orange; a very broad shining metallic purplish patch, occupying median $\frac{2}{3}$ of wing; mixed with fuscous and containing on its costal edge two somewhat triangular black spots; its anterior edge with a few greenish metallic scales, posterior edge fiery metallic-coppery; some greenish metallic scales at base of wing; two narrow curved lines of groundcolour near apex, separated by narrow streak of dull metallic-coppery, which appears raised; a smaller mark, but more obscure on lower edge of streak of groundcolour; cilia dark fuscous. Hindwings and cilia bronzy-fuscous.

Townsville and Cairns (*Dodd*) and Duaringa, Queensland. Several specimens; in December.

LIMNŒCIA IDA, n. sp.

♂ ♀, 8-10 mm. Head, palpi, thorax, and antennæ ochreous-white, second joint of palpi with a fuscous terminal ring, becoming fuscous beneath towards base. Antennæ more or less annulated with fuscous, especially posterior half. Abdomen dull ochreous, becoming broadly fuscous on last three segments. Legs ochreous fuscous, tibiæ and tarsi sharply banded with black. Forewings elongate, rather narrow; dark purplish-fuscous, with ochreous-white markings; a narrow oblique irregular band from $\frac{1}{4}$ of costa to dorsal streak at $\frac{1}{4}$, edges waved; a similar streak from middle of costa to very near extremity of dorsal streak, much narrower on lower half; a third band formed into two roundish spots, caused by groundcolour intervening from $\frac{5}{6}$ of cell to dorsum near anal angle; a moderately thick ochreous-orange streak along dorsum, from base to beyond middle; cilia dark fuscous, with a moderately large whitish apical spot. Hindwings lanceolate fuscous; cilia light fuscous.

Henley Beach, South Australia. Several specimens, bred by my sister (to whom I have dedicated it) from larva feeding in seed-heads of *Juncus sp.;* in November.

LIMNŒCIA ZONOMACULA, n. sp.

♀, 20 mm. Head ochreous-white. Palpi ochreous-white, terminal joint and lower $\frac{2}{3}$ of second joint beneath dark fuscous. Thorax dark purplish-fuscous. Antennæ dark purplish in middle, terminal fourth whitish-ochreous. Abdomen ochreous-yellow. Legs dark fuscous, posterior tibiæ banded with ochreous-whitish, all tarsi ringed with ochreous-yellow. Forewings lanceolate-ovate; very dark purplish fuscous, somewhat shining; 3 ochreous-white bands; first broad, from $\frac{1}{3}$ costa to $\frac{2}{3}$ across wing; second from middle of costa to $\frac{5}{6}$ of wing, not quite reaching dorsum, somewhat crescentic; third, rather narrow from $\frac{3}{4}$ costa to anal angle, somewhat curved outwards at lower extremity; cilia dark fuscous, with an ochreous-white apical patch. Hindwings ovate lanceolate; dark fuscous.

Penola, South Australia. Two specimens; in October. Mr. Meyrick has it from Hoyleton, South Australia.

LIMNŒCIA CROSSOMELA, n. sp.

♀, 22 mm. Head, palpi, antennæ, and thorax ashy-grey-fuscous. Legs ashy-grey, posterior pair yellow. Forewings elongate, moderate, costa gently arched; ashy-grey-whitish, mixed with fine fuscous scales; markings black; a dot on fold at $\frac{1}{3}$ from base; a second just above and slightly before; a third in middle, lying on upper edge of cell; a curved, somewhat lunate mark at end of cell; a moderately thick line from costa at $\frac{5}{6}$ to dorsum at $\frac{5}{6}$, indented beneath costa, thence curved to termination, where it becomes more distinct; a suffused row of marks along termen; cilia ashy-grey-whitish. Hindwings with apex rather pointed; light fuscous; cilia yellow.

Hoyleton, South Australia. One specimen (taken in September probably); and one at Broken Hill, New South Wales; in November.

Notes on the Geology of the Mount Lofty Ranges chiefly the Portion East of the Onkaparinga River.

By W. G. Woolnough, D.Sc., F.G.S., Acting Professor in Geology and Mineralogy, University of Sydney.

Plates I. and II.

[Read May 5, 1908.]

The notes presented in this paper form a record of work done during the years 1902 to 1904 inclusive, but principally during the latter half of 1904.

It is not claimed that they give a complete description of the district. The area is so large and its geographical structure so complicated that it will require years of patient, painstaking work before its intricacies can be unravelled. I had hoped to carry out this research, but my removal to Sydney brought my labours to a sudden conclusion. All I can hope to do is to give a general account of my work in its unfinished condition, and to suggest lines of research which may be followed by future observers. My best thanks are due to the officers of the Mines Department of South Australia for obtaining a pass for me on the South Australian railways, which enabled me to take journeys which would otherwise have been beyond my means. Mr. Gill, Under-Treasurer, also interested himself on my behalf, and I would include him in this recognition.

I have also to thank the Rev. J. W. Gower for repeated hospitality and advice as to routes, etc. To Mr. Stirling Smeaton, B.A., I owe a debt of gratitude also. He has interested himself much in my work, and has on many occasions assisted me by obtaining information as to altitudes, etc.

No detailed traverses were made along the strike of the beds, as many of the correlations did not become obvious until the observations were worked up recently. I traversed the whole length of the railway lines of the district on foot, and most of the main roads by bicycle, and made a number of pedestrian excursions across country as well.

Mr. Howchin has given a complete and detailed account of the geology of the western portions of the Mount Lofty area,(1)

(1) Trans. and Proc. Roy. Soc., S.A., vol. xxviii. (1904)., p. 253. *Ibid*, vol. xxx. (1906), p. 227. Aus. Assoc. Ad. Soc., vol. xi., p. 414.

and has summarized the literature, so that there is no necessity for me to cover the ground he has so ably traversed. These papers were not published at the time I was working in South Australia.

The choice of the Onkaparinga as the western limit of the area under discussion is not an arbitrary one. The river follows a distinct axis of earth-structure; it is, in fact, a typical subsequent stream. West of it there is considerable monotony in the rocks. The dominant types are soft quartz schists (of the Mount Lofty series) and hard quartzites. Here and there, as at Carey's Gully, and thence northward to Forest Range, there is a strong belt of conglomerate containing pebbles of titaniferous sandstone. Mr. Howchin has shown this to be the basal bed of the Lower Cambrian, and it will form a most useful datum-horizon for the detailed mapping of the area. On the Norton Summit-Woodside road the conglomerate is interbedded (?) with an extremely tough blue slate, vesicular in places, which is very much like the non-boulder-bearing portions of the Sturt River glacial beds. A little to the south of the Balhannah-Uraidla road the conglomerate is abruptly truncated by an east and west fault, which causes it to abut against the blue slate. It appears probable that this fault may be connected with the ore deposition at the Balhannah Mine.

Neither blue slate nor conglomerate appears in the railway cuttings between Bridgewater and Ambleside. Almost the whole of this stretch of country is occupied by soft friable sandstone, of the Mount Lofty species.

At Grunthal there occurs a well-marked shatter-zone. The crushed rocks are much impregnated with iron, and injected by large quartz veins. No doubt these phenomena are responsible for the ore deposition at this point. A very pretty example of extreme plication is shown by a series of slates in the railway cutting close to the Ambleside down distant signal. About a mile north-east of Ambleside there is another occurrence of cellular blue slate, but it is doubtful whether this is the same rock as that noted above at Forest Range.

Coming now to the area with which I wish more particularly to deal, I shall first describe in some detail the partial sections afforded by several routes.

Owing to the irregular way in which these lines of section cross one another, it is difficult to devise any logical method of presenting the observations. I shall, therefore, give the details in approximately the order in which I observed them. The first section to be described is that between Balhannah and Murray Bridge along the railway line.

Thoroughly crystalline schists are first met with about a mile west of Mount Barker Junction. They have the character of tremolite- and actinolite-schists, passing in places into a perfect tremolite rock. Their strike is north and south and their dip vertical. From Mount Barker Junction for about one and a half miles east we have soft friable white quartz schists, lithologically like those of the Mount Lofty series. Structurally they appear to be members of the schistose series, though it is possible they form an outlier of the Mount Lofty beds infolded into the older rocks.

About one and a half miles east of the Junction these rocks are affected by a marked shatter-zone, and become much veined with quartz. Approaching Nairne we pass again to schists, which become spotted, owing to development of incipient andalusite. This mineral increases in importance until just to the east of Nairne Station the schist shows well-marked knots of it. Rocks of this type are widely developed amongst the schists of South Australia, and as I shall have to refer to them frequently I shall coin the name "Paringite" for them, after Paringa, a group of railway cottages between Nairne and Callington, where they are typically developed.

Paringite is a moderately coarse, friable, silvery, muscovite-biotite-schist, with very wavy lamination, and with very prominent "knots" or "eyes" of impure andalusite, which may be upwards of an inch in diameter.

From the thirty-five and a half mile peg (about half a mile east of Nairne) to the thirty-six and a half mile peg the rocks (schist and quartzite) are much shattered, all the evidence pointing to a zone of intense fracture. For some distance east of the fracture-zone there is a notable discordance between the dip of the beds and the dip of their cleavage planes. This discordance gradually disappears as we pass eastwards, and is additional evidence of powerful earth movement in the neighbourhood.

There is no outcrop of quartzite in the railway section at all comparable with the immense mass of Mount Barker.[2] From the thirty-eight mile peg to about the forty-one mile peg the character of the rocks is pretty uniform. They consist of a thick series of mica schists, with occasional bands of sericite schist. Their dip is very constantly about E. 5 deg. N. at from 30 deg. to 40 deg. Several small faults

(2) Mount Barker and Mount Barker town are nearly three miles apart, so that there is considerable ambiguity in speaking of Mount Barker. When the name is used in this paper it will refer to the mount itself; when the town is intended it will be specified.

leading to the N.N.E. appear about the thirty-nine and a half mile peg. For more than a mile east of the forty-one mile peg the dips again become disturbed, and another fracture-zone is suggested in the neighbourhood of the railway cottages at Paringa. The rocks are thrown into sharp folds.

At about forty-two and three-quarter miles from Adelaide another belt of paringite occurs. It is quite possible that there may be two or more distinct horizons of this rock, but I think it more probable that a single belt of it has suffered repetition through heavy strike faults or by folding. From this point to Callington the rocks are chiefly tough mica- and chlorite-schists. At Callington itself the schists are strongly mineralized, and the Callington Mine was at one time an important ore-producer. There is a wide break in the section here caused by the valley of the Bremer River, which occupies a broad U-shaped valley. On the eastern slope of this valley there is a very considerable area of sand-dunes. These I think represent the advanced guard of the Lake Alexandrina beach sands moving northwards along the Bremer valley. Above the reach of the sand here the rocks exposed consist of dark and very tough biotite schists, with high angles of dip towards the E.S.E. These form a ridge separating the Bremer valley from a much wider one in which Monarto lies. This valley, though possessing a well-defined north and south trend, is not occupied by a stream like the Bremer. The absence of a stream is to be accounted for by repeated captures by small streams running direct to the Murray, as, for instance, the Rocky Gully Creek, through whose gorge the railway line passes.

Like the Bremer Valley, this one is much filled with drift sand, which hides the bed-rock from view. Where the sand-drifts have been stripped there are large areas of solid ringing travertine. This formation, almost ubiquitous in South Australia, is conspicuous by its absence or rarity in the area between Nairne and Callington. In this area it is prevented from forming partly by the comparatively high and well-distributed rainfall, but mainly by the low lime content of the schists. Its conspicuous developments near Monarto, and thence, in patches, east to Murray Bridge, is due to the occurrence of thin patches of tertiary limestone lying on the upturned edges of the schists. The latter outcrop at intervals over the floor of the valley, but do not give rise to conspicuous features there. About two and a half miles east of Monarto Station is the western boundary of a strip of granite intrusive into the schists. Though this granite has a considerable north and south extent, its width from east to west is very little over one mile. While the schists on both sides are thoroughly metamorphosed and recrystallized the granite, though somewhat foliated, is not very highly altered, showing that, while it has suffered from some of the later earth movements, it is very considerably younger than the schists.

Lying to the east of the granite there is a wonderful variety of rock types, the normal schists having undergone extensive contact metamorphism. The resulting rocks are well exposed in the cuttings through Rocky Gully. Close to the granite contact are highly crystalline quartz schists, with bundles of radiating tremolite needles. These are extremely handsome rocks in hand specimen. They are succeeded by very coarse felspathic biotite schists, through which are numerous veins of pegmatite; in fact, there is a regular *lit par lit* injection in places. Some of the schists in texture and composition approach gneisses. In one of the pegmatite veins two small crystals of beryl were observed: this occurrence is interesting, from the fact that the same mineral occurs in the very coarse pegmatites of Williamstown, thirty-eight miles to the north-west.

Between Rocky Gully and Murray Bridge no outcrops other than eocene limestone are met with. As might be expected, there is a very notable development of travertine.

The road sections approximately parallel with the railway will now be described. Along the road from Oakbank to Woodside there occur schists generally similar to those met with just west of Mount Barker Junction. These bound the Onkaparinga valley on the east; on the west occur less schistose quartzites and slates, the river following the junction between the two series for a considerable distance.

The road section from Nairne to Callington *via* Dawesley and Kanmantoo is also very interesting. For some two and a half miles from the Railway Station at Nairne the rocks are schists and quartzites similar to those encountered along the railway line. Just to the east of the town is an outcrop of quartzite lithologically similar to that forming Mount Barker, but there is no trace of the very strong feature formed by the Mount Barker escarpment. In a quarry one and a half miles east of the town biotite schists are exposed with a dip of W. 10 deg. S. at 85 deg., that is, in a direction opposite to that of the dominant dips of the district. It is probable that this reversal is caused by a very sharp flexure, perhaps combined with faulting. A little farther east the direction of dip is E. 10 deg. S. at varying angles down to as low as 35 deg.

At about two and a half miles from Nairne there occurs a thin band of extremely tough, vesicular, blue slate like

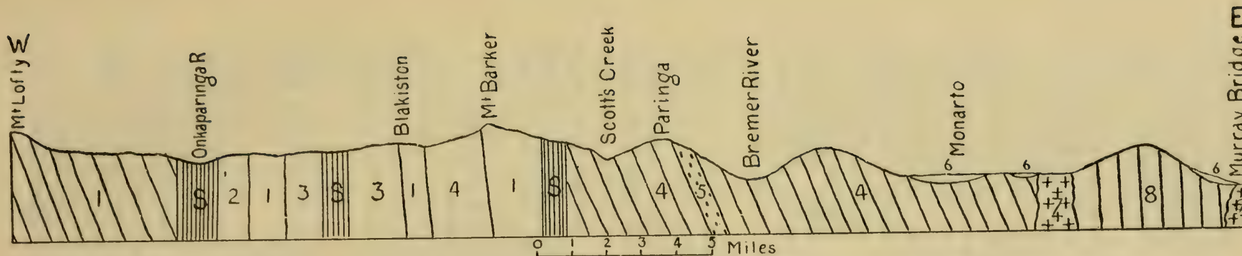

Fig. 1.—Geological Section, considerably generalized, from Mount Lofty to Mount Barker, thence to Murray Bridge. Profile only approximately correct.

Legend.—1, Quartzite and quartz schist; 2, slaty rocks; 3, actinolitic schists; 4, mica schist; 5, paringite; 6, tertiary and recent deposits; 7, Monarto granite; 8, Rocky Gully gneisses and schists; 9, Murray Bridge granite; SS, shatter-zones. N.B.—For details of section between Blakiston and Mount Barker see fig. 2.

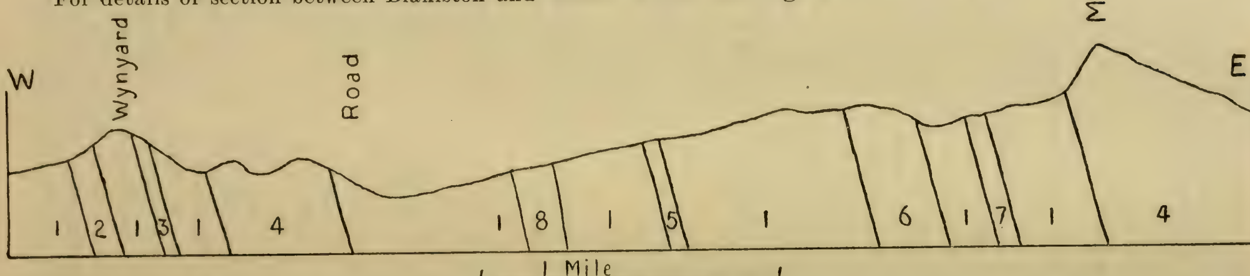

Fig. 2.—Geological Section from Wynyard, Blakiston, to Mount Barker.

Legend.—1, Mica schist; 2, actinolite schist; 3, purple "soapstone"; 4, quartzite; 5, black mica schist, with large white spots; 6, paringite; 7, pegmatite; 8, horizon of Mount Barker marble, which appears *in situ*, in lenticular mass, a short distance to the south of the actual line of section.

that described above (p. 122). It is to be noted that a similar rock occurs in a railway cutting between Balhannah and Ambleside. We cannot at present correlate these occurrences. It is quite possible that they are quite independent, but the lithological characters are so peculiar and so strikingly similar that they are worthy of careful study. Two other exposures which should be compared with those above noted are, the steep bluff forming the right bank of the Onkaparinga close to Ambleside Station, and the long road cutting about a mile from Forest Range, on the Lobethal road. Typical mica schists continue for some distance past Dawesley. About a mile past the bridge over Scott's Creek, and just past a little chapel on top of the hill, there is another splendid exposure of paringite. This must be directly connected with the exposure at the type locality on the railway line (p. 123). The connection has not been mapped in.

From this point to Callington the road traverses the schists in a direction not departing widely from their strike; the variety of rock types is, therefore, not great. There is a general tendency towards increasing metamorphism, with extensive development of muscovite. This mineral is often in porphyritic crystals lying across the schistosity.

Shortly after passing Kanmantoo a very perfect S-shaped fold is visible on the hill slope, about a quarter of a mile west of the road. Close to Callington the schists are much shattered and injected with quartz veins. Some of these veins are slightly felspathic, showing that they represent the limiting members of a series of pegmatite dykes.

From Callington to Murray Bridge the road follows the railway line so closely that there is practically no difference between the sections they reveal. The width of the Monarto granite belt is practically the same on the road as it is on the railway.

On the right bank of the river at Murray Bridge a few outcrops of granite occur. This rock is quite different in character from the Monarto granite. It has not been sectioned, as all the exposures are too rotten. The rock is reddish in colour, more coarsely crystalline, and much more gneissic in texture than the Monarto rock. It contains fairly large pink phenocrysts of orthoclase.

Another very instructive road section is seen between Callington and Mount Barker Town, *via* the Bremer road. For the first four and a half miles from Callington the road (to Strathalbyn) following the Bremer River runs practically along the strike of the beds, so that very little variety is met with. Muscovite schists, like those noted above, are the chief types. It is extremely difficult to obtain readings of dip, on account of the cleavage and fissility which the rocks display. In one case the planes of dip and fissility slope westerly, and that of the cleavage easterly, all at high angles.

At four and a half miles south of Callington the road to Mount Barker leaves the Strathalbyn road and turns west, so that the strike of the bed is once more crossed. Considerable variety is seen amongst the schists, including white and grey friable muscovite schists, and very tough, black biotite schists. In all these beds the dip is generally a little south of east, at angles varying from 65 deg. to as little as 32 deg.

On the west these pass into white quartzites, which, however, make nothing like so strong a feature as the Mount Barker mass. These quartzites in colour and texture are more like a rock from Tanunda [3] (given me by my colleague, Mr. Howchin) than any other I have met with in South Australia.

This lithological resemblance is not an accident, but is a very important clue (see p. 131).

West of the quartzite band, and about a mile east of the little hamlet of Morning Star,[4] a very strong outcrop of paringite occurs; this lies between the occurrences at Mount Barker and at Gemmel's Station. Just west of the village is a strong development of marble. It is very coarse in grain, and has all the appearance of the Angaston marble (see also p. 131). From the marble quarry to Mount Barker town there is very little conspicuous outcrop of rock. The soil suggests much soft black schist, and I have noted "ferruginous slate." It is probable that this is really the very persistent and important band of purplish "soapstone," which will be described later. I failed to recognize it at the time.

Between Mount Barker town and Echunga there is a series of mottled purplish schists, interspersed with thin-bedded quartzites, which give rise to a very pronounced feature. There is plentiful evidence of heavy earth movement in this area, and it appears to be a definite shatter-zone. West of the quartzite belt we meet with soft schists, in which appear spots suggestive of development of incipient andalusite crystals. These continue to the town of Echunga.

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(3) Trans. Roy. Soc., S.A., vol. xxviii. (1904), p. 203.

(4) I am a little uncertain as to exact distances at this part of my journey, as my pencil notes are very indistinct. It is possible that the hamlet is Wistow, and not Morning Star. The outcrop of paringite shown on the map may be a good deal out of place.

West of the township, on the bush road to the Echunga diggings, there occurs a rock of facies quite different from any other I have seen in this part of South Australia. It is a coarse quartzose grit, strongly cemented with silica. At first sight it recalls some varieties of the desert sandstone met with in the far northern parts of the State. It forms a thin capping unconformable on the upturned edges of the schistose rocks, and by differential weathering gives rise to a steep, though not high, escarpment. The change from schist to grit is very strongly marked by the vegetation, which upon the latter is characterized by abundance of grass-tree. It is possible that this grit may be an outlier of upland miocene.

From Echunga to Macclesfield the road cuts obliquely across the strike of the beds, and shows a section somewhat similar to that between Mount Barker and Echunga. For the first three miles the rocks are soft, sandy schists, which give very little surface outcrop. At this point a belt of soft, shaly, mottled soapstone occurs, similar to rocks at Nairne, Blakiston, and west of Mount Barker town, and, like the former two at any rate, used as a building stone. Just west of Macclesfield is a strong belt of quartzite, very like the rocks just west of Mount Barker town and others between Blakiston and Mount Barker. East of Macclesfield is a broad belt of grey sandy mica schist, followed by alternate tough and friable schists. Some of these contain knots of andalusite, though the latter is nowhere so strongly developed as in the typical paringite. Mica schists of the same general character continue all the way to Strathalbyn. Most of the dips measured along this section are in directions between east and south-east, and at angles which in contrast with those generally obtained in the district are low, averaging between 45 deg. and 50 deg. Along the railway line, Gemmel's to Bugle Ranges, there is a great exposure of paringite, alternating with schists, which have not the large phenocrysts of andalusite, this being the most southerly locality at which I have observed thoroughly typical paringite.

The sections described so far have all been of considerable extent, and only the broad features of them have been given. An extremely interesting and very important section between Blakiston and Mount Barker has been examined in considerably more detail, though even here much remains to be done. Many of the points of resemblance to other sections did not strike me until I began to work up my results recently.

Fig. 2 represents this section.

On the west, between Blakiston Church and "Wynyard," the residence of Rev. J. Gower, the rocks are actinolite schists of various types. The knoll upon which Wynyard stands is composed of the purplish rock which I have elsewhere designated soapstone, and has furnished the building stone for the house. Exactly similar rock, also used as a building stone, occurs about half a mile south of Nairne Station. We then have a series of solid quartzites, which make strong outcrops. These give place to soft, very dark schists, which have worn down to form the bed of the creek. On the actual line of section there is no sign of marble, but less than a mile to the south there is a very strong outcrop of very coarse crystalline limestone like that of Angaston. I have, therefore, included it in the section. East of the limestone belt we have dark schists in which light spots begin to appear. These spots increase in size and abundance, and the rock passes into typical paringite. Intruded along the bedding planes of these schists is a narrow dyke or sill of coarse pegmatite. Eastward the paringite gives place to a great thickness of quartzites. These are for the most part flaggy in structure, though the huge mass of Mount Barker is as solid as the great belt of quartzite at Mitcham and Burnside, near Adelaide.

Summary of Geological Descriptions.—East of the Onkaparinga there exists an immense thickness of crystalline schists of a variety of types. These have pretty uniformly high dips between east or south-east, and there are few instances of reversal of these dips. These facts led Professor Tate to the conclusion that the schists formed the upper portion of a continuous series many thousands of feet in thickness, and building the Mount Lofty Ranges. Their age he believed to be pre-Cambrian. It has been shown by Mr. Howchin that the western part of this series is lower Cambrian, and the same observer has proved the existence of a basal conglomerate to this system resting unconformably on pre-Cambrian rocks near Aldgate and other places. The general conformity in dip throughout the Mount Lofty Ranges is very misleading.

The rocks of the schist series east of the Onkaparinga are lithologically much more highly metamorphosed than those of the lower Cambrian, and though stratigraphical data are, as yet, incomplete, there is little doubt that Professor Tate was right in classing them as pre-Cambrian.

It is probable that they do not form a continuous series for the whole distance, some thirty miles, between the Onkaparinga and the Murray, but that the beds have been repeated by strike faulting and by heavy folding. Certain shatter-zones have been indicated in this paper. The reason why the folding, if such occurs, is not obvious, and does not cause reversal of dips, is probably that the movements have been so intense that the anticlines and synclines have been overfolded and converted into a series of isoclines.

To decipher the structure in a region of such complexity as this it is absolutely essential to recognize persistent horizons and to map such horizons out in detail.

I claim to have discovered several such persistent horizons:—

(i.) The remarkable knoten-schiefer, which I have called "paringite," has been observed at so many isolated points along approximately the same line of strike that its value as a persistent horizon is practically demonstrated. It makes a good surface outcrop, which should be easily followed.

(ii.) The associated crystalline limestone appears to occur only in lenticular beds of considerable extent, but, nevertheless, should prove to be a valuable horizon for mapping purposes. An outcrop of it occurs at Bull's Creek.

(iii.) The purplish rock which, for want of a better name, I have called "soapstone," appears to be persistent. I know of several places where it occurs, and is used as a building stone.

(iv.) The white saccharoidal quartzite described on page 128 may be found of value.

(v.) The belt of tremolite and actinolite schists typically developed west of Mount Barker Junction is characteristic, but yields little surface outcrop.

It is to be noted that *all the above horizons occur in the Angaston district, forty miles to the north of Blakiston, in the same relative positions as they occur at Blakiston, showing their remarkable persistence, and indicating their extreme value as stratigraphical landmarks.*

Suggestions to Future Observers.—I may perhaps be permitted to make a few suggestions which will enable future observers to save some time in preliminary investigations. I think the Blakiston to Mount Barker (mount) section should be carefully studied, and the area just to the north and south of it. I believe this section will afford the key to very much of the geology of the district. I then suggest that the observer become familiar with the paringite in some of its typical occurrences, and then systematically map this important formation. In doing so many other problems will be suggested.

I think it likely that the valley in which Mount Barker town lies is the axis of an important fold; the sections from Mount Barker town to Echunga, and from Echunga to Macclesfield, appear to be somewhat similar to the Blakiston section, but in reverse order.

Finally, I beg to suggest that the immense series of rocks of, almost certainly, pre-Cambrian age, should receive a distinctive name. Mr. Howchin has used the name Mount Lofty series for the lower Cambrian rocks to the west of the range, and I propose that the rocks described in the present paper be grouped as the Barossa series (or "Barossian"), from their extensive development in the Barossa Ranges. Some such name will, I feel sure, be found necessary in dealing with the enormous mass of pre-Cambrian rocks in South Australia. I am fairly familiar with rocks of this group in other parts of the State, and, on lithological grounds, I am persuaded that it will be necessary to recognize at least three included series represented respectively by the basement complex rocks of Eyre Peninsula and the islands of Spencer Gulf, by the series in Yorke Peninsula typically developed at Ardrossan, and by the rocks I have termed Barossian.

Petrographical Descriptions of some of the more important Rock Types.

Rocky Gully, between Monarto and Murray Bridge. *Hornblendic gneiss*, completely granular, with very uniform grainsize, about ·25 mm. on an average. Texture thoroughly schistose (hornoblastic). Quartz is the most abundant mineral present in rounded and ovoid grains. These are full of little circular flakes of biotite and very numerous liquid and gas inclusions. These cavities are very irregular in shape, and some are comparatively large in size; some of them have "spirit-level bubbles," others have bubbles showing spontaneous movement.

There is a good deal of albite in perfectly round grains. Most of it is untwinned, but some shows twinning after albite, carlsbad, and pericline laws. Measurements show it to be an almost pure albite. In addition to the albite there is some orthoclase distinguished by its refractive index. Owing to the absence of twinning in much of the albite, it is difficult to estimate the relative abundance of the felspars accurately; the albite is certainly predominant. Both felspars are clear of inclusions. Biotite flakes are fairly abundant, and have very marked parallel orientation. They are intergrown with muscovite, and contain inclusions of magnetite. There is a little muscovite, mostly intergrown with biotite, but partly independent also. Some of the latter is developed across the schistosity of the rock.

Hornblende is not abundant, but occurs in largish, irregular flakes developed across the schistosity, and containing inclusions of all the other minerals.

There is a little zircon, sphene, and rutile in small crystals and grains.

There are a few curious pseudomorphs present. These are square in cross section, and consist of a fibrous brownish aggregate of radiating fibres with weak double refraction. Their size is very minute, and I have not been able to determine the mineral. In another specimen from the same locality hornblende is somewhat more abundant.

Rocky Gully. *Biotite gneiss.*—In general characters very like the rock described above. It has no hornblende. In addition to albite and orthoclase, a small amount of anorthoclase is present. Biotite is partly bleached to a light bluish green material, which is almost uniaxial. This bleaching is accompanied by the separation of brilliant golden yellow webs of "sagenite," or of beautiful little six-rayed rosettes of the same material. Sometimes these rosettes are arranged on an axis, the whole very strikingly resembling in shape a Norfolk Island pine. There is also a good deal of orange-red primary rutile present. Some of the iron ore is ilmenite, and is decomposing into or intergrown with rutile.

Rocky Gully. *Pegmatite.*—Rock is coarse in grain, and consists essentially of quartz and felspars.

Quartz is in large grains of irregular shape, some of which show no strain structures, though most have undulous extinction, or are granulated. The quartz contains small gas and liquid inclusions of very minute size. Felspars are remarkable for their variety. Orthoclase, anorthoclase, albite, and oligoclase-albite are all present, and can be distinctly differentiated. They are all rather decomposed, and show a considerable amount of strain. There is a little biotite present in long thin flakes, often bent and broken. It is partly intergrown with muscovite, and partly decomposed into talc.

Muscovite is very subordinate in amount. In addition to that noted above, there are flakes developed as inclusions in the felspars parallel to the zonary lines, indicating traces of potential crystal edges. (Plate ii., fig. 1.)

Rocky Gully. *Pegmatite.*—Very similar to the last one on the whole. Felspar is more abundant than quartz, and a good deal of it shows "moirée" structure. All stages are observed, from perfectly untwinned orthoclase, through orthoclase with slightly undulous extinction (obviously the result of strain) to "moirée mikroklin," and ultimately to "gitter mikroklin" structure. The twinning is always so fine as to give superpositions within the thickness of the slide, so that measurements cannot be satisfactorily made. This felspar is granophyrically intergrown with quartz.

Oligoclase is also present in fairly idiomorphic crystals which show no sign of mechanical strain. Round the edges of some of the oligoclase crystals there is a pegmatitic intergrowth with quartz.

Quartz grains are fairly large. All show strain effects from undulous extinction to complete shattering.

Biotite present in small amount, pleochroism from dark-green-brown to yellow, shows dark halos round included zircon. Muscovite very scarce.

A little apatite is scattered through the rock.

Railway line between Callington and Monarto, at the forty-eight mile post. *Biotite schist.* Perfectly granular with very fine grainsize. Thoroughly schistose. Light and dark constituents about equally abundant. The former include chiefly quartz and acid felspar. Recrystallization is complete, and there is no trace of undulous extinction. The felspar is almost entirely untwinned.

The dark-coloured material is chiefly biotite of a clove-brown colour.

There is a notable amount of muscovite present in largish flakes whose lengths lie across the schistosity.

As accessory minerals we have a little tourmaline with pleochroism colourless to brown, and a little zoisite in rounded grains. No garnet is to be seen.

Near Kanmantoo. *Biotite schist.*—Finely granular and completely schistose. Quartz and biotite are the most abundant constituents, the latter being dark-brown. A little untwinned acid felspar is present, but much less than in any of the other rocks so far described. There are grains and flakes of magnetite and a few microscopic garnets; also an occasional prism of rutile. A fair amount of muscovite is present in porphyritic flakes lying across the schistosity and containing ovules of quartz.

First Railway Cutting west of Callington. *Chlorite schist.*—The texture is markedly porphyritic, the grainsize of the base being uniform and fine (about ·025 mm.).

There is no felspar discernible in the base, which is essentially composed of thoroughly granular quartz and brown biotite, with subordinate amounts of muscovite and ilmenite. Biotite and ilmenite both have extremely minute orange webs and rosettes of "sagenite" like those above described (p. 133), but on a much finer scale. There is a little tourmaline and a fair amount of rutile also. The rock is rendered porphyritic by clinochlore in irregular flakes up to about 1·5 mm. across by about ·5 mm. thick. This mineral is light greasy green in colour, with pleochroism from light bluish-green to darker green. There are abundant very minute inclusions (zircon ?), round which are dark halos. The optical character is almost uniaxial and positive. In vertical sections twinning is seen, giving symmetrical extinctions of 5½ deg. The flakes lie across the schistosity at irregular angles, and contain much of the groundmass.

Another very peculiar feature of the rock is the occurrence of pseudomorphs of light-coloured materials. The original mineral was porphyritic, and slightly larger than the chlorite. It was probably andalusite, as we encounter this mineral very strongly developed a short distance to the west of the present locality. The material composing the pseudomorphs is a granular mixture of about two-thirds muscovite and one-third quartz. They contain very little biotite and magnetite. In shape they are lozenge-shaped and distorted. (Plate ii., fig. 2.)

Between Callington and Paringa.—The rock in hand specimen is silvery and lustrous, perfectly fissile, and shows abundant small dark spots in a fine groundmass. Round these "knots" the groundmass exhibits flow structure.

Under the microscope the rock is found to consist of about equal proportions of fine groundmass and porphyritic aggregates. The groundmass is composed chiefly of light-brown biotite, in flakes about ·004 mm. in average diameter, and quartz of about the same order of size. A little muscovite and tables of ilmenite are present.

The aggregates, which in hand specimen appear like porphyritic crystals, are found to vary considerably in character. Some appear as ovoid areas very ill-defined, and are distinguished from the groundmass by their lighter colour. The minerals composing such an aggregate are quartz muscovite, biotite, ilmenite, and dark chlorite in grains and flakes, with average dimensions of about ·05 mm. The light-coloured constituents are more abundant than the dark, and in the better defined aggregates make up fully 90 per cent. of the material. There is no trace of parallel arrangement of the plates in some of the aggregates, but in most of them the muscovite tables have their large surfaces parallel to the plane of schistosity of the rock. Between crossed nicols these aggregates are much more conspicuous than in ordinary light, owing to the contrast between the polarization colours of quartz and biotite.

Other aggregates are in the form of fairly well-defined polygonal areas, more or less distorted, in which the minerals are clear muscovite and dark-green chlorite in large flakes.

Individual flakes may be as much as 1 mm. by ·5 mm. Ilmenite in small grains is scattered through the aggregates just as it is through the groundmass. In these chlorite-muscovite aggregates the chlorite is usually central, and the muscovite peripheral, though there is a good deal of mutual penetration.

Between the two extreme types of aggregates described above there are numerous transitional types in which the grainsize is intermediate between the limits given, and the amount of quartz and biotite varies also. The aggregates run up to about 2 mm. diameter.

In addition to these aggregates there are also some independent porphyritic crystals of clinochlore about ·4 mm. by ·05 mm. These possess characters exactly similar to those described in the preceding rock. (Plate ii., fig. 3.)

WYNYARD, BLAKISTON. *Scapolite amphibolite.*—The rock consists essentially of actinolite and scapolite. The structure answers admirably to the description of *poikiloblastic structure* given by Grubermann.

Actinolite is the most abundant constituent. At first sight it appears to be irregularly scattered about in stumpy rods, here and there aggregated into masses. The masses are, however, crystal grains, and the surrounding rods are in optical continuity with them. The optical orientations of adjacent areas are quite independent, and are in no way determined by the schistosity of the rock.

The scapolite is perfectly colourless, and forms a base in which the actinolite is scattered. It is optically continuous over wide areas whose boundaries are extremely irregular. The refractive index is notably greater than that of Canada balsam, and the double refraction quite strong. The mineral is uniaxial and negative. There is little trace of cleavage, and the mineral is remarkably fresh. In places there is a tendency towards fibrous structure, probably pointing to incipient decomposition. Adjacent fibres show marked differences of double refraction. When the lengths of the fibres are parallel to the plane of vibration of the light no Becke's effect is noticeable between them, but when they are rotated through a right angle marked differences of refractive index are apparent.

Biotite pleochroic in red-brown to light yellow tints is abundant locally through the rock. There is plenty of greyish sphene in small fusiform grains. Fine iron ore is scattered through the rock, particularly in the actinolite.

WYNYARD, BLAKISTON. (This rock and the preceding one are from a well.) *Amphibolite.*—The rock is somewhat similar to that last described, but lacks the diablastic structure. In this rock the structure is porphyroblastic.

The constituent minerals are abundant light green actinolite, and felspar, sphene, vesuvianite, magnetite, and decomposition products.

Light green actinolite makes up about 75 per cent. of the rock. It occurs in idioblasts, about ·2 mm. in diameter, with strong suggestions of crystallographic boundaries in the vertical zone. The pleochroism is weak from colourless to light green, extinction on (010) is 19 deg., and the optic axial angle is not far from a right angle.

About 23 per cent. of the rock is felspar. This is mostly in untwinned rounded grains, about ·02 mm. in diameter. An occasional fragment of plagioclase of larger dimensions occurs. The untwinned felspar is probably near oligoclase in composition, as its refractive index is scarcely to be distinguished from that of balsam. The mineral is not quartz, as it is biaxial and decomposed. I have not been able to recognize any quartz at all in the rock. The borders of the felspar grains show much alteration into an opaque greyish fibrous mass. Under higher powers this is resolved into fine fibres with weak double refraction strongly suggestive of zoisite.

Sphene in dark orange-brown irregular grains makes up the bulk of the remaining 20 per cent. of the rock.

A few grains of vesuvianite occur of light brownish colour, the colour being somewhat irregular in its distribution. They show no trace of crystal form.

A very few grains of magnetite, slightly decomposed to hæmatite, occur. (Plate ii., fig. 4.)

DESCRIPTION OF THE PLATES.

Plate I.—Geological sketch map of the area described in the paper. Geological traverses have not been run, so that boundaries are only sketched to show approximate positions. No attempt has been made to differentiate the various mica schists.

Plate II., fig. 1.—Orthoclase felspar in pegmatite, Rocky Gully, Murray Bridge, showing inclusions (flakes of muscovite) arranged parrallel to crystal planes of the host. ×60 diameters.

Plate II., fig. 2.—Porphyroblastic chlorite schist, near Callington, showing large crystals of clinochlore arranged across the schistosity of the rock, and light pseudomorphs parallel to the schistosity. ×16 diameters.

Plate II., fig. 3.—Porphyroblastic mica schist, near Callington, showing general structure of rock. ×16 diameters.

Plate II., fig. 4.—Amphibolite, Blakiston, showing poikiloblastic structure. ×86 diameters.

Notes on some Species of the Isopod Family Sphæromidæ, from the South Australian Coast.

By W. H. Baker, F.L.S.

[Read June 7, 1908.]

Plates III. to X.

In presenting these notes I must acknowledge the great assistance I have had from Dr. Hansen's paper entitled "The Propagation, Structure, and Classification of the Family Sphæromidæ," in the "Quarterly Journal of Microscopic Science," n. series, vol. 49, pt. 1, 1905. Without it it would have been quite impossible for me to treat with any degree of success species of this acknowledged difficult family which have come under my notice from our coast. At the same time it will be seen that my observations do not quite agree with statements in Dr. Hansen's paper regarding the parts occupied by the developing young in some genera.

In studying the species of this family, the thing that strikes one most is their great variability—this, indeed, is the main cause of the confusion which has held sway in their classification so long; but a general statement may be made, namely, that the young of both sexes resemble each other, the deviation occurring in adult males and females; that of the young-bearing females of many genera has been shown by Dr. Hansen in the above-mentioned paper. As an instance with the males, to take the case of *Cymodoce tuberculosa*, Stebbing. In this species there are two conspicuous processes on the anterior division of the pleon which are not figured or mentioned by the author or by Mr. Whitelegge, who refers at length to the same species from New South Wales; the inference, of course, is that they were not present in the specimens examined by them, athough Mr. Whitelegge speaks of his as being adult males. Another instance will be seen in the case of *Cilicæa curtispina*, Haswell, later on.

With regard to the young-bearing females, whose mouth parts and viscera have been so much altered, one fails to see how the animal recovers itself after rearing a brood, and is driven to the conclusion that the individual perishes in the effort, and is probably, in some cases at least, perhaps eaten by the brood. In the female of a species of *Cymodoce* which, as yet, I have not been able to identify, I have observed the transverse slits in the sternal plates referred to by Dr. Hansen, and have seen well-formed young emerge from under the marsupial plates; these were somewhat hardened. The young ready to emerge from the body through the slits are very soft, and can consequently squeeze through a small space; the slits, however, in this species are large.

The following descriptions are from the male in each case, except where otherwise stated.

Family SPHÆROMIDÆ.

Subfamily SPHÆROMINÆ.

Group HEMIBRANCHIATÆ, Hansen.

Genus *Cymodoce*, Leach.

Cymodoce longicaudata, n. sp.

Plate iii., figs. 1 to 11.

The body is little convex, the tendency to curl up much reduced, becoming slightly narrow towards the head.

The head is arcuate in front, and considerably longer than the first thoracic segment. The eyes are large, prominent, and wedge-shaped. There is a median rostral projection, which is rather large and terminally obtuse.

The first thoracic segment is rather shorter than those which follow, the rest are short and subequal in length. The epimera, except the ones belonging to the last segment of the thorax, project laterally, and are very conspicuous viewed from above. They are sickle-shaped backward and very acute, and are all—except the first—marked off from their respective segments by distinct sutural lines. The last segment has epimera rounded and scarcely projecting.

Four fused segments are indicated on the anterior portion of the pleon; the first terminates laterally under the side of the preceding segment; the second has an acute lateral projection, similar to those of the thoracic segments; the fourth has the median portion of the posterior margin slightly arcuate, with the usual notch on each side. The terminal segment of the pleon is dome-shaped, and has an acute lateral projection; behind this the surface is strongly depressed until the basal portion of the median posterior spine is reached. The posterior notch is bounded by two acute projections, with the median spiniform process large and reaching much beyond them; this process is dorsally carinate and very acute.

The epistome is well developed; its lateral limbs are subacute.

The rather large basal joint of the antennule has the anterior side of the distal notch scarcely produced, but on the posterior side the projection is very acute, curved, and reaches nearly to the end of the second joint, as in *Circeis*. The second joint is more than half the length of the first to the base of notch of the first; it is distally obliquely truncated, and has below a very prominent and acute keel. The third joint is very slender, and shorter than the second, and is articulated to it in a small cavity. The slender flagellum has about 24 joints. The flagellum of the antenna has from 26-32 joints.

In the right mandible the spine row is well developed, consisting of 7-8 coarsely pectinate spines; a small tubercle faintly toothed lies between these and the molar tubercle, which is well developed; the incisory plate is distally entire. The left mandible has a secondary plate divided into three teeth. The first two joints of the palp are subequal in length.

The maxillæ and maxillipeds are of the usual type. The lobes of the palp of the maxillipeds are long, with their setæ well developed.

The first gnathopods are robust, the basis subequal in length to the two following joints, taken together, the fourth, fifth, and sixth joints are posteriorly spined. The dactylus is rather long, robust, and two-clawed. The legs following the first pair are sparely spined; the pads, so much in evidence in other species of this family, are here represented by soft plumose setæ.

The sternal filaments of the male are rather long. The *appendix masculina* is longer than the ramus which bears it, and is very slender. The exopods of the third, fourth, and fifth pleopods have each a division; a few distal setæ are on the exopods of the fourth pleopods.

The uropods are long and slender; the peduncle has a small spine below the insertion of the outer ramus; the outer ramus is narrow lanceolate, and reaches beyond the inner ramus; the inner ramus is also narrow, carinate below, with the inner margin slightly curved, reaching beyond the terminal spine of the pleon. The margins of the uropods and pleon are sparingly clothed with very short hairs.

The female does not differ from the male in any noteworthy respect, except, of course, when bearing young; then the mouth parts and viscera are modified in the usual way. In what appears to be an old female there are no ova or young, but there are the remains of marsupial plates; the viscera seem to have disappeared, as the sternites are sunken in or wanting; the pleopods, however, are intact.

Cymodoce tuberculosa, Stebbing.

Plate iii., figs. 12 to 15.

The epistome has two projecting teeth transversely placed on the anterior portion, similar to the rostral teeth, and inclined to be bifid.

There are five teeth on the anterior border of the first peduncular joint of the antennule, with a sixth smaller outermost.

The posterior notch of the pleon is wide and deep.

The male has two prominent posterior projections on the anterior portion of the pleon.

The internal ramus of the uropod has three terminal teeth, one larger above, two below. The external ramus is shorter and narrower, with two terminal teeth.

The body is minutely pubescent, but the hairs are coarser on the pleon and uropods.

The female of this species has not been identified.

Cymodoce hamata, n. sp.

Plate iv., figs. 1 to 11.

Body moderately convex, covered with a furry tomentum, which entangles much foreign matter, with longer scattered hairs. It is conspicuously contracted at the seventh thoracic segment.

The head is evenly rounded and anteriorly very obtuse, with two very obscure median projections. The eyes are prominent and subcircular.

The first segment of the thorax is about as long as any two together of those which follow; these are narrow, prominent, and scarcely differ in length. The epimera slightly project outwards; their lower outline, taken together, is very irregular, the individual apices being more or less obtuse; that of the seventh segment is much shorter than the rest.

The sides of the anterior part of the pleon project downwards, much in contrast to that of the seventh thoracic segment, but the antero-lateral angle is subacute; this portion of the pleon bears one small tubercle each side of the median line, whilst the posterior portion has also two tubercles, which are more or less spiniform, and situated on a dome, which is granular: between these two tubercles is a longitudinal depression. The posterior notch is wide, with a strong median process, which projects beyond the sides, is obtuse, and slightly turned up or tuberculate at its end.

The basal antennular joint is large, about twice as long as broad, with the distal notch shallow. There is a small keel on the underside of the second joint. The flagellum has 11 joints.

The flagellum of the antenna has 16 joints.

The epistome is slightly lobulate, the upper lip externally convex.

The maxillipeds have the plate of the second joint shorter than the joint itself, with the distal spines well developed, several of them strongly pectinate; the coupling spine is rather near the end. The lobes of the palp are long.

The legs are of the usual type, and spiniform.

In the first and second pleopods the exopods are areolate, or apparently covered with scale-like markings. The *appendix masculina* is thick and concave, or semi-cylindrical for its whole length. The exopods of pleopods three, four, and five have divisions; that of the fifth has two lobes on the distal end, and two at the inner side on the angle of the proximal division.

The uropods have a short inner ramus, the end of which is subacute, and projects backwards, it does not nearly reach the notch. The external ramus is long, cylindrical, curved, and ends in a recurved hook, with two or more less curved.

In a female, whose mouth parts are modified in the usual way, the size is the same as that of the male; the more posterior segments of the thorax are very short. The posterior notch of the pleon is roofed over by a process which projects far behind, and is turned up at the end and bifid. The uropods are weaker than in the male, the inner rami more acute, the outer more hooked.

In an unmodified female which I have figured the external rami of the uropods are very strongly hooked, there being three other curved spines on each. The inner ramus is very acute. The legs are rather slenderer than in the male.

In both sexes the limbs are dotted with black spots.

South Australian coast, found in sponges.

Genus *Cilicœa*, Leach.

Cilicæa curtispina, Haswell.

Plate iv., figs. 12 to 17; and plate v., figs. 1 to 8.

The body is strongly convex, smooth, with areolate markings; glabrous, with one or two lateral tubercles on each side of the sixth and seventh segments of the thorax. Obscure tubercles are also indicated on the posterior margins of more of the segments in some males.

The head is evenly rounded anteriorly, the margin being slightly thickened; it is narrower than the first segment of the thorax, and more than twice as long. The rostral portion is broad and distally truncated, meeting the anterior part of the epistome by a transverse sutural line.

The segments of the thorax are short, and do not differ much in length. The epimera are nearly vertical in direction, somewhat sculptured, and at their junctions, with their respective segments, are raised, forming an interrupted longitudinal ridge, which also is marked on the first segment; the individual plates approach gradually to the quadrate shape behind; that of the first segment projects behind and before to an equal degree, and is deeper than the others; that of the seventh is not so deep as the others. The plates, being slightly excavate, show ridges on the free margins.

The sides of the anterior portion of the pleon show three faint lines crowded together, marking coalesced segments; this portion is deeper than the epimera of the thorax, and its anterior border carries a small tooth-like projection, usually hidden by the last plate of the thorax. Posteriorly there is a large median projection, which is vertically compressed, and far exceeds the end of the pleon; its end is obtuse and rounded. The posterior portion of the pleon bears a conical tubercle on each side of the median projection of the anterior part, with two or three small granules above each, and its antero-lateral parts have oblique ridges extending to the insertions of the uropods. The posterior notch is vertically excavated, moderately deep, its roof projecting behind very slightly, and there is only the faintest indication of three teeth on this.

The first joint of the antennular peduncle is about three times longer than broad; its distal end has two projections, the posterior one projecting outwards, the anterior upwards. The second joint, which reaches out to the level of the anterior end of the eye, is about one-third the length of the first, and is distally bifid and ridged above and below; the third joint, which is considerably narrower, is cylindrical, and is articulated under the bifid projection of the second. The flagellum has 15 or 16 joints.

The antenna has the last two joints of the peduncle subequal in length; the flagellum is not much longer than the peduncle, and consists of 18 short joints.

The mandibles are massive, without dark tips to the incisory plates, and with no distinct division into incisory plates and molars, and there are no secondary plates or spine rows. The palp is rather feeble.

The spines on the outer branch of the first maxillæ are dark.

The second maxillæ are narrow, all the lobes reaching the same distance.

In the maxillipeds the distal end of the plate of the second joint is sparingly setose; the lobes of the palp are long.

The legs are rather slender.

In the first gnathopods the ischium is shorter than the basis; the merus, carpus, and propodus are spined in the usual manner, and together they are subequal in length to the ischium.

In the second gnathopods the basis and ischium are subequal in length, the merus a little longer than the carpus, the propodus longer than the carpus. The spines on this limb and three following pairs are mostly replaced by furry pads.

The first pleopod has the inner margin of the endopod folded at right angles to the other part, as shown in the figure. In the second pleopod the *appendix masculina* reaches farther than the fringe of the endopod, and there is also a less pronounced fold on the inner margin. The proximal end of the *appendix* is bent down quite to the base of the peduncle, as is seen in *C. latreillii*. The exopod of the third pleopods has a division; its endopod has some curious minute crowded teeth on the inner margin; its external distal angle is abrupt. The exopod of the fifth pleopods has six denticulate lobes, four of which are on the distal division.

The two sternal filaments are long.

The uropods have the internal ramus much reduced; the outer ramus is strong, rounded externally, flattened internally, curved, and slightly bifid at the end, projecting well beyond the dorsal process.

The female differs considerably from the male; in it the anterior portion of the pleon has two short median longitudinal ridges, but no large projection. The posterior portion has, besides the two large conical projections, two small tubercles a short distance above each. The posterior notch is deeper than in the male, and has a roofing projection more or less tridentate at its apex.

The inner ramus of the uropod is bifid at its apex; the outer ramus also is bifid, with an external projection, and an inferior keel terminating abruptly short of the bifid end. The inner uropod is channelled to receive part of the outer one when folded.

Sometimes none of the ambulatory legs are padded.

In the specimen examined the marsupial plates were well developed and overlapping; the mouth parts were modified, although the external appearance of the mandibles closely resembled those of the male.

A young female, which I take to be a variety of this species, has the following distinctions:—The posterior segments of the thorax are narrower, and all are more or less provided with small tubercles arranged transversely. The two ridges on the anterior part of the pleon are more converging behind. There are more small tubercles above the larger projections on the posterior portion. There is a large tubercle above the uropods. The posterior prolongation which roofs the notch is strongly tridentate, and a small median tubercle is just above it. The ridge formed by the upper parts of the epimera of the thorax is more pronounced. There is a conical tubercle on the underside of the peduncle of the uropod.

A common species.

Group Eubranchiatæ, Hansen.

Genus *Dynamene*, Leach.

Dynamene ramuscula, n. sp.

Plate v., figs. 9 to 20.

The body is strongly convex, rather narrow, covered sparely with long, harsh hairs, which are more numerous on the pleon and uropods.

The head is a little longer than the first segment of the thorax, convex, and rather abruptly declivous anteriorly.

The first segment of the thorax is declivous anteriorly, and is longer than either of the four which follow, but not so long as the sixth, which bears two posteriorly projecting processes, which reach nearly as far as the end of the pleon; each of these processes has a slightly sinuous shape and a small branch near the end, which projects downwards. The apices of the epimera are nearly in the same curve, and are without distinct sutural lines marking them off from their respective segments. The seventh segment of the thorax is short, and its small epimera fall short of the preceding ones. The anterior portion of the pleon is only distinctly indicated at the sides, where its anterior angles are nearly right angles. The posterior portion of the pleon is convex, rough, and hairy, having five tubercles; one large median is obscurely cleft apically, two lateral on each side, the more anterior pair larger and nearer the middle; there is also a low tubercle just above the insertion of each uropod. Behind the median tubercle the surface descends abruptly to the posterior notch, which is situated on a conical projection, is a circular foramen with the inferior slit quite closed for its whole length underneath, and showing a very slight median projection behind at the extremity.

The eyes are subcircular.

The antennular peduncle is rather long, projecting distinctly beyond the eyes when raised; the notch on the first joint, which holds the second, is not deep, and inferiorly there is a small projection. The second joint is rather more than half the length of the first, and projects obtusely beyond the articulation of the third joint; it has also an inferior keel-like projection. The third joint is a little curved; the flagellum consists of about 8 joints, which are longer than those usually met with in other species.

The antennal flagellum has 11 joints.

The maxillipeds are of the usual type, the lobes of the palp rather long, the distal setæ rather short, the last joint is subequal in length to the penultimate, apart from the projecting lobe of that joint.

The second gnathopods and the last pereiopods are subequal in length, and are longer and slenderer than the rest of the legs; the last pair bears irregularly disposed long hairs, as also do the others in a less degree; the spines are poorly developed.

The first pleopod has the endopod much broader than long. The second pleopod is without *appendix masculina*, and in both pairs the fringes of the exopods are very long. In the third pleopods the endopod is much larger than the exopod; the exopod is without division, and its fringe is long. The third pleopods as a whole are larger than the others, including the peduncle.

The external ramus of the uropods is straight and lanceolate, much narrower and longer than the inner ramus, and terminally subacute. The inner ramus is obtuse, and slightly curved outwards.

The female is narrow-ovate in shape, the posterior part of the body being conspicuously narrowed; the legs are much shorter and slenderer than in the male; there are no processes on the sixth segment of the thorax, the posterior notch is an inverted triangular-shaped foramen, almost closed behind. The uropods are subcylindrical and small; the posterior part of the pleon has a low median tubercle.

There are well-developed marsupial plates, and the young, most of which were well advanced in the specimen observed—I counted 50 in somewhat varying degrees of development—occupied the whole of the body cavity, and were seen close beneath the marsupial plates, as well as away back near the dorsum; the body seemed to be reduced to a shell, the viscera having apparently disappeared. The mouth parts were highly modified. A second female had eggs scarcely more advanced than a round or slightly elongated shape would suggest; these showed to be directly under the marsupial plates, and also to occupy the body, as in the other female.

Length of parent, about 5 mm.; that of the largest young, about 1 mm.

Gulf St. Vincent, found on sponges. Three specimens only.

Genus *Amphoroidea*, M. Edw.

Amphoroidea angustata, n. sp.

Plate vi., figs. 1 to 10.

The body is narrow, smooth, moderately convex, with the epimera not distinctly marked off from their respective segments, and are almost vertical in direction. The head is moderately depressed, and is longer than the first segment of the thorax; there is a slight excavation of the margin on each side of a small rostral process. The eyes are rather small and slightly prominent. The first segment of the thorax is rather shorter than the rest, which are subequal in length. The posterior margins of the fourth, fifth, sixth, and seventh project slightly behind in an increasing degree serially. The anterior portion of the pleon shows the median portion of a first segment; the second forms the whole of the lateral portions; the others are obscure. The posterior portion is dome-shaped, tapering behind, with an obtuse rounded end, having a very faint insinuation, representing a notch, scarcely visible from above.

The basal joints of the antennules are expanded into broad sub-lamellar ovate plates, projecting in front of the head, with their inner margins diverging. The second joints are slightly expanded. The third joints much narrower, and short. The flagellum has 7 joints, the two terminal ones very minute.

The antennæ have their third and fourth peduncular joints rather more expanded than usual. The flagellum has 11 joints.

The epistome is large, quite like that in *A. australis*, Dana.

The maxillipeds have the joints of the palp with small lobes sparingly setose.

The legs are in a single series, and—except the first gnathopods—subequal: they are all hairy, and almost devoid of spines. The basal joints are short.

The first gnathopods are somewhat twisted, the basis and ischium are subequal in length, the merus is strong and much broader than long, the carpus is insignificant, the propodus is compressed—being flattened on the inner side—to a narrow posterior edge, which, besides the hairs, has two pectinate spines; the inner surface of the joint also bears short hairs, which are not numerous. The dactylus is strong with a terminal curved claw, and in place of the secondary claw there are three strong teeth close together, followed by a short series of very short teeth inwardly. The dactylus moves at right angles to the plane surface of the propodus.

The second gnathopods are scarcely twisted, and are a little longer than the following legs.

The pleopods are rather narrow. The first pair has the endopod much smaller than the exopod, and is about twice as long as broad; the inner margin is straight and slightly thickened; the outer insinuate, with a small turned-up point near the proximal end. There is a "shelf," on which rests the inner margin of the exopod. The exopod is broadly-ovate. Areolate structure is well marked.

The second pleopods have an elongate endopod nearly twice as long as the exopod. The *appendix masculina* is as long as the lamina; on the lamina is a faint "shelf" on which the appendix rests. The exopod is narrow-ovate, with a much longer fringe than that of the endopod.

The third pleopods are shorter than the second; in them the exopod is shorter and narrower than the endopod, and has a nearly straight inner margin, and is without division

The fourth pleopods have both rami branchial.

The exopod of the fifth pleopods has two lobes at the distal end, and two on the inner margin, one above the other, a short distance; a division is not plain; the external margin is almost devoid of setules.

The uropods are broadly lamellar, ovate, the inner rami projecting beyond the end of the pleon, the outer projecting a little beyond the inner. The outer ramus is a little smaller than the inner.

Gulf St. Vincent, shallow water. One male specimen and two immature.

Amphoroidella, new sub-genus of *Amphoroidea*.

Amphoroidella elliptica, n. sp

Plate vi., figs. 11 to 18.

The body is ovate, convex in both directions above, concave beneath, covered with a kind of skin that can easily be scraped off, the "skin" thrown into a median dorsal fold or thickening, rendering each segment of the thorax apparently tuberculate in the larger specimens. First and second joints of the antennules, segments of the thorax, anterior and posterior divisions of the pleon, with the uropods, much expanded, so that only the head and extremity of the pleon are not concerned in the outline.

Head short, somewhat depressed; anteriorly there is an insinuation each side of a small rostral projection not more developed than is usual.

The lateral expansions of the first thoracic segments approach those of the second joints of the antennules; there is, however, a much wider gap between these than between any of the other side expansions, the ends of the two uropods excepted. The margins of all the expansions have a dense membrane-like fringe, with projecting hairs. The head and all the segments of the thorax do not differ much in length. The epimera of all except the first are separated by distinct sutures from their respective segments, and project nearly in the same curve as the segments.

The anterior portion of the pleon is short, marked with the usual lines, which do not extend on to the lateral plates, showing probably that only the more anterior segment bears the expansion. The posterior portion of the pleon is convex, and has anteriorly a median low convexity; it tapers quickly to a narrow rounded end, which is without notch, being only channelled below in the faintest manner; the sides and ends are thin.

The third joint of the antennule is of the usual size, the flagellum short, with 8 or 9 joints.

The epistome is arcuate and very distinct, without an anterior prolongation. The upper lip is large.

In the mandibles the molar is much reduced; on the left mandible the spine row and secondary plate are not distinctly differentiated; in the right the spines also are coalesced. The incisory plates of both are well developed and dentate. In the male the mandibles are normal.

The maxillipeds have the lobes of the joints of the palp short, especially that of the penultimate, which is subequal in length to the last. The setæ are rather scanty.

The legs are in a simple series, and all are similar—except the first gnathopods—and do not differ much in size. The carpus of each, except the first, has an insinuation on one side; all are nearly spineless. The dactyli are short, but the principal claw is rather long and acute.

The endopod of the first pleopods is much longer than broad; it has a ridge, or shelf, on which the inner margin of the exopod lies. The exopod of the third pleopod is ovate, and is without division; the endopod is much longer than broad. In the male the rami of the fourth pleopods are very thin, but both are well marked with branchial folds. The exopod of the fifth pleopods has a division and two lobes on the distal portion, and two at the inner distal angle of the proximal part opposite each other on each side. There are no small setæ on the external margin of this ramus.

In the uropods the peduncle and endopod are fused, and the exopod occupies a notch in the side. The end of the endopod slightly exceeds the end of the pleon.

The description and figures are taken chiefly from female specimens; the males I possess, which appear to be full grown, are much smaller.

This genus bears much external resemblance to *Chitinopsis*, Whitelegge.

Gulf St. Vincent, shallow water.

Moruloidea, n. gen.

Moruloidea lacertosa, n. sp.

Plate vii., figs. 1 to 10.

The body is expanded, moderately convex, the epimera of the thorax extending obliquely, and form, with their segments each side, a longitudinal shallow groove, which converges a little behind, continuing a similar groove extending round the pleon.

The head is short, with a small depressed rostral projection; much narrower than the first segment of the thorax; nodular and abruptly declivous in front.

The eyes are small.

The first segment of the thorax is broad and longer than any of the others which follow, rather nodular, its sides showing three faint tubercles on each margin; it is depressed anteriorly rather deeply; the extreme antero-lateral angles beneath the eyes are bifid or emarginate. Of the epimera of the following segments the fourth is longer fore and aft than the rest, the last is very short; they (six) are slightly accentuated at each posterior angle by a slight nodule or tubercle.

The anterior portion of the pleon, which is produced to a pointed plate laterally, is short, with the sutural lines scarcely showing. The posterior portion is dome-shaped and tuberculate, with its anterior angles also produced to points, the sides are slightly insinuate, thin, ending posteriorly in acute teeth, which do not reach the level of the sides of the posterior notch, the margins between which are insinuate. The notch is oblique in direction, rather deep, rectangular, its base slightly convex.

The basal antennular joints are not much expanded; they are uneven, rounded, and project very little beyond the head; the distal end of the first joint is not notched, or scarcely so; the second joint is short, small, and has a backward direction; the third joint is narrower and longer than the second; the flagellum short and slender, with 11 joints.

The antennæ are unusually large, all the joints of the peduncle are robust, the second has a distal obtuse tooth on the inner side, the fifth joint is a little longer than the preceding one, slightly curved, and bent back at an angle with it. The flagellum, the first four joints of which are robust, is turned in the opposite direction; it bears 11 joints, the terminal ones being very small.

The epistome is short, broader than long, with the small anterior surface nearly at right angles to the posterior part; it is rough, and tapers quickly to an acute point beneath the rostral projection; the upper lip is slightly convex.

In the maxillipeds the lobes of the palp are rather long, resembling those in the *Cymodocinæ.*

The first gnathopods are very robust in contrast to the rest of the legs, a short thick basis is subequal in length to the ischium; the three following joints are sparely provided with spines (3 each), which are not serrate, but are apically split. The dactylus is strong, not forming with the propodus a subchelate or prehensile organ, but being somewhat inclined that way.

The first pleopods are smaller than the rest; the exopod is nearly oblong, and, lying obliquely, projects at its base beyond the edge of the peduncle; the endopod is slightly longer than broad. The second pleopods have the endopod a good deal longer than broad, with a thick *appendix masculina*, which reaches as far as its fringe; the exopod is ovate and smaller than the endopod. In the third pleopods the exopod is longer than the endopod, with an oblique suture ending in a small notch on the inner margin. The exopod of the fifth pleopod has the division very near the end; terminally there are two lobes nearly on the same level, and two small or rudimentary at the inner end, one above the other, below the suture.

The uropods are placed on the edge of the pleon, they are sublaminar; the peduncle has an anterior projection slightly over-reaching that of the antero-lateral angle of the pleon; the inner ramus is broad, curved, and distally bifid, its end scarcely reaching the posterior tooth of the pleon; the outer ramus is shorter and narrower, and has its upper surface slightly carinate, with its outer side nearly straight, the inner convex, the end acute.

One male specimen.

This genus seems to differ considerably from any others of the group that I am acquainted with. The much-developed antennæ and the large first pair of gnathopods are, as far as I know, unique.

Gulf St. Vincent.

Genus *Dynamenopsis*, new gen.

Dynamenopsis obtusa, n. sp.

Plate vii., figs. 11 to 17; and plate viii., figs. 1 to 7

The body is smooth, except on the pleon, which is rather rough, glabrous, very convex, becoming slightly wider at the end of the thorax.

The head is anteriorly rounded, without a transverse anterior ridge, longer than the first segment of the thorax. The eyes are rather small.

Of the segments of the thorax the first and seventh are longer than the rest, and subequal in length. The seventh almost completely covers the anterior portion of the pleon; its posterior border has four short lobes, the two median ones projecting somewhat behind. The epimeral plates of the thoracic segments are vertical in direction; that of the first segment is well produced anteriorly, but posteriorly very little; the following four are subquadrate; that of the sixth is wedge-shaped and produced behind, more than overlapping that of the seventh segment and the lateral portion of the anterior part of the pleon.

The posterior portion of the pleon is dome-shaped, and has a conical tubercle each side of the median line, with a smaller one posteriorly just above the posterior notch. The posterior notch is a transversely-ovate foramen, a closed slit below forming a funnel-shaped tube, the two sides form a small notch at the immediate end, while the sides of the pleon are turned under, enclosing the pleopods much more than is usual.

The first joint of the antennulary peduncle is not very broad; it is about twice as long as the second, and is without distal notch or produced angle. The second joint has a slight keel; the third joint is as long as the second, expanding a little distally. The flagellum is as long as the last two joints of the peduncle together, and has 8 short joints. The antennal peduncle is only a little longer than that of the antennule; its flagellum has 11 joints.

The anterior part of the epistome is not separated from the depressed rostral projection; this fits into a notch of the epistome with a sutural line marking the union, the whole being in the same curved surface with the front of the head. The labrum is quadrate.

The mandibles are abnormal, without distinct incisory plates, secondary plate, and spine rows, neither is there a distinct molar, but the part corresponding to the posterior edge of the molar bears a few brown recurved spines.

The maxillipeds are rather slender.

The first pair of gnathopods are robust, the ischium has an anterior lobe, the merus is short and wide, with a small distal spine behind, as also has the wedge-shaped carpus and the propodus; the dactylus is robust. The remaining legs are robust, with a few spines, but with the furry pads on the usual joints. The dactyli are well developed in all.

The endopod of the first pleopod is considerably longer than broad, thickened on its inner margin, with the outer margin slightly insinuate, but with a proximal angle or projection. The exopod is much larger, although reaching the same distance as the endopod; it lies obliquely, and the fringes of both are long. The outer end of the peduncle of this limb narrows out somewhat. In the second pair the exopod is much shorter and smaller than the endopod; the appendix exceeds the length of the endopod, including its fringe; there is a short ridge on the inner side of the endopod. The third pleopod has the peduncle much longer at its inner side; the exopod is divided near its end.

The uropods are lamellar, subequal in size, rounded on their distal margins, the outer one being slightly concave above.

The two processes of the seventh sternite of the thorax are short.

This species, represented by only one male, is from Denial Bay, and was collected by Drs. Verco and Torr in January, 1908.

Genus *Circeis*, M. Edw.

Circeis tridentata, M. Edw.

Plate viii., figs. 8 to 16.

This species is the type of the genus, and is here noted for purposes of comparison.

The body is shaped typically, being somewhat vertically compressed, with the head gradually declivous and narrowing considerably, and is very like *C. acuticaudata*, Haswell; in fact, the females are hard to distinguish from those of that species.

The posterior notch of the pleon in the male is deep, narrow, widening inwardly, the median process slightly raised, broadly triangular, obscuring the base in a dorsal view, not projecting as far as the arms of the notch, which are terminally obtuse.

The distal end of the first joint of the antennule has the posterior limb of the notch curved, and projecting much more than the anterior limb, but not quite reaching the end of the second joint.

The exopod of the first pleopod has 11 strong teeth.

The exopod of the second pleopod has 21 teeth.

The exopod of the third pleopod with a division and 10 teeth.

The exopod of fifth pleopod with two lobes on the distal portion, and two on the inner margin, near the middle of the lamina.

The legs in both sexes are provided with the furry pads so common in this group.

The female is more convex than the male, with a more ovate outline. The posterior portion of the pleon is more dome-shaped, the small median tubercle less marked, and this portion is less hairy. The posterior notch is simple, narrow, rather deep, cut nearly vertically, U-shaped. The uropods are similar in shape to those of the male, but smaller. The legs are less robust, and the teeth on the pleopods smaller.

The eggs I have found deep in the body, quite to the dorsal surface, and the usual modifications of the mouth parts and viscera occur.

Circeis trilobata, n. sp.

Plate viii., figs. 17 to 20; and plate ix., figs. 1 to 7.

The body of the male narrows anteriorly, as seen in other species of this genus; it is smooth—except on the posterior portion of the pleon, where there are a few small granules—and glabrous.

The head is longer than the first thoracic segment and narrower, with a very small depressed rostral projection.

The eyes are large, and slightly projecting.

The first segment of the thorax and the seventh are subequal in length, and are longer than the remaining segments. The epimeral plates are marked off from their respective segments by faint longitudinal grooves; the antero-lateral angle of the first segment projects forward very much, but not much posteriorly; the succeeding plates project behind each in a slightly increasing degree, except the last, which also is not so deep.

The anterior portion of the pleon is subequal in length to the seventh thoracic segment, and it is slightly raised in the middle. The posterior portion bears three bosses, the median one of which is somewhat triangular and abrupt behind, the lateral ones less so; behind these is a semicircular depression, but the immediate region of the posterior notch is tumid. The notch is simple, cut nearly vertical, quadrate, with a convex base, but no real process.

The epistome is long, anteriorly appearing thickened, but actually slightly turned upward at the tip, occupying most of the interantennulary space. When viewed in profile the two posterior limbs each show two small projections, one above the other, on the inner borders.

The basal antennular joint is rather short, its posterior distal angle produced, reaching nearly to the end of the second joint; the anterior angle is scarcely produced. The second joint is distally truncated, and does not show a slight notch or insinuation above, as in *C. tridentata* and *C. acuticaudata*. The under keel is well marked. The third joint is much narrower and about as long as the second; the flagellum has 10-11 joints.

The antenna has a flagellum of 13 joints, and is slightly longer than its peduncle.

The legs are of the usual type, rather robust, sparingly spined, their places being occupied by furry pads, even in the first pair of gnathopods. The dactyli are short.

The mandibles have incisory plates, moderately strong and dentate; the left mandible has a secondary plate, tridentate. The spine row and molar of each are well developed.

The filaments of the male on the seventh thoracic sternite are short.

The endopod of the first pleopods is nearly twice as broad as long; the exopod has a row of well-marked teeth on the external border. The exopod of the second pleopod has a row of teeth and a row of small simple setæ close to the external border; the fringes of the usual setæ are very dense. The *appendix masculina* is short, and proceeds from about the middle of the inner border of the endopod. The exopod of the third pleopod has a suture rather near the end, and 5 or 6 distal teeth, also a row of small simple setæ near the external border. The exopod of fifth pleopod has a distal suture very obscure; the two lobes which this carries are rather distant from each other. A third small lobe is on the proximal division, rather far down on the inner side.

The uropods are lamellar.

The female resembles the male when not young-bearing. The young-bearing female is broader or more ovate and shorter, and the legs are much slenderer; the posterior notch is similar in shape, but rather deeper; the greatest difference is found in the uropods, the shape of which is seen by reference to the figure. The marsupial plates are large and overlapping, and the young and eggs are found deep in the body. The mouth parts are strongly modified. The young males and females bear great resemblance to the females of *Haswellia emarginata*.

Gulf St. Vincent, from jetty piles.

Circeis obtusa, n. sp.

Plate ix., figs. 8 to 17.

The body is rather broad, convex, the surface is rather rough, with granules becoming well developed on the pleon, glabrous.

The head is not so pointed as in other species of this genus; rather short, anteriorly strongly declivous, with an anterior faint transverse ridge.

The eyes are well developed.

The epimeral plates of the thoracic segments are not distinctly marked off from the segments. They are vertical in direction.

The anterior portion of the pleon is short. The posterior portion dome-shaped, with a very slight depression each side of a median faint elevation. The posterior notch is well marked, narrower at its apex than at its base, with a V-shaped median lobe, which reaches about halfway to the end. In a side view the end appears slightly turned up.

The epistome has its anterior portion slightly convex.

The basal joint of the antennular peduncle has a distal notch whose posterior limb does not reach the end of the second joint; the anterior limb is nearly as long as the posterior, and is slightly turned forward at its apex. The third joint is narrow and slightly longer than the second; the flagellum has 11-12 short joints of a moniliform appearance.

The flagellum of the antenna has 13 longer joints.

The mandibles are large, the primary plates are well developed and dentate; the secondary plate also is well developed, as also are spine rows and molars.

The maxillipeds have the plate of the second joint as long as the joint itself; the palp is well developed.

The legs are strong. The first gnathopoas have well-developed spines on fourth, fifth, and sixth joints. In the other legs the spines are replaced mostly by the furry pads.

The first pleopods have short endopods, much broader than long. The exopod is without marginal teeth, or with only one or two faint ones. Internally, from the usual row of marginal setæ, there is a row of setules, as noticed in other species. Second pleopods, with the endopods also short, bearing the *appendix*, nearly halfway along its internal border. The appendix is thick, and nearly of the same diameter its whole length. The exopod has 4-5 small teeth on its external border and a row of setules. The exopod of the third pleopods has a division and a row of setules, as in the others. The exopod of the fifth pleopods has three lobes, which are slender, the most distal one projecting horizontally, the most proximal close to the inner margin. The division is very obscure.

The uropods are lamellar, rather broad, the inner ramus distally truncate and exceeding the end of the pleon. The outer ramus rather ovate, slightly exceeding the inner, the margins of both faintly and irregularly serrate.

This species is represented by two males, the females being unknown.

Gulf St. Vincent.

Haswellia emarginata, Haswell.

Plate ix., fig. 18; and plate x., figs. 1 to 11.

The body becomes narrower anteriorly, smooth, with very few hairs towards the lateral margins.

The head is slightly longer than the first segment of the thorax, with a well-marked rostral projection very acute at the tip.

The eyes are large, and project slightly.

The segments of the thorax behind the first increase in length successively behind, while the seventh tapers to a long process, which extends beyond the end of the pleon, and is terminally truncated and notched or emarginate.

The epimeral plates of the thoracic segments are produced subacutely behind, except that of the seventh, which is large and rounded; sutures marking off these plates are not evident.

The anterior portion of the pleon is covered, except at the sides. The posterior portion is depressed and slightly granular. The posterior notch is very deeply cut, its median process projecting well beyond the sides, is truncated, and slightly notched.

The first joint of the antennular peduncle is rather broad; there is a deep distal notch, the arms of which are equal in length, and do not reach the end of the second joint; the anterior one is curved outwards a little at the end. The second joint has a prominent keel below, ending distally in an acute tooth. The flagellum has 17 small joints.

The antennal flagellum has 17 joints.

The mandibles are rather slender, the incisory plates are entire, the other parts are well developed.

The legs are similar to those found in the genus *Circeis*.

The exopods of the first and second pleopods are toothed, as also in the genus mentioned. The *appendix masculina* is small, and originates rather far along the inner margin of the endopod of the second pleopods. In the third pleopods the transverse suture is near the end; the setules noticed before are present.

The uropods are broad and very rigid. The exopod has the inner margin more convex than the outer; this is minutely serrate. The inner ramus is large and slightly sigmoid, its inner margin has a slight prominence near the distal acute end; both are densely fringed with short setæ, as well as having hairy surfaces, and project slightly beyond the median process of the seventh thoracic segment.

In an egg-bearing female the first and second pleopods are areolate in both rami; the exopods in both instances have teeth, but they are less numerous and weaker than in the males. The setules near the margin are present.

The marsupial plates are large and overlapping, the eggs are internal in densely packed masses up to the dorsal region, and even amongst the muscles which control the pleopods. The mouth parts are very much modified.

The end of the pleon has a deep vertical notch with its roof slightly projecting behind; this is rather obtusely pointed and conspicuous from the side.

Females without brood and young males approach each other, though at an early stage the young male has a short developing process to the seventh thoracic segment. In both these cases the posterior notch, though not so deep, is more roofed over by the triangular process than in the female with brood, and the process is more acute.

I have repeated the observation with regard to the eggs with *Circeis acuticaudata*, Haswell, and have found the young deep in the body apparently as well developed as those immediately under the marsupial plates; few were in that position, the majority—very numerous—were within the body, even over the pleopods.

As Dr. Hansen remarks, *Haswellia* is closely allied to *Circeis*, there being, as far as I am aware, only the character of a dorsal process separating them.

Gulf St. Vincent; a common species.

Haswellia cilicioides, n. sp.

Plate x., figs. 12 to 23.

The body is very convex, gradually narrowing towards the anterior end; smooth, except on the pleon and uropods, which are granulate and glabrous, except the margins of the uropods, which are slightly hairy.

The head is obliquely declivous and rounded in front. The eyes are scarcely raised above the surface.

The first and sixth thoracic segments are subequal in length, the seventh produced as a process which is rather broad, curved downwards, and distally obtusely rounded, over-reaching the end of the pleon and excavated a little underneath. The epimeral plates of the thorax are vertical in direction, not forming with their respective segments a perceptible longitudinal groove.

The anterior portion of the pleon, with its two transverse sutures, are well seen at the sides. The posterior portion has three lobes, the middle one slightly projecting behind more than the others; below these the surface is slightly excavated medianly, and then descends obliquely to the posterior notch. The posterior notch is shallow, the channel becoming deeper inwardly; there is a median triangular process which over-reaches the sides, is oblique in direction, and subacute.

The first peduncular joint of the antennule has the usual distal notch, the posterior limb of which is longer than the anterior, but does not reach the end of the second joint. The third joint is longer and narrower than the second. The flagellum has 14 joints.

The antenna has the last peduncular joint longer than the one which immediately precedes it; its flagellum has 16 joints.

The epistome shows very slight projections in the corresponding positions as in *Circeis trilobata.*

Mandibles well developed, with the usual features well marked.

The first gnathopods are shorter and stouter than any of the legs which follow, though not markedly so; the basis is thickened, the ischium subequal in length to the three succeeding joints taken together, these are posteriorly spined; the dactylus is moderately developed.

The following pairs of legs are moderately long, and differ only in the relative length of the joints; they are poorly or scarcely at all spined. The furry pads are present on the usual joints.

In the first pleopods the endopod is much broader than long. The exopod has 6-7 marginal teeth; both rami are areolate. The exopod of the second pleopod has areolate markings, and the row of setules near the outer margin; on the same margin there are 12 teeth. The *appendix masculina* is short and thick, and is attached to about the middle of the inner margin of the endopod. The endopod is broader than long, and has a few areolate markings. The third pleopods are larger than the two pairs which precede them without marginal teeth on the exopod, but with the row of setules as in the others. The division is near the end, and there are indistinct areolæ. The endopod is distally truncate. The exopod of the fifth pleopod has three lobes, the two distal ones well developed and well apart, the third on the inner margin also well marked.

The uropods have the inner ramus much reduced, the outer one strongly developed, subcylindrical, curved inwards, fringed with fine hair, and over-reaching the median process of the seventh thoracic segment.

The female of this species has not been recognized.

Gulf St. Vincent.

DESCRIPTION OF PLATES.

All figures are from adult males, except where otherwise mentioned.

The legs are drawn to approximate proportion in each individual.

Plate III.

Fig.	1.	*Cymodoce*	*longicaudata,*	n. sp., magnified 2½ diameters.
,,	2.	,,	,,	side view of male.
,,	3.	,,	,,	pleon from below.
,,	4.	,,	,,	antennula, antenna, and epistome.
,,	5.	,,	,,	left mandible.
,,	6.	,,	,,	maxilliped.
,,	7.	,,	,,	first gnathopod.
,,	8.	,,	,,	second gnathopod.
,,	9.	,,	,,	fourth pereiopod.
,,	10.	,,	,,	second pleopod.
,,	11.	,,	,,	exopod of fifth pleopod.
,,	12.	,,	*tuberculosa,*	Stebbing, magnified 4 diameters.
,,	13.	,,	,,	pleon from below.
,,	14.	,,	,,	antennula, antenna, and epistome.
,,	15.	,,	,,	second pleopod.

Plate IV.

,,	1.	*Cymodoce*	*hamata,*	n. sp., magnified 4 diameters.
,,	2.	,,	,,	female, magnified 4 diameters.
,,	3.	,,	,,	side view of male.
,,	4.	,,	,,	pleon from below.
,,	5.	,,	,,	female pleon from below.
,,	6.	,,	,,	antennula, antenna, and epistome.
,,	7.	,,	,,	maxilliped.
,,	8.	,,	,,	first gnathopod.
,,	9.	,,	,,	second gnathopod.
,,	10.	,,	,,	fifth pereipod.
,,	11.	,,	,,	second pleopod.
,,	12.	*Cilicæa*	*curtispina,*	Haswell, magnified 2½ diameters.
,,	13.	,,	,,	side view of male.
,,	14.	,,	,,	female, magnified 2½ diameters.
,,	15.	,,	,,	pleon from below.
,,	16.	,,	,,	female pleon from below.
,,	17.	,,	,,	antennula, antenna, and epistome.

Plate V.

,,	1.	*Cilicæa*	*curtispina,*	Haswell, left mandible, with palp.
,,	2.	,,	,,	maxilliped.
,,	3.	,,	,,	first gnathopod.
,,	4.	,,	,,	second gnathopod.
,,	5.	,,	,,	fifth pereiopod.
,,	6.	,,	,,	endopod of first pleopod, anterior and posterior aspect.
,,	7.	,,	,,	exopod of fourth pleopod.
,,	8.	,,	,,	exopod of fifth pleopod.
,,	9.	*Dynamene*	*ramuscula,*	n. sp., magnified 6 diameters.
,,	10.	,,	,,	side view of male.

Fig. 11. *Dynamene ramuscula*, female, magnified 6 diameters.
,, 12. ,, ,, pleon from below.
,, 13. ,, ,, female pleon from below.
,, 14. ,, ,, antennula, antenna, and epistome.
,, 15. ,, ,, maxilliped.
,, 16. ,, ,, first gnathopod.
,, 17. ,, ,, second gnathopod.
,, 18. ,, ,, fifth pereiopod.
,, 19. ,, ,, second pleopod.
,, 20. ,, ,, third pleopod.

PLATE VI.

,, 1. *Amphoroidea angustata*, n. sp., male magnified 4 diameters.
,, 2. ,, ,, pleon from below.
,, 3. ,, ,, antennula, antenna, and epistome.
,, 4. ,, ,, maxilliped.
,, 5. ,, ,, first gnathopod right.
,, 6. ,, ,, second gnathopod right.
,, 7. ,, ,, third pereiopod right.
,, 8. ,, ,, first pleopod.
,, 9. ,, ,, second pleopod.
,, 10. ,, ,, exopod of fifth pleopod.
,, 11. *Amphoroidella elliptica*, n. sub-gen., n. sp., magnified 2½ diameters.
,, 12. ,, ,, oral region from below.
,, 13. ,, ,, pleon from below.
,, 14. ,, ,, right mandible.
,, 15. ,, ,, second gnathopod.
,, 16. ,, ,, fifth pereiopod.
,, 17. ,, ,, first pleopod.
,, 18. ,, ,, second pleopod.

PLATE VII.

,, 1. *Moruloidea lacertosa*, n. gen., n. sp., magnified 3½ diameters.
,, 2. ,, ,, side view.
,, 3. ,, ,, antennula, antenna, and epistome.
,, 4. ,, ,, maxilliped.
,, 5. ,, ,, first gnathopod.
,, 6. ,, ,, second gnathopod.
,, 7. ,, ,, fifth pereiopod.
,, 8. ,, ,, first pleopod.
,, 9. ,, ,, second pleopod.
,, 10. ,, ,, exopod of fifth pleopod.
,, 11. *Dynamenopsis obtusa*, n. gen., n. sp., magnified 5 diameters.
,, 12. ,, ,, side view.
,, 13. ,, ,, antennula, antenna, and epistome.
,, 14. ,, ,, pleon from below.
,, 15. ,, ,, left mandible.
,, 16. ,, ,, right mandible.
,, 17. ,, ,, maxilliped.

PLATE VIII.

,, 1. *Dynamenopsis obtusa*, n. gen., n. sp., first gnathopod inside view left.
,, 2. ,, ,, second gnathopod left.
,, 3. ,, ,, fifth pereiopod left.
,, 4. ,, ,, first pleopod.
,, 5. ,, ,, second pleopod.
,, 6. ,, ,, third pleopod.
,, 7. ,, ,, exopod of fifth pleopod.

Fig. 8. *Circeis tridentata*, M. Edw. magnified 2½ diameters.
,, 9. ,, ,, female, magnified 2½ diameters.
,, 10. ,, ,, side view of male.
,, 11. ,, ,, antennula and epistome.
,, 12. ,, ,, maxilliped.
,, 13. ,, ,, pleon from below, male.
,, 14. ,, ,, first gnathopod.
,, 15. ,, ,, fourth pereiopod.
,, 16. ,, ,, second pleopod.
,, 17. ,, *trilobata*, n. sp., magnified 4 diameters.
,, 18. ,, ,, side view of male.
,, 19. ,, ,, pleon from below, male.
,, 20. ,, ,, female pleon (egg-bearing) from below.

PLATE IX.

,, 1. *Circeis trilobata*, n. sp., antennula, antenna, and epistome.
,, 2. ,, ,, maxilliped.
,, 3. ,, ,, first gnathopod.
,, 4. ,, ,, second gnathopod.
,, 5. ,, ,, fifth pereiopod.
,, 6. ,, ,, second pleopod.
,, 7. ,, ,, exopod of fifth pleopod.
,, 8. ,, *obtusa*, n. sp., magnified 3½ diameters.
,, 9. ,, ,, side view.
,, 10. ,, ,, pleon from below.
,, 11. ,, ,, antennula, antenna, and epistome.
,, 12. ,, ,, maxilliped.
,, 13. ,, ,, first gnathopod right.
,, 14. ,, ,, second gnathopod right.
,, 15. ,, ,, fourth pereiopod right.
,, 16. ,, ,, second pleopod.
,, 17. ,, ,, exopod of fifth pleopod.
,, 18. *Haswellia emarginata*, Haswell, magnified 3 diameters.

PLATE X.

,, 1. *Haswellia emarginata*, Haswell, pleon from below.
,, 2. ,, ,, young female, magnified 3 diameters.
,, 3. ,, ,, female pleon from below.
,, 4. ,, ,, pleon of young male from above.
,, 5. ,, ,, pleon of egg-bearing female.
,, 6. ,, ,, antennula, antenna, and epistome.
,, 7. ,, ,, mandible of young female.
,, 8. ,, ,, exopod of second pleopod young female.
,, 9. ,, ,, exopod of second pleopod egg-bearing female.
,, 10. ,, ,, second pleopod.
,, 11. ,, ,, exopod of fifth pleopod.
,, 12. ,, *cilicioides*, n. sp., magnified 3½ diameters.
,, 13. ,, ,, side view.
,, 14. ,, ,, pleon from below.
,, 15. ,, ,, epistome.
,, 16. ,, ,, antennula.
,, 17. ,, ,, left mandible.
,, 18. ,, ,, maxilliped.
,, 19. ,, ,, first gnathopod.
,, 20. ,, ,, second gnathopod.
,, 21. ,, ,, fifth pereiopod.
,, 22. ,, ,, second pleopod.
,, 23. ,, ,, exopod of fifth pleopod.

Secondary γ Radiation.

By J. P. V. Madsen, D.Sc. (Adel.), B.E. (Syd.), Lecturer in Electrical Engineering, University of Adelaide.

[Read July 17, 1908.]

Introduction.

As a result of the passage of γ rays through matter, secondary rays of two types make their appearance. As it will be necessary to distinguish between the secondary rays which proceed from the sides at which the original γ rays enter and emerge from the plate which they penetrate, we shall refer to these as the "incidence" and "emergence" rays respectively.

The secondary radiation consists of β and of γ rays.

The former appear on both sides of the plate; the "incidence" β rays have been recently investigated in some detail by Kleeman (Phil. Mag., Nov., 1907) and by Eve (Phil. Mag., June, 1908).

In papers by Professor Bragg and myself (Phil. Mag., May, 1908; Trans. Roy. Soc., S. Aus., v. xxxii., 1908) it is shown that most of the experimental results so far obtained with these rays can be very simply explained on the "material" theory, if we suppose that the β radiation is produced directly from the γ particle and at the outset moves in the direction of the original γ radiation, subsequently undergoing scattering in the ordinary manner of β rays.

The second type of secondary radiation resulting from the primary γ rays, viz., the secondary γ rays, have been investigated on the incidence side of plates of different material by Kleeman (Phil. Mag., May, 1908), and later by Eve (Phil. Mag., Aug., 1908).

It was a deduction made by Professor Bragg (Trans. Roy. Soc., S. Aus., Jan., 1908) from the theory of the material nature of X- and of γ rays previously propounded by him, that "the existence of modified or softened γ rays might be suspected, since there is an analogous effect in the case of X-rays; and probably they would be found more at the back of the penetrated plate than in front of it." The back and front sides spoken of here refer of course to the sides of emergence and incidence respectively.

It will be shown in the present paper that this prediction is fulfilled very exactly: that the want of symmetry in the amount of radiation from the two sides of the plate is very marked, that a softening of the original rays is effected, and that in addition there is in some cases a lack of symmetry in the quality of the emergence and incidence γ radiation.

Kleeman, from a study of the incidence radiation, has advanced a theory of selective absorption, not only for the secondary but also for the primary γ rays. In the light of the more comprehensive information which can be obtained from a study of both the emergence and the incidence radiation, an attempt will be made in the present paper to show that most of the secondary ray effects can be explained, if we suppose that from the radium there are originally emitted two sets of homogeneous γ rays, which each subsequently suffer modification by the process of scattering, becoming softened and in some cases broken up, giving rise to β rays.

The present paper is intended to give a preliminary outline of the experimental work and general theory.

The measurements are in many cases small and difficult to make with any very great accuracy, but the effects to be described seem well marked. It will be necessary to extend with greater care many of the details of the work before it can be considered as at all complete.

§ I.

The arrangement of apparatus employed in the first experiments is shown in fig. i. The radium is placed near the

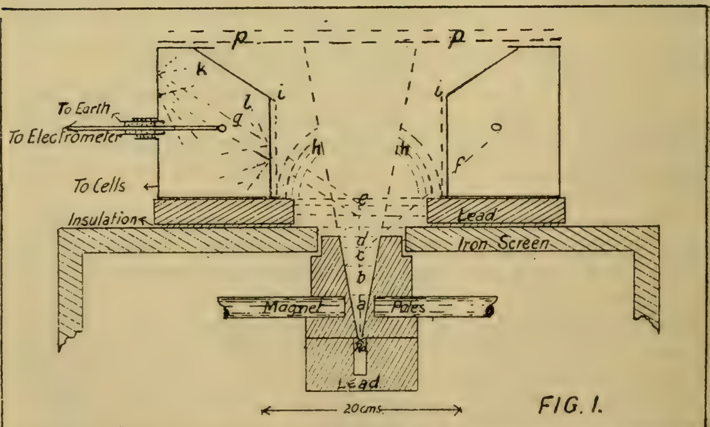


FIG. I.

The γ radiation proceeds from the Ra through the conical hole. Radiators may be placed in its path as at *e*. The quality of the secondary radiation may be tested by the domes *h*,*h* or the cylinders *i*,*i*. When measuring the effects of the secondary incidence radiation, the ionization chamber is inverted and radiators placed as at *p*,*p*.

apex of a conical hole made in a block of lead. By means of a powerful magnet, the poles of which are shown, most of the β rays could be prevented from passing out of the conical hole. The magnet and lead block containing the Ra were surrounded by an iron case, to prevent the magnetic field from producing any effect in the ionization chamber. Resting upon the iron case and suitably insulated from it is placed a lead plate one inch thick, with a circular portion removed from the centre. The ionization chamber standing upon this lead plate is made of lead 1·25 mm. thick, and contains an insulated electrode in the form of a circular wire ring, suitably protected by sulphur, and connecting to the electrometer or to earth by suitable keys.

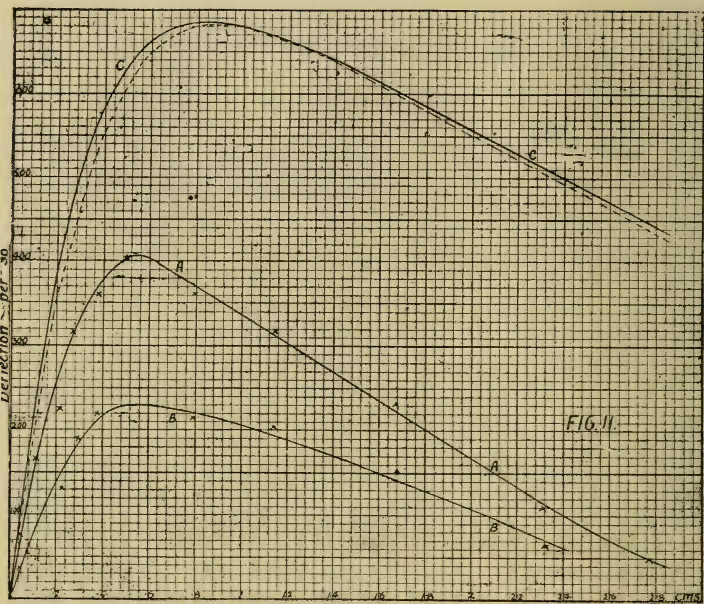
In the path of the γ radiation which proceeds from the conical hole, plates of material which are used as radiators can be placed horizontally as at *e*. When increasing the thickness of radiator the top plate is always kept in the position *e*, and additional thicknesses are placed immediately below and in contact with it. When large thicknesses are required, plugs of the material may be inserted in the conical hole.

The ionization chamber was filled with ethyl-chloride; this increased the effect considerably and worked very satisfactorily.

It was necessary to balance the leak due to natural ionization in the chamber, and to γ radiation which was not completely absorbed by the lead block and plates. For this purpose a balance chamber of about the same size as the ionization chamber was placed against one of the sides of the iron case insulated from it.

This was connected up in the usual manner, and was found to give quite sufficient balance with the ionization produced by the γ radiation which came through the sides of the lead block containing the Ra. The electrometer was a sensitive instrument of the Dolezalek pattern, giving a scale reading of about 4,000 divisions per volt; each division could easily be subdivided to tenths. The charge was allowed to pass into the electrometer for 30 sec., and the mean of the first and second swings was taken as the deflection.

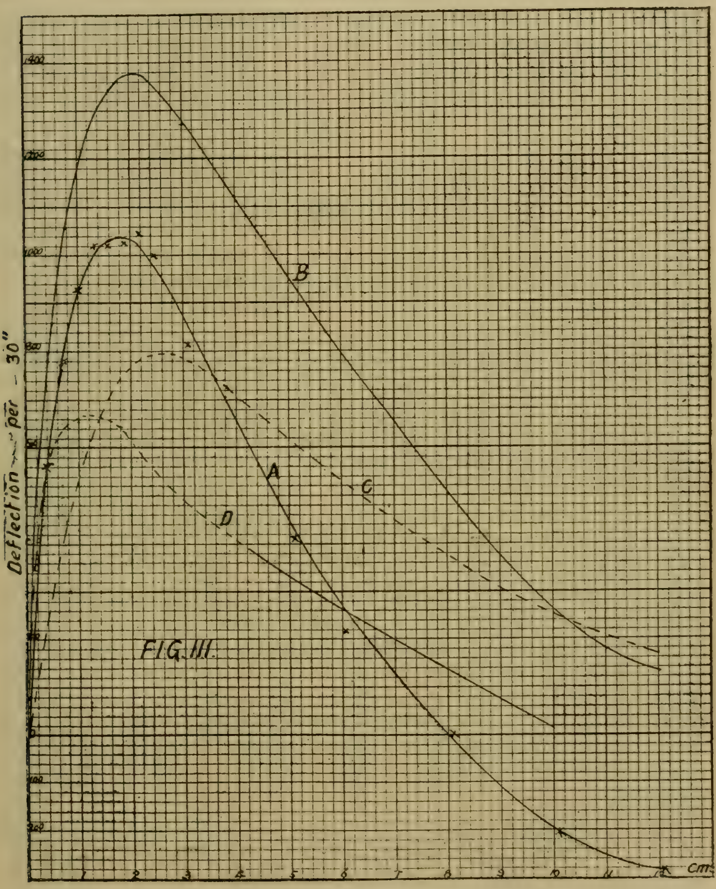
In fig. ii., curve *A* shows the effect of increasing the thickness of a Pb radiator. In an experiment, the zero leak was first obtained as a mean of several determinations, and this was subtracted from the measurement obtained with the radiator in position. It will be seen from the curve that the effect increases until a thickness of between 5 and 6 mm. of Pb is reached, after which it decreases gradually.



If, now, a hemispherical dome of Pb 4 mm. thick, with its central portion removed so as not to intercept the original stream of γ rays, be placed in the position shown by h,h, fig. i., and a set of observations be taken as before, subtracting the reading with the radiator in from that with it not in position, the curve B is obtained. Again, a maximum is reached for about the same thickness of radiation as before, but the effect is for the different thicknesses of radiator about 60 per cent. of its previous value. We may conclude that it is γ radiation which is being intercepted by the dome, as in neither case can any but a very small amount of β radiation pass obliquely through the thickness of 1·25 mm. of lead forming the sides of the ionization chamber; that from the radiator are proceeding secondary emergence γ rays which produce ionization in the testing chamber, as shown in previous papers by means of—

(*a*) "tertiary emergence" β rays as at l;
(*b*) tertiary incidence β rays as at k;
(*c*) β radiation produced in the gas of the chamber from the γ rays as they pass through it;
(*d*) possibly some ions produced directly in the gas by the γ rays; and
(*e*) subsequent β and γ ray effects of a higher order.

The results of a similar set of experiments without a Pb dome and with Zn as radiator are shown in fig. iii., curve *A*. The maximum value of the effect measured is considerably greater than in the case of Pb and occurs at a thickness of about 2 cm. of the radiator; for increased thick-



nesses the curve falls as in the case of Pb. It will be noticed that with sufficient thickness of radiator in this case the curve falls below zero. This was found to be due to the fact that a considerable amount of secondary γ radiation, proceeding from the sides of the conical hole in the Pb block containing the Ra, could enter the ionization chamber as shown by the line *c,f* (fig. i.). As any radiator is increased in thickness it not only sends out its own secondary, but absorbs that coming from the sides of the conical hole. It will be shown later how proper correction can be made for this effect.

A third set of experiments was carried out with Al as radiator; the effects were of a similar nature as those from Zn, the maximum value being about the same in amount as for Zn, and was obtained with a thickness of about 4·5 cm.; but it was found that an appreciable difference was made when a plug of Al was placed at *b* in place of *d* as shown in fig. i., even though the total thickness of Al was kept the same in both cases. It will thus be seen that some secondary radiation can, after emerging obliquely from a depth of several cm. of Al, produce an effect in the ionization chamber. The present form of apparatus was therefore not suitable for obtaining from Al all the results so far obtained for Pb and Zn; in these latter it was found that similar errors were very small. It may, however, safely be said for Al as for Zn that the effect produced is considerably greater than for Pb.

We have so far neglected all consideration of the secondary radiation which comes from the sides of the conical hole; this it will now be shown is by no means small, but the correction which it introduced was found not to be sufficient to interfere with the deduction just made. Consequently we may say that Zn and Al both give out more secondary emergence γ radiation than does Pb, provided of course that the quality of the radiation in the two cases is not so different as to balance the effect.

In order to find the amount and nature of the radiation which proceeds from the sides of the conical hole, Pb domes were placed as at *h,h*, or Pb cylinders as at *i,i*, fig. i. When the latter were used, their equivalent thickness was found in terms of corresponding domes. A cylinder was found to be approximately equivalent to a dome 1·5 times its thickness.

The results of experiments upon the radiation from the sides of the cone are shown in fig. iv., curve *A*, in which thicknesses of dome are shown horizontally and the corresponding leaks per 30 sec. vertically.

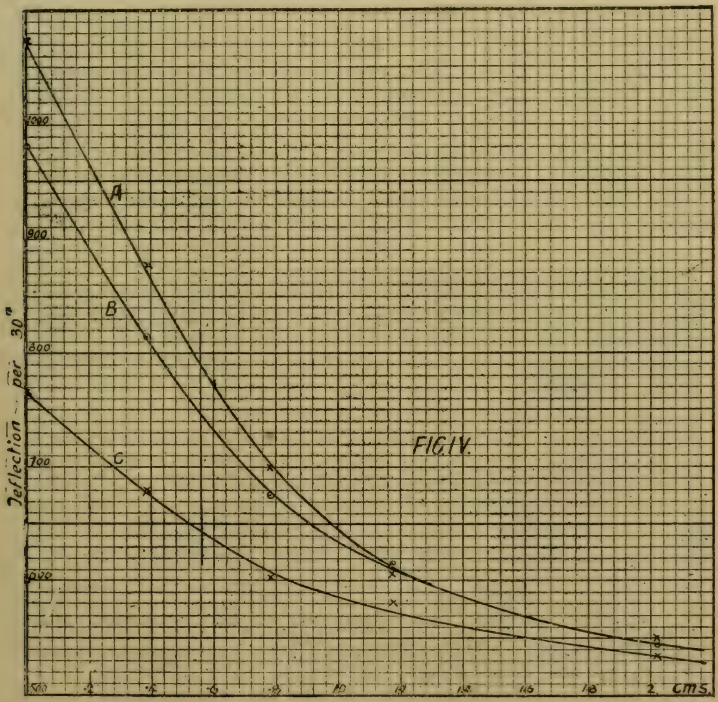
The curve *A* can be represented approximately by the expression $500 + 570e^{-1 \cdot 25d}$.

That the radiation comes from the sides of the cone can be shown by placing at *e*, fig. i., Pb plates in which circular holes are cut so as not to intercept the main stream of γ radiation coming from the Ra.

The results now obtained for different dome thicknesses are shown by curve B, fig. iv., which it will be seen can again be represented approximately by the expression $500 + 430e^{-1\cdot25d}$.

It seems reasonable to suppose that besides the constant normal leak in the ionization chamber, secondary γ radiation from the sides of the conical hole can enter the chamber, and that this radiation may for the purposes of correction to which it is to be applied later on, be taken as equivalent to a homogeneous radiation for which $\lambda = 1\cdot25$.

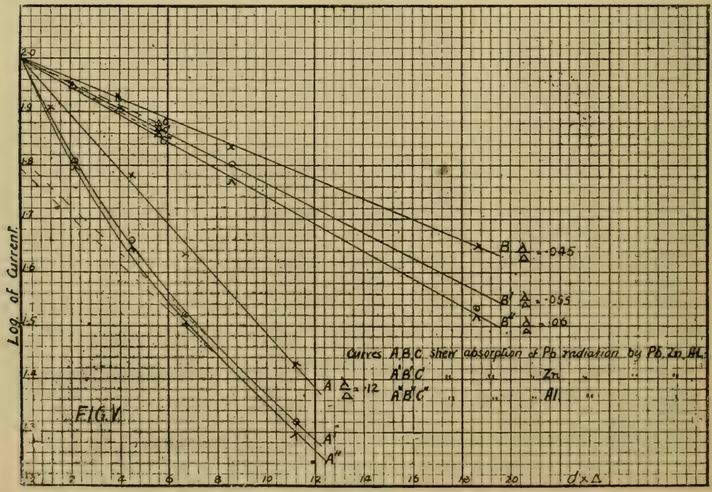
If now a Pb plug, 4 cm. deep, be placed in the conical hole in the position shown by a, fig. i., so as to intercept the main stream of γ radiation, but still leave the sides of the cone exposed to the ionization chamber, and a set of experiments similar to the above be performed, the results shown in curve C, fig. iv., are obtained. These again are approximately represented by $500 + 270e^{-1\cdot25d}$.



It is not surprising that the constant normal leak has not been reduced to any appreciable extent, for it will be seen from fig. i. that the plug would hardly intercept any γ radiation passing directly from the Ra to the ionization chamber. On the other hand, we obtain a rather important result, for assuming, of course, that the interpretation put upon these experiments is correct, even when the Ra is completely surrounded by a thickness of 4 cm. of Pb, a secondary radiation escapes, which has a value of λ approx. 1·25. Now it has been shown by Wigger (Jahrbuch der Rad. Band 2, '05) that practically all soft γ rays coming from the Ra are stopped by a thickness of Pb considerably less than 4 cm., and that the hard γ rays which can penetrate such a thickness have a value of $\lambda = {\cdot}24$.

Again, the amount of the secondary radiation has only been reduced from 570 to 270 by the insertion of the 4 cm. plug of Pb, so that we must suppose most of the secondary radiation we are dealing with to be produced from the hard γ rays and very little of it from the soft γ rays. This result, it will be shown later, is supported by other experiments.

It is now possible to apply the necessary correction to the curve A, fig. ii. The result is shown by the full line curve C, the proper correction being obtained by adding a quantity $400(1 - e^{-(1{\cdot}5 \times 1{\cdot}25)d})$ to the original values. Part of the secondary radiation from the sides of the cone was in these experiments cut off by suitable Pb screens; the factor 1·5 is introduced to allow for the obliquity with which the rays coming from the sides of the cone cross the radiators.



In order to investigate now the quality of the secondary radiation which comes from the Pb radiators, a Pb plate 5 mm. thick was used as radiator, and the emergence radiation was absorbed by Pb domes. In each experiment the dome having been placed in position, two sets of measurements were taken, one with, the other without, the radiator, and the results of these subtracted. The mean of a number of experiments is shown in table i., and in fig. v., curve *A*, the value of the thickness of the dome multiplied by its density is shown horizontally, and the log. of the corresponding current vertically, the reading with no dome being reduced to 100. It will be seen that the emergence radiation from Pb, within the range of thickness of dome, over which it has been measured with sufficient accuracy, is approximately equivalent to a homogeneous radiation for which $\lambda = 1{\cdot}33$.

Now these results require correction on account of the absorption by the 5 mm. Pb radiator of the secondary radiation from the sides of the cone. As, however, this latter has been shown to have approximately the same value of λ, viz., 1·25, it is hardly necessary at the present stage to attempt to apply the correction.

The quality of the radiation from Pb was now tested by Zn and by Al domes. The results are shown in the curves *B* and *C*, fig. v. It will be seen that λ/Δ is of much the same value when the radiation is tested by Zn or Al; but is considerably greater when tested by Pb. This is similar to the results which are obtained when the original γ radiation coming from Ra, which apparently consists of a mixture of hard and soft rays, is tested by small thicknesses of absorbing screen.

TABLE I.

PB DOMES.

Radiation from Pb

Thickness of Dome, mm. ...	0	1	4	6	10
...	100	80	60	43	26·5

Radiation from Zn

Thickness of Dome, mm. ...	0	2	4	6	10
	100	64	46	33	21

Radiation from Al

Thickness of Dome, mm. ...	0	2	4	6	10
	100	63	45	32	20

Zn Domes.

Radiation from Pb

Thickness of Dome, mm. ...	0	5·4	11·7	25·3
	100	85	67·5	44

Radiation from Zn

Thickness of Dome, mm. ...	0	5·4	11·7	25·3
	100	84	63	34

Radiation from Al

Thickness of Dome, mm. ...	0	5·4	11·7	25·3
	100	81	59	33

Al Domes.

Radiation from Pb

Thickness of Dome, mm. ...	0	8	21
	100	88	75

Radiation from Zn

Thickness of Dome, mm. ...	0	21
	100	74

Radiation from Al

Thickness of Dome, mm. ...	0	21
	100	72

It has already been shown that the radiation from the sides of the cone is approximately of the same quality as that from a Pb radiator; we may therefore assume without much possibility of error that the value of λ by Zn for this radiation is ·34.

It is now possible to apply the necessary correction to the curve *A*, fig. iii. A quantity $570(1 - e^{-(1 \cdot 5 \times \cdot 34)d})$ has been added to the previous readings; the result is shown in the full-line curve *B*. The last two readings require a slightly less correction on account of the Zn plug cutting off some of the original γ radiation which produces the effect from the sides of the cone; the necessary correction in this case was determined by a separate experiment.

The quality of the emergence radiation from Zn and from Al was now tested by Zn and by Al domes. The results are given in table i., proper correction being applied in each case for the absorption of the radiation from the side of the cone.

The Zn radiator was 12 mm. thick, the Al 17 mm. Measurements were also made with radiators of other thicknesses, but the results were not sufficiently accurate to enable one to say whether the quality of the emergence radiation varied with the thickness of radiator.

The results are plotted in fig. v., from which it will be seen that the radiation from Zn and Al is far from homogeneous when tested by Pb domes.

The emergence radiation from Zn and Al appears to consist of two sets of γ rays—one of much the same quality as those which are produced from Pb, the other a very much softer bundle. A rough analysis of either the Zn or Al curve, if such is legitimate, would suggest that it may be derived from a hard and soft bundle of γ rays, for which the values of λ by Pb are 1·3 and 5 respectively, the effect of the hard bundle being initially almost twice that of the soft.

It will be seen from the figure that mass for mass Al and Zn domes are not able to bring out so clearly as Pb domes the distinction between the quality of the secondary radiations from Zn and Al as compared with that from Pb.

This, again, is much the same as is found when one attempts to sort out the original hard and soft γ rays of Ra by such screens.

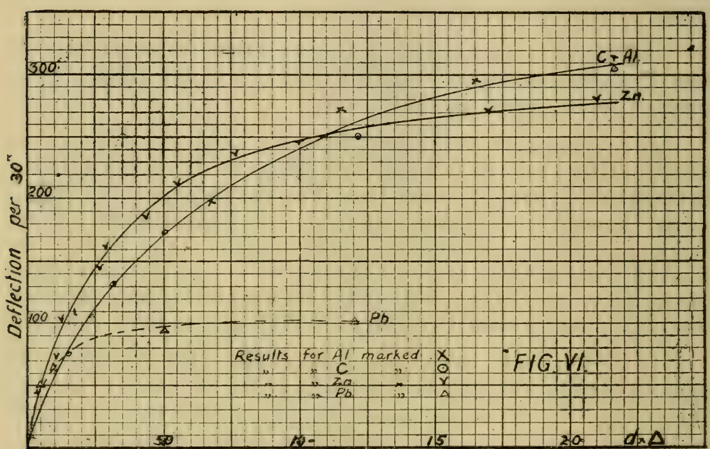
However, the radiation from Pb always appears somewhat harder than that from Zn and Al, no matter what screen is used.

This result has been checked on different occasions with care, and is of importance, as the results obtained by Kleeman from the secondary incidence γ rays, and the theory of selective absorption founded thereon, and extended to the original γ radiation, should apparently apply also to the secondary emergence rays.

§ II.

To investigate the secondary incidence γ rays the ionization chamber, fig. i., was inverted, and the large plates which served as radiators were laid directly upon the ionization chamber as at *p*,*p*. This enabled the secondary incidence rays from the radiator to enter the ionization chamber, not only by the sides *i*,*i* but also through the top of the chamber, and should more than compensate for any decrease in effect due to the primary γ rays falling upon a larger area than they did in the case where the emergence radiation was measured.

The secondary incidence radiation increased in amount as the thickness of the radiator was increased. In fig. vi. is shown the relation between the mass of the radiator and



the amount of the secondary incidence γ radiation for C, Al, Zn, and Pb.

C and Al give maximum values of nearly the same amount, viz., 300; Zn not quite so much, viz., 270; while Pb gave only 100. Comparing these with the corrected values for the emergence radiation from Pb and Zn respectively, which were 680 and 1400 approximately, it is seen that the lack of symmetry between the effects on the two sides of a plate is very marked—the effect on the emergence side being from about 4·5 to 6·5 times that on the incidence side. The quantities on the incidence side are consequently so small that they become difficult to measure with any great accuracy, especially when an attempt is made to determine the quality of the radiation.

To measure the quality of the incidence radiation the top of the ionization chamber was covered with a lead sheet about 1 cm. thick, from the centre of which was cut a circular hole 17·5 cm. diameter. One of the larger domes was then inverted and placed so as to intercept the radiation from the radiator, which was placed in the large circular hole just mentioned. A thickness of radiator sufficient to give the maximum effect was used in all cases. There appeared to be very little difference in the quality of the radiation returned from C, Al, and Zn. A Pb dome 4 mm. thick reduced the effect to approximately 20 per cent., indicating a radiation for which the value of λ is 4, if we can suppose it homogeneous.

In the case of Zn and Al it will be seen from table i. that a 4 mm. Pb dome reduces the effect of the emergence radiation to about 45 per cent. There is thus a considerable difference in the quality of the emergence and the incidence γ radiations from these substances.

That the incidence radiation from these substances is softer than the emergence, is also supported by the experiments of Kleeman and Eve already referred to, both these observers having found the value of λ for the incidence rays from these or similar substances to be of the order 4, measured by Pb. In the case of the incidence radiation from Pb the measurements were not sufficiently accurate to decide whether the incidence radiation was softer than the emergence; it appeared to be of much the same quality, *i.e.*, $\lambda = 1{\cdot}3$ approximately.

§ III.

As the apparatus described in fig. i. was unsuitable for measuring the amount of secondary emergence radiation from substances such as Al and C, and as we do not know that the distribution of the emergence radiation is the same in all directions for all substances an experiment was set up as shown in fig. vii.

The lower portion of the diagram shows the arrangement of the Ra, magnet, and iron case which is the same as previously described. Some distance above the Ra was supported—upon an insulated stand—a flat cylindrical ionization chamber. The floor of this chamber was of sheet lead 1·25 mm. thick, the sides were of Zn, and for a lid was used a thin Al plate. The conical chamber, shown by dotted lines, was used in experiments to be described later. The radiators were in the form of flat plates, the first of which in any experiment was placed in the position *p,p*. Additional thicknesses were added immediately below *p,p* and in contact with the top plate, while for very great thicknesses plugs of the material could be inserted in the conical hole in the Pb block, through which the γ radiation streamed.

In the first set of experiments the Pb plates *L,L* were used in the position shown, the large central hole in them

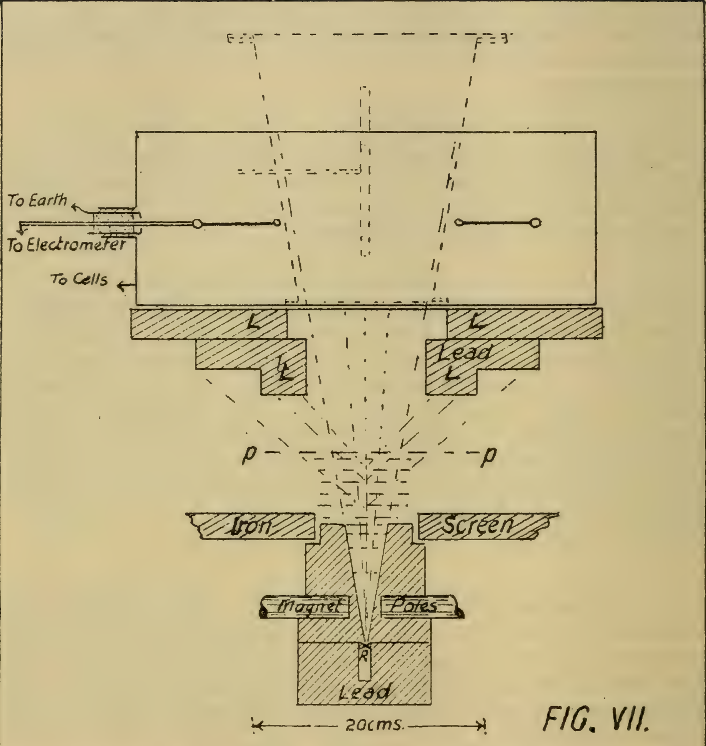


FIG. VII.

The radiators shown by horizontal dotted lines below p,p intercept the radiation from the Ra. By means of Pb plates L,L an amount of the secondary radiation may be prevented from entering the ionization chamber. The dotted conical chamber was used in a separate set of experiments.

allowing the γ rays to pass without obstruction to the ionization chamber; while a considerable amount of secondary γ radiation from the radiating plates p,p was prevented from reaching the chamber. A strong magnetic field was applied during the experiments. The floor of the ionization chamber, consisting of Pb 1·25 mm. thick, was sufficient, as has been shown in previous papers, to give the full amount of emergence β radiation. Several readings were taken with each thickness of radiator in position, and the readings were sufficiently large with the chamber filled with air. From any reading it is necessary to subtract an amount corresponding to the leak produced by the natural ionization in the chamber, to the radiation which comes directly from the Ra and has not all been cut off by the interposed screens, such as L,L, and to secondary γ radiation from surrounding bodies, which may be able to enter the chamber. This latter quantity was found to be by no means negligible, and so far as I know has not been allowed for in many experiments by previous observers. To obtain with great accuracy the zero reading necessary for subtraction, is a course exceedingly difficult.

In the present experiment a close approximation to its value was found by inserting a large Pb plug in the conical hole and placing plates of Pb above this, so as to make in all a thickness of about 20 cm. This, as shown by previous observers, should be sufficient to reduce even the hard γ radiation, which streamed through the conical hole, to almost a negligible amount, while it should not affect to any great extent the secondary radiation coming from surrounding bodies.

The results of experiments with different materials used as radiators are given in table ii., and in fig. viii. are shown by full-line curves the thickness of radiator multiplied by its density, plotted horizontally against the logarithm of the corresponding currents vertically. The value of the current with no radiation in position at p,p has in each case been reduced to the common value 100, and the zero for the ordinates has in some of the curves been altered so as to prevent overlapping. It will be seen that Pb, Bi, and Hg give results almost identical: while Sn, Zn, Al, and C all give results very similar to each other, but differing from those of the first group in that a more sudden drop of the curve is shown for the initial thicknesses of radiator. From a value of $d\Delta = 7$ onwards the curves for all the substances become practically parallel.

The Pb screens L,L, fig. vii., were now removed, and radiators were used in the form of large, flat plates, the first of which was placed horizontally just below the floor of the ionization chamber, merely separated from it by a small thickness of ebonite for insulation.

Successive thicknesses of radiator were added immediately below the first. By this means it was thought possible to allow a large proportion of all the emergent secondary γ radiation to add on its effect in the chamber. The results

TABLE II.

LEAD FLOOR.

C		Al		Zn		Sn		Bi		Pb	
d	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*
mm.											
0·0	100·0	0·0	100·0	0·0	100·00	0·0	100·00	0·00	100·00	0·0	100·00
10·0	90·4	4·8	92·5	6·7	73·60	7·8	67·60	5·12	54·50	1·1	83·50
20·0	81·2	10·0	86·5	12·0	57·40	15·0	51·70	10·50	38·20	2·5	69·30
30·0	71·0	18·5	73·5	18·0	44·80	22·8	38·80	15·70	27·50	5·0	54·50
40·0	64·7	33·5	57·3	24·0	33·80	37·8	21·00	25·20	16·95	7·5	44·20
54·0	54·4	43·5	49·2	30·0	25·60	47·8	14·70	35·70	10·65	11·6	31·40
76·0	42·6	63·5	35·8	40·0	18·40	67·8	9·00	55·20	5·28	16·6	23·00
99·0	33·7	93·5	22·3	60·0	8·90	87·8	5·37			21·6	17·40
128·0	23·4	133·5	12·7	80·0	5·99	107·8	4·17			26·6	12·80
				100·0	3·78					36·6	8·10
										46·6	4·90
										56·6	3·64
										66·6	2·76

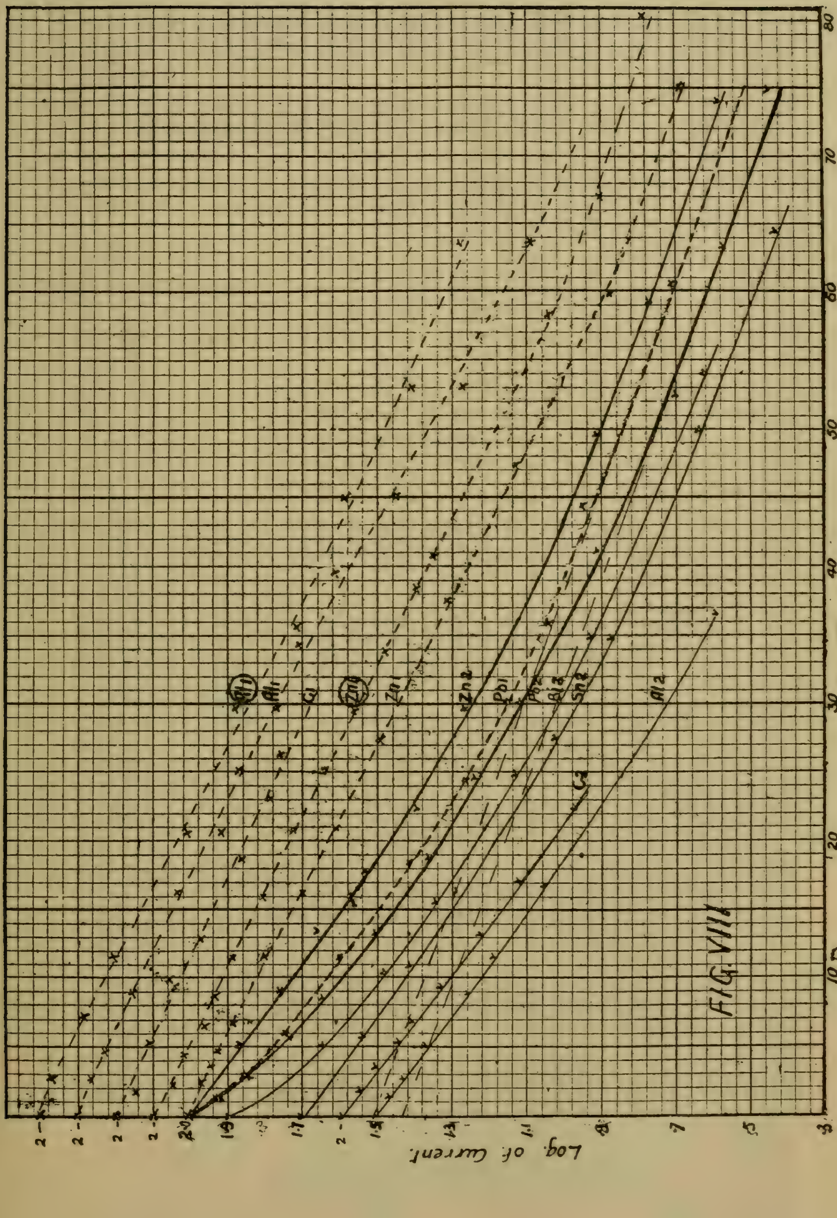

Al1
Al1
C1
Zn1
Zn1
Zn2
Pb1
Pb2
Bi2
Sn2
Al2
C2
Δ × d (cms.)
Log. of Current.

FIG. VIII

TABLE III.

LEAD FLOOR.										CARBON FLOOR.			
Al		Zn		C		Pb		Fe		Al		Zn	
d	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*
mm.													
0·0	100·00	0·0	100·00	0·0	100·0	0·00	100·00	0·0	100·0	0·0	100·0	0·0	100·00
10·0	94·00	3·0	92·50	10·0	89·0	1·10	84·00	22·0	50·7	10·0	93·7	3·0	89·70
17·0	85·50	4·5	87·60	30·0	83·0	2·55	71·20	S		27·0	77·2	6·0	82·70
34·0	72·00	6·0	84·20	57·0	72·5	5·10	55·70	0·0	100·0	44·0	64·5	9·0	74·00
61·0	54·80	9·0	75·80	77·0	59·6	10·20	39·60	13·0	91·4	78·0	45·5	12·0	69·00
78·0	46·00	15·3	62·20	87·0	53·8	16·30	26·00	27·0	81·0	112·0	30·4	15·3	61·40
95·0	37·60	21·6	50·00	107·0	49·5	21·60	18·20	Hg.		139·0	20·6	21·6	51·50
112·0	29·40	28·0	41·60	132·0	39·0	26·70	14·20	0·0	100·0	169·0	15·5	28·0	42·30
129·0	25·60	37·0	30·80	152·0	37·0	31·80	10·80	6·0	48·0	199·0	11·6	34·0	35·30
149·0	20·80	52·0	20·60			44·00	8·00	15·3	21·0	239·0	7·6	40·0	29·50
169·0	14·70	58·0	15·60			54·00	5·15	Sn				46·0	24·10
199·0	10·30	64·0	13·30			64·00	3·40	0·0	100·0			52·0	19·80
239·0	6·15	72·0	10·15					25·0	46·0			55·0	18·10
		81·0	7·52									61·0	13·70
		102·0	4·82									67·0	11·30
												79·0	9·05
												91·0	6·45
												109·0	4·90

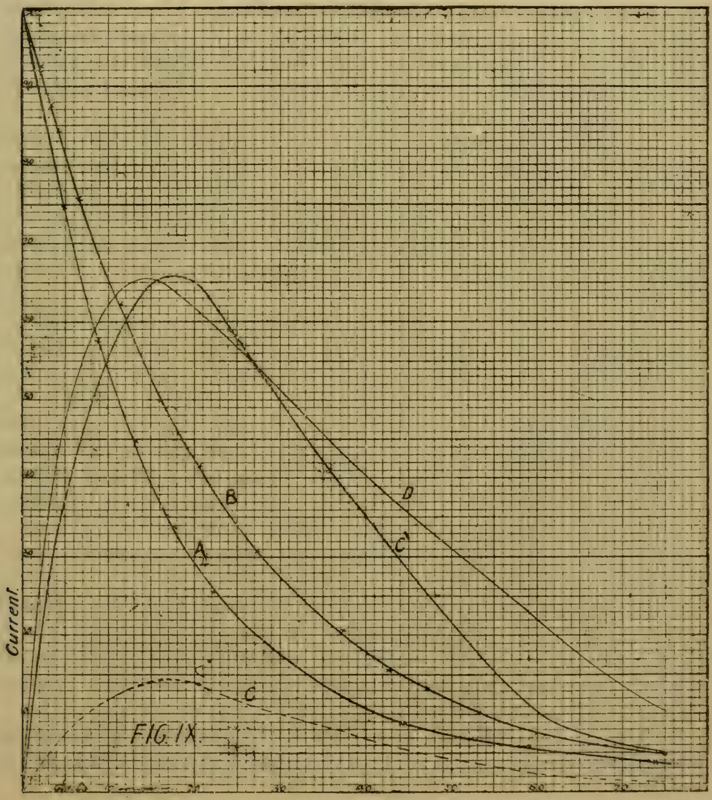
of these experiments, given in table iii. and shown by the dotted curves in fig. viii. show that this anticipation was realized.

The dotted curves (Al′) and (Zn′) need not be considered at present; they were obtained with a carbon floor introduced into the ionization chamber.

Al, C, Zn, Fe, S, and Sn give results which are all very nearly identical, and the curves show a considerable difference in slope to what they did in the previous experiment.

Pb and Hg, however, are distinctly different from the other substances, of which we may hereafter take Zn as typical.

The curve for Pb has not been altered to such a large extent by the change of arrangement of the experiment as has that for Zn and such substances.



The results for Zn are shown separately in fig. ix. by curves A and B, in which the values of thickness of absorbing screen multiplied by its density are shown horizontally and the corresponding currents vertically. The difference between the ordinates for any value of $d\,\Delta$ represents the amount of secondary radiation which it was possible to cut out by the Pb screens L,L in the first experiment. This difference is shown by the dotted curve C. It will be seen that the amount of secondary γ radiation increases with the thickness of absorbing screen or radiator, until a value corresponding to $d\Delta = 18$ has been reached, after which it gradually falls. For certain values of $d\,\Delta$ the effect produced by the secondary γ rays may be almost as great as that which is being produced by the primary γ rays.

It is thus seen that the effect produced in an ionization chamber in an ordinary absorption experiment depends largely upon the position of the absorbing plate relatively to the ionization chamber, and the shape of an absorption curve may consequently be made to vary between considerable limits. The shape of the chamber, however, appears to make very little difference to the shape of the absorption curve, within of course certain limits.

A conical ionization chamber, as shown by the dotted diagram in fig. vii., gave results for the first few thicknesses of radiator almost the same as those shown by the dotted curves, fig. viii. ; while, again, with the plates placed at p,p results similar to those shown by full-line curves in the same figure were obtained, without of course the necessity of using Pb screen such as L,L.

This is readily explained if we remember that probably most of the effect produced in the ionization chamber is due to emergence and incidence β rays coming from the floor and lid of the chamber; these rays being the product of the original γ rays and of the secondary γ rays. The β rays as a result of the scattering they undergo emerge in all directions from the floor and lid of the chamber, and any alteration in the shape of the chamber will affect the ionization produced by the β rays, which come from the secondary γ rays to much the same extent as it will those which come from the original γ rays.

Returning to fig. viii. it will be found that the ordinary absorption curve, corresponding to the dotted curve Pb 1, *i.e.*, in which as much secondary radiation as possible is included, can be represented very accurately by the expression: $30e^{-\cdot 32d} + 70e^{-1\cdot 35d}$.

Again, the full-line curve Pb 2, from which as much as possible of the secondary radiation has been excluded, is represented by the expression: $\cdot 24e^{-\cdot 32d}+\cdot 76e^{-1\cdot 35d}$. The difference between these two expressions, viz., $\cdot 6(e^{-\cdot 32d}-e^{-1\cdot 35d})$ is a measure, therefore, of the total emergence secondary γ radiation from Pb. Now it has been shown in previous experiments in this paper that the secondary γ radiation from Pb can be approximately represented by a homogeneous radiation, for which the value of λ is 1·25; we are, therefore, able to account for the results which have just been obtained if we suppose that the original hard bundle of γ rays, which proceed from the Ra, makes all, or, at least, very nearly all, the secondary radiation which comes from Pb; this is in agreement with the result obtained previously (page 169).

In the case of substances of the nature of Zn the difference between the two absorption curves, as shown in fig. ix., cannot be explained so simply. The secondary radiation after reaching its maximum value falls off more rapidly than we should expect, had all the secondary been derived from the hard set of original γ rays. We must suppose that in such substances the soft γ rays from the Ra also produce a certain amount of secondary emergence radiation, or that even though such may be produced in all substances it is better able to escape from such substances as Zn than from substances of the nature of Pb. This of course is merely another way of saying that Pb absorbs the softened secondary radiation to a much greater extent than Zn.

Again, it has been shown earlier in this paper that the emergence radiation from such substances as Zn appears, when tested by Pb, to be divisible into two quantities corresponding to a hard and soft bundle of γ rays, the hard having about the same penetrating power as the secondary rays from Pb. As it will be shown presently that there is good reason to believe that two distinct bundles of γ rays—a hard and a soft—are given out from the Ra, we may for the present look upon the two bundles of secondary rays which are produced from Zn and such substances as the products of the corresponding hard and soft bundles of the original radiation.

It will be seen from fig. viii. that when as much secondary radiation as possible is excluded the curves for all substances very nearly correspond. Let us suppose that had it been possible to exclude all the effects of secondary γ radiation, the curves for all substances would have become identical. This supposition must apparently be very near the truth, for it can be seen from the geometry of the arrangement in fig. vii. that by no means can all the secondary radiation have been excluded in the first set of experiments. We arrive, then, at this result: that, excluding all secondary γ

radiation and its effects, we may consider the Ra to give out two distinct sets of γ rays, one more penetrating than the other, each practically homogeneous, with values of $\lambda/\Delta = \cdot 028$ and $\cdot 012$ respectively, these values being practically independent of the nature of the absorbing substance.

When the secondary γ radiation is allowed to produce its effect in addition to that produced directly by the original γ rays, this law may be modified to a very considerable extent. In the usual arrangement of apparatus used for determining the quality of a radiation the absorbing plates are as a rule placed close to the ionization chamber, and the values of λ deduced from the tangent to the absorption curve —that is to say, it is generally with the dotted line curves of fig. viii. that we are dealing, and the effects of secondary radiation may, as has already been shown, be in some cases very nearly as important as the effects produced directly from the original γ radiation.

This, for example, affords a ready explanation of the effect observed by Eve (Phil. Mag., Aug., 1908), who states: —"It is noteworthy that the Ra in 2·2 cm. of nickel-steel gives an effect about 1·5 times as great as when the Ra is in 1 cm. of Pb. From the relative densities we should expect 2·2 cm. of steel to be equivalent to 1·5 cm. of Pb, and therefore the Ra in the steel cylinder should give, by the density law, two-thirds of the effect of the Ra in Pb. It actually gives one and a half times as much; thus the primary γ rays traverse steel much more readily than Pb, but the rays passing through iron are subsequently absorbed more readily by Pb than if the Ra were in Pb."

From the results of the present paper we can say that in going through 2·2 cm. of steel or 1·5 cm. of Pb, the soft primary γ rays will have suffered in each case the same number of collisions, but that the effect of a collision with an atom of Pb, or rather with the constituent of such an atom, is much more definite than in the case of substances of lower atomic weight; that in the case of Pb the collision has broken the original γ ray up, immediately sending out a β ray, or has so shattered the original γ ray as to make it easy for Pb to subsequently complete the process.

In the case of Zn, etc., the effect of the collision has not been so definite: much scattered γ radiation is produced, somewhat softened by the effects of collision, but still able to suffer further modification as a γ ray before being eventually broken up and sending out the β ray.

It must be noticed that in experiments upon the secondary incidence γ rays, such as have been carried out by Kleeman and by Eve, the nature of the secondary effect may be modified to a very considerable extent if the Ra be covered directly by a considerable mass of a substance such as Zn. Where a similar screen of lead would appear to have hardened the primary beam which is being experimented with, the screen of Zn may very well appear in some cases to have softened the primary beam, more especially if the secondary effects produced by hard and by soft rays do not conform to the same law of distribution.

It may be observed that the value of λ/Δ obtained in the present investigation for the hard γ rays from Ra is ·028, whereas the mean value obtained by Wigger was ·021. The difference probably arises from the fact that Wigger appears to have taken the natural ionization in the chamber as the amount to be subtracted from all the readings. It seems quite possible that a considerable amount of secondary radiation from surrounding bodies may have been able to enter the chamber, in which case the correction should have been greater, and this applied to all the readings would increase the value of λ/Δ which he obtained.

Again, since the hard γ rays produce a considerable amount of secondary radiation in Pb, it is not surprising that with a long, narrow chamber, such as Wigger used, the shape of the absorption curve for Pb differs from that obtained in the present experiments.

We have now sufficient information to enable us to construct at least a working theory. The main points to be observed are, firstly, the lack of symmetry in the amounts, and, secondly, a lack of symmetry in some cases in the quality of the secondary γ radiation.

The asymmetry shown by the secondary emergence and incidence β rays, which are produced from the primary γ rays of Ra, has already been put forward as an argument in favour of the "material" theory propounded by Professor Bragg.

The modification of the ether-pulse theory, recently advanced by Professor J. J. Thomson, may possibly furnish a partial explanation of the facts: but there are many difficulties in the way of a pulse theory, even modified to this extent: some of these have been pointed out in a recent paper by Professor Bragg and myself (Trans. Roy. Soc., S. Aus., v. xxxii., 1908).

When one attempts to further explain by the pulse theory the lack of symmetry which exists in the case of the secondary γ rays, the difficulties become much greater.

If we are to suppose that the incidence and emergence γ rays are true secondary effects produced by vibrations of electrons in the absorbing material, the effect resembles very closely that of fluorescence. The corresponding optical problem, however, gives rise to no such lack of symmetry; we find in its case no corresponding asymmetry of distribution or of quality of the secondary effect.

If, however, we attempt an explanation upon the "material" theory, these difficulties at once disappear.

Let us consider in the first place the effects produced by a homogeneous bundle of hard γ rays. These in passing through matter suffer collision; the effect of such collision is to change the direction of motion of the incident primary ray—in other words, to scatter it; at the same time the scattered ray loses a certain amount of energy—it has become softened; this softening may be due either to a change in its speed or to a change in moment of the γ pair, or it may be both. The distribution of the scattered radiation will probably depend upon the nature of collision, and may be influenced largely by the atomic structure of the matter with which the γ particle has collided. We have seen, for instance, that in the case of Pb, where the secondary radiation is produced mainly from the hard bundle of γ rays proceeding from the Ra, that much more of the scattered γ radiation moves on in the direction of the original rays than returns in the opposite direction.

Consider the case of a fine stream of homogeneous rays moving in the direction x, a plate of absorbing material of thickness L being placed in their path, at right angles to the direction of motion of the particles. Let I_o be the number of γ particles which are sent out by the Ra per unit time. The number I which are able to proceed a distance x through the absorbing plate without suffering appreciable effect is such that $I = I_o e^{-\lambda x}$. In a distance, dx, the number which have suffered serious collision is $I_o \lambda e^{-\lambda x} dx$. Of these let a fraction, q, be merely scattered, at the same time softened or reduced to what we may call an intermediate stage, in which their coefficient of absorption (so called) is λ'.

The remainder represented by the fraction $(1-q)$ are turned into β rays at once. Let $i_o = qI_o \lambda e^{-\lambda x} dx$.

As a result of scattering in a direction inclined to the original at an angle θ, let $i_o F\theta$ represent the number of particles per sec. which cross the unit area of a spherical surface of unit radius described with centre at the point where scattering occurs; then the number of scattered rays which emerge per sec. from the flat plate of thickness L

$$= \int_0^L \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} 2\pi \, Sin.\, \theta.\, F\theta.\, q\, I_o \lambda\, e^{-\lambda x}\, e^{-\lambda'(L-x)\, Sec.\, \theta}\, d\theta\, dx$$

In addition to these rays we have emerging per sec. a number $I_0 e^{-\lambda L}$ which have suffered no scattering.

We are not at present able to evaluate the expression given above, from want of knowledge regarding $F\theta$. However, we may proceed to make an approximate calculation of the effect which might be expected in such a case as we have investigated in fig. i.

Considering as before a fine pencil of homogeneous γ rays falling normally upon a plate of thickness L, we may express the emergence radiation as—

$$k I_0 \lambda \int^{L} e^{-\lambda x} e^{-a\lambda'(L-x)} dx = \frac{K I_0 \lambda}{\lambda' - \lambda} \left(e^{-\lambda L} - e^{-a\lambda' L} \right)$$

where k is a constant, λ the coefficient of absorption of the primary set of rays, λ' a similar coefficient for the secondary rays, and a a constant obliquity factor, which in the present case is taken as 2, a value obtained by considering the geometrical arrangement of the radiators in fig. i. with regard to the ionization chamber.

Let us now apply this result to the case of a Pb radiator: the values of λ and λ' are ·32 and 1·3 respectively. The curve corresponding to $e^{-\cdot 32L} - e^{-2\cdot 6L}$ is shown by the dotted line in fig. ii., the maximum having been adjusted to the same value as for the experimental curve.

The agreement between the theoretical and the actual curve is very good.

The maximum value is reached for about the same thickness of radiator, and for thicknesses of radiator greater than that required to give the maximum effect the curves slope away to about the same extent. This, taken in conjunction with previous experiments, seems to show that practically all the secondary γ radiation obtained in these experiments from Pb may be considered as derived from the original hard γ rays of the Ra.

It must, however, be remembered that the secondary emergence rays have to penetrate the Pb sides of the ionization chamber, and allowing for obliquity this corresponds to a thickness of about 2 mm., so that it is still quite possible that a fair amount of very soft secondary γ radiation may have escaped detection.

If we now proceed in a similar manner to construct the corresponding curve for Zn, viz., $e^{-\cdot 21L} - e^{-\cdot 64L}$, it is found that it by no means corresponds to the experimental curve. If, however, we assume that for a thickness of about 10 cm. of the Zn radiator the primary soft bundle is producing very little of the secondary emergence γ radiation, the curve as calculated above may be placed in the position shown by C, fig. iii. The curve D is now drawn to represent the difference between the curves B and C. We may now see how closely this remainder corresponds to what might be expected if the soft bundle of original γ rays produced a corresponding softer secondary. The maximum in the case of this remainder curve is further to the left than in the case of curve C, and after reaching its maximum value the curve falls away much more rapidly than does C. It corresponds, in fact, very well with what we might reasonably expect to be produced by the soft bundle of γ rays coming from the Ra. Again, although for any given thickness of radiator the ratio of the ordinates to the curves C and D is by no means constant, it is of the order indicated in fig. v. by the curve A''.

If, now, the curves C and D represent the effects due respectively to the hard and soft γ rays from the Ra, it should be possible to show experimentally that the quality of the radiation from a Zn radiator depends to some extent upon the thickness of the radiator. No serious attempt has so far been made to carry out this investigation. However, we may check the result in another way. The quality of the radiation from Zn should show some change if we absorb some of the soft γ rays coming from the Ra by means of a Pb screen or plug before allowing the radiation to fall upon the Zn radiator. As we have already seen, it is possible in this way to reduce the softer radiation without cutting down the hard to such an extent as would be necessary if a plug of material such as Zn were used.

Using 17 mm. of Al as radiator, with no plug, the reading with no dome was to the reading with a 6 mm. dome as 100 : 31. With a 9 mm. plug, however, inserted in the conical hole just over the Ra the reading with no dome was to the reading with a 6 mm. dome as 100 : 39. A similar effect was also obtained with a Zn radiator.

We see, then, that hardening the primary radiation has the effect of hardening the secondary, and this is in agreement with the suggestion put forward, viz., that in the case of Zn, Al, and such substances the secondary emergence γ radiation consists of two bundles corresponding to, in fact derived immediately from, the two corresponding bundles constituting the original γ radiation.

In fig. ix. the dotted curve C has been plotted to a larger scale, and the curve D obtained previously in fig. iii., and shown in that fig. curve B, has been plotted with the same maximum value as C' for comparison with it. It will be noticed that the curve D *reaches* its maximum for a smaller thickness of radiator than does C'. This we might expect as the secondary rays will be able to emerge from a greater depth of the radiator, when some of them come out more normally, as happens in the case represented by curve C'.

In the experiment from which the curve D is derived the rays emerge very obliquely, and their self-absorption by the radiator is much greater for a given thickness of radiator.

Otherwise the curves are in very good agreement. It is to be noticed that in curve C' certain effects may show themselves which are probably not present to such a large extent in the case represented by D. Soft radiation, for instance, has a much better opportunity of producing its effect in the former case.

Returning now to a brief consideration of the secondary incidence γ radiation. Although no attempt has as yet been made to determine whether the radiation from different substances is strictly homogeneous, it was thought advisable to find out how its amount varied for any substance as the Ra was covered with different screen thicknesses of Pb.

In these experiments C, Zn, and Al showed much the same effect. With no plug, a 5 mm. plug, and a 10 mm. plug over the Ra, the corresponding readings were as 100 : 60 : 35. Now, since the value of λ for the soft γ radiation from Ra is 1·35 for Pb, it should have required about 8 mm. of Pb to reduce it to 35 per cent. of its original value, and had the incidence secondary radiation been due entirely to the original soft γ rays it should apparently have been reduced to much the same amount. It is shown above that 10 mm. of Pb, placed in the path of the primary, reduces the secondary effect to 35 per cent., so that it appears that very nearly all the secondary incidence γ radiation from Zn and such substances is derived from the soft bundle of primary γ rays.

In the case of the radiation from Pb the measurements could not be performed with any great accuracy. However, it was found possible to place a 2 cm. Pb plug over the Ra without cutting off all the incidence radiation : the reading was reduced to about 30 per cent.

The experiment is accurate enough to enable us to say that the secondary incidence radiation from Pb is derived to a large extent from the original hard bundle of γ rays : its quality, as tested by Pb domes, shows also that it is of much the same nature as the emergence radiation, which appears to be the product of the hard γ rays.

In all these experiments, and especially in those which deal with the incidence radiation, it must be borne in mind that the radiation has to penetrate a thickness of Pb, corresponding to 2 mm. before its effect is measured, and consequently the effect of very soft γ radiation may have been missed.

The lack of symmetry in quality of the emergence and incidence radiation from some materials may be explained if we suppose the distribution of the scattered radiation which is produced from the hard γ rays is not the same as for that produced from the softer rays. The secondary radiation produced from the hard γ rays appears to move on more in the direction of the original stream than do the secondaries produced from the softer rays.

The distribution of the secondaries may also to some extent depend upon the nature of the medium in which scattering has taken place, and it does not seem at all unlikely that the atomic structure of the radiator should determine to some extent the nature and result of a collision between the γ particle and the constituent part of the atom.

It has already been stated that these experiments give little or no support to the theory of selective absorption advanced by Kleeman; the effects seem much simpler than we might be led to suppose from that theory. It seems possible, also, to suggest probable causes for the effects which Kleeman has observed. In some cases the absorbing screens used by Kleeman seem not to be of sufficient thickness to preclude the possibility of a certain amount of β rays, given off by the radiator, penetrating the screen. Secondly, it has been assumed that the incidence γ radiation from all the substances experimented with is homogeneous. If, for example, the incidence radiation from Pb contained a very soft bundle in addition to the hard, many of the results obtained by Kleeman could be immediately explained. With the present form of apparatus I have not of course been able to test this point; it does not, however, seem at all improbable that Pb should give out an exceedingly soft bundle of γ rays, the product of the soft γ rays in the original radiation; indeed, if it is safe to make comparisons from the behaviour of such substances as Zn, it would be surprising if such a soft bundle did not exist, although of course its effect may be small. Thirdly, in dealing with the very soft γ rays, which constitute the secondary incidence radiation, it seems necessary to take into account the effect of tertiary radiation.

In conclusion it may not be out of place to discuss one or two points of some interest which have arisen during the progress of these experiments.

In fig. viii. it will be observed that for a mass of absorbing screen 70 the result of cutting out a considerable amount of the secondary radiation has been to change the value of the effect produced with Zn screens from 56 to 43. In the case of Pb the corresponding change is from 38 to 30. In other words, the ratio of the effect produced by a Zn screen to that produced by a Pb screen of the same mass is apparently much the same whether secondary radiation is included or not. It appears almost as if the effect produced in the ionization chamber were due more to the secondaries produced from the hard γ rays than to direct effects of these hard γ rays. The hard γ rays are not apparently broken up as the result of the first collision; a few may be, but most of the rays seem capable of passing into what we may for convenience speak of as an intermediate stage. A second collision when the ray is in this stage may be more effective in breaking up the γ ray and causing the β particle to be sent out. In some cases the γ ray may still retain the characteristics of a γ ray even after many collisions.

It would seem possible for a γ ray to produce some ionization in a gas as a result of its passage through that gas, slow-speed delta rays being produced from the atoms of the gas. Where high-speed electrons appear they are to be considered as having been produced from the γ ray itself, being originally a part of it, as already suggested by Professor Bragg.

It has been found by Eve (Phil. Mag., 1906) that the γ rays from Thorium have an absorption curve, measured by Pb, very nearly the same as that for Ra. We should expect, then, that Thorium gave out two homogeneous sets of γ rays as does Ra, the values of λ by Pb for these groups being ·32 and 1·35. It has also been found by Eve that the value of λ for the γ rays given out by Ur is 1·4, and that these rays appear nearly homogeneous. The γ rays of Ur appear, then, to correspond very closely with soft bundle of rays emitted by both Th and Ra.

Again, it seems rather striking that the secondary rays produced by the hard γ rays of Ra produce in Pb, and apparently in all substances, a secondary, for which the value of λ is of the same order as for the Ur rays and the soft rays of Ra and Th.

In the case of the secondary rays produced from the hard γ rays of Ra it has been possible to treat them as practically homogeneous over the range of thickness of screens which have been used. It will, however, require much more careful research to determine the exact quality of this radiation.

Again, the value of λ / Δ for the soft primary bundle of rays has been shown to be nearly four times that of the hard. It seems possible that this may have some connection with the result obtained previously by Professor Bragg and myself for the β rays which are produced from the γ rays of Ra. It was found that the value of λ for the hard and soft β rays was approximately as one to four.

Summary.

1. The γ rays of Ra and probably of Th appear to consist of two distinct homogeneous bundles, the value of λ/Δ for the soft set being approximately four times that for the hard.

2. For each set of rays the value of λ/Δ is constant and practically independent of the nature of the absorbing material with which λ is measured, provided that in the case of the soft rays secondary effects be excluded.

3. Secondary γ radiation appears on both sides of a plate which is penetrated by a stream of γ rays. There exists a marked lack of symmetry between the amount of secondary radiation which proceeds from the two sides.

4. A lack of symmetry exists in the case of some substances between the quality of the radiation on the two sides.

5. The last results seem very difficult to reconcile with a pulse theory. On the "material" theory propounded by Professor Bragg no such difficulty arises.

6. The secondary γ radiation appears to be derived from the primary by a process of scattering. This process generally involving a reduction in the subsequent penetrating power of the ray affected.

7. There appears to be reason to believe that the distribution of the scattered radiation depends to some extent upon the hardness of the radiation which is scattered; also upon the nature of the material in which the scattering is produced. The softer radiation appears to be turned back to a somewhat greater extent than the hard. Materials of high atomic weight seem to be able to produce more complete scattering than those of lower atomic weight.

8. The absorption of γ radiation which has already passed through a thickness of one substance by screens of a different substance may not in all cases give a true measure of the absorption of the original radiation which has been effected by the first screens.

In conclusion, it is a pleasant duty for me to acknowledge my indebtedness and sincere thanks to Professor Bragg for his keen interest and advice during the progress of these experiments.

University, Adelaide,
Sept., 1908.

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part VIII.

By Jos. C. Verco, M.D., F.R.C.S.

[Read June 2, 1908.]

Plates XI. to XIII.

Emarginula subtilitexta, n. sp. Pl. xi., figs. 6, 7, 8.

Shell ovate, rather thin, white. Apex well curved, one-sixth of the length from the posterior end. Convex anteriorly from apex to margin; posteriorly concave below the apex, then convex, then somewhat spreading near the margin. Slit narrow, margined by a low thin erect lamella. Posterior two-thirds closed; closing callus sunken, scalloped with transverse erect lamellæ convex towards the apex. Sculpture: 60 radial ribs, low and flatly rounded, about one-half as wide as the interspaces, projecting beyond and crenulating the margin. Concentric narrow erect lamellæ rather crowded cancellate the surface. Interior smooth and white.

Dim.—Length, 6·5 mm.; breadth, 4·9; fissure, 1·4 mm.; height, 2 mm.

Locality.—110 fathoms, off Beachport, 1 dead.

Diagnosis.—*E. superba*, Hedley, has the same number of radial ribs and the dentate margin, but has higher concentric lamellæ. *E. dilecta*, A. Adams, has a similar sunken scalloped slit fasciole, and nearly the same number of radials, rather more; but has ruder ribs wider than their interspaces.

Puncturella (Cranopsis) corolla, n. sp. Pl. xi., figs. 1 to 5.

Shell thin, roundly oval, depressed conic. Apex eccentric, one-fifth of the length from the posterior end, spiral, well curved backwards. Protoconch projects on the right side and consists of two whorls, the first turn and a half are smooth, convex, glistening; the second half turn, which increases rapidly, is minutely crowdedly granular; at the junction of the two is a minute scar, the first part fitting into the second. In the adult shell the latter part of the protoconch looks directly backward. The sculpture of the shell begins gradually as accremental wrinkles, and next as radial riblets. Where the wrinkles commence the slit begins. The dorsum in front is a uniform convex curve, behind it is a continuous concave curve. The perforation occupies the middle third of the dorsal slope, and is lanceolate. Between it and the protoconch its previous site is closed by a sunken lamina with subdistant erect transverse lamellæ, convex posteriorly. Between it and the anterior margin is a differentiated rib, broader and higher than the rest, fissured superficially throughout. In its upper part the fissure is as wide as the perforation, but is nearly closed internally by horizontal laminæ from the sides. It gradually contracts anteriorly to a fine line; in its upper half the fissure communicates with the interior, in the lower it is shut off. The slit fasciole and perforation are bounded on each side by a delicate erect lamina, highest at the perforation, in front of which the laminæ gradually approximate to form the differentiated rib. From the protoconch to the margin this lies a little to the right of the actual median line of the shell. Sculpture: Radial ribs, well rounded, nearly smooth, about as wide as their interspaces, sixteen primary, but increasing rapidly by intercalation of secondary and tertiary riblets to 90 in a shell of 10 mm. length, and crenulating the margin. These riblets appear first as gradually enlarging tubercles in the centre of the intercostal spaces, situated on the concentric laminæ, which conspicuously cross the interspaces, slightly scale the bases of the ribs, but are barely visible under the microscope on their summits. They produce radial lines of punctations in the interspaces, and in old dead specimens, where the glaze disappears from the interior, these appear as perforations. The ribs posteriorly are broader and closer together. Internally a small shelf or septum convex towards the interior, with a sharp simple margin anteriorly hides the upper fourth of the perforation, being attached to the shell at a distance from the margins of the perforation about equal to the width of the perforation; it gets gradually narrower and less obvious posteriorly. Its dorsal surface slopes up to the slit fasciole, the last one or two scales of which roof in the back of its cavity. From the perforation anteriorly runs a gutter to the margin; in older examples this becomes a thin central ridge. Shallow radial furrows correspond with the external ribs. As individuals get older, the shell grows more rapidly posteriorly, so that the apex gets less eccentric, and the back part becomes very flat and sloping.

Dim.—When half-grown, length, 10 mm.; width, 8 mm.; height, 1·4 mm.; apex, 1·8 mm. from the posterior end. When full-grown, length, 18 mm.; width, 15·4 mm.; height, 4·7 mm.; apex, 5·4 mm. from the posterior end.

Locality.—130 fathoms, off Cape Jaffa, 20 whole or broken; 300 fathoms, 4, all dead.

Obs.—The shell appears to fall within the limits of *Cranopsis*. I have no shells of this genus with which to compare it, and the illustrations in Tryon's "Manual" are very small; but the perforation on the slope and the internal septum coincide with its definition. One can see in different individuals the varied aspects of the shell at successive stages, first a depressed spiral shell with a simple aperture; then an emarginula-like form, with a slit and slit fasciole; then a rimula-like shell, with a perforation just above the margin, continued as a narrow fissure to the border, and finally with the fissure closed and the perforation complete.

Modiola projecta, n. sp. Pl. xiii., figs. 12 and 13.

Shell solid, narrowly oblong, inequilateral. Umbo directed forward at the junction of the first and second fourth of the shell, approximate, round, inflated. Anterior dorsal margin with a uniform rounded slope, commencing just behind, and within the apex of the umbo, over the front of which it is reflected. Posterior dorsal margin straight, very gently convex. Anterior end round; posterior end sloping convex. Post-dorsal angle a very obtuse curve, post-ventral angle a much smaller curve. Ventral border nearly straight, slightly concave, almost parallel with the dorsal borders. Margin simple, smooth. A groove increasing in width runs from the umbo backwards within the post-dorsal border for three-quarters of its length, formed by a stout, projecting internal lamina, which widens for half its length, and then gradually dwindles. The posterior muscle scar is rather deep. Of the two oblique umbo-ventral ridges the anterior is the more distinct. Externally there are obsolete accremental striæ, and in the earlier stage distant, rounded, low, concentric ridges, more marked towards the front. Traces of a dark epidermis are present.

Dim.—Antero-posterior diam., 10·9 mm.; umbo-ventral, 4·1 mm.

Locality.—Off Beachport, 200 fathoms. One right valve.

Modiolaria semiradiata, n. sp. Pl. xiii., figs. 14 and 15.

Shell oblong-ovate, ventricose. Umbo terminal, flattened, directed forward, applied to the front end of the shell. Post-dorsal border straight, short, thin, then faintly curved. Posterior end round: ventral border straight, anterior end round. Margin crenulated on the edge, with rounded teeth along the curved part of the post-dorsal border and at both ends. The ventral border shows no teeth, but probably because it is a little eroded. A narrow oblique furrow runs between the apex of the umbo and the adjacent front margin of the shell. An inflated ridge runs from the umbo to the posterior end, steep on the dorsal side, and gently sloping on the ventral.

Accremental striæ irregular in distance and size mark the surface, and form rude flat concentric ridges at intervals. Well-marked radial striæ cover all the posterior half of the shell, extending from the umbo to the ventral border, somewhat interrupted at the edges of the concentric ridges; these are quite absent from the anterior half.

Dim.—Antero-posterior diameter, 8·9 mm.; umbo-ventral, 5·2; sectional of one valve, 3·5 mm.

Locality.—Cape Jaffa, 130 fathoms, one valve.

Arcoperna scapha, n. sp. Pl. xii., figs. 1 to 5.

Shell small, solid, white, oval. Umbos terminal, round, inflated, directed slightly forward, approximate but not in contact. Prodissoconch very distinct, separated definitely from the dissoconch by a fine groove; its earliest third is quite smooth, its later two-thirds engraved with concentric lines, gradually growing more valid. Post-dorsal border nearly straight for 1·7 mm., forming an open rounded angle with the posterior border, which is nearly straight for 1·7 mm., then sweeps with a slight convexity into the short-curved, circular, ventral border. The anterior dorsal border is very short, almost entirely under the umbo. The antero-ventral border is slightly convex. The whole dorsum is engraved with crowded, slightly-curved, radial lines, latticed by concentric lines nearly as valid; some of the latter at distant intervals in the early stages of growth are much deeper, so as to form slightly imbricating ledges. The inner margin of the shell has fine denticulations from the end of the post-dorsal border all round and almost to the central extremity of the anterior dorsal border under the umbo; they do not reach the outer edge of the shell. The straight edge of the prodissoconch is set somewhat obliquely to the anterior dorsal border, the central extremity of which extends slightly behind the centre of the edge of the prodissoconch. The post-dorsal line is provided with many (more than 20) close-set, low, vertical teeth on its inner surface. Beneath them is the scar of the ligament for the anterior three-fourths of their extent, somewhat increasing in width posteriorly, and having a rounded end. It seems to pass out between the prodissoconch and the anterior dorsal hinge-line to become external. The anterior dorsal border has a few denticulations and one tooth, and is supported by a sort of thickening which projects slightly into the cavity of the shell and has a rounded central end. Two elongated muscle-scars occupy the middle third of the sides of the shell, not far from the margin, narrowing dorsally; the posterior is rather the larger.

Dim.—Antero-posterior diameter, 3·2 mm.; umbo-ventral, 4·5; sectional of closed valves, 3·6 mm.

Locality.—Off Beachport, 49, 100, 110, 150, 200 fathoms; off Cape Jaffa, 90 and 130 fathoms; off Cape Borda, 55 fathoms; east of Neptunes, 45 fathoms. Only one living specimen was taken in 45 fathoms. Valves were secured in numbers, chiefly between 45 and 110 fathoms; beyond this depth they were few. Mr. Hedley reports to me that it has been taken in 80 fathoms, 22 miles east of Narrabeen, New South Wales.

Diagnosis.—It somewhat resembles *Crenella globularis*, Tate, a tertiary fossil; but this is a wider shell comparatively, and more symmetrical.

The generic location of this shell has been somewhat difficult, and Mr. Hedley and Mr. Etheridge and Mr. Kesteven have compared it with allies in the Australian Museum, Sydney, and discussed its characters, and as a result it has been placed in *Arcoperna*, and becomes a second recent Australian species of this previously fossil genus, the first, *A. recens*, having been figured and described by Tate in Journ. Mal. Soc., Lond., 1897, p. 181.

Leptothyra carinata, n. sp.

Figured in Trans. Roy. Soc. of S. Austr., vol. xxxi., 1907; pl. xxix., fig. 8.

Shell minute, solid, three and a half whorls. The first two whorls are smooth, white and convex. The spire-whorl shows three rounded carinations, one just below the suture which is channelled by it, the second about one-third the distance between the sutures, and the third about one-fourth the distance from the lower suture. The interspaces are concave, and have spiral cords, equidistant; two in the upper space, the posterior the smaller; three in the middle space, small and equal. The body-whorl has seven carinations which become gradually lower towards the base, and closer; interspaces concave, and provided with spiral liræ, varying from six to two, according to the width of the spaces. The lowest carina forms a margin to the umbilicus which is wide and sculptured with about eight spiral liræ. The spirals are cut up at irregular intervals by radial incisions, and marked by very fine crowded microscopic radial scratches. The aperture is circular; its inner surface smooth, and its outer scalloped by the spirals. Colour, very light amber; some examples are white, others faintly tinged with pink

Dim.—Largest diameter 1·4 mm., smallest 1 mm.; height 1·1 mm.; width of aperture, ·7 mm.

Locality.—20 fathoms, outside Backstairs Passage, with six other examples, dead.

Diagnosis.—From *L. arenacea*, Pritchard and Gatliff; in its marked carinæ, more widely canaliculated suture, and wider umbilicus. From *Liotia alazon*, Hedley, in being a smaller shell, with less valid carinæ, and in its radial incisions.

Cuspidaria dorsirecta, n. sp. Pl. xi., figs. 9 and 10.

Shell small, moderately solid, oval, equilateral. Umbo prominent, acute, prosogyre. Post-dorsal line straight; anterior concave in front of the apex, then straight; the front end uniformly widely curved, ventral border gently curved, with very slight incurving at the base of the rostrum, which is very short and wide. Well-marked granulated ridge from the umbo to the postero-inferior angle of the rostrum; a second ridge cuts off its upper fourth. In front of the former is a moderate depression. Surface smooth but for sublenticular accremental striæ. It has one anterior and one posterior lateral tooth well developed, roundly-triangular; the latter slightly the larger, and from its end a very low but gradually rising lamina is continued nearly to the end of the rostrum, and forms a narrow, slightly-widening groove with the dorsal margin.

Dim.—Antero-posterior diameter, 5 mm.; umbo-ventral, 3·3 mm.

Locality.—Off Beachport, from 40, 100, and 110 fathoms; off Cape Borda, 60 fathoms; valves.

Cuspidaria alta, n. sp. Pl. xiii., figs. 8 to 11.

Shell small, thin. Umbo tumid, blunt. Anterior dorsal border very faintly convex sloping; posterior dorsal border concavely sloping. Anterior end sharply rounded; posterior moderately and broadly rostrated. Ventral border uniformly widely arcuate, running concavely into the rostrum. An oblique, gradually-widening depression between the body and the rostrum, and an oblique ridge between its lower angle and the umbo; there is a second ridge close to the median line, the intervening space nearly flat. Outer surface smooth, but for sublenticular concentric striæ, which are much more marked on the rostrum. Right valve with an anterior and posterior triangular lateral tooth, the latter the larger, and its groove running some distance into the rostrum. Left valve edentulous, and lies within the margin of the right. The pallial line ends by a nearly vertical curved line from the umbo.

Dim.—Antero-posterior diameter, 6·8 mm.; umbo-ventral, 4 mm.

Locality.—Off Beachport, in 100 fathoms, 1 valve; 150 fathoms, 2 valves. Off Cape Jaffa, in 90 fathoms, 20 valves; in 130 fathoms, 1 valve. South-west of Neptunes, 104 fathoms, 3 alive and 26 valves.

Cuspidaria angasi, E. A. Smith.

Neæra angasi, n. sp., E. A. Smith, Chall. Zool., vol. xiii., 1885, p. 47, pl. ix., f. 2. *Type locality.*—Sta. 164B, off the coast of New South Wales, 410 fathoms, green mud.

Dredged in 130 fathoms, off Cape Jaffa, 2 alive, 1 dead, 3 valves.

The ventral border and the lower border of the rostrum of the right valve lie within the margin of the left valve, while its dorsal borders, anterior and posterior, extend beyond those of its fellow.

Cuspidaria exarata, n. sp. Pl. xii., figs. 6 and 7.

Shell ovately-pyriform, subequilateral, thin. Umbo round, inflated, directed backwards. Anterior dorsal margin slightly convex; front end with a round, uniform curve; ventral border gently arcuate, joining the rostrum with a short incurvation. Post-dorsal slope nearly straight, barely incurved; rostrum short, slightly tapering. Fossette small, directed obliquely backwards. Right valve has no distinct tooth, but a low lamina runs from the fossette backwards for half the length of the posterior slope, to make a shallow, narrow furrow with its slightly more projecting border. The anterior dorsal slope is bevelled on its inner side, and has the trace of a furrow within it near the fossette. Interior glistening, smooth, white, with subdistant radial translucent lines ending at the simple pallial line. Externally about twenty triangular concentric ribs, with sharp lirate summits and sublenticular concentric striæ on their sides; the ribs become less costate and more lamelliform towards the ventral margin, and at the depression in front of the rostrum, over which they are only irregular vertical striæ. Colour dull opaque white, with faint axial less white striations.

Dim.—Antero-posterior diameter, 13·2 mm.; umbo-ventral, 7·5 mm.

Locality.—35 miles south-west of Neptune Islands, in 104 fathoms, one right valve perfect and the posterior half of a left valve, which if whole would be half as large again as the type.

Diagnosis.—It closely resembles *C. trailli*, Hutton, as figured by Mr. Hedley in Trans. N.Z. Institute, vol. 38, 1905, p. 72, pl. ii., figs. 9, 10, 11, dredged in 110 fathoms, east of the Great Barrier Island. It is also about the same size, mine probably varying from 13 to 19 mm.; his example was 15 mm. Three differences appear. My species is more concave along the post-dorsal border, shows only bare traces of umbo-rostral liræ, and has no teeth in its right valve projecting beyond the vertical plane. Mr. Hedley tells me he has the same shell from 250 fathoms, off Sydney.

Cuspidaria (Cardiomya) pinna, n. sp. Pl. xiii., figs. 5 to 7.

Shell squarely oval, ventricose, rather thin, umbos inflated, rounded, approximate. Front dorsal border short, straight, scarcely convex, joining by a rounded slightly obtuse angle the straight barely incurved anterior end. This with a faint angulation joins the open-curved ventral border, which, after a definite incurvation, unites with the lower border of the rostrum. The post-dorsal border is feebly-concave to the end of the rostrum, which is rounded at its rather attenuated end.

The sculpture is very bold. Three distant valid round ribs curve from the umbo to the posterior third of the ventral border. In front of these are about seventeen subequal less prominent rounded ribs, equal in width to their interspaces. Behind them are two rather distant, less valid ribs, and three more extend from the umbo to the end of the rostrum. All these ribs furrow the inside of the shell, and all crenulate or scallop the ventral border in the ratio of their size and distance. The border of the rostrum is not scalloped. There are microscopic accremental striæ, most marked and erect towards the end of the rostrum. Immediately beneath the umbo is a small triangular cartilage pit, wider than high. In the right valve is a triangular laminar posterior lateral tooth, with a slight furrow forward to the pit and backwards nearly to the rostrum. Anteriorly, there is a long invalid lamina just within the border. The left valve has an anterior lamina, which forms, with its front dorsal margin, a shallow furrow to receive the lamina of the right valve. The post-dorsal margin of the left valve and its anterior lamina form a straight line, only interrupted by the notch of the cartilage pit.

The left valve lies inside the right valve throughout its post-dorsal border; the right valve lies inside the left, markedly along the posterior two-thirds of the ventral border, barely along its anterior third, and distinctly along the straight anterior end, where the right valve has a rather more concave edge than the left.

Dim.—Antero-posterior diam., 6·5 mm.; umbo-ventral, 4·1; section of united valves, 2·75.

Hab.—Off Cape Jaffa, in 300 fathoms, 3 alive and 12 valves; in 130 fathoms, 1 alive and 11 valves.

Diagnosis.—It is very closely allied to the *Cuspidaria perrostrata*, Dall, Bull. Mus. Comp. Zool., Harvard Coll., Cambridge, xii., 1885-1886, p. 296, pl. ii., figs. 3*a*, 3*b*, obtained in 339 fathoms, off Tortugas, and in 416 fathoms, gray ooze, near Grenada. Also in Bull., 37, United States National Mus., 1889, p. 66, pl. ii., figs. 3*a*, 3*b*. My species has a shorter rostrum, and the three bold ribs give it a distinct aspect. Dall says there is a good deal of variation in this group, and though my specimens vary scarcely at all, they may prove to be a variety of Dall's species. This shell contributes another new subgenus to the South Australian record, viz., *Cardiomya.*

Cuspidaria (Halonympha) ros, n. sp. Pl. xiii., figs. 1 to 4.

Shell small, inflated, pyriformly orbicular, very thin, diaphanous. Umbos visible, tumid directed somewhat backwards. Post-dorsal border a gentle incurved slope; anterior nearly continuous with the posterior for about two millimetres, then sweeping with an almost circular curve round the whole front and ventral border, to merge into the obliquely upward slope of the lower border of the rostrum, which is short, rather tapering, and round-ended.

Immediately beneath the minute approximate apex of each umbo is a projection carrying a tiny elongate cartilage pit. Some little distance behind this a wide-curved hollowed lamina, like half the bowl of a spoon, stands out in each valve.

There is a small elongate laminar cardinal tooth in front of the fossette of the right valve; none in the left.

The surface is smooth, but for microscopic concentric striæ, chiefly near the ventral margin.

Dim.—Antero-posterior diameter, 6 mm.; umbo-ventral, 4; sectional of closed valves, 2·5 mm.

Locality.—300 fathoms, off Cape Jaffa, 2 alive and 3 valves; 130 fathoms, 3 alive and 14 valves.

This new species introduces, for South Australia, a new subgenus, *Halonympha*, created by Dall and Smith, with *Neæra claviculata*, Dall, as the type (Bull. of Mus. of Comp. Zoöl., Harvard Coll., Cambridge, vol. xii., 1885-1886, p. 301). It is characterized by an acute cardinal tooth in the right valve, none in the left; a small central fossette, and by a clavicular rib or myophore in the posterior part of each valve.

Our shell is very closely allied to *Neæra claviculata*, Dall, Bull. Mus. Comp. Zoöl., 1881, vol. ix., p. 112, and *Halonympha claviculata*, Dall, Bull. Mus. Comp. Zool., Harvard

Coll., vol. xii., 1885-1886, p. 301, pl. ii., figs. 2 and 2*a*; also No. 425, p. 68, pl. ii., figs. 2 and 2*a*, in Bull. of the U.S. National Mus., xxxvii., 1889. *Type locality.*—North Atlantic, from 100 to 539 fathoms; also Chall. Zool., xiii., 1885, p. 52, pl. ix., figs. 8, 8*b*. *Locality.*—Bermudas, 425 fathoms, coral mud; here by the artist's mistake the clavicular process is omitted from the figure. But, judging from the illustrations and measurements given, our species differs in having a slightly longer rostrum, in being much smoother, and in its more spoon-shaped clavicle.

EXPLANATION OF PLATES.

PLATE XI.

Fig. 1. *Puncturella (Cranopsis) corolla*, Verco, ventral view.
,, 2. ,, ,, ,, ,, young specimen showing protoconch.
,, 3. ,, ,, ,, ,, dorsal view.
,, 4. ,, ,, ,, ,, sculpture.
,, 5. ,, ,, ,, ,, profile.
,, 6. *Emarginula subtilitexta*, Verco, profile.
,, 7. ,, ,, ,, dorsal view.
,, 8. ,, ,, ,, sculpture.
,, 9. *Cuspidaria dorsirecta*, Verco, exterior.
,, 10. ,, ,, ,, interior.

PLATE XII.

,, 1. *Arcoperna scapha*, Verco, prodissoconch.
,, 2. ,, ,, ,, profile, joined valves.
,, 3. ,, ,, ,, interior.
,, 4. ,, ,, ,, exterior.
,, 5. ,, ,, ,, shell tilted up, so as to show the deep groove for the reception of the ligament.
,, 6. *Cuspidaria exarata*, Verco, exterior.
,, 7. ,, ,, ,, interior.

PLATE XIII.

,, 1. *Cuspidaria ros*, Verco, exterior, lateral.
,, 2. ,, ,, ,, ,, joined valves.
,, 3. ,, ,, ,, hinge.
,, 4. ,, ,, ,, ,,
,, 5. *Cuspidaria pinna*, Verco, exterior, lateral.
,, 6. ,, ,, ,, hinge.
,, 7. ,, ,, ,, ,,
,, 8. *Cuspidaria alta*, Verco, exterior, lateral.
,, 9. ,, ,, ,, hinge.
,, 10. ,, ,, ,, ,,
,, 11. ,, ,, ,, ,,
,, 12. *Modiola projecta*, Verco, interior, lateral.
,, 13. ,, ,, ,, exterior.
,, 14. *Modiolaria semiradiata*, Verco, exterior, lateral.
,, 15. ,, ,, ,, interior.

Descriptions of Australian Curculionidæ, with Notes on Previously Described Species.

By Arthur M. Lea.

Part VI.

[Read August 4, 1908.]

SUBFAMILY LEPTOPSIDES.

Onesorus squamosus, n. sp.

Black, densely clothed with soft, pale-brown, round scales; interspersed with fine setæ.

Head with small dense concealed punctures; inter-ocular fovea minute. Eyes narrowly ovate, finely faceted. Rostrum stout, not much shorter than prothorax, rather strongly dilated at apex; with a strong central carina, but rest of sculpture hidden. Scape about half the length of funicle, the latter with first joint slightly longer than third, but distinctly shorter than second. *Prothorax* moderately transverse, sides strongly rounded, base and apex almost equal; ocular lobes strong and rounded; with large, deep punctures or foveæ occupying most of the surface. *Scutellum* distinct. *Elytra* very briefly ovate or subcordate, much wider than prothorax, sides strongly and regularly rounded; with regular rows of very large, partially concealed punctures; interstices regularly convex. *Legs* rather robust; tibiæ apparently not denticulate below. Length (excluding rostrum), 10½-11 mm.

Hab.—North-Western Australia: Onslow (C. French).

The scales are almost uniformly distributed, but are slightly paler on the under surface and legs than elsewhere; they are almost perfectly circular, very closely applied to derm, and have a peculiar velvety appearance. The setæ, especially on the elytra, are very fine and hair-like. The triangular apical plate is almost hidden by setæ, as in the description of *Obesus*, but that species (amongst other discrepancies) is said to have three sordid ochraceous vittæ on the prothorax.

Some specimens in the Macleay Museum have the clothing almost white.

Catastygnus densus, n. sp.

Reddish-brown or black. Densely and almost uniformly covered with scales of a very light-brown colour, but in places with a slight golden gloss; elytra with paler markings and with dense setæ, usually slightly darker than the scales amongst which they are placed.

Rostrum tricarinate, carinæ normally concealed, but median one rather acute, the longitudinal depressions with rather coarse but concealed sculpture. *Prothorax* moderately transverse, sides moderately rounded, base not much wider than apex; with rather coarse partially concealed sculpture, but leaving a feeble median node exposed. *Elytra* considerably wider than prothorax, very feebly dilated to beyond the middle; with very large punctures in striæ, but appearing much smaller through clothing. Length (excluding rostrum), 11-13 mm.

Hab.—Queensland: Brisbane (R. Illidge and E. W. Ferguson).

The larger of the two specimens before me is (except as to its clothing) of an almost uniform reddish-brown, whilst the smaller one is black, but with parts of the appendages diluted with red. On each elytron of the larger specimen, just before the summit of its posterior declivity, there is a small patch of white scales, extending across two interstices, and vaguely connected with the shoulder by a stripe of scales slightly paler than most of those on the elytra; on the smaller specimen these markings can be just traced. They appear to be remnants of the V common to several species of the genus. The elytral setæ are not in two almost regular rows on each interstice (as in the description of *Rivulosus*), but are fairly dense, and although not in regular rows, generally three or four (sometimes more) can be traced at any one line between the interstices.

Catastygnus ochreipennis, n. sp.

Black, elytra and parts of legs obscurely diluted with red, scutellum dull red. Densely clothed with greyish or light-brown scales, thickly interspersed with fine setæ; but elytra with decided ochreous scales and setæ, except towards the sides, where the clothing is mostly black or sooty.

Rostrum tricarinate, the median carina acute and shining, the others less regular; sublateral sulci almost as deep as scrobes. *Prothorax* rather lightly transverse, sides moderately rounded; base distinctly wider than apex, granulate-punctate; with a distinctly impressed median line. *Scutellum* distinctly transverse. *Elytra* distinctly but not much wider than prothorax, sides feebly dilated to basal third; with large but partially concealed punctures in striæ. Length, 12½-15 mm.

Hab.—Queensland: Mackay (C. French).

The elytra are without trace of a V, but have dark sides, as in *scutellaris*, *textilis*, and others. The clothing is sparser on the upper surface of the head and rostrum than elsewhere. The femora are very feebly annulated.

Readily distinguished from all others of the genus by the conspicuous ochreous clothing of the elytra. The legs are stouter than in any other species of the genus known to me, and the prothorax is wider in proportion. The elytral clothing, except in its colour, is much as in *textilis*.

Catastygnus elegans, n. sp.

Black; parts of appendages obscurely diluted with red. Under surface with dense pale scales, having a more or less decided golden lustre; elytra with dense whitish scales, thickly interspersed with setæ, clothing of sides (except the extreme margins) blackish, the dark parts meeting at apex and running irregularly along suture to base; prothorax almost glabrous.

Rostrum with coarse partially concealed punctures; median carina very distinct, the others rather feeble. *Prothorax* moderately transverse, sides rather strongly rounded, base distinctly wider than apex, with coarse vermiculate sculpture, and with a rather feeble median line. *Elytra* much wider than prothorax, shoulders somewhat rounded, parallel sided to beyond the middle; punctures in striæ large and deep, but partially concealed. Length, 12½-14 mm.

Hab.—Queensland: Coen River (H. Hacker).

The elytra appear to have two wide stripes of white scales; the dark sutural marking is not quite so dark as on the sides. On one specimen almost the whole of the scales on the under surface are black, but this may be due to grease.

The elytral markings somewhat resemble those of certain specimens of *limbatus*, but the shoulders are square and the elytra are not dilated posteriorly. The prothorax is without the white lateral stripe nearly always present in members of the genus. In shape it is like *textilis*, and the elytral clothing (except about the suture) is much the same.

Amisallus tuberosus, Boh.

In the specific diagnosis of this species the antennæ are described as "subtenues," but in the generic diagnosis they are described as "validiusculæ," and the scape as "apice valde incrassato," with the two basal joints of the funicle elongate.

Four specimens before me (from Blue Mountains, Jenolan, and Forest Reefs) evidently belong to the species. They differ from *nodosus* in having the elytra flatter, with the shoulders squarer, the tubercles more numerous and more obtuse—some of the basal ones on the inner interstice are almost obsolete, and the basal one does not overhang the prothorax. They also have a small but rather conspicuous tubercle on each side of the scutellum.

AMISALLUS WHITEI, Waterh.

Specimens of this species vary in length from $7\frac{1}{2}$ to 12 mm. The species occurs in the coastal districts of E. Australia from the Clarence River, in New South Wales, to Mackay, in Queensland.

POLYPHRADES CONCINNUS, n. sp.

Blackish, appendages dull red. Very densely clothed with soft white or whitish scales, in places on the upper surface very feebly variegated with pale brown. With short dense setæ, not conspicuous on prothorax, but semierect on elytra, on which they form two or three rows on each interstice.

Head wide. Eyes briefly ovate, strongly convex, finely faceted. Rostrum slightly longer than wide, diminishing in width from base to apex; apical plate feeble, not triangular, and not sharply limited; inter-antennary space convex, rather narrow and almost parallel-sided. Scape thin, distinctly curved, passing eyes; first joint of funicle not much longer than second, second slightly longer than third, the others transverse; club moderately long. *Prothorax* moderately transverse, sides rather strongly rounded, base much wider than apex. *Elytra* somewhat ovate, base almost truncate and very closely applied to prothorax, widest at basal fifth, thence strongly diminishing in width to apex. Front *tibiæ* rather long, moderately curved, feebly denticulate. Length (excluding rostrum), 4-$4\frac{1}{2}$ mm.

Hab.—N.W. Australia: Roebuck Bay (C. French).

A pretty little species, with more prominent eyes than usual. In its very dense elytral setæ it resembles *setosus*, but the two species have little else in common. The scape when drawn back passes the front margin of the prothorax, a *Cherrus*-like character. On the head the scales mostly have a silvery gloss, but on the muzzle and under surface they mostly have a greenish or opalescent gloss.

On abrasion the head is seen to have small and not very dense punctures, and to be transversely impressed at its junction with rostrum. The rostral carina is very feeble. The prothorax has dense and rather coarse punctures, and is without granules. The punctures in the elytral striæ are large and not much narrower than the interstices; before abrasion, however, they appear to be much narrower.

Polyphrades emblematicus, n. sp.

Black, appendages dull red. Densely clothed with soft scales, mostly muddy-brown on upper surface, and whitish (usually with a faint bluish gloss) on under surface. With dense and very stout but not conspicuous setæ.

Head wide. Eyes briefly ovate, rather coarsely faceted. Rostrum shorter than its width at base, sides decreasing in width from base to apex, apical plate small but with rather coarse punctures; inter-antennary space narrow, incurved, depressed, and apparently not carinated along middle. Antennæ stout; scape rather long, strongly curved, passing the eye; first joint of funicle not much longer than wide, distinctly longer than second, all the others transverse; club rather briefly ovate. *Prothorax* rather lightly transverse, sides strongly but not quite regularly rounded, base distinctly wider than apex, and both somewhat rounded. *Elytra* wider than usual, ovate-cordate, base conjointly rather strongly arcuate, distinctly wider than prothorax in both sexes, but especially in female. Front *tibiæ* comparatively short and stout, rather strongly denticulate. Length, 4½-5½ mm.

Hab.—North-Western Australia (Macleay Museum).

In shape somewhat like *exoletus*, but setæ very different, the scape shorter, stouter, and more noticeably curved, the space between scrobes narrower, etc. The setæ are stouter even than in *setosus*, and are more depressed. The prothoracic punctures, however, readily distinguish it from all other species known to me.

The colour of the derm appears to be usually black or blackish, but in some specimens is of a dingy reddish-brown. The head has a very vague median line; on the prothorax two very faint discal lines can sometimes be traced, and on the elytra there are usually small irregularly distributed pale spots. The setæ (which are unusually stout) are (contrary to the normal fashion) more noticeable on the prothorax than on the elytra, and on the posterior declivity of the latter they are no more conspicuous than elsewhere.

On abrasion the head is seen to be closely covered with irregular longitudinal ridges, some of which are continued on to the rostrum. On the prothorax there are no granules, but the punctures are remarkable; they are of two kinds, large ones impressed each in the form of a crescent, the convex side of each directed towards a median line which has simple punctures only; between the arms of each crescent there is usually one small puncture; the rest of the surface has rather dense small punctures. On the elytra the punctures in the striæ are rather large, and the interstices are moderately convex; before abrasion the punctures appear to be much smaller and the interstices scarcely separately convex.

POLYPHRADES LATUS, n. sp.

Black, antennæ and tarsi almost black. Densely clothed with brown, slightly mottled scales. With stout and rather dense setæ.

Head wide. Eyes ovate, coarsely faceted. Rostrum about as long as wide, almost parallel-sided, inter-antennary space somewhat cordate, decidedly lessened in width posteriorly; apical plate sharply defined and with distinct punctures, depressed, but not carinated along middle. Antennæ rather stout; scape rather strongly curved, distinctly passing eyes; first joint of funicle distinctly, but not much, longer than second, second slightly longer than third, fifth to seventh transverse; club moderately elongate. *Prothorax* almost as long as wide, sides strongly rounded, base not much wider than apex. *Elytra* wide, briefly subovate, base conjointly lightly arcuate and not margined, sides rather strongly rounded. Front *tibiæ* moderately long, rather lightly curved, moderately denticulate. Length, $6\frac{1}{2}$-$7\frac{1}{2}$ mm.

Hab.—Queensland: Cairns, Kuranda (H. Hacker).

An unusually wide species, with strongly curved scape and the eyes with coarser facets than usual. The rostrum, although wide, has the space between the scrobes rather narrow in front, and very narrow behind. The elytra are about as wide as in *laticollis*, but the prothorax is wider and more globose; the two species, however, have little in common. There is a vague resemblance to some dingy specimens of *cæsalon*, but the rostrum is utterly different. On the under surface the scales are paler than on the upper, and usually have a faint golden gloss.

On abrasion the head is seen to be coarsely and rugosely sculptured, with small dense punctures on the raised portions; the rostrum is densely and rather coarsely punctate. The prothorax has dense granules, except close to apex, these being quite easily traceable before abrasion; the punctures are small and dense, with some larger ones scattered about, even on the granules. The punctures in the elytral striæ are rather large, and not much obscured by the clothing, but the dense and minute ones on the interstices are normally concealed.

POLYPHRADES PARVUS, n. sp.

Black, appendages dull red. Densely clothed with soft feebly variegated scales. With thin and rather sparse setæ, suberect only on posterior declivity.

Head wide. Eyes large, ovate, rather finely faceted. Rostrum slightly longer than wide, almost parallel-sided; inter-antennary space rather wide, parallel-sided; apical plate sharply defined and with distinct punctures, with, from its apex, a narrow but normally concealed carina extending backwards. Antennæ rather stout, scape rather lightly curved and passing eye; first joint of funicle as long as second and third combined, second distinctly longer than third, third to seventh transverse; club elongate-elliptic. *Prothorax* moderately transverse, sides strongly and regularly rounded, base and apex equal. *Elytra* somewhat ovate, conjointly lightly arcuate at base, at widest part distinctly wider than prothorax in female, not much wider in male. Front *tibiæ* moderately long, rather lightly denticulate. Length, $3\frac{3}{4}$-$4\frac{1}{4}$ mm.

Hab. — Queensland: Brisbane (A. J. Turner and H. Hacker).

A small and apparently somewhat variable species as regards its clothing. In general appearance it is very close to *inconspicuus*, but the scape is slightly curved (in *inconspicuus* it is quite straight). The pattern of the markings (obscure in both species) is not quite the same, but before abrasion the only valid distinction that I can find is in the scape. On abrasion, however, the prothorax in *inconspicuus* is seen to be covered with flattened densely punctate granules, some of which are connected together, and with spaces between causing a somewhat vermiculate appearance. In the present species the granules are smaller, more rounded, all (or at least where I have abraded the surface) isolated, and with sparser punctures. On the upper surface the scales are of a pale dingy brown, faintly variegated with grey, the grey forming feeble rings around the eyes, a feeble line on forehead, a very feeble stripe (distinct only towards the base) on each side of middle of prothorax, and a feeble line from each shoulder to near the middle, when it is obliquely directed towards (but not to) the suture, elytra elsewhere with very feeble spots. On the under surface and sides the scales are mostly greyish white, sometimes with a faint silvery or golden gloss.

On abrasion the head is seen to be feebly subgranulate and with small but distinct punctures, the rostrum has distinct punctures, and there is a transverse impression at its base. The prothorax has numerous granules, except at apex, but they are greatly obscured by clothing; the punctures in the elytral striæ are rather large, but normally appear to be very small.

Polyphrades granicollis, n. sp.

Black, antennæ and tibiæ dull red. Densely clothed with blackish-brown scales, more or less variegated on upper surface; under surface mostly with greyish-green scales. With thin and rather numerous setæ, suberect only on posterior declivity of elytra.

Head very wide. Eyes ovate, coarsely faceted. Rostrum about as long as wide, almost parallel-sided; inter-antennary space rather wide, parallel-sided; apical plate large, sharply defined, and with distinct punctures, a narrow but acute carina proceeding backwards from its apex. Antennæ not very stout; scape lightly curved, passing eye; first joint of funicle the length of second and third combined, second distinctly longer than third, the others rather feebly transverse; club elongate-elliptic. *Prothorax* rather lightly transverse, sides rather strongly rounded, base slightly wider than apex, the latter slightly sinuous. *Elytra* ovate, base conjointly arcuate and closely applied to prothorax, wider than prothorax in both sexes and widest just before middle. Front *tibiæ* moderately long, lightly curved, moderately denticulate. Length, 4½-6 mm.

Hab.—South Australia: Mount Lofty (A. M. Lea).

The eyes are more coarsely faceted than usual, and the species at a glance appears to belong to *Essolithna* (its resemblance to *echimys* is quite striking), but the claws are not single. The prothoracic granules are much more conspicuous before abrasion than usual. Although not a striking species it does not seem close to any other before me. One specimen has the tibiæ and femora pale as well as the tarsi. On the head the pale scales form three distinct but irregular lines, on the prothorax they form two very irregular lines on each side, and on the elytra they form numerous small spots about the punctures.

On abrasion the head is seen to be feebly subgranulate, and to have small punctures, the latter becoming denser and more distinct on the rostrum. The prothorax (except at its apex) is closely covered with round flattened granules (these being traceable before abrasion) and with dense small punctures interspersed (even on the granules) with a few slightly larger ones. The punctures in the elytral striæ are rather large, and normally not much concealed.

Polyphrades cordipennis, n. sp.

Black. Densely clothed with pale golden-brown scales, becoming bluish-white (in places with golden gleams) on under surface and sides. With dense, moderately stout, more or less erect setæ, more noticeable on elytra than on prothorax. Club with black sensitized pubescence.

Head moderately wide. Eyes large, ovate, finely faceted. Rostrum distinctly, but not much, longer than wide, sides very feebly increasing in width almost to apex; inter-antennary space fairly wide, parallel-sided, widely depressed and apparently feebly carinated along middle; apical plate sharply defined, curvilinearly triangular, with dense punctures. Antennæ rather stout; scape almost straight, just passing eye; first joint of funicle as long as the two following combined, second distinctly longer than third, the others rather feebly transverse; club elongate-ovate, with black sensitized pubescence. *Prothorax* lightly transverse, sides strongly and regularly rounded, base, if anything, slightly narrower than apex, the latter slightly sinuous. *Elytra* cordate, widest (and considerably wider than prothorax) near base, thence strongly diminishing in width to apex. Front *tibiæ* rather long, feebly curved, denticulate, but with a strong apical spur. Length, 7½ mm.

Hab.--Queensland: between Charters Towers and Cloncurry (H. Hacker).

The elytra are quite remarkably heart-shaped; even more so than in *tumidulus*. Compared with that species it differs in the elytra having longer and more erect setæ, the prothorax more globose, the rostrum with normal triangular plate, the space between the scrobes narrower and differently shaped, eyes less coarsely faceted, etc. The scape when extended forwards appears to be too short to reach the hind margin of the eye, but when drawn backwards just passes it. The spur at the apex of the tibiæ is very conspicuous, and is not at all concealed by clothing.

Where I have abraded the head of the unique specimen before me it is seen to be covered with small granules and small dense punctures, but I have not abraded much of it, nor any portion of the rostrum. The prothorax has dense granules (a few of which are traceable before abrasion) and numerous small punctures. The punctures in the elytral striæ are large, but normally greatly obscured by the clothing.

SUBFAMILY GONIPTERIDES.

OXYOPS FRENCHI, n. sp.

Black; muzzle, antennæ, and parts of legs obscurely diluted with red. Rather densely clothed with short stout setose whitish scales, becoming setæ on antennæ and parts of legs.

Head with small, dense, and usually concealed punctures; inter-ocular fovea small, narrow, and deep. Rostrum about once and one half as long as greatest width; with a fine median carina, on each side of which is a shallow groove, but, except at apex, where the carina and grooves are absent, sculpture more or less concealed. First joint of funicle almost as long as second. *Prothorax* with coarse irregular punctures; disc somewhat flattened; with a feeble median carina on apical half. *Elytra* wide; with rows of large deep punctures, becoming somewhat smaller posteriorly; with granules rather densely scattered about; second interstice with a tubercle at summit of posterior declivity, third with the largest of all near base, fourth with one near that on second, preapical callus conical and distinct, shoulder with a large tubercle. Intercoxal process of *mesosternum* strongly produced, but obtuse. *Tibiæ* apparently not denticulate. Length (excluding rostrum), 10 mm.

Hab.—Queensland: Somerset (C. French).

On the prothorax the scales are rather stouter than elsewhere, and are interrupted by four feeble irregular longitudinal lines, which, under a lens, appear to be granules formed by the irregularity of the punctures. To the naked eye each elytron appears to have a row of tubercles commencing near the suture and directed towards the side at the basal fourth; but only two of these tubercles (the ones on the second and fourth interstices) are at all distinct, the apparent presence of tubercles on the sixth, eighth, and ninth being caused by rather numerous nude granules; the sixth, however, is really slightly elevated.

At a glance not unlike large specimens of *vitiosa*, but the third interstice with one tubercle only instead of three. The type (except as to its clothing) is almost entirely black; but a second specimen (perhaps owing to immaturity) is almost entirely of a dull red.

Oxyops scabra, n. sp.

Black; antennæ almost black. Irregularly clothed with whitish scales and setæ.

Head with dense and minute punctures; inter-ocular fovea rather small, narrow, and deep. Rostrum about once and one half as long as greatest width; with a smooth minutely punctate median line, on each side of which are several irregular rows of large partially concealed punctures; apex with small punctures interspersed with some of moderate size. *Prothorax* with coarse irregular punctures, causing an appearance in places as of irregular granules; with a strong but irregular median carina. *Elytra* much wider than usual;

with rows of very large irregular punctures, many of which are separated from each other only by a large shining granule; third interstice with a large and coarsely granulated tubercle near base, and a large subconical one at summit of posterior declivity; shoulder tuberculate and laterally produced; preapical callus granulate but not very conspicuous; fifth interstice elevated and granulate, but scarcely tuberculate beyond the middle; elsewhere with numerous shining granules, some of which (especially about the middle of the disc of each, and on the basal third near the suture) are of considerable size. Intercoxal process of *mesosternum* moderately acute. *Tibiæ* feebly denticulate. Length, 12 mm.

Hab.—Queensland (C. French).

The median line of the rostrum could scarcely be regarded as a carina. The type is probably partly abraded, but represents such a distinct species that I have not hesitated to describe it. Between the two large tubercles crowning the posterior declivity there is a very distinct and subtriangular patch of scales, but this may be due simply to the tubercles protecting it from abrasion. At a glance it looks somewhat like a large rough specimen of the preceding species, but the rostrum is smoother, and the third interstice has two tubercles.

Oxyops mucronata, n. sp.

Black, antennæ and tarsi obscurely diluted with red. Rather densely clothed with long thin whitish setæ, shorter and sparser (but still moderately dense) on elytra than elsewhere.

Head with rather large but normally almost concealed punctures; inter-ocular fovea unusually small. Rostrum (excluding the glabrous apical portion) subquadrate; with a conspicuous median carina, on each side of which is a distinct and rather wide groove. *Prothorax* with dense and partially concealed punctures of moderate size; with a strong but irregular median carina in the middle of a wide and rather shallow depression. *Elytra* wide, rather strongly narrowed from near base to apex; apex strongly mucronate; with rows of large rugose punctures, becoming smaller posteriorly; each with three large tubercles, one on the fourth interstice near base, one on the third about middle, and the preapical callus; with numerous flattened granules scattered about. Intercoxal process of *mesosternum* strongly produced and acute. *Tibiæ* apparently not denticulate. Length, 11-12 mm.

Hab.—Queensland: Bowen (Aug. Simson).

The elytra are much more strongly mucronate than in any other species known to me. The large basal tubercle situated on the fourth interstice instead of on the third is unusual.

At first sight apparently belonging to *Gonipterus*, but the intercoxal process of mesosternum is quite strongly produced. In most species of *Oxyops* the eyes are strongly convex, and the head appears to be suddenly constricted behind them, so as to give them an appearance as of projecting; but in the present species the eyes, although moderately convex, appear to be quite regularly embedded (as in the species of *Pantoreites*). When alive specimens are probably covered with an ochreous meal, as on one specimen this meal is caked in places.

Oxyops griffithi, n. sp.

Black or piceous black, antennæ and tarsi obscurely diluted with red. Moderately, in places densely, clothed with whitish setæ, varying from thin to thick, and in places appearing as elongate scales, and forming a distinct postmedian fascia.

Head with dense, more or less concealed punctures; interocular fovea large, rather wide and deep. Rostrum about once and one third as long as greatest width; with a rather feeble, shining, and feebly punctured median line, on each side of which are coarse irregular rows of partially concealed punctures. Two apical joints of funicle somewhat transverse. *Prothorax* with coarse irregular punctures, causing an appearance as of granules in places; with a rather fine median carina, on each side of which the surface is somewhat flattened, and the punctures less irregular than elsewhere. *Elytra* with rows of very large punctures, becoming smaller posteriorly; third interstice with two tubercles, a large one near base, and a smaller somewhat elongate one at summit of posterior declivity; fifth elevated but scarcely tuberculate beyond the middle, shoulder tuberculate, preapical callus large but obtuse; with numerous granules scattered about and dense on tubercles. Intercoxal process of *mesosternum* not very acute. *Tibiæ* feebly denticulate. Length, 9-9½ mm.

Hab. — Queensland: Townsville (H. H. D. Griffith), Upper Endeavour River (C. French).

The postmedian fascia occupies the upper half of the posterior declivity, and is directed obliquely forwards so as to touch, or almost touch, the margins. One of the three specimens before me (except as to its clothing) is almost entirely of a dull red, but this may be due to immaturity.

With a vague resemblance to *fasciata*, but fascia not narrowed to suture, and the third interstice abruptly tuberculate at summit of posterior declivity. From *vitiosa* it differs in the third interstice having two tubercles only.

Oxyops decipiens, n. sp.

Black; antennæ and tarsi obscurely diluted with red. Rather densely clothed with thin setæ, becoming much shorter on elytra.

Head with dense and small more or less concealed punctures; inter-ocular fovea rather narrow. Rostrum about once and one third as long as greatest width; with dense and coarse punctures; with two feeble shallow grooves, between which is a very feeble carina or punctured line. Antennæ unusually short; first joint of funicle slightly longer than second, second feebly, all the others strongly, transverse. *Prothorax* with coarse irregular punctures, in places becoming foveate and in places small; with a feeble and interrupted median carina. *Elytra* wide at base, strongly narrowed from shoulders to apex; with rows of large punctures, becoming very large and deep on an oblique space from near shoulders to suture at basal third; each with three tubercles near base, one on third interstice, one on shoulder, and a strongly conical one between shoulder and side; preapical callus obtuse. Intercoxal process of *mesosternum* distinctly produced, but obtuse. *Tibiæ* strongly denticulate. Length, 8½-9½ mm.

Hab.—Queensland (C. French).

On the elytra the clothing is very dense and short, except for a wide oblique irregular seminude stripe where the punctures are coarsest. To the naked eye the preapical callosities appear to be feebly fasciculate and surrounded by a slightly darker space than the surface just outside of this space. The elytra also to the naked eye appear to have a wide oblique and rather feeble postmedian fascia. The granules of the under surface are rather more conspicuous, and the parts of the metasternum overhanging the hind tibiæ are much more produced than usual.

At a glance quite a typical *Gonipterus*, but the mesosternum produced, and the subhumeral tubercles placed in a line with the others near the base, instead of behind them, as in *Gonipterus*. The eyes are more convex, but otherwise much as in *mucronata*.

Oxyops rufa, n. sp.

Of a rather bright flavous-red, rostrum darker; head and claws black. Rather densely clothed with whitish setæ, except on prothorax and elytra, where they are sparser.

Head with very dense but almost concealed punctures; inter-ocular fovea rather small and narrow. Rostrum about once and two thirds as long as greatest width; apical portion with small punctures and smoother than usual, elsewhere with dense and coarse punctures; with a narrow but sometimes partially concealed median carina. *Prothorax* granulate-punctate; sides more evenly rounded than usual; disc somewhat flattened and scarcely carinate. *Elytra* almost parallel-sided from shoulders to beyond the middle; with regular rows of large round punctures, becoming smaller posteriorly; with numerous small and more or less depressed granules. Intercoxal process of *mesosternum* strongly produced but obtuse. *Tibiæ* moderately denticulate. Length, 6½-9 mm.

Hab.—Victoria (C. French); New South Wales: Jenolan (J. C. Wiburd).

The sides of the prothorax and some of the punctures on the elytra are sometimes stained with black or brown, and on the elytra this causes a feeble mottling, or an appearance as of feeble interrupted fasciæ. On the prothorax the setæ are condensed so as to form a moderately distinct median line, and feeble lateral ones. On the elytra they appear, to the naked eye, to form very feeble transverse patches, but on one specimen there is a distinct postmedian fascia, which might quite fairly be regarded as formed by scales. On both prothorax and elytra there are black setæ scattered about amongst the others.

In some respects close to description of *rutila*, but head darker than rest of body and elytra smooth.

OXYOPS PALLIDA, n. sp.

Pale flavous-red, antennæ somewhat darker, claws and parts of muzzle black. Densely (very densely on parts of the under surface) clothed with white setæ, shorter and somewhat sparser on the elytra than elsewhere.

Head with regular but partially concealed punctures; inter-ocular fovea (for the genus) very small. Rostrum (excluding the muzzle) about as long as greatest width (which is at the base instead of near the apex); without a median carina or line, and with rather small and even, partially concealed punctures. *Prothorax* less transverse than usual, sides evenly rounded; densely granulate-punctate; with a distinct, but irregular, median carina. *Elytra* evenly convex, sides feebly diminishing in width from shoulders to near apex; with regular rows of round, and (for the genus) rather small punctures, becoming smaller posteriorly; with numerous small depressed granules. Intercoxal process of *mesosternum* acute. *Tibiæ* feebly denticulate. Length, 9½ mm.

Hab.—North-Western Australia: Ashburton River (C. French).

Entirely pale except for the combs of tibiæ and the claws, which are deep black; the combs are unusually conspicuous, owing to the colour of the tibiæ and tarsi, but they are of quite normal size. The specimen described is apparently not immature, as Mr. French has another specimen of exactly the same colour. The eyes are almost exactly as in *mucronata*. The joints of the funicle are of normal proportions, but are rather more cylindrical than usual.

OXYOPS PARALLELA, Blackb.

The length given in the description of this species is 2 lines, but Mr. Blackburn informed me that 2 was a misprint for 4. A specimen from Port Darwin before me is but 3½ lines.

OXYOPS UNIFORMIS, Lea.

A specimen from the Grampians (Victoria) of this species has a moderately distinct transverse fascia of pale clothing before the middle, and an irregular stripe one-third from the apex of the elytra. On the type these markings can be just perceptibly traced.

PANTOREITES MAJOR, n. sp.

Black or blackish-brown; elytra, tip of prothorax, and appendages (except claws) more or less reddish. Clothed with thin whitish or ochreous setæ, and with glistening white scales.

Head with dense partially concealed punctures; interocular fovea narrow and partially concealed. Rostrum slightly dilated towards, but not to, apex, almost twice as long as greatest width; with dense punctures throughout, but smaller and exposed towards apex, and more or less concealed towards base. Two basal joints of funicle subequal in length, but first somewhat stouter than second. *Prothorax* with very dense punctures of moderate size. *Elytra* with regular rows of rather large punctures, but which are quite concealed in places, shoulders strongly rounded, sides feebly diminishing in width to beyond the middle, and then strongly to apex. Intercoxal process of *mesosternum* obtusely produced. *Tibiæ* strongly denticulate. Length, 7-8½ mm.

Hab.—South Australia: Murray Bridge (H. H. D. Griffith); Victoria (C. French), Sea Lake (J. C. Goudie).

The setæ are rather sparse, but the snowy scales (which from some directions are faintly opalescent) are very dense except on head and base of rostrum, where, however, they form a moderately distinct line. On the prothorax they form three lines, which gradually dilate to the base. On the elytra the suture is clothed throughout, the second interstice becomes clothed beyond the middle, and the third about one-third from the apex; the fifth interstice is clothed from the basal fifth, and the white stripe is dilated posteriorly so as to cover the fourth and sixth as well; the three lateral interstices are clothed throughout. The under surface and legs are also densely clothed with white scales.

In appearance somewhat close to *vittatus*, but larger (it is the largest of the genus yet known), and silvery clothing covering a much greater portion of elytra and somewhat differently disposed. One of the specimens (except as to its clothing) is almost entirely of a dull red.

PANTOREITES TRILINEALBUS, n. sp.

Head, rostrum, and prothorax reddish-brown; elsewhere paler, but claws black. Densely clothed with white glistening scales, but in places more or less setose, and with an ochreous meal.

Head with very dense but concealed punctures; interocular fovea of moderate size, but partially concealed. Rostrum subparallel-sided, about once and two thirds as long as greatest width; apical half nude, and with small punctures, basal half with much coarser but partially concealed ones. First joint of funicle stouter but distinctly shorter than second. *Prothorax* scarcely, if at all, wider than long, base and apex subequal in width; with dense but more or less concealed punctures. *Elytra* considerably wider than prothorax, shoulders rounded, almost parallel-sided to near apex; with rows of rather large but usually concealed punctures. Intercoxal process of *mesosternum* scarcely produced. *Tibiæ* curved and moderately denticulate. Length, $4\frac{3}{4}$ mm.

Hab.—New South Wales: Gosford (A. M. Lea).

The derm and punctures are almost entirely concealed by clothing. The clothing of the under surface is entirely white, except that from certain directions it appears to be slightly opalescent. On the upper surface the setæ or thin scales, which are mixed with an ochreous kind of dust or meal, form a stripe on each side of the middle from apex of prothorax almost to apex of elytra, and a more feeble stripe on each side for the same length. In consequence the prothorax appears to have three conspicuous white stripes, each of which is dilated towards the base; and the elytra to have three stripes, of which the sutural one is the narrowest and most conspicuous. The sublateral white stripes have several small nude spots about their middle, and these are probably not accidental, as they are much the same in the two specimens before me. It is probable that after immersion in some fluids the darker stripes (especially on the elytra) would lose their ochreous meal and become less conspicuous.

In appearance somewhat like *micans*, but outline of elytra not almost continuous with that of prothorax, and the clothing more conspicuously bicolorous. In shape it is much like *illuminatus* and *vittatus*.

Iptergonus, n. g.

Eyes strongly convex and projecting, owing to constriction of head immediately behind them. Elytra without subhumeral tubercles. Intercoxal process of mesosternum rounded. Body very short and compact. Other characters as in *Oxyops* and *Gonipterus*.

This genus is proposed to receive a number of small and very robust species, which differ from *Gonipterus* in the absence of subhumeral tubercles, and from *Oxyops* in the simple mesosternum. The type of the genus is *Gonipterus cionoides*, Pasc.; but I also refer to it *Oxyops aberrans*, Lea. To judge from the description *Oxyops hyperoides*, Pasc., belongs to it, and *Oxyops turbidus*, Pasc., may also do so.

The Australian genera of *Gonipterides* may be tabulated as follows: —

Tarsi three jointed ... ... *Syarbis.*
Tarsi four jointed
  Club continuous with funicle ... ... *Bryachus.*
  Club not continuous with funicle.
    Eyes not prominent... ... ... *Pantoreites.*
    Eyes very prominent.(1)
      With a distinct tubercle on each side
        near base of elytra (2) ... ... *Gonipterus.*
      Without such a tubercle.(3)
        Intercoxal process of mesosternum
          produced ... ... *Oxyops.*
        Intercoxal process not produced. *Iptergonus.*

Iptergonus bifurcatus, n. sp.

Reddish-castaneous, under surface darker in parts; claws black. With snowy-white scales on head, forming three lines on prothorax, and lines at sides of elytra, dense on scutellum and parts of under surface and legs; elytra with several fascicles of white or ochreous scales. Rest of surface with scattered setæ or scales.

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(1) In several species of *Oxyops* the eyes are but little more prominent than in *Pantoreites*, but the two genera are otherwise very distinct.

(2) Not on the shoulder, which, however, is often more or less tuberculate.

(3) In *Oxyops*, a tubercle is sometimes present near the base, but these species differ from *Gonipterus* in having the mesosternum produced.

Head with quite concealed punctures; inter-ocular fovea more or less concealed. Rostrum about once and one third as long as greatest width; non-carinate; apical portion strongly convex and with dense and rather small punctures; basal two-thirds with coarse but more or less concealed punctures. First joint of funicle slightly longer than third, but distinctly shorter than second. *Prothorax* with dense punctures of almost even size; sides rather strongly diminishing in width from base to apex. *Elytra* briefly subcordate, much wider than prothorax; shoulders very feebly produced; with rows of deep, more or less oblong punctures; with small dense granules, and with feeble tubercles. *Tibiæ* strongly denticulate. Length, 4½-5 mm.

Hab.—Queensland (Horace W. Brown), Blackall Range (H. Hacker).

The white stripe on each side of the prothorax is continued on to the elytra. On perfectly fresh specimens it clothes the shoulders, but these are usually abraded; on the sixth interstice it terminates at the middle, but the eighth and ninth are clothed almost to the apex, and the tenth is clothed near the base and again near the apex. On each elytron there are five feeble tubercles crowned with feeble fascicles (white on two specimens, ochreous on two others, and all apparently easily abraded); of these there are three on the third interstice, the basal one being elongate and very feeble, and the hind one on summit of posterior declivity. On the fifth interstice there are two, of which one is postmedian, and the other is the preapical callus. When completely abraded some of the tubercles appear to be little more than feebly elevated spaces, with rather more numerous granules than usual.

Readily distinguished from *aberrans* by the stripe on each side of prothorax bifurcating on to elytra, instead of stopping at the base.

IPTERGONUS NIVEOPICTUS, n. sp.

Reddish-brown, appendages somewhat paler; claws black. With snowy-white scales on head, forming three lines on prothorax, lines and fascicles on elytra, and dense on scutellum parts of under surface and legs; elsewhere with sparse ochreous or white setæ or scales.

Head, rostrum, antennæ, and *prothorax* much as in preceding species. *Elytra* much less parallel-sided, and with much coarser punctures, interstices narrower and with less numerous granules; tubercles apparently much the same. Front *tibiæ* rather strongly curved and all strongly denticulate. Length, 4⅓ mm.

Hab.—New South Wales: Sydney (A. M. Lea).

The only specimen before me is evidently in perfect condition. On the elytra the snowy scales clothe the suture and parts of the sides, and form three oblique stripes on each, with each stripe ending in a fascicle; one commences near the shoulder and terminates before the middle, one commences a short distance behind the first and terminates beyond the middle, and the third terminates on the preapical callus. Of the fascicles (which are of such a nature that they may be easily abraded) there are three on the third interstice and three on the fifth, with several feeble ones elsewhere.

In some respects close to description of *hyperoides* (described as from Queensland), but smaller (two instead of two and a half lines), and with conspicuous elytral fascicles.

SUBFAMILY BELIDES.

Belus cristatus, n. sp.

Piceous-brown, antennæ and claws somewhat paler. Clothed with white pubescence, margining eyes, forming three feeble lines on prothorax, forming numerous small spots in the subsutural depression (especially towards the base) and three feeble rows of small spots elsewhere on each elytron, and rather dense on under surface.

Head with dense clearly defined punctures, becoming rather coarse between eyes. Rostrum slightly shorter than head and prothorax combined, feebly inflated at insertion of antennæ, the sides very feebly incurved between these and apex; behind antennæ with rather coarse but partially concealed punctures, between antennæ with fairly large punctures but becoming very small to apex. Antennæ thin, first and third joints subequal, eleventh shorter than ninth and tenth combined. *Prothorax* strongly inflated towards base, with a wide but slightly interrupted median channel, the sides of which are rather more strongly elevated than usual; with dense but irregular granules and punctures. *Scutellum* moderately transverse. *Elytra* shallowly depressed on each side of suture, each depression bounded by a distant carina, which gradually runs out towards the base, but is rather suddenly terminated towards the apex, a feeble carina outside the first one and about half its length, each separately strongly rounded and granulate at base; apex acutely produced and passing abdomen for a greater length than its apical segment; with dense and rather coarse punctures, and with rather numerous granules at base. *Metasternum* with a few small granules. *Femora* edentate, posterior passing middle of second abdominal segment; front tibiæ moderately, the others feebly denticulate below. Length, 12 mm.

Hab.—South Australia: Port Lincoln (Macleay Museum).

The type is probably a male; on its metasternum there are two nude spots on each side piece and numerous smaller and irregular nude spots (mostly caused by granules) elsewhere. The abdomen is densely clothed at the sides, and with a nude spot on each side of each segment, but these nude spots open into the nude median portion, instead of being isolated.

From *bison* (which at a glance it strongly resembles) it is distinguished by the elytral carinæ, and these being two on each elytron (instead of three) distinguish it from the description of *perplexus*. From *semipunctatus* (which also in shape it strongly resembles) it is distinguished by its edentate femora.

BELUS VARIPILIS, n. sp.

Black; part of antennæ and the claws obscurely diluted with red. Clothed with stramineous (on the elytra becoming ochreous) pubescence at the sides of the eyes, forming three lines on prothorax (the median line interrupted in middle), dense on scutellum, and forming numerous more or less feeble spots in feeble rows on elytra. Under surface with a dense line on each side from the eye to apex of abdomen, but with two nude spots on side piece of metasternum.

Head with dense and irregular punctures, becoming coarse between eyes. Rostrum thin; in female the length of head and prothorax combined, in male somewhat shorter; with fine punctures almost throughout in female, but becoming rather dense and coarse behind antennæ in male. Antennæ (for the genus) not very thin, first joint as long as second and third combined, eleventh stout and about the length of ninth and tenth combined. *Prothorax* strongly inflated towards base, with a wide but interrupted median channel; with dense clearly defined and mostly rather large punctures. *Scutellum* moderately transverse. *Elytra* depressed on each side of suture, the depression bounded on each side by a strong carina, outside of this on each elytron a shorter and finer carina, then a feeble depression and then a feebly raised line or very feeble carina; base strongly separately rounded; apex acutely produced and passing abdomen fully the length of its apical segment; with dense and fairly large punctures. *Femora* edentate, front pair stout, especially in female, hind pair not extending to middle of second abdominal segment; front tibiæ strongly, the others feebly denticulate below. Length, 13-15 mm.

Hab.—Queensland: Somerset (C. French), Endeavour River (Macleay Museum).

The spots are numerous in the subsutural depression and form three rows (of which only the median one is at all distinct) elsewhere on each elytron. The metasternum is glabrous in the middle, but not towards the sides. On both specimens before me the pubescence on each side of the basal segment of abdomen is suddenly interrupted, so that at its apex it is glabrous, the three following segments have each a similar but much smaller glabrous space, and these three have as well a small spot of pubescence which is sometimes joined to the lateral stripe. On one of the specimens the pubescence is of an almost snowy whiteness. There are no distinct granules on either prothorax or elytra, although about the base of the latter the punctures are so irregular as to cause (from some directions) the apparent presence of a few. The elytra are not suddenly elevated behind the scutellum.

In general appearance close to *semipunctatus*, but wider, femora edentate, and tibiæ and tarsi dark. Also very close to the preceding species, but basal joint of antennæ considerably longer, the two carinæ on each elytron much stronger, with traces of a third and the clothing of abdomen different. It is also rather more robust, with the prothorax much less elevated on each side of the median channel. *Perplexus* is described as having "three well-defined carinæ on each of its elytra"; in the present species two carinæ are distinct, but the outer one, if indeed it should be regarded as a carina at all, is very indistinct; the inner one commences quite close to the base, very much nearer, in fact, than "at a distance from the base about equal to a quarter of the length of the elytra"; the prothorax also is not "ruguloso-granuloso."

BELUS PULVERULENTUS, n. sp.

Black, antennæ and claws feebly diluted with red. Clothed with white pubescence, margining eyes, forming an interrupted median line on prothorax, and feeble lateral lines; forming numerous feeble spots about suture (these more or less tinged with ochreous), and two very feeble rows on each elytron elsewhere; and rather dense, but irregularly distributed, on under surface.

Head with dense and rather coarse punctures; scarcely transversely impressed behind eyes. Rostrum slightly longer than prothorax; with dense and fine punctures at apex, becoming slightly sparser and larger to antennæ, but thence more rapidly so till on the base itself they are coarse. Antennæ thin, moderately long, first joint distinctly longer than second and third combined, eleventh the length of ninth and tenth combined. *Prothorax* rather strongly inflated towards base, with a wide but interrupted median channel, closely covered with rounded and usually flattened granules. *Scutellum* moderately transverse. *Elytra* feebly depressed on each side of suture, the depression bounded by a slight elevation but not by a carina, base suddenly raised and granulate behind scutellum; each separately strongly (somewhat angularly) rounded and granulate at base; apex produced and passing abdomen for rather more than the length of its apical segment, with rather dense punctures, becoming towards base interspersed with round granules, interspaces between punctures and granules with very small punctures. *Metasternum* with a few rather conspicuous granules. Front *femora* stout, with two minute teeth placed transversely near apex, the others edentate, posterior extending almost to middle of second abdominal segment; front tibiæ strongly, the others feebly denticulate below. Length, 17½ mm.

Hab.—Queensland: Gayndah (Australian Museum), Chillagoe (J. A. Anderson).

On the under surface the clothing is dense (except for a nude spot on each side piece of the metasternum), on the sides of sterna and fairly dense in their middle, and forms a rather large but loose spot on each side of each of the abdominal segments, also a fairly large spot on the middle of the first segment; the second and third have a feeble white line along the middle, and there are minute scattered spots elsewhere. The elytral granules from all directions are distinct only near the base, but from some directions they appear to extend almost to the apex. In addition to the subsutural depression each elytron has a feeble longitudinal depression about its middle. One specimen differs from the type in being (except the head and rostrum, which are black) of a deep reddish-brown, with pale antennæ, tibiæ, and tarsi. Its abdomen is apparently partly abraded, as, except for the clothing on the sides and middle, it is practically glabrous.

Moderately close to *semipunctatus*, but elytra noncarinate and with a hump about scutellum; the hump is much more prominent than in *puncticeps*, and the basal joint of its antennæ considerably longer. *Anguineus*, to which it is also very close in appearance, has edentate femora.

Belus niveopilosus, n. sp.

Blackish-brown, antennæ and claws of a dingy red. Clothed with white pubescence, margining eyes (rather sparse elsewhere on head), forming a distinct median and feeble lateral lines on prothorax, rather dense on scutellum, forming three rows of spots on each elytron, and dense but irregularly distributed on under surface.

Head with dense and coarse but partially concealed punctures. Rostrum (for the genus) rather stout, the length of prothorax, feebly inflated at insertion of antennæ, behind which the punctures are rather coarse and in front of which they are fine, especially towards the apex. Antennæ not very thin, first joint slightly longer than third, second and third equal in length, eleventh slightly shorter than ninth and tenth combined. *Prothorax* rather strongly inflated towards base, median channel rather feeble, with dense granules and punctures throughout. Scutellum rather strongly transverse. Elytra flattened but scarcely depressed along suture, not suddenly raised behind scutellum; each separately strongly rounded at base, apex somewhat acutely produced and passing abdomen for about the length of its apical segment; punctures and granules, except that they are smaller and more numerous, much as in preceding species. Granules of *metasternum* almost entirely concealed. *Femora* edentate, front pair very stout, posterior just passing apex of first abdominal segment. Length, 12 mm.

Hab.—Queensland: Endeavour River (C. French).

On each elytron the rows of spots tend to become confused towards the base; the sutural row consists of larger but less clearly defined spots than elsewhere; the spots on the outer row are small and also rather ill-defined. On the sterna and sides of abdomen the clothing is dense, but there is a nude spot on each of the side pieces of the metasternum. The basal segment of abdomen is rather densely clothed in the middle, as well as on the sides, and the second segment has a small supplementary spot on each side. Although in general appearance quite a typical *Belus*, the scrobes are very short (not half the length of the basal joint of antennæ) and abruptly terminated; so that they could quite fairly be called foveiform.

The edentate front femora distinguish from *hemistictus* and *puncticeps*, the comparatively short rostrum and short tail from *anguineus* and *cristatus*; *amplicollis* is considerably larger, and has a rather prominent hump behind the scutellum. It is close to the description of *helmsi*, but the antennæ are not black, and the size is less than 7 lines.

Belus brevipes, n. sp.

Blackish-brown, apical half of rostrum and appendages more or less diluted with red; scutellum and elytra of a rather light brown, but the latter almost black at apex; third, fourth and fifth abdominal segments tipped with flavous. Clothed with pale ochreous pubescence, margining eyes, rather dense on sides of prothorax, forming a spot on the middle of its base, and forming rows of spots on the elytra and dense but almost white on sides of under surface; abdomen in addition with a patch of pubescence in middle of basal segment and a feeble spot on each side of middle of the three following segments.

Head with dense but partially concealed punctures. Rostrum thin, the length of prothorax; with fairly coarse punctures close to base, becoming much smaller to apex. Antennæ (for the genus) not very thin, first joint almost the length of second and third combined, eleventh slightly longer than ninth and tenth combined. *Prothorax* moderately inflated towards base, median channel rather feeble, densely granulate-punctate throughout. *Scutellum* very narrow and transverse. *Elytra* flattened but scarcely depressed along suture, not suddenly raised behind scutellum; each separately strongly rounded at base, apex denticulate, feebly produced and passing abdomen for a short distance only; densely punctate-granulate throughout. *Metasternum* with a few feeble granules. Each side of each segment of *abdomen* at its base with a small, opaque, densely punctate space. *Femora* edentate, front pair very stout, hind pair not passing apex of basal abdominal segment; front tibiæ strongly, the others feebly denticulate below. Length, 12 mm.

Hab.—Queensland: Cape York (H. Elgner).

The elytral spots of pubescence are small and feebly defined, but are rather numerous close to the suture; on the disc of each there is a very feeble row of small spots, and the sides are almost glabrous. There is a conspicuous nude spot on each side piece of the metasternum. Each abdominal segment in addition to the lateral spots has two small spots, except the basal segment, which has a large subtriangular median spot. The denticulations at the apex of elytra are partially concealed by short blackish pubescence. The elytra at apex are shaped much as in *brunneus*, but the two species have little else in common.

Two specimens from North-Western Australia are rather smaller (10-10½ mm.) than the type, and have the abdomen with sparse pubescence in addition to the white spots; on one of these the peculiarly punctate spaces at the bases of the segments are exactly as on the type; but on the other these spaces are almost or quite concealed by the clothing.

Belus granicollis, n. sp.

Black; apical half of rostrum, tibiæ and part of antennæ more or less obscurely diluted with red; claws of a rather bright red. Clothed with pure white pubescence, margining eyes, forming a median line, and two very feeble lateral ones, on prothorax, dense on scutellum, and forming numerous feeble spots about suture and feebly distributed elsewhere on elytra; dense on under surface but leaving a nude spot on each side piece of metasternum, and on each side of each of the abdominal segments.

Head with dense and minute punctures at base, but rather coarse between eyes. Rostrum comparatively stout, the length of prothorax, feebly inflated at insertion of antennæ, behind which the punctures are rather dense and coarse, and in front of which they are mostly small. Antennæ somewhat inflated towards apex, first joint the length of second and third combined; second, third, fourth, and fifth of equal length *inter se;* eleventh briefly obpyriform, and shorter than ninth and tenth combined. *Prothorax* moderately inflated towards base, regularly convex, median line very feeble, disc densely the sides sparsely granulate. *Scutellum* moderately transverse. Elytra not at all depressed along suture, not suddenly raised behind scutellum, each separately strongly and somewhat angularly rounded at base; moderately produced at apex and passing abdomen for about the length of its apical segment; granulate-punctate throughout. *Femora* edentate, front pair stout, especially in female, hind pair just passing apex of first abdominal segment; front tibiæ rather strongly the others very feebly denticulate below. Length, $7\frac{1}{2}$-$8\frac{1}{2}$ mm.

Hab.—Australia (W. W. Froggatt). Given to me without exact locality by Mr. Froggatt, but probably from New South Wales or Queensland.

On the elytra of one of the specimens there appears to be a very feeble row of spots midway between the suture and each side. On the under surface the pubescence, although fairly dense in the middle, is not so dense as on the sides. The second, third, fourth, and fifth joints are of equal length, a most unusual feature, although the antennæ of *parallelus* and *acaciæ* are somewhat similar.

In general appearance close to *parallelus*, but somewhat shorter and more robust and basal segments of abdomen with nude lateral spots only; *acaciæ*, to which it is fairly close, has bidentate front femora, and is somewhat narrower; *pudicus* is larger, and has the first joint of antennæ shorter than the second and third combined.

BELUS NIGRICEPS, n. sp.

Light brownish-red; head, base of rostrum, scutellum, meso- and metasternum, base and sides of abdomen and third tarsal joint more or less black, antennæ feebly infuscate towards apex. Upper surface (except for a small amount of pubescence near eyes and on scutellum) glabrous; under surface with dense regular white pubescence.

Head longer than usual; punctate-granulate between eyes and densely punctate elsewhere. Rostrum slightly longer than prothorax, feebly inflated at insertion of antennæ; in male with coarse punctures and a distinct median impression behind antennæ, and impunctate elsewhere; in female without the median impression and with coarse punctures at extreme base only. Antennæ long and very thin, first and third joints subequal, eleventh shorter than ninth and tenth combined. *Prothorax* (for the genus) rather feebly inflated towards base, median channel very feeble, densely and finely granulate. *Scutellum* almost round. *Elytra* not at all depressed along suture, each separately strongly rounded at base, apex gently and regularly narrowed and passing abdomen for a very short distance; with dense punctures rather larger towards base than elsewhere, and in almost regular, closely placed rows. *Under surface* with dense but more or less concealed punctures. *Femora* edentate, front pair rather stout, especially in female, hind pair just passing apex of basal abdominal segment; tibiæ longer than usual, the front pair feebly the others very feebly denticulate below; basal joint of all the tarsi much longer than usual. Length, 8-9 mm.

Hab.—New South Wales: Forest Reefs, Armidale; Tasmania: Ulverstone (A. M. Lea).

A very thin species. The type is a male; a female differs from it in having the rostrum entirely red, and a transverse space behind the eyes diluted with red. To the naked eye there appear to be small nude spots at the sides of the abdomen, but this appearance is due solely to the colour of the derm, except in the single Tasmanian specimen, where they are really present. The elytra from some directions appear to be closely covered with rows of granules, but there are two quite regular rows of granules on the suture itself.

In general appearance remarkably close to a Western Australian species which I have identified as *acicularis*, and which has the antennæ more noticeably (although not strongly) inflated towards the apex, with the eleventh joint but little more than twice as long as wide, and the tenth much less than twice as long as wide. In the present species the eleventh joint is more than three times as long as its greatest width, and its tenth joint is slightly more than twice as long as wide. In the Western Australian specimens also the basal joint is almost black (a character not mentioned by Pascoe), whilst in the present species it is no darker than the rest of the antennæ. Its basal joint of tarsi is also slightly longer. It is also close to *longicornis*, but is larger and paler.

BELUS SEMIPUNCTATUS, Fab.

? *cyaneipennis*, Boh.
? *bispinosus*, Perr.

The typical form of this species has somewhat ochreous pubescence only in the subsutural depression and in a line outside of the second carina on each elytron, except for a few feeble spots near the shoulders.

It seems probable that *cyaneipennis* is a synonym of this species, despite several discrepancies in the description. The elytra of *semipunctatus* are certainly not cyaneous, although they usually have a violet or purplish gloss, and the elytra are not "almost three times the length of the prothorax," but fully four times the length. The prothorax of one large specimen measures $2\frac{2}{3}$ and the elytra 11 mm. Boheman also makes no mention of the conspicuous elytral costæ, but his description is so full and tallies in so many respects with *semipunctatus* (a quite common species about Sydney) that my surmise will probably prove to be correct.

It is also possible that *bispinosus* is a synonym, although Perrond describes the prothorax as granulate. In the typical form the prothorax could certainly not fairly be called granulate, although from certain directions certain parts of it appear to be so, owing to the density of the punctures; these, however, are quite clearly defined, and not confluent in most places. In some of the varieties, however, the prothorax might almost be called granulate-punctate.

Variety A.—Two specimens from Mackay differ from the normal form in having two additional rows of spots on each elytron; the extra rows being at the side and between the two carinæ. Their derm at the subsutural depression is also largely diluted with red, but this also occurs in forms having the typical clothing.

Variety B.—A specimen from Whitton differs from the normal form in being very small (10 mm.) and thin, and with the clothing of an almost snowy whiteness.

A specimen from Cairns agrees in its clothing with the typical form, but its elytra are of a decided green, without the least trace of violet, and the legs and abdomen are somewhat similarly coloured. The colour, however, may be due to immaturity. Another specimen from Cairns is smaller (11 mm.) than usual, and has the small sublateral spots of the abdomen absent, but this may be due to abrasion.

Belus bison, Blackb.

Three specimens under examination (two from South Australia and one from Tasmania) evidently belong to this species. In one of them the antennæ are really black, in another they are slightly diluted with red, and in the third decidedly diluted with red.

Belus tibialis, Blackb.

This species is evidently very close to *linearis*,(4) and agrees with it in the very remarkable tibiæ and tarsi. The description of the abdominal clothing, however, does not agree with specimens of *linearis* before me.

Belus amplicollis, Jekel.

Four specimens before me (from Port Denison and Moreton Bay) evidently belong to this species, but all differ in their abdominal clothing, this, however, being almost certainly due to abrasion. On a specimen, apparently in perfect condition, the abdomen is densely clothed with white pubescence at the sides from base to apex, the basal segment in addition has a large white spot on each side of middle, and the three following segments each have similar but smaller spots. In two of the other specimens faint traces of these spots can be noticed, but in one of these the clothing at the sides of the basal segment has evidently been worn away through friction with the femora; in the fourth specimen the median spots are entirely absent. With age the violet gloss of the elytra is apt to disappear.

Belus bidentatus, Don.

This species varies considerably in the intensity of its colour, some specimens being (except for the head, which is always black) of a rather pale reddish-brown, with still paler femora and tibiæ; whilst others have the derm and appendages almost entirely dark-brown. Some have numerous minute spots in addition to the two conspicuous ones on each elytron. On each elytron there are usually three carinæ, but of these only the one nearest the suture (being the third interstice raised for a portion of its length) is always distinct, the others usually being feeble and sometimes altogether wanting. The male has the rostrum behind the antennæ with denser and coarser punctures than in the female.

Belus longicornis, Lea.

Two specimens from Hobart appear to belong to this species, but differ from the type in being smaller (6 mm.),

(4) Described from Queensland; my specimens are from King George's Sound.

with paler prothorax (but not its disc), elytra and legs (but not tarsi); the antennæ are also somewhat stouter, but this may be sexual.

BELUS PUDICUS, Lea.

A specimen from Brisbane differs from the type in having the pubescence of the upper surface and on the sides of the lower surface somewhat ochreous; the elytra paler, but with the suture black. The nude space on the middle of the third and fourth abdominal segments is probably due to abrasion.

BELUS HEMISTICTUS, Germ.

This species appears to be intermediate between those having a distinct carina bounding each side of a subsutural depression and those without such. On one specimen the carina on each side of the depression is quite distinct to the naked eye, appearing as a shining line from the basal third to the apical fifth; on two others it is faintly traceable to the naked eye but practically disappears under a lens. On a fourth it is more noticeable on the right than on the left elytron. In the original description the elytra are said to be obsoletely carinate.

BELUS PHŒNICOPTERUS, Germ.

This species varies in length from 12 to 18 mm., and some specimens are much paler than others. The femoral teeth are occasionally so small as to be seen only with difficulty.

BELUS SUTURALIS, Boi.

A specimen from Western Australia is much smaller ($9\frac{1}{2}$ mm.) than usual, and has the pubescence of a snowy whiteness, instead of more or less stramineous.

The species of *Belus* known to me may be tabulated as follows:—

A. Basal half of elytra strongly contrasted in colour with apical half ... ... *divisus*, Pasc.
AA. Basal half not strongly contrasted.
  B. Front tibia with a strong subbasal tooth ... ... *linearis*, Pasc.
  BB. Front tibia at most denticulate.
    C. Elytra carinate.
      a. Femora edentate.
        b. Each elytron with two conspicuous spots of unequal size ... *bidentatus*, Don.
        bb. Elytral spots not isolated and conspicuous.
          c. First joint of antennæ longer than second and third combined ... ... *varipilis*, Lea.
          cc. First joint shorter than second and third combined ... ... *cristatus*, Lea

aa. Femora dentate.
d. Elytral carinæ feeble ... ... *hemistictus*, Germ.
dd. Elytral carinæ distinct.
e. Abdomen almost glabrous except for two conspicuous spots on each side ... ... *ruficornis*, Lea.
ee. Abdomen with a continuous stripe on each side ... ... *semipunctatus*, [Fab.
CC. Elytra not carinate.
D. Elytra conspicuously striped (not spotted) along suture and nowhere else.
f. Femora dentate . ... *suturalis*, Boi.
ff. Femora edentate.
g. Rostrum suddenly paler in front of antennæ ... ... *tenuis*, Lea.
gg. Rostrum nowhere suddenly paler.
h. Abdomen with two pale stripes ... ... *subsuturalis*, Lea.
hh. Abdomen with three ... *vertebralis*, Lea.
DD. Elytral clothing not as in D.
E. Suture suddenly and strongly raised at base.
i. Elytra each with a single conspicuous spot ... ... *bimaculatus*, Pasc.
ii. Elytra without such spots.
j. Elytra not strongly produced at apex.
k. Rostrum (when viewed laterally) with two colours strongly contrasted ... *grayi*, Jekel.
kk. Rostrum differently coloured ... ... *punctirostris*, Lea
jj. Elytra strongly produced at apex.
l. Prothorax with median channel wide and conspicuously interrupted in middle ... ... *pulverulentus*, Lea.
ll. Prothorax with median channel narrow and not, or scarcely, interrupted in middle.
m. Abdomen not conspicuously striped along middle . ... *picus*, Jekel.
mm. Abdomen conspicuously striped along middle.
n. Each elytron with two stripes or rows of spots ... ... *subparallelus*, [Jekel.
nn. Each elytron with three ... ... *regalis*, Blackb.
EE. Suture not suddenly and strongly raised at base.
F. Femora dentate.
o. Elytra with conspicuous isolated ochreous spots ... *plagiatus*, Pasc.

oo. Elytra with a conspicuous mediosutural ochreous spot ... *centralis*, Pasc.

ooo. Elytral spots, if present, not both conspicuous and ochreous.

p. Elytra feebly increasing in width to beyond the middle ... ... *pictirostris*, Lea.

pp. Elytra parallel-sided or decreasing in width to beyond the middle.

q. Abdomen uniformly clothed except for nude lateral spots ... ... *acaciæ*, Lea.

qq. Abdomen differently clothed.

r. Elytra feebly produced at apex ... ... *brunneus*, Guer.

rr. Elytra acutely produced at apex.

s. Abdomen (for the genus) rather sparsely clothed at sides *acrobeles*, Oll.

ss. Abdomen densely clothed at sides.

t. White clothing of abdomen (except on basal segment) confined to sides.

u. Nude spot of metasternal episternum conspicuous and transverse ... *insipidus*, Blackb.

uu. Nude spot feeble and longitudinal ... *phoenicopterus*, [Germ.

tt. White clothing of abdomen not confined to sides.

v. Elytra with conspicuous spots halfway between suture and sides ... *puncticeps*, Lea.

vv. Elytra without such spots ... *sparsus*, Germ.

FF. Femora edentate.

G. Prothorax and elytra of a rather bright chestnut-red.

w. Elytra immaculate.

x. Tenth joint of antennæ less than twice as long as wide ... ... *acicularis*, Pasc.

xx. Tenth joint more than twice as long as wide ... *nigriceps*, Lea.

ww. Elytra maculate on suture towards apex.
y. Head partly black ... *filus*, Jekel.
yy. Head not at all black *rubicundus*, Lea.
GG. Prothorax and elytra not both bright chestnut-red.
H. Second joint of antennæ no shorter than third.
z. Rostrum entirely dark ... *niveopilosus*, Lea.
zz. Rostrum partly red ... *granicollis*, Lea.
HH. Second joint of antennæ shorter than third.
I. Metasternal episterna without nude spots.
a. Basal joint of front tarsi almost as long as second and third combined.
b. Suture with feeble subapical spots ... *longicornis*, Lea.
bb. Suture without such spots ... ... *filiformis*, Germ.
aa. Basal joint of front tarsi much shorter than second and third combined.
c. Lateral pubescence of abdomen with nude spots ... ... *pudicus*, Lea.
cc. Lateral pubescence without nude spots *inconstans*, Lea (in [part).
II. Metasternal episterna each with one or two nude spots.
J. Abdomen with four pale stripes ... ... *ganglionicus*, Pasc.
JJ. Abdomen differently clothed.
K. Elytra distinctly paler than prothorax ... ... *brevipes*, Lea.
KK. Elytra slightly, or not at all, paler than prothorax.
L. Abdomen with three nude isolated spots on basal segments ... *parallelus*, Pasc.
LL. Abdomen differently clothed.
M. Rostrum decidedly reddish on at least the apical half.
d. Elytra passing abdomen for more than length of apical segment *edentulus*, Lea.

dd. Elytra passing abdomen for a less length.	
e. First joint of antennæ (if anything) slightly shorter than third	*angustulus*, Germ.
ee. First joint longer than third ...	*inconstans*, Lea (in part).
MM. Rostrum at most reddish at extreme apex only.	
N. Elytral clothing (except at base) confined to suture	*scalaris*, Germ.
NN. Elytral clothing not confined to suture.	
O. Elytral clothing ochreous ...	*vetustus*, Pasc.
OO. Elytral clothing white.	
P. Elytra gradually and (for the genus, rather feebly produced at apex	*amplicollis*, Jekel.
PP. Elytra suddenly and strongly produced at apex	
Q. Prothoracic channel narrow ...	*anguineus*, Pasc.
QQ. Prothoracic channel considerably wider	*bison*, Blackb.

Notes on above table.

D. In *scalaris* and *brunneus*, the white elytral clothing, although confined to the suture, in places appears as spots.

E. In *phœnicopterus*, *amplicollis*, *brunneus*, and some others the suture is slightly elevated at the base; but in all the species included in E the elevation is strong and sudden.

oo. In the variety *granulatus* the suture is irregularly spotted about the middle.

G. The apex of the prothorax (but not its disc) is sometimes stained with black.

HH. In *acaciæ* and *vetustus*, however, it is very little shorter.

RHINOTIA SIMPLICIPENNIS, n. sp.

Black, mandibles and appendages more or less diluted with red, prothorax and elytra reddish flavous, two stripes on prothorax and scutellum darker. Clothed with fine pubescence.

Head with very dense punctures. Rostrum slightly longer than prothorax and scutellum combined; with punctures behind antennæ much as on head, and with a feeble median carina or impunctate line, elsewhere with small and sparse punctures. Antennæ (for the genus) rather thin, first joint almost as long as second and third combined. *Prothorax* scarcely wider than long, sides rather feebly rounded, median line distinctly impressed on basal half only; with dense but more or less concealed punctures. *Elytra* very feebly impressed on each side of suture, apex conjointly rounded; with almost regular series of rather large punctures. *Femora* stout, the front pair stouter than the others and acutely bidentate, the teeth transversely placed, the others unidentate, posterior extending to middle of second abdominal segment; tibiæ denticulate below, the front pair very distinctly the others rather indistinctly so. Length (excluding rostrum), 8-9 mm.

Hab.—Queensland: Mackay (C. French).

The stripes on the prothorax are close together, commence at the apex and gradually narrow towards the base, which they do not quite touch, the median line towards the base is of the same colour as the stripes. The eyes are margined with ochreous pubescence above and flavous below; on the prothorax and elytra the clothing is ochreous; on the under surface and legs it varies from white, through ochreous, to black.

In general appearance close to *venusta*, but smaller, femora dentate, antennæ much thinner, with the first joint distinctly longer than the third, eyes completely margined with pale clothing, the stripes on prothorax much paler, not conjoined at apex and the elytra nowhere black.

RHINOTIA PARVA, n. sp.

Black, basal half of elytra flavous. Clothed with short pubescence.

Head strongly convex, with very dense punctures. Rostrum comparatively short, very feebly curved, with dense punctures except at apical fourth, which is smooth and shining. Antennæ long, and not very thin, first joint not as long as second and third combined, and about half the length of eleventh. *Prothorax* more convex than usual, not much wider than long, median line absent, sides rather strongly rounded; with very dense punctures. *Scutellum* strongly transverse, feebly bilobed. *Elytra* very thin, parallel-sided to near apex, which is very distinctly denticulate; with fairly large and almost regular series of punctures; the second, fourth, and sixth interstices feebly raised. *Legs* rather thin: femora edentate, posterior extending to middle of second abdominal segment; front tibiæ feebly denticulate, the others not at all. Length, 6 mm.

Hab.—New South Wales: Tweed River (W. W. Froggatt).

The black part of the elytra is slightly advanced along the suture, and retarded at the sides, and occupies rather less than half of the surface. The eyes are margined on the front with ochreous pubescence, there is a small spot of similar clothing on each side of base of prothorax, and the pale part of the elytra has similiar clothing, the rest on the upper surface being black. On the under surface the clothing is mostly white and sparse, but is dense below the eyes and across the second, third, and fourth abdominal segments.

The smallest and thinnest species of the genus. The denticulations at the apex of the elytra are rather larger and less numerous than in *elytrura* (which has also the suture mucronate).

RHINOTIA HŒMOPTERA, Kirby.

kirbyi, Bohem.

Fresh specimens of this species have parts of the sterna clothed with a most beautiful purplish pubescence, which, however, is invisible from certain directions, and becomes obscured with age.

Two specimens from New South Wales differ from the typical form in having golden pubescence (interrupted in the middle) in the median channel of the prothorax, as well as on the sides; and their elytra slightly smoky, although to a much less extent than in *marginella*.[5]

RHINOTIA ELYTRURA, Pasc.

This species may be readily identified by its very strongly convex metasternum and mucronate elytra. It is almost certainly the species commented upon by Lacordaire [6] as being in Paris under the name (evidently M.S.) of *spinipennis*, and as having the elytra truncate and denticulate at apex with the suture spinose.

var. BELLA, n. var.

Three specimens from New South Wales (Jenolan, Bulli, and Sydney) differ from the typical form in having the greater portion of the elytra black; the red in these specimens is confined to the margins, to a more or less small space at the apex, and then follows the line of the suture on the second and third interstices, then is confined to the second, and then at the middle becomes sutural, finally disappearing almost at the scutellum.

ISACANTHA DERMESTIVENTRIS, Boi.
fascicularis, H. & J.
pectoralis, Er. (Rhinotia).[7]
var. *fumigata*, Germ. (*Belus*).

This is a very variable species, ranging in length from 9 to 13, and in width from 2½ to 4½ mm. The clothing of the elytra varies from almost entirely greyish, but with a few minute dark spots, to almost entirely dark; the dark clothing is generally in spots (many of which have a velvety appearance) of which there is often a large one on each side of suture about the middle. Ochreous pubescence is often scattered about and sometimes rather thickly so on the suture. On one Victorian specimen the surface (more noticeably towards the suture than elsewhere) is thickly covered with small white spots, many of which are somewhat ochreous (although not at all eye-like in character) at the sides. The clothing on the prothorax is also variable. The rostrum varies

(5) This species is very close to *hœmoptera*, but apart from its smoky elytra it may be distinguished by the terminal joint of its antennæ being longer and by its somewhat more prominent post-scutellar hump.

(6) Gen. Coleop., VI., p. 526, note 1.

(7) A rather curious mistake occurs in Erichson's description of this insect. He says "Coleoptera thorace paulo *longiora*," evidently meaning "*latiora*"; as the elytra are more than thrice the length of the prothorax.

from reddish-brown to black, and is often diluted with red at the apex and sides. The prothorax in some specimens is much more conspicuously inflated at the base than in others.

The appearance of the specimens is often considerably altered by immersion in alcohol and by abrasion.

ISACANTHA RHINOTIOIDES, Hope.

congesta, Pasc.

This species has been redescribed by Pascoe under the name of *congesta;* it is to be noted that the appearance of the upper surface is considerably altered by alcohol. But it is readily distinguished from all others of the subfamily known to me by the clothing of the metasternum. In several collections I have seen the name *rhinotioides* applied to *dermestiventris*, which, however, has the metasternal clothing very different.

ISACANTHA PAPULOSA, Pasc.

The conspicuous spotting of the elytra of this species is subject to great alteration with age and abrasion, etc.

SUBFAMILY TYCHIIDES.

ELLESCHODES PICTUS, n. sp.

Black; head, rostrum, antennæ, shoulders and apex of elytra, tibiæ, tarsi, and parts of femora more or less red. Upper surface with stout white setæ in spots or patches, the interspaces with fine, dark, and indistinct pubescence; under surface and legs with whitish pubescence, denser on sides of meso- and metasturnum than elsewhere.

Rostrum not very thin, the length of prothorax in male, very little longer in female, moderately curved; with a fine median carina and with four very feeble ones caused by rows of punctures; sculpture partially concealed behind antennæ in male, at base only in female. Antennæ rather thin, inserted one-third from apex of rostrum in male, two-fifths in female. *Prothorax* about once and one third as wide as long, with traces of a very feeble median carina; with very dense, round, and (except beneath spots of setæ) well-defined punctures. *Elytra* cordate, hardly parallel-sided anywhere; seriate (scarcely striate) punctate, punctures of moderate size but smaller towards suture than sides; interstices fairly wide, not separately convex, with small scattered punctures. *Abdomen* with dense, partially concealed punctures. *Femora* rather stout, very feebly dentate. Length, $2\frac{1}{4}$ mm.

Hab.—New South Wales: Forest Reefs, Glen Innes (A. M. Lea).

The reddish parts of the elytra are not sharply limited, and in one specimen the red from the shoulder is obscurely connected with the apex; in another the apex is scarcely paler than the rest of the elytra; the femora, especially the hind pair, are more or less diluted with red. There is a very distinct white spot of setæ between the eyes, and three at the base of the prothorax; on the elytra the white setæ form distinct patches, which are sometimes broken up into feeble spots; but in the normal form they appear to clothe the suture at the base and near the apex, and to form two feeble transverse fasciæ—a very irregular subbasal one (at times so loosely formed as almost to cover the basal third) and a more regular but shorter one at summit of posterior declivity; there are generally also white setæ on the slight preapical callosities.

The three patches of snowy-white setæ at the base of the black prothorax render this species very distinct, although it is closely allied to *eucalypti*.

Elleschodes modicus, n. sp.

Black; head, rostrum, antennæ, and legs (the femora more or less deeply stained with black) more or less red. Clothed with setæ or pubescence, white on the under surface and legs, variegated on the upper surface.

Rostrum and antennæ as in preceding species. *Prothorax* and *elytra* much the same, except that the prothorax is slightly wider, and its punctures are slightly less numerous and more obscured by the clothing. *Abdomen* and *femora* much the same, except that the femoral dentition is somewhat stronger. Length, 2-2¼ mm.

Hab.—New South Wales: Armidale (A. M. Lea).

The elytra are more or less diluted with red on each side of the base, and there is a rather indistinct subquadrate reddish patch at the apex; the head is sometimes darker than the rostrum. There is a rather dense patch of straw-coloured clothing between the eyes; the prothorax is similarly clothed except that there is a darker spot (sometimes very indistinct) on each side of middle. On the elytra the straw-coloured clothing is nowhere condensed into distinct spots, but is fairly dense in parts; there are also white setæ, placed much as they are in the preceding species.

The species certainly belongs to the *eucalypti* group, but the clothing on the elytra is denser and more uniform in extent, although somewhat variable in colour, than on any of the close allies of that species. The prothorax and legs are differently coloured to those of *eucalypti* itself.

ELLESCHODES RUFULUS, n. sp.

Male. Dull reddish-brown. Densely clothed with straw-coloured setæ, with feeble darker spots; scutellum with dense whitish clothing. Under surface and legs with fairly dense whitish clothing.

Rostrum thin, slightly longer than prothorax and lightly curved; with a thin median carina, and with four very feeble ones caused by rows of punctures; sculpture almost concealed on basal half; antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* about once and one half as wide as long, punctures normally concealed. *Elytra* elongate-cordate, nowhere parallel-sided; with series of not very large but almost regular punctures; interstices not separately convex, with small concealed punctures. *Abdomen* with dense and regular punctures. *Femora* stout, rather strongly and acutely dentate. Length, 2½ mm.

Hab.—Victoria: Wangaratta (A. M. Lea).

On the prothorax of the type the darker spots amongst the pubescence are very indistinct; but on the elytra they are fairly distinct and about forty in number.

A specimen obtained at the same time as the type is probably the female, it differs in being larger, in having the dark elytral clothing covering most of the surface, the paler clothing covering the base only, except for a few indistinct spots posteriorly, the rostrum thinner and decidedly longer, and the antennæ inserted almost in exact middle of sides of rostrum.

ELLESCHODES SUTURALIS, n. sp.

Of a rather pale reddish-brown. Clothed with whitish setæ or pubescence, dense on sides and middle of prothorax and on suture.

Rostrum thin, curved; in male slightly longer than prothorax and longer in female than in male; with a fine median carina and with four very feeble ones caused by rows of punctures; sculpture partially concealed on basal third in male, at base only in female. Antennæ thin, inserted about two-fifths from apex of rostrum. *Prothorax* about once and one third as wide as long; with dense, round, more or less concealed punctures. *Elytra* rather elongate-cordate, nowhere parallel-sided; with series of not very large punctures, but becoming larger towards base and sides; interstices not separately convex, with small and usually concealed punctures. Abdomen with dense partially concealed punctures. *Femora* moderately stout, very feebly dentate. Length, 1¾-2 mm.

Hab.—New South Wales: Galston (A. M. Lea).

Of three specimens one has the metasternum almost black, whilst in the two others it is darker than the rest of the under surface but not infuscated. The three whitish prothoracic lines are distinct, but rather wider and not so densely formed as the sutural one. The clothing of both surfaces is practically of one shade of colour.

Elleschodes uniformis, n. sp.

Reddish-brown, scutellum, suture (very narrowly), and sides near base, sterna, and three basal segments of abdomen black; club infuscate. Moderately densely and almost uniformly clothed with whitish pubescence or setæ, paler on the under surface than elsewhere.

Rostrum thin, lightly curved, in male distinctly longer than prothorax, and slightly longer in female than in male; with a thin median carina, and with four very feeble ones caused by rows of punctures; sculpture partially concealed behind antennæ in male, at extreme base only in female. Antennæ thin, inserted one-third from apex of rostrum in male, two-fifths in female. *Prothorax* about once and one third as wide as long; with dense but normally concealed punctures; apparently with traces of a feeble median carina. *Elytra* elongate-cordate, parallel-sided for a short distance near base; with series of rather large punctures (larger towards base and sides than elsewhere), in rather shallow striæ; interstices feebly separately convex, with small but usually concealed punctures. *Abdomen* with dense regular partially concealed punctures. *Femora* moderately stout, very feebly dentate, especially in female. Length, 2 mm.

Hab.—Tasmania: Hobart (A. M. Lea).

On two out of three specimens the clothing on the elytra is denser on the third, and to a less extent on the fifth and seventh interstices than elsewhere, but the elytra do not appear to be distinctly striped. The second, third, and fourth abdominal segments are scarcely produced backwards at the sides, a character which will readily distinguish the species from all others known to me.

Elleschodes bryophagus, n. sp.

Chestnut-brown; suture and sides of elytra near base and parts of under surface black. Clothed with rather thin greyish pubescence, denser and paler on scutellum than elsewhere.

Rostrum rather stout, feebly curved; in male the length of prothorax, in female slightly longer and thinner than in male; with a fine median carina and with four very feeble ones caused by rows of punctures; sculpture partially concealed on basal half in male, at base only in female. Antennæ thin, inserted one-fourth from apex of rostrum in male, one-third in female. *Prothorax* depressed, about once and one-half as wide as long; with small and dense but more or less concealed punctures. *Elytra* elongate-cordate, parallel-sided from near the base to beyond the middle; with series of small and rather narrow punctures, becoming larger (but not large) and more rounded towards base and sides; interstices not separately convex, with small and more or less concealed punctures. *Abdomen* with dense punctures, larger and sparser on basal and denser on apical segment than on the others. *Femora* stout and feebly (especially the front pair) dentate. Length, 2-2½ mm.

Hab.—Tasmania: Mount Wellington, Hobart (in moss, A. M. Lea).

An elongate, depressed form, with the elytra somewhat wider than the prothorax than is usual. The meso- and metasternum appear to be always black. The two basal segments of the abdomen are sometimes no darker than the others, but are sometimes (and especially the first one) deeply infuscated. From some directions the pubescence or setæ appears to have a faint golden gloss; on the elytra it is not quite depressed, and it is denser on the upper than on the under surface. Except towards the sides, there is an almost complete absence of striation from the elytra.

Elleschodes similis, n. sp.

Female (?). Dark reddish-brown; rostrum and appendages paler, under surface black. Moderately densely clothed with greyish pubescence, becoming whitish on under surface and legs.

Rostrum thin, moderately curved, slightly longer than prothorax; with a fine median carina and with four feeble ones caused by rows of punctures; sculpture not concealed by clothing. Antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* depressed, about once and two thirds as wide as long; with small, dense, and only partially concealed punctures. *Elytra* elongate-cordate, scarcely parallel-sided anywhere; punctures and interstices much as in preceding species. *Abdomen* with rather more regular punctures than in the preceding species, but the femora much the same. Length, 2½ mm.

Hab.—Tasmania: Mount Wellington (in moss, A. M. Lea).

Close to the preceding species, but darker and wider, elytra less parallel-sided and not so wide in proportion to the prothorax, and the prothoracic punctures less concealed. The clothing is much the same, but is darker on the upper and paler on the lower surface, on the elytra also it is feebly variegated with single but rather thickly scattered paler setæ. The rostrum is more strongly and uniformly curved, and the antennæ are inserted at a greater distance from the apex.

Elleschodes pallidus, n. sp.

Pale testaceous. Moderately clothed with straw-coloured or slightly golden pubescence.

Rostrum thin, moderately curved, slightly longer than prothorax, parallel-sided; behind antennæ with a fine median carina and with others caused by rows of punctures, in front of antennæ with fine punctures only. Antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* depressed, almost twice as wide as long, widest (but not by much) slightly in advance of middle; with dense but more or less concealed punctures. *Elytra* elongate-cordate, parallel-sided from near base to beyond the middle; punctures and interstices almost exactly as in *ellipticus*. *Abdomen* with moderately dense and only partially concealed punctures; apical segment depressed in middle. *Femora* stout and feebly (especially the front pair) dentate. Length, 2-2¼ mm.

Hab.—South Australia (Macleay Museum).

On the elytra of one of the two specimens before me (both apparently of one sex) some of the pubescence is of a brownish colour, but it is very indistinct, and the clothing everywhere is very similar in colour to the derm on which it rests.

Elleschodes scutellaris, n. sp.

Bright red; scutellum black; suture and parts of sterna more or less infuscated. Moderately, in places sparsely, clothed with short whitish pubescence.

Rostrum thin, moderately curved, longer than prothorax; with a fine carina behind antennæ, and with other very feeble ones caused by rows of punctures; in front of antennæ with fine punctures only. Antennæ thin, inserted two-fifths from apex of rostrum. *Prothorax* somewhat depressed, about once and one third as wide as long; with numerous round and only partially concealed punctures. *Elytra* cordate, nowhere parallel-sided; with series of not very large punctures (larger towards base and sides than elsewhere) in rather feeble striæ; interstices feebly separately convex, with small and rather numerous, but more or less concealed punctures. *Abdomen* with moderately dense and distinct punctures. *Femora* stout, feebly but acutely dentate. Length, 2-2¼ mm.

Hab.—Western Australia: Swan River (A. M. Lea).

In general appearance somewhat close to the preceding species, but prothorax larger and the sides less rounded, scutellum black, etc. In colour (except of under surface) it somewhat resembles *bryophagus*, but it is much more robust than that species. The two specimens described are apparently females.

Elleschodes placidus, n. sp.

Reddish-castaneous. Densely clothed with straw-coloured pubescence or setæ, sparser and paler on the under than on the upper surface.

Rostrum (for the genus) rather stout, moderately curved, slightly longer than prothorax; behind antennæ with a fine median carina, and with rather coarse rows of punctures, in front of antennæ with distinct punctures only, and feebly decreasing in width to apex. Antennæ (for the genus) not very thin, inserted two-fifths from apex of rostrum. *Prothorax* about once and two thirds as wide as long; with dense, round, partially concealed punctures. *Elytra* elongate-cordate, parallel-sided from near base to about the middle; with series of fairly large punctures in rather feeble striæ; interstices feebly separately convex, with small dense and partially concealed punctures. Abdomen with dense, partially concealed punctures. *Femora* very stout, strongly and acutely dentate. Length, $3\frac{1}{4}$ mm.

Hab.—Western Australia: Karridale (A. M Lea), King George's Sound (Macleay Museum).

On two of the four specimens before me the clothing is absent from the middle of the prothorax, and from a subtriangular space behind the scutellum, but this appears to be due to abrasion.

Elleschodes compactus, n. sp.

Of a rather bright red; sterna black; moderately clothed with rather loosely applied pubescence or setæ, whitish on sterna, straw-coloured elsewhere, and longer on prothorax than on elytra.

Rostrum thin, feebly curved on its upper surface, almost straight on its lower, feebly but regularly decreasing in width from base to apex; behind antennæ in male with rather coarse but concealed sculpture (in female at base only), in front of antennæ with fairly distinct punctures in male, but very fine ones in female. Antennæ rather thin, inserted slightly nearer base than apex in male, and nearer the base in female; scape about half the length of funicle; funicle with first joint as long as second and third combined, second longer than third; club oval, distinctly jointed. *Prothorax* convex, sides strongly rounded, about once and two thirds as wide as long, apex incurved to middle, base not bisinuate but very feebly and continuously rounded; with dense, round, partially concealed punctures. *Elytra* cordate, wide, strongly convex, parallel-sided from near the base to about the middle, shoulders rounded; with series of large punctures in rather shallow striæ, interstices feebly separately convex, with fairly large but partially concealed punctures. *Abdomen* strongly convex; with rather coarse partially concealed punctures; suture between first and second segments almost as distinct across middle as at sides. *Femora* stout, strongly and acutely dentate; tibiæ with a fringe of teeth at apex; each claw with a stout supplementary basal piece. Length, $2\frac{3}{4}$-3 mm.

Hab.—New South Wales: National Park (H. J. Carter), Sydney (A. M. Lea).

The colour as described is that of three specimens, but in a fourth the head, base of rostrum, scutellum, apex of prothorax, and sides of elytra are also black, and the suture is slightly infuscated; in a fifth the sides of the elytra and the under surface of the head are infuscated. The pubescence on the elytra is rather denser on the third, fifth, and seventh interstices than on the others, but it is not sufficiently dense to cause the appearance of distinct stripes.

This and the following species will probably not rest in *Elleschodes*, but at present no good purpose would be served by proposing a special genus for their reception.

Elleschodes nigirostris, n. sp.

Bright red; head, rostrum, funicle, club, front femora, and tibiæ, and middle femora black or blackish. Elytra moderately densely clothed with golden or straw-coloured pubescence or setæ, some of which are suberect; elsewhere more or less sparsely clothed.

Rostrum rather stout, moderately curved, slightly longer than prothorax, parallel-sided; behind antennæ with a feeble median carina and with distinct rows of punctures; in front of antennæ with distinct punctures only, and these not in regular rows. Antennæ thin, inserted about two-fifths from apex of rostrum; scape more than half the length of funicle and club combined; funicle with first joint as long as second and third combined, second longer than third; club elongate-ovate, rather loosely jointed. *Prothorax* convex, about once and one third as wide as long, sides rounded but decreasing in width from base to apex, apex truncate, base not bisinuate but gently and continuously rounded; with dense, round, and rather small punctures; with a very feeble median carina or impunctate line. *Elytra* subcordate, strongly convex, wide, nowhere parallel-sided, shoulders embracing prothorax; with series of large, subquadrate punctures; interstices feebly separately convex only towards base and sides, with rather dense but partially concealed punctures. *Abdomen* and *femora* much as in preceding species, except that the abdominal punctures are rather smaller but less concealed. Length, $3\frac{1}{2}$ mm.

Hab.—Queensland: Brisbane (R. Illidge).

Allied to the preceding species, and with similar claws, and probably also variable in colour, but I have but one specimen (probably a male) to judge from. The shape of the rostrum, the length of the scape, and the shoulders (apart from colours) will readily distinguish the two species. The elytra are rather densely clothed, but from some directions appear to be almost glabrous; possibly the prothorax and head of the type are partly abraded.

Hibberticola, n.g.

Head rather large, but not wide. Eyes of moderate size, rather distinct, finely faceted. Rostrum short and stout; scrobes oblique, directed beneath eyes, their tips not visible from above. Antennæ rather short; scape rather thin; funicle seven-jointed, basal joint rather large; club briefly ovate, joints fairly distinct. Prothorax moderately transverse, base not bisinuate; without ocular lobes. Scutellum small. Elytra cordate. Metasternum rather short. Abdomen with suture between first and second segments feeble, across middle, second, third, and fourth rather feebly drawn backwards at sides, fifth rather small. Legs rather stout; femora edentate; tibiæ almost straight; claws appendiculate.

The finely faceted eyes will readily distinguish this from the other Australian genera of the subfamily. The male has a distinct pygidium, and which encroaches upon the middle of the apical segment of abdomen. In the female the pygidium is concealed, and the apical segment of abdomen is rounded at its apex. The only known species lives in galls on *Hibbertia sericea*, and Mr. Griffith writes me of it:—"I have only seen the gall around Black Hill, Athelstone, but *H. sericea* is a common enough plant on our hills, so probably the gall is to be found all around. These galls are very plentiful at base of Black Hill, and the beetle is abundant. I know nothing of the habits of the weevil beyond the fact that they are always *in* the gall, sometimes two or three in a large one, yet so far I have found no more than one larva in each gall, and have opened a good many scores, large and small."

HIBBERTICOLA ECHINATA, n. sp.

Reddish-castaneous. Rather densely clothed with loose pubescence or setæ, whitish on the under surface, straw-coloured or slightly golden on the upper; the elytra in addition with dense, more or less erect setæ.

Head with rather numerous punctures. Rostrum short (scarcely more than half the length of prothorax), stout, straight, parallel-sided; with rather coarse but partially concealed punctures on basal half, and finer but less concealed on apical half. Antennæ rather thin, inserted almost in exact middle of sides of rostrum; scape almost the length of funicle; funicle with first joint stout, the length of second and third combined; club briefly ovate, rather indistinctly jointed. *Prothorax* about once and one third as wide as long, rather strongly convex, sides rounded, apex truncate, base gently and continuously rounded; with dense, round, partially concealed punctures. *Elytra* somewhat elongate-cordate, each separately rounded at base, nowhere quite parallel-sided; with series of fairly large punctures, in distinct striæ; interstices separately convex, with fairly numerous punctures. *Abdomen* with very dense but more or less concealed punctures. Length, $1\frac{4}{5}$-$2\frac{1}{2}$ mm.

Hab.—South Australia: Athelstone (H. H. D. Griffith).

The club is infuscated or almost black, but is sometimes no darker than the rest of the antennæ. Some specimens are slightly darker than others, and some parts are slightly darker than other parts; but (except for the club) no parts are black or even deeply infuscated. The disc of the prothorax in all the numerous specimens examined is glabrous. The erect elytral setæ are dense and apparently irregularly distributed, but when viewed from behind or the front are seen to be in regular lines. The punctures, both on the interstices and in the striæ, are partially concealed by the clothing.

SELLECHUS, n.g.

Head of moderate size. Eyes rather large, coarsely faceted, moderately distant. Rostrum moderately long and thin; scrobes lateral, their commencement scarcely visible from above. Antennæ rather thin; scape rather long; funicle seven-jointed, basal joint large; club ovate, joints distinct. Prothorax transverse, base feebly bisinuate, ocular lobes very obtuse. Scutellum small. Elytra cordate. Metasternum moderately long. Abdomen with suture between first and second segments feeble, across middle, second, third, and fourth drawn backwards at sides, fifth rather large. Legs stout; femora edentate; four front tibiæ of male suddenly excavated towards apex; each claw with a rather stout supplementary piece at the base.

Readily distinguished from all Australian genera of the subfamily by the remarkable structure of the male tibiæ, which is described at length under the species.

SELLECHUS TIBIALIS, n. sp.

Black; antennæ (the club excepted), tibiæ, and tarsi reddish, rostrum obscurely diluted with red towards the apex. Upper surface rather densely clothed with short dark pubescence or setæ, with paler setæ or pubescence scattered about, and sometimes condensed into small spots at the junction of the prothorax and elytra. Under surface, legs, head between eyes, and base of rostrum, with whitish pubescence. Tibiæ of male, and especially the hind pair, with long golden hair towards the apex.

Head with dense but more or less concealed punctures. Rostrum thin, moderately curved, about the length of prothorax; with a fine median continuous carina, and with rows of punctures, becoming very irregular, however, in front of antennæ; sculpture on basal half more or less concealed in male, on basal fifth only in female. Antennæ thin, in male inserted about one-fourth from apex of rostrum, in female almost in exact middle of sides; scape almost the length of funicle in male, but shorter in female; two basal joints of funicle elongate, but first longer than second; club elliptic-ovate. *Prothorax* rather feebly convex, about once and one fourth as wide as long, apex much narrower than base; with dense, rather fine and partially concealed punctures; usually with traces of a very feeble median carina. *Elytra* elongate-cordate, almost parallel-sided from near the base to middle; with series of rather small punctures; interstices, except towards apex and sides, not separately convex, with small and more or less concealed punctures. *Under surface* of male with a wide shallow depression, continuous from near base of metasternum to near apex of abdomen; in female this space flattened. *Femora* stouter and more curved in male than in female. Length, $2\frac{1}{3}$-3 mm.

Hab.—New South Wales: Tamworth (A. M. Lea).

Two of the eight specimens examined are of a piceous brown, but all the others are of a deep black. To the naked eye the upper surface appears to be of a rather dingy black. The rostrum of the female is thinner and with much finer sculpture than that of the male, its widest part is at the base, and thence it is parallel-sided to the apex; in the male its widest part is between the antennæ and apex. Except towards the apex and sides there is a complete absence of elytral striation. The front tibiæ of the male are suddenly and largely excavated near the apex, so that the apical portion from some directions appears to form a rather large basal tarsal joint; projecting over the excavation from the lower edge is a strong obtuse tooth. The middle pair are rather strongly emarginated on the lower surface towards the apex, and behind the emargination are some long golden hairs. The hind pair are stout, somewhat curved, and also with long golden hairs. The female tibiæ are quite simple. The excavation of the under surface of the male is bounded by denser clothing than elsewhere.

Elleschus concinnus, n. sp.

Black, appendages reddish; rostrum sometimes entirely reddish, sometimes infuscated on the basal half, and sometimes on the sides of the basal half. Head, base of rostrum, prothorax, scutellum, and a spot on elytra, with straw-coloured or golden pubescence; rest of elytra with greyish or brownish pubescence; under surface and legs with white pubescence.

Rostrum in male moderately stout and curved, slightly longer than prothorax, behind antennæ with a fine median carina and rather coarse but concealed punctures, in front of antennæ with fairly distinct punctures; in female the rostrum is longer and thinner, and the punctures are smaller and less numerous but concealed only at the basal fifth. Antennæ thin, inserted about two-fifths from apex of rostrum in male, nearer the middle in female. *Prothorax* about once and one half as wide as long, with dense, concealed punctures. *Elytra* cordate, nowhere parallel-sided; with series of rather small punctures (but fairly large at base and sides) in feeble striæ; interstices not separately convex, except at sides and apex, with small and usually concealed punctures. *Abdomen* with rather dense partially concealed punctures. *Femora* moderately stout, edentate. Length, $1\frac{1}{2}$-2 mm.

Hab.—New South Wales: Forest Reefs, Inverell, Tamworth (A. M. Lea).

The head is sometimes not black, but of a rather deep brown. The pale spot of clothing on the elytra is distinct in the four specimens examined, but is more sharply defined in some than in others; it appears to be transversely oblong in shape, and is situated on the suture at about the basal third, and extends across three interstices on each elytron; in two specimens it is feebly connected with the shoulders. On the prothorax the pubescence is so directed as to cause a fairly distinct median line where it meets. Each claw appears deeply cleft under the microscope.

ELLESCHUS WELLINGTONIENSIS, n. sp.

Reddish-testaceous; under surface black, but apex of abdomen diluted with red. Rather densely clothed with straw-coloured or slightly golden pubescence or setæ; becoming sparser and paler on under surface, both of body and legs.

Rostrum rather stout, feebly curved, distinctly shorter than prothorax, narrow near base and then rather strongly inflated; with fairly dense and distinct punctures on apical half, but concealed on basal half. Antennæ stout, inserted about one-third from apex of rostrum; scape about half the length of funicle and club combined. *Prothorax* feebly convex, about once and one half as wide as long, sides rounded and decreasing in width from near base to apex, base feebly and continuously rounded; with small, dense, and usually concealed punctures; with traces of a very feeble median carina. *Elytra* elongate-cordate, scarcely parallel-sided anywhere; with series of fairly large punctures in feeble striæ; interstices feebly separately convex, with fairly numerous but usually concealed punctures. *Abdomen* with rather fine and partially concealed punctures. Femora stout, edentate. Length, 3 mm.

Hab.—Tasmania: Summit of Mount Wellington (A. M. Lea).

The type is evidently a male. There are four other specimens (also taken on the summit of Mount Wellington) before me, which are possibly females, but the rostrum is of very different shape, being quite straight, parallel-sided from base to apex, thinner and longer. The antennæ (and more noticeably the scape) are thinner and inserted almost in exact middle of sides of rostrum. The clothing is much the same but rather paler. The colour of the abdomen of one of these is exactly as in the type; in another only its base is infuscated; the two others being intermediate.

A Contribution to the Botany of South Australia

By J. H. Maiden, Honorary Member.

[Read September 8, 1908.]

Introductory.

South Australia will ever be of especial interest to the Australian botanist, because it was the first *terra incognita* that Robert Brown explored (coastally). He was with Flinders on his voyage of discovery, but the Australian land first touched by that navigator, South-Western Australia, had been previously visited, and some attention had been given to its botany; but in South Australia Brown was the first botanist to see its plants (with the reservation, as regards Leschenault de la Tour, who visited, it is believed, a portion of Eastern South Australia).(1)

The Association for the Advancement of Science met at Adelaide in January, 1907, and the Government of South Australia graciously placed the steamer "Governor Musgrave," Captain P. Weir, at the disposal of a limited number of local and visiting naturalists, in order that certain places rich in historical associations or promising useful scientific collections might be visited. The following formed the party:—*South Australia*—Mr. Thomas Gill, I.S.O., Dr. R. S. Rogers, Dr. W. Torr, Messrs. W. Howchin, D. Mawson, B. S. Roach, and J. W. Mellor; *Victoria*—Professors R. Berry and E. W. Skeats, and Mr. Sweet; *New South Wales*—Rev. Clement Wilkinson, Mr. Charles Hedley, Dr. W. G. Woolnough, Messrs. J. Clunies Ross, T. G. Taylor, and the writer.

It will thus be observed that various sciences were represented, and valuable observations and collections were the result of the cruise. Mr. Thomas Gill and Dr. R. S. Rogers were my special mates for botany, and I am very grateful to them for the unselfish help they gave me. The latter has since sent me specimens from some of the places visited by us, and also from other South Australian localities; these have been incorporated in the present paper, which is an expression of gratitude and an indication that the hospitality of the South Australian Government has not been bestowed in vain. I would remark that the foregatherings of scientific men from various States on occasions like these promote good fellowship and make for the advancement of science.

I was landed alone by the "Governor Musgrave" at Port Lincoln, and spent several days in that botanically rich dis-

(1) Select Bibliography (2).

trict, the scene of collecting trips by Robert Brown in 1802. On the north I went nearly as far as Tumby Bay, and on the west to Coffin Bay.

Proceeding up Spencer Gulf by steamer to Port Augusta I spent a day there.

This paper is mainly a contribution to the local florulas of South Australia. I much felt the want of such for the places I visited, and incomplete as those are which I submit, I hope they may prove useful. No record has been admitted into any of the lists for which a herbarium specimen is not available. Imperfect as they are, they will serve as a hint for other naturalists to amplify them, for we have much to learn in regard to the geographical distribution of species in South Australia, as, indeed, in the other States.

The genera Eucalyptus and Acacia have been separately dealt with as a matter of convenience.

Select Bibliography.

(1) "The Botany of Kangaroo Island," by Ralph Tate (Tr.R.S.S.A., vol. vi., p. 116 [1883]).

See the bibliography of the flora of Kangaroo Island enumerated in (2).

(2) Presidential Address, Biology Section, Australian Association for the Advancement of Science, Adelaide, 1907

It will be convenient to refer to certain papers on the Euronotian Region under Y and L enumerated in (2).

For the plants from the following localities—Coobowie and Edithburgh (Yorke Peninsula): Althorpes: Cape Borda; South Neptunes: Port Elliston (Port Waterloo): Flinders Island: Fowler Bay: Point Sinclair (LeHunte Bay): Davenport River: Bird Rock: Murat Bay: Denial Bay: Laura Bay: Flagstaff Landing: Streaky Bay: Venus Harbour: Taylor Island: Cape Donington: Port Lincoln: Dangerous Reef: Althorpes (second visit): Rhino Point and the wrecked "Willyama": Marion Bay: and Port Moorowie—I am indebted to Dr. R. S. Rogers.

Kangaroo Island.

KINGSCOTE.

* Denotes an alien species. Compare Tate (1).

(**T**) Denotes also native of Tasmania.

Resedaceæ—* Reseda alba, *L.* A roadside weed.

Geraniaceæ—(**T**) Pelargonium australe, *Willd.*

Myrtaceæ—(**T**) Melaleuca squarrosa, *Don:* Melaleuca parviflora, *Lindl.*

Compositæ—(**T**) Cassinia spectabilis, *R. Br.:* Helichrysum retusum, *Sond.* and *F. v. M.;* Olearia rudis, *F. v. M.* (Aster exsul), Ray florets blue, viscid leaves, 2-3 ft. high.

(T) Senecio odoratus, *Hornem.* (T) Vittadinia australis, *A. Rich.*

Apocynaceæ—(T) Alyxia buxifolia, *R. Br.*

Solanaceæ—(* ?) Solanum nigrum, *L.* Lycium australe, *F. v. M.*

Myoporaceæ—Eremophila Brownii, *F. v. M.* Viscid leaves, red flowers.

Labiatæ—* Marrubium vulgare, *L.*

Chenopodiaceæ—(T) Salicornia australis, *Sol.*

Thymelæaceæ—Pimelea sp. 3-3 ft. 6. in. high, very abundant, but not in flower.

Santalaceæ—Choretrum glomeratum, *R. Br.* This may be C. chrysanthum, *F. v. M.* Bentham unites C. glomeratum and C. chrysanthum. Mueller and Tate keep them distinct, but I can see no other difference than that the flowers are yellow in C. chrysanthum and white in C. glomeratum.

Liliaceæ—(T) Dianella revoluta, *R. Br.* Tate has D. lævis only.

Gramineæ—(T) Danthonia penicillata, *F. v. M.*, var. setacea. * Lagurus ovatus, *L.* Well acclimatized.

HOG BAY.

Ranunculaceæ—(T) Clematis microphylla, *DC.*

Dilleniaceæ—(T) Hibbertia stricta, *R. Br.*

Pittosporaceæ—Billardiera. (T) Bursaria spinosa, *Cav.*

Sterculiaceæ—Lasiopetalum Baueri, *Steetz.*

Zygophyllaceæ—Nitraria Schoberi, *L.*

Geraniaceæ—(T) Pelargonium australe, *Willd.*

Rutaceæ—(T) Correa speciosa, *Ait.* Locally called "Honeysuckle."

Rhamnaceæ — (T) Spyridium eriocephalum, *Fenzl.* Broad-leaved form, apparently an addition to the flora of the island. (From J. M. Black.) Spyridium spathulatum, *F. v. M.* The great viscidity of the flowers is not mentioned in the "Flora Australiensis." (T) Spyridium vexilliferum, *Reiss.* (J. M. Black).

Sapindaceæ—Dodonæa viscosa, *L.*, var. attenuata.

Leguminiosæ—(T) Goodia lotifolia, *Salisb.* I have seen Tate's specimen, and it is identical with my own. Tate labelled his specimen G. medicaginea, *F. v. M.* I follow Bentham in reducing medicaginea to lotifolia; I cannot see any difference between the Kangaroo Island plant and the common Eastern Australian one (Salisbury's plant). G. medicaginea should be dropped from the South Australian flora and G. lotifolia substituted.

Rosaceæ—(T) Acæna sanguisorbæ, *Vahl.*

Myrtaceæ—Callistemon coccineus, *F. v. M.* (T) Melaleuca gibbosa, *Labill.*; Melaleuca uncinata, *R. Br.*

Aizoaceæ—(**T**) Mesembryanthemum æquilaterale, *Han.*

Umbelliferæ—(**T**) Apium prostratum, *Labill.*

Rubiaceæ—Opercularia hispida, *Spr.* Determination doubtful. The seeds are like those of O. aspera, but the habit and other characters are like O. hispida.

Compositæ — (**T**) Calocephalus Brownii, *F. v. M.* * Carduus lanceolatus, *L.* * Carduus marianus, *L.* * Centaurea melitensis, *L.*, called "Cockspur" on Kangaroo Island. (**T**) Cotula coronopifolia, *L.* * Cryptostemma calendulacea, *R. Br.* (**T**) Gnaphalium japonicum, *Thunb.;* Helichrysum retusum, *Sond.* and *F. v. M.* (**T**) Ixiolæna supina, *F. v. M.* A white or pale purple, weak, trailing plant at Frenchman's Rock; Ixodia achilleoides, *R. Br.* (I. alata, *Schlecht*). (**T**) Olearia ramulosa, *Labill.;* Olearia teretifolia, *F. v. M.*

Goodeniaceæ—(**T**) Goodenia ovata, *Sm.* (**T**) Scævola microcarpa, *Cav.* (?) New for the island.

Primulaceæ—* Anagallis arvensis, *L.*

Gentianaceæ—(**T**) Erythræa australis, *R. Br.*

Solanaceæ—Lycium australe, *F. v. M.;* *Solanum sodomæum, *L.*

Myoporaceæ—(**T**) Myoporum insulare, *R. Br.*

Polygonaceæ—(**T**) Mühlenbeckia adpressa, *Meissn.* The roots are boiled and the plant known as "Sarsaparilla."

Proteaceæ—(**T**) Hakea rostrata, *F. v. M.*

Casuarinaceæ—(**T**) Casuarina distyla, *Vent.* (**T**) Casuarina stricta, *Ait.*

Coniferæ—(**T**) Callitris cupressiformis, *Vent.;* Callitris propinqua, *R. Br.* (W. Gill). See my "Forest Flora of New South Wales," part xii., p. 54. Tate records C. verrucosa (doubtless this plant) from Kangaroo Island, but there is no evidence satisfactory to me of the occurrence of true C. verrucosa on the island.

Iridaceæ—Sisyrinchium cyaneum, *Lindl.*

Liliaceæ—(**T**) Bulbine semibarbata, *Haw.* (**T**) Dianella revoluta, *R. Br.;* Thysanotus dichotomus, *R. Br.;* Xanthorrhœa quadrangulata, *F. v. M.* "Yucca" is the name on Kangaroo Island for Xanthorrhœa, hence Yucca Gum, which is an article of export.

Gramineæ—* Hordeum murinum, *L.* (**T**) Spinifex hirsutus, *Labill.*

CAPE COUEDIE (R. S. Rogers).

Cruciferæ—(**T**) Lepidium foliosum, *Desv.*

Frankeniaceæ—(**T**) Frankenia pauciflora, *DC.* (lævis, *Tate*).

Zygophyllaceæ—Nitraria Schoberi, *L.;* Zygophyllum Billardieri, *DC.*

Rutaceæ—(T) Correa speciosa, *Ait.*

Rhamnaceæ—(T) Spyridium vexilliferum, *Reiss.*

Sapindaceæ—Dodonæa humilis, *Endl.*

Leguminosæ—Eutaxia empetrifolia, *Schl.* (T) Lotus australis, *Andr.* Leaves succulent.

Myrtaceæ—(T) Melaleuca gibbosa, *Labill;* Melaleuca parviflora, *Lindl.*

Aizoaceæ—(T) Mesembryanthemum australe, *Sol.*

Compositæ—(T) Calocephalus Brownii, *F. v. M.;* Ixodia achilleoides, *R. Br.;* Podolepis rugata, *Labill.* (T) Senecio lautus, *Forst.* Very succulent.

Goodeniaceæ—(T) Goodenia ovata, *Sm.* Coriaceous form, yellow-and-green leaves. (T) Scaevola crassifolia, *Labill.*

Campanulaceæ—(T) Lobelia microsperma, *F. v. M.*

Gentianaceæ—(T) Sebæa ovata, *R. Br.*

Scrophulariaceæ—Buechnera (?) linearis, *R. Br.* In fruit only. Doubtful in absence of flowers.

Lauraceæ—(T) Cassytha pubescens, *R. Br.*

Thymelæaceæ—(T) Pimelea glauca, *R. Br.* Apparently a new record for the island.

Gramineæ—(T) Poa cæspitosa, *Forst.*

CAPE BORDA (Dr. R. S Rogers).

Dilleniaceæ—(T) Hibbertia stricta, *R. Br.*

Tremandraceæ—Tetratheca thymifolia, *Sm.*

Olacaceæ—Olax Benthamiana, *Miq.*

Stackhousiaceæ—(T) Stackhousia monogyna, *Labill.*

Rhamnaceæ—(T) Spiridium vexilliferum, *Reiss.*

Leguminosæ—Dillwynia hispida, *Lindl.*

Halorrhagidaceæ—(T) Halorrhagis teucrioides, *A. Gray.*

Myrtaceæ—(T) Calythrix tetragona, *Labill.*

Compositæ—(T) Ixiolæna supina, *F. v. M.;* Ixodia achilleoides, *R. Br.* A very distinct form with *narrow linear* almost filiform leaves. Bentham describes the leaves as "linear, lanceolate, or slightly spathulate." Olearia teretifolia, *F. v. M.*

Goodeniaceæ—(T) Goodenia amplexans, *F. v. M.* (T) Scævola æmula, *R. Br.*

Epacridaceæ—Astroloma conostephioides, *F. v. M.*

Labiatæ—Prostanthera spinosa, *F. v. M.*

Polygonaceæ—(T) Muehlenbeckia adpressa, *Meissn.*

Thymelæaceæ—(T) Pimelea glauca, *R. Br.*

Orchidaceæ—(T) Caladenia latifolia, *R. Br.* (T) Caladenia Patersoni, *R. Br.*

Gramineæ—(T) Stipa semibarbata, *R. Br.*

GREVILLEA ROGERSI, *nova species.*—In capite Borda, insula Kangaroo Island, in solo arenoso crescens.

Frutex humilis intricate ramosus. Folia in brevissimis lateralibus ramulis conferta, similia fasciculo 4-5 mm. longa, angusto-lanceolata dense revolutis marginibus, sæpe curvata, duræ texturæ et dense tecta brevibus et conicis asperitatibus subtus lanata. Flores solitarii, vel in umbellis paucissimis floribus in brevibus foliosis lateralibus ramulis; pedicelli circiter 7-8 mm. longa. Corollæ tubus 12-13 mm. longus, pars inferior leviter dilatata, glaber in exteriore parte, intus inferne barbatus ad fundum puniceus, obtusi et revoluti lobuli subflavi. Torus obliquus. Hypogyna glandula semi-annulata. Ovarium dense villosum, breviter stipulatum. Styla erecta quum flores decidissent, circiter $2\frac{1}{4}$ cm. longa; stigma lateralis.

A low, dense, intricately-branched shrub about 18 to 30 in. high as seen, with terete rather thick branches covered when young with crisp white hairs. *Leaves* densely crowded on very short lateral shoots so as to appear clustered, rarely alternate, and more distant on some elongated shoots, 4 to 5 mm. long, narrow-lanceolate, acute, with margins so closely revolute that the under-side is mostly concealed, often curved, of hard texture and densely covered on the upper side with short conical asperities: woolly-hairy on the underside. *Flowers* solitary, in pairs or in very few-flowered umbels, terminal on the short lateral shoots, the pedicels slender, about 7 to 8 mm. long, sparingly hairy. *Corolla-tube* 12 to 13 mm. long, the lower part slightly dilated, pink to scarlet, 6-veined, glabrous outside, with a tuft of hairs inside near the base, the upper part of the tube with the short obtuse lobes revolute and of yellowish colour. *Torus* oblique. *Hypogynous gland* semi-annular. *Ovary* densely villous, shortly stipitate. *Style* straight after flowering, about $2\frac{1}{4}$ cm. long, sparingly hairy in the lower half; stigmatic disk lateral. *Fruit* ovate-oblong, about 13 mm. long, glabrous when old. *Seed* scarcely winged.

This interesting new species belongs to Section iii., Plagiopoda, but is not closely allied to any described species known to me. The peculiar clustered, hard and rough leaves are unique in the genus; they remind somewhat of the leaves of *Dendrobium cucumerinum.* It seems strange that such a remarkable species should have remained undiscovered until now, but Dr. Rogers writes that this part of Kangaroo Island has been little visited by collectors on account of the difficulty of reaching the place by water or by land. Dedicated to Richard Sanders Rogers, M.A., M.S., M.D. (Edin.), Honorary Physician to the Adelaide Hospital, etc., the leading authority on South Australian Orchids. He collected this species at Cape Borda.

The Tasmanian Element in the Kangaroo Island Flora.

Tate (1) deals with this matter so far as certain species, which he enumerates as not known in any other part of South Australia, are concerned. In the same paper he deals further with the Tasmanian element, and adds: —

> The number of its (Kangaroo Island) peculiar species and those of Tasmanian origin entitle it to a subregional rank.

He further states: —

> The absence of a large number of species, alien and endemic, widely spread over the continent would seem to imply isolation before immigration of the extra-Australian species and those endemic ones of marked exotic genera to the shores of the adjacent mainland. The isolation was, without doubt, subsequent to that of Tasmania, though prior to the advent of man in Australia, botanical isolation being secured against man's aggression by reason of his inability to cross the Straits.

He also states that of 348 Australian species inhabiting Kangaroo Island, 203 occur in Tasmania.

I have not time to bring these figures up to date, but will only point out that enumeration of the few species (precisely 100) collected by Dr. Rogers and me in Kangaroo Island from four localities, gives us 67 Tasmanian species. Species collected at more than one of the four localities have, in these figures, been enumerated more than once.

Tate further says that Kangaroo Island is the meeting-ground of Tasmanian and Western Australian species. At Proc. R.S.S.A., xiii., 119, he shows the affinity of Kangaroo Island plants and those of South Eyre Peninsula, and observations in these two directions might well occupy the attention of a young South Australian botanist now that enumeration of the floras is better defined than when Tate first made his statements.

Tepper's paper, "Discovery of Tasmanian Plants near Adelaide" (Journn. Linn. Soc., xx., 72), may be referred to.

I have drawn attention to alien species by asterisks; compare Tate (1).

Port Augusta.

MALVACEÆ—Sida corrugata, *Lindl.*

ZYGOPHYLLACEÆ—Nitraria Schoberi, *L.* Fruits purple when ripe and saline to taste.

SAPINDACEÆ — Dodonæa viscosa, *L.*, var. attenuata, *F. v. M.* Twenty feet high, and with stem diameter of 6 in.

LEGUMINOSÆ—Cassia eremophila, *A. Cunn.*, var. platypoda, *Benth.* 3 to 4 ft. high. Cassia Sturtii, *R. Br.*, var.

coriacea, *Benth.* 3 to 4 ft. high. Templetonia egena, *Benth.*

Aizoaceæ—Mesembryanthemum æquilaterale, *Haw.*; Mesembryanthemum crystallinum, *L.*

Loranthaceæ—Loranthus sp. on Acacia salicina, and on Exocarpus aphylla. This seems to belong to the section of Loranthus with the petals united to the middle, and with adnate anthers. In that case it may be Loranthus angustifolius, *R. Br.*, a South Australian species not in the Herbarium. Open flowers are required to determine the species with certainty.

Goodeniaceæ—Scævola collaris, *F. v. M.*

Borraginaceæ—Heliotropium europæum, *L.*

Solanaceæ—Solanum nigrum, *L.*

Myoporaceæ—Eremophila scoparia, *F. v. M.* With purple flowers and 6 to 7 ft. high.

Chenopodiaceæ—Atriplex angulatum, *Benth.*; Atriplex holocarpum, *F. v. M.* Bassia diacantha, *F. v. M.* With nearly always a third small spine on the fruits. Kochia brevifolia, *R. Br.*; Kochia oppositifolia, *Benth.*; Salsola Kali, *L.*

Nyctaginaceæ—Boerhaavia diffusa, *L.*

Thymelæaceæ—Pimelea microcephala, *R. Br.*

Euphorbiaceæ—Phyllanthus Fuernrohrii, *F. v. M.*

Casuarinaceæ—Casuarina glauca, *Sieb.* Some were planted; I am uncertain whether all were planted. Casuarina stricta, *Ait.*

Santalaceæ—Exocarpus aphylla, *R. Br.*

Gramineæ—Cynodon dactylon, *L. C. Rich.*; Eragrostis falcata, *Gaud.*; Stipa setacea, *R. Br.*

Murray Bridge.

My friend Mr. R. H. Cambage, of Sydney, accompanied me to the locality, and we took the opportunity of examining the flora and comparing notes, and a list of our finds is referred to below.

Dilleniaceæ—Hibbertia stricta, *R. Br.*

Cruciferæ—* Diplotaxis tenuifolia, *DC.* See also page 268. The commonest local weed.

Pittosporaceæ—Billardiera cymosa, *F. v. M.*; Bursaria spinosa, *Cav.*

Malvaceæ—* Malva rotundifolia *L.*

Sterculiaceæ—Lasiopetalum Baueri, *Steetz.*

Rutaceæ—Boronia cœrulescens, *F. v. M.*

Rhamnaceæ—Stenanthemum leucophractum, *Reiss.*

Sapindaceæ—Dodonæa hexandra, *F. v. M.*; Dodonæa viscosa, *L.*, var. cuneata, *F. v. M.*

Leguminosæ—Cassia eremophila, *A. Cunn.*, var. platypoda; Cassia eremophila, *A. Cunn.*, var. zygophylla; Daviesia genistifolia, *A. Cunn.* Leaves hardly articulate on the branches. Daviesia ulicina, *Sm.*, var. ruscifolia.

MYRTACEÆ—Baeckia Behrii, *F. v. M.;* Leptospermum lævigatum, *F. v. M.;* Melaleuca acuminata. We have two dense shrubs, one with bright-green leaves, comparatively broad. This is M. acuminata. It is mallee-like, and forms a dense shrub of 5-6 ft. Only fruits available. A second species which might casually be confused with it, has slightly broader and less curved leaves. Size and habit about same. Of a paler green. I refer this doubtfully to M. parviflora. I have not seen flowers. We have straight-, curved-, and broad-leaved Melaleucas at Murray Bridge, showing how impossible it is to maintain M. curvifolia, *Schl.*, as a species. These Melaleucas should be further examined.

ŒNOTHERACEÆ—* Œnothera biennis, *L.*

RUBIACEÆ—Opercularia hispida, *Sm.* (See also Hog Bay, Kangaroo Island.)

COMPOSITÆ—Athrixia tenella, *Benth.;* Cotula australis, *Hook.;* * Hedypnois cretica, *Willd.;* Helichrysum apiculatum, *DC.;* Olearia glandulosa, *Labill.;* Olearia lepidophylla, *Benth.;* Vittadinia australis, *A. Rich.* (2 forms).

GOODENIACEÆ—Goodenia geniculata, *R. Br.;* Goodenia lanata, *R. Br.;* Goodenia varia, *R. Br.* (with long, weak branches); Velleya paradoxa, *R. Br.*

CAMPANULACEÆ—Lobelia microsperma, *F. v. M.*

EPACRIDACEÆ—Leucopogon cordifolius, *Lindl.*

BORRAGINACEÆ—Halgania cyanea, *Lindl.*

MYOPORACEÆ—Eremophila Brownii, *F. v. M.;* Myoporum platycarpum, *R. Br.* A medium-sized tree.

LABIATÆ—Prostanthera coccinea, *F. v. M.;* Westringia rigida, *R. Br.*

CHENOPODIACEÆ—Atriplex Muelleri, *Benth.* With large leaves. Enchylæna tomentosa, *R. Br.*

LAURACEÆ—Cassytha melantha, *R. Br.*

PROTEACEÆ—Hakea ulicina, *R. Br.*

THYMELÆACEÆ—Pimelea curviflora, *R. Br.;* Pimelea serpyllifolia, *R. Br.*

EUPHORBIACEÆ—Adriana quadripartita, *Gaud.;* Euphorbia Drummondii, *Boiss.*

SANTALACEÆ—Exocarpus spartea, *R. Br.;* Fusanus acuminatus, *DC.*

CONIFERÆ—Callitris propinqua, *R. Br.* This handsome Cypress Pine has often much the habit of a Pinus, say of an Aleppo Pine. It has not a pointed top in large trees, and is of spreading habit. There are trees with trunks 3 ft. in diameter, but not proportionately tall. Foliage dark-coloured, not glaucous. Would be called a Black Pine. I believe I saw the same species at Quorn and other places from a railway carriage. For further particulars concerning this not well-known species, see my "Forest Flora of New South Wales," part xii., p. 54. It should be extensively cultivated for timber, and shelter purposes in dry country.

LILIACEÆ—Arthropodium paniculatum, *R. Br.;* Tricoryne elatior, *R. Br.*

CYPERACEÆ—Gahnia deusta, *Benth.*

GRAMINEÆ—Amphipogon strictus, *R. Br.;* Festuca rigida, *Mert.* and *Koch.;* Panicum Mitchelli, *Benth.* Small form. Pappophorum commune, *F. v. M.;* Stipa pubescens, *R. Br.;* Stipa scabra, *Lindl.*

Fowler Bay (121).[2]

The specimens from Fowler Bay were partly collected by Dr. R. S. Rogers, and partly communicated by that gentleman on behalf of Mrs. Tom Brown, of Nullarbor Station.

PAPAVERACEÆ—* Papaver hybridum, *L.* Introduced from Europe.

CRUCIFERÆ — Capsella cochlearia, *F. v. M.*, var. ochrantha, *F. v. M.* (Thlaspi ochranthum, *F. v. M.*); Capsella elliptica, *Mey.;* Lepidium rotundum, *DC.;* Stenopetalum lineare, *R. Br.*

POLYGALACEÆ—Comesperma volubile, *Labill.*

FRANKENIACEÆ—Frankenia pauciflora, *DC.*

MALVACEÆ—* Malva parviflora, *L.* Introduced from Europe. Plagianthus microphyllus, *F. v. M.;* Plagianthus spicatus, *Benth.*

ZYGOPHYLLACEÆ — Zygophyllum ammophilum, *F. v. M.* (?) Determination doubtful. It differs from the type by the greater number of stamens. It is either a form of Zygophyllum ammophilum or a new species. More material required. Zygophyllum apiculatum, *F. v. M.;* Zygophyllum Billardieri, *DC.* Also a small-fruited form,(?) but no flowers available. Zygophyllum fruticulosum, *DC.*, var. bilobum.

GERANIACEÆ—* Erodium cicutarium, *L'Hér.* Introduced from Europe. * Oxalis corniculata, *L.*

RUTACEÆ—Geijera parviflora, *Lindl.*

SAPINDACEÆ—Dodonæa stenozyga, *F. v. M.*

LEGUMINOSÆ—Cassia eremophila, *A. Cunn.;* Swainsona lessertiifolia, *DC.;* Templetonia retusa, *R. Br.*

MYRTACEÆ—Melaleuca pustulata, *Hook.*

AIZOACEÆ—Aizoon zygophylloides, *F. v. M.;* Tetragonia diptera, *F. v. M.*(?) Ripe fruits required to confirm the determination. New for South Australia if correctly determined. Tetragonia implexicoma, *Hook.*

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(2) The numbers given after the localities are the pages in the "Australia Directory," vol. i., 9th edition, 1897, where a description of each locality will be found. They are in regular sequence.

UMBELLIFERÆ—Daucus brachiatus, *Sieb.*

RUBIACEÆ—Galium umbrosum, *Sol.*

COMPOSITÆ—Brachycome pachyptera, *Turcz.;* Brachycome ciliaris, *Less.;* Calotis cymbacantha, *F. v. M.;* Calotis hispidula, *F. v. M.;* Helipterum Haigii, *F. v. M.;* Helipterum incanum, *DC.;* Olearia exiguifolia, *F. v. M.;* Olearia glutinosa, *Benth.;* Olearia Muelleri, *Sond.;* Podolepis rugata, *Labill.* (flower-heads usually small); Senecio lautus, *Forst.;* Senecio vulgaris, *L.*

GOODENIACEÆ—Goodenia pinnatifida, *Schl.;* Velleia paradoxa, *R. Br.*

BORRAGINACEÆ—Echinospermum concavum, *F. v. M.*

SOLANACEÆ—Solanum aviculare, *Forst.*

MYOPORACEÆ—Eremophila Brownii, *F. v. M.* (form with white tomentose leaves); Myoporum insulare, *R. Br.*

LABIATÆ—Teucrium sessiliflorum, *Benth.;* Westringia rigida, *R. Br.*

PLANTAGINACEÆ—Plantago varia, *R. Br.*

CHENOPODIACEÆ—Atriplex vesicarium, *Hew.;* Chenopodium Preissii, *Diels* (in fragments only, and therefore doubtful); Kochia ciliata, *F. v. M.;* Kochia pentatropis, *Tate;* Kochia sedifolia, *F. v. M.;* Kochia villosa, *Lindl.;* Rhagodia crassifolia, *R. Br.*

AMARANTACEÆ—Ptilotus obovatus, *F. v. M.*

THYMELÆACEÆ—Pimelea curviflora, *R. Br.*

URTICACEÆ—Parietaria debilis, *Forst.*

LILIACEÆ—Arthropodium minus, *R. Br.;* Wurmbea dioica, *F. v. M.*

GRAMINEÆ—Danthonia penicillata, *F. v. M.;* Poa nodosa, *Nees.;* Stipa scabra, *Lindl.*

Sinclair Point (LeHunte Bay). (123)

Sinclair Point is sixteen miles from Eyre Bluff.

CRUCIFERÆ—Sisymbrium orientale, *L.*

FRANKENIACEÆ—Frankenia pauciflora, *DC.*

ZYGOPHYLLACEÆ—Zygophyllum Billardieri, *DC.*

COMPOSITÆ — Helipterum incanum, *DC.;* Ixiolæna tomentosa, *Sond.* and *F. v. M.;* Senecio lautus, *Forst.*

GOODENIACEÆ—Scævola crassifolia, *Labill.*

SOLANACEÆ—Nicotiana suaveolens, *Lehm.;* Solanum hystrix, *R. Br.*

LABIATÆ—Westringia Dampieri, *R. Br.*

CHENOPODIACEÆ—Kochia villosa, *Lindl.*

Davenport River (131).

Davenport is a mangrove creek on the southern side of Tourville Bay, which is itself on the north-western part of Denial Bay.

ZYGOPHYLLACEÆ—Zygophyllum Billardieri, *DC.*

Leguminosæ—Templetonia retusa, *R. Br.*
Compositæ—Helipterum incanum, *DC.*
Primulaceæ—Samolus repens, *Pers.*
Verbenaceæ—Avicennia officinalis, *L.* (Mangrove).
Chenopodiaceæ—Rhagodia crassifolia, *R. Br.*
Santalaceæ—Santalum sp.

Murat and Denial Bays (132).

Murat Bay is the north part of Denial Bay.

Polygalaceæ—Comesperma volubile, *Labill.*

Rutaceæ—Geijera parviflora, *Lindl.;* Microcybe pauciflora, *Turcz.* (Eriostemon capitatus, *F. v. M.*).

Myrtaceæ—Melaleuca pustulata, *Hook.*, and a narrow-leaved Loranthus (without flowers) on it.

Compositæ—Brachycome trachycarpa, *F. v. M.;* Olearia Muelleri, *Sond.*

Labiatæ—Westringia rigida, *R. Br.*

Chenopodiaceæ—Atriplex paludosa, *R. Br.* (?); not in fruit.

Laura Bay (135).

Polygalaceæ—Comesperma volubile, *Labill.*

Compositæ—Brachycome pachyptera, *Turcz.*; Ixiolæna tomentosa, *Sond.* and *F. v. M.;* Leptorrhynchos Waitzia, *Sond.*

Labiatæ—Westringia Dampieri, *R. Br.*

Chenopodiaceæ—Atriplex paludosa, *R. Br.*

Euphorbiaceæ—Beyeria viscosa, *Miq.*

Gramineæ—Danthonia penicillata, *F. v. M.;* Poa nodosa, *Nees.;* Stipa pubescens, *R. Br.*

Streaky Bay (141).

Geraniaceæ—* Erodium cicutarium, *L'Hér.;* * Oxalis corniculata, *L.*

Rutaceæ—Geijera parviflora, *Lindl.*

Leguminosæ—* Melilotus parviflorus, *Desf.*

Compositæ—Athrixia tenella, *Benth.:* Erigeron pappochromus, *Labill.:* Helichrysum apiculatum, *DC.:* Olearia glutinosa, *Benth.*

Goodeniaceæ—Goodenia pinnatifida, *Schl.;* Goodenia sp. Near the narrow-leaved form of G. elongata.

Campanulaceæ—Wahlenbergia gracilis, *DC.*

Labiatæ—Teucrium sessiliflorum, *Benth.*

Amarantaceæ—Trichinium spathulatum, *R. Br.*

Venus Harbour (146).

Polygalaceæ—Comesperma volubile, *Labill.*

Sterculiaceæ—Lasiopetalum discolor, *Hook.*

Zygophyllaceæ—Nitraria Schoberi, *L.*
Geraniaceæ—Erodium cicutarium, *L'Hér.*
Crassulaceæ—Tillæa verticillaris, *DC.*
Myrtaceæ—Melaleuca acuminata, *F. v. M.;* Melaleuca parviflora, *Lindl.*
Compositæ—Leptorrhynchos Waitzia, *Sond.;* Podotheca angustifolia, *Less.;* Senecio lautus, *Forst.*
Primulaceæ—* Anagallis arvensis, *L.;* Samolus repens, *Pers.*
Borraginaceæ—Echinospermum concavum, *F. v. M.*
Myoporaceæ—Myoporum insulare, *R. Br.*
Verbenaceæ—Avicennia officinalis, *L.*
Chenopodiaceæ—Atriplex cinera, *Poir.*
Amarantaceæ—Trichinium spathulatum, *R. Br.*
Liliaceæ—Bulbine semibarbata, *Haw.*
Gramineæ—Distichlis maritima, *Rafin.;* Poa cæspitosa, *Forst.*

Flinders Island (148).

The largest and central island of the Investigator group.
Ranunculaceæ—Clematis microphylla, *DC.*
Zygophyllaceæ—Zygophyllum Billardieri, *DC.*
Leguminosæ—* Medicago denticulata, *Willd.;* * Melilotus parviflorus, *Desf.;* Swainsona sp.; Templetonia retusa, *R. Br.*
Myrtaceæ—Calythrix tetragona, *Labill.*
Aizoaceæ—Tetragonia implexicoma, *Hook.*
Compositæ—Senecio lautus, *Forst.*
Epacridaceæ—Leucopogon Richei, *R. Br.*
Myoporaceæ—Myoporum insulare, *R. Br.*
Labiatæ—Westringia Dampieri, *R. Br.*
Gramineæ—* Hordeum murinum, *L.*

Port Elliston (151).

On the east side of Waterloo Bay.
Polygalaceæ—Comesperma volubile, *Labill.*
Malvaceæ—Hibiscus Wrayæ, *Lindl.*
Portulacaceæ—Calandrinia calyptrata, *Hook.*
Geraniaceæ—* Erodium cicutarium, *L'Hér.*
Stackhousiaceæ—Stackhousia monogyna, *Labill.*
Leguminosæ—Eutaxia empetrifolia, *Schl.;* Lotus australis, *Andr.*
Myrtaceæ—Malaleuca pustulata, *Hook.*
Compositæ—Erigeron pappochromus, *Labill.;* Helichrysum apiculatum, *DC.;* Helipterum incanum, *DC.;* Podotheca angustifolia, *Less.;* Senecio lautus, *Forst.*
Goodeniaceæ—Goodenia geniculata, *R. Br.;* Scævola crassifolia, *Labill.*

Primulaceæ—* Anagallis arvensis, *L.*
Myoporaceæ—Myoporum humile, *R. Br.*
Labiatæ—Westringia Dampieri, *R. Br.*
Euphorbiaceæ—Adriana quadripartita, *Gaud.*
Gramineæ—Poa cæspitosa, *Forst.*

Williams Island (168).

A gentle, undulating island, and covered with a dense mass of hummocky bushes about 2 ft. high. The foliage is almost entirely glaucous. Grasses almost absent. No trees or grazing animals on the island. There are a few snakes; these animals were very rare in the places we visited.

Cruciferæ—Lepidium foliosum, *Desv.*

Frankeniaceæ—Frankenia pauciflora, *DC.*

Zygophyllaceæ—Nitraria Schoberi, *L.*

Aizoaceæ—Mesembryanthemum æquilaterale, *Haw.*, but the section scarcely triangular.

Umbelliferæ—Apium leptophyllum, *F. v. M.*

Chenopodiaceæ—Atriplex (?) campanulata, *Benth.* Very common. Rhagodia (crimson fruit). A sea of Atriplex cinerea, *Poir.*

Gramineæ—Bromus arenarius, *Labill.* Two feet high.

Neptune Isles.

Named by Flinders, February 21, 1802, "for they seemed inaccessible to men." They consist of the North and South Neptunes. We landed on that South Neptune Island (there are two) on which is the lighthouse. It is about two miles round and about 120 ft. high.

SOUTH NEPTUNE (169).

This has some interest as a granite flora. The vegetation is very hummocky and intensely succulent and saline. Nothing higher than 2-3 ft. There are very few species. There is a large number of big goats on the island, and these animals have already changed the vegetation.

Cruciferæ—Lepidium foliosum, *Desv.*

Frankeniaceæ—Frankenia pauciflora, *DC.*, with pleasing, purple-pink flowers; very common.

Caryophyllaceæ—Spergula marina, *Bartl.* and *Wendl.*; Spergularia rubra, *Cambess.*

Malvaceæ—Lavatera plebeja, *Sims.* "Marshmallow." Almost extinct owing to the goats. Also a Malva or Modiola in leaf only. Everywhere eaten down.

Zygophyllaceæ—Nitraria Schoberi, *L.* A dense shrub with fleshy spathulate leaves, oval- or egg-shaped fruits ½ in., brownish purple when ripe. Fleshy pericarp.

Aizoaceæ—Mesembryanthemum æquilaterale, *Haw.*, in full fruit; crimson. You squeeze out the seedy pulp, which has a peculiar flavour, partly saline, and with not too pleasant an odour. It is sweetish, and some people say they like it. The blacks on the mainland are very fond of it.

Umbelliferæ—Apium australe, *Thou.* (leptophyllum); * Conium maculatum, *L.* The Poison Hemlock! (*Dr. Rogers.*)

Compositæ—Cotula australis, *Hook.;* Cotula coronopifolia, *L.* (occurs wherever there is a spring of fresh water); Senecio lautus, *Forst.;* Sonchus oleraceus, *L.*

Chenopodiaceæ—Atriplex cinerea, *Poir.*, locally called "Blue Bush." Atriplex Muelleri, *Benth.;* Enchylæna tomentosa, *R. Br.;* Salicornia australis, *Sol.*

Gramineæ—Distichlis maritima, *Rafin.* There is only one other grass not in flower. It is said that rabbits ate out the grass.

Wedge Island (170).

is one of the Gambier Isles, is three miles long, and has an average width of one mile. The "Australia Directory" says that it is principally formed of limestone, is covered with low bushes and Camarina trees, and a little grass, and has been used as a sheep-run.

Cruciferæ—Cakile maritima, *Scopoli.*

Rhamnaceæ—Spyridium vexilliferum, *Reiss.*

Leguminosæ—Pultenæa rigida, *R. Br.* Not in flower, but typical.

Compositæ—Helichrysum leucopsidium, *DC.;* Ixodia achilleoides, *R. Br.;* Senecio lautus, *Forst.*

Goodeniaceæ—Goodenia ovata, *Sm.*

Chenopodiaceæ—Atriplex cinerea, *Poir.*

Santalaceæ—Exocarpus stricta, *R. Br.*

Cyperaceæ—Scirpus nodosus, *Rottb.*

Thistle Island (173).

Named by Flinders February 21, 1802, after the master of the "Investigator." Here the eagles, as Flinders supposes, mistook the men for kangaroos, and swooped at first. It is nine miles long and rises to a height of 772 ft. in the centre. The "Australian Directory" says:—"Thistle Island has from time to time been used as a sheep- and cattle-run, but has not been found hitherto to answer, owing, it is stated, to the cattle and sheep eating some poisonous herb which grows on the island; otherwise it appears very fit for grazing purposes." At present it is used for grazing and cultivation, and I could not find any plant which could be looked upon as a poison plant. We landed at Whalers' Bay, where there was a large area under barley. Fennel very abundant; acres of it.

CRUCIFERÆ—Cakile maritima, *Scopoli.*

STERCULIACEÆ—Lasiopetalum discolor, *Hook.* Four feet high, in full bloom, pink flowers, and forming a very handsome shrub. It is surely a very desirable plant for gardens in marine situations.

GERANIACEÆ—Pelargonium australe, *Willd.*

RHAMNACEÆ—Spyridium vexilliferum, *Reiss.*

COMPOSITÆ—Brachycome ciliaris, *Less.* A very small-flowered form. Disc achenes winged: achenes of the ligulate flowers with rough sides and without wings. Calocephalus Brownii, *F. v. M.;* Centaurea melitensis, *L.* Very plentiful. Helichrysum apiculatum, *DC.;* Helichrysum leucopsidium, *DC.;* Ixodia achilleoides, *R. Br.;* Olearia lepidophylla, *Benth.;* Picris hieracioides, *L.;* Podolepis rugata, *Labill.;* Senecio lautus, *Forst.;* Sonchus oleraceus, *L.*, var, asper.

GOODENIACEÆ—Goodenia ovata, *Sm.* Coriaceous form, very broad, yellow-green leaves (near G. varia).

MYOPORACEÆ—Myoporum insulare, *R. Br.;* Myoporum humile, *R. Br.* Very lovely dwarf-spreading bush, a blaze of white flowers.

CHENOPODIACEÆ—Chenopodium microphyllum, *F. v. M.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

EUPHORBIACEÆ—Adriana quadripartita, *Gaud.*

CASUARINACEÆ—The island is lightly timbered with Casuarina stricta, *Ait.*

SANTALACEÆ—Exocarpus stricta, *R. Br.*

CYPERACEÆ—Lepidosperma gladiata, *Labill.;* Scirpus nodosus, *Rottb.*

GRAMINEÆ—Bromus sp.

Memory Cove (178).

PITTOSPORACEÆ—Pittosporum phillyræoides, *DC.* (with rigid leaves).

STERCULIACEÆ—Lasiopetalum discolor, *Hook.*

ZYGOPHYLLACEÆ—Zygophyllum Billardieri, *DC.*

MYRTACEÆ—Melaleuca parviflora, *Lindl.*

AIZOACEÆ—Mesembryanthemum australe, *Sol.*

EPACRIDACEÆ—Acrotriche patula, *R. Br.*

LABIATÆ—Westringia Dampieri, *R. Br.* These specimens have three leaves in a whorl like W. rigida, but with the long leaves of W. Dampieri. There is really no difference between the two species. See Bentham's note, B. Fl., v. 129. W. rigida should be merged in W. Dampieri, the latter being technically the older name, since in the original descriptions of both (R. Br., Prod. 501) W. Dampieri comes first in sequence.

THYMELÆACEÆ—Pimelea sp. A large, bushy species without flowers.

GRAMINEÆ—Poa cæspitosa, *Forst.*

Taylor Island (180).

Named by Flinders after the midshipman of the "Investigator" who lost his life near Cape Catastrophe. It is one and a half miles long and about half a mile broad. It is mostly covered with scrub; the south end is grassy ("Australia Directory").

RANUNCULACEÆ—Clematis microphylla, *DC.*

CRUCIFERÆ—Sisymbrium officinale, *Scop.*

MALVACEÆ—Lavatera plebeja, *Sims.*

COMPOSITÆ—Senecio lautus, *Forst.*

CHENOPODIACEÆ—Chenopodium nitrariaceum, *F. v. M.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

Cape Donington (182).

The north-east point of a headland, on the south-east side of the entrance to Port Lincoln.

ZYGOPHYLLACEÆ—Zygophyllum Billardieri, *DC.*, var. bilobum.

RUTACEÆ—Geijera parviflora, *Lindl.*

UMBELLIFERÆ—Didiscus pilosus, *Benth.*

APOCYNACEÆ—Alyxia buxifolia, *R. Br.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

THYMELÆACEÆ—Pimelea flava, *R. Br.*

Port Lincoln (182).

DILLENIACEÆ—Hibbertia Billardieri, *F. v. M.* Two and a half miles along the old Western Road. A tall, floriferous, very beautiful form.

CRUCIFERÆ—* Diplotaxis tenuifolia, *DC.* The pest of Port Lincoln, a yellow-flowering plant, 1-2 ft. high, very bright and beautiful, and exceedingly abundant everywhere at Port Lincoln; a worthless Wild Mustard. Called outside "Port Lincoln Weed." See also J. M. Black in "Journ. Agric. S.A.," June, 1907, p. 687.

MALVACEÆ — Hibiscus Wrayæ, *Lindl.* Rich purple flowers; 4 ft. high.

STERCULIACEÆ—Lasiopetalum Baueri, *Steetz;* Lasiopetalum discolor, *Hook.*

RUTACEÆ—Correa speciosa, *Andr.* Stamford Hill.

LEGUMINOSÆ—Eutaxia empetrifolia, *Schl.* A prickly, uncomfortable shrub. Boston Island. Pultenæa vestita, *R. Br.;* Templetonia retusa, *R. Br.;* 6 ft. high.

MYRTACEÆ—Calythrix tetragona, *Labill.*; Melaleuca decussata, *R. Br.;* Melaleuca parviflora, *Lindl.* Stamford Hill and Kirton Point. Some trees remarkably beautiful in shape. Melaleuca uncinata, *R. Br.* Boston Island, 6 in. diameter, 20 ft. high. Papery bark.

AIZOACEÆ — Mesembryanthemum æquilaterale, *Haw.* (Even on summit of Stamford Hill.)

COMPOSITÆ—Helichrysum apiculatum, *DC.;* Ixodia achilleoides, *R. Br.* Stamford Hill; acres of it. Olearia ciliata, *F. v. M.*

CAMPANULACEÆ—Wahlenbergia gracilis, *DC.*

EPACRIDACEÆ—Acrotriche patula, *R. Br.;* Leucopogon cordifolius, *Lindl.;* Leucopogon Richei, *R. Br.*

APOCYNACEÆ—Alyxia buxifolia, *R. Br.*

SCROPHULARIACEÆ—Veronica distans, *R. Br.* (Dr. Rogers).

MYOPORACEÆ—Myoporum viscosum, *R. Br.*

CHENOPODIACEÆ—Bassia (?) anisacantha. On seashore, 1 ft. high, and spreading. In leaf only. Boston Island.

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.* Boston Island.

LAURACEÆ—Cassytha glabella, *R. Br.*

EUPHORBIACEÆ—Beyeria viscosa, *Miq.*

CASUARINACEÆ—Casuarina stricta, *Ait.* Boston Island.

SANTALACEÆ—Exocarpus aphylla, *R. Br.* Stamford Hill. Fusanus acuminatus, *DC.;* Leptomeria aphylla, *R. Br.*

GRAMINEÆ—Distichlis maritima, *Rafin.;* Spinifex hirsutus, *Labill.;* Stipa scabra, *Lindl.* All from Boston Island.

The following trees are planted in the streets of Port Lincoln, and are doing well on the whole:—

Lagunaria Patersoni, *G. Don;* from Norfolk Island. Schinus molle, *L.;* Pepper. Callitris propinqua, *R. Br.;* the Cypress Pine, native of the district. Eucalyptus globulus, *Labill.;* a forest tree; seems to be too large for street-planting. Pinus halepensis, *Mill.;* does splendidly. Nicotiana glauca, *R. Grah.;* a small tree. Cupressus sempervirens, *L.* Moreton Bay Fig; not doing well. Pomegranate. Oleander.

Port Lincoln to North Shields.

DILLENIACEÆ—Hibbertia sericea, *Benth.*

HYPERICEÆ—* Hypericum perforatum, *L.* A pretty yellow-flowered plant. A weed pest.

CACTACEÆ — * Opuntia monocantha, *Haw.* Prickly Pear; not much of it along the road; apparently not a pest there, but there is plenty at North Shields. This is a plant which, however, requires watching, and, if necessary, dealing with by authority.

COMPOSITÆ—* Carduus lanceolatus, *L.* (the common Black or Scotch Thistle). Not rare. Humea cassiniacea, *F. v. M.* A squatty little plant, with the flowers sometimes solitary in the headlets. It appears to be uncommon. * Onopordon acanthium, *L.* (the Cottony or Scotch Heraldic Thistle). Not rare.

GOODENIACEÆ—Goodenia ovata, *Sm.*

EPACRIDACEÆ—Astroloma conostephioides, *F. v. M.;* Astroloma humifusum, *R. Br.*

PRIMULACEÆ—Samolus repens, *Pers.*

CONVOLVULACEÆ—Convolvulus erubescens, *Sims.*

CHENOPODIACEÆ—Enchylæna tomentosa, *R. Br.*

AMARANTACEÆ—Ptilotus, sp.

PROTEACEÆ—Hakea cycloptera, *R. Br.*

LILIACEÆ—* Asphodelus fistulosus, *L.* An onion-like plant. A weed pest. Xanthorrhœa semiplana, *F. v. M.* Occurs 3-4 miles out.

Port Lincoln to Lake Wangary and Mount Dutton Bay.

RANUNCULACEÆ—Clematis microphylla, *DC.*

DILLENIACEÆ—Hibbertia Billardieri, *F. v. M.* Remarkably fine, 4-5 ft. high, in shelter and very bushy. Hibbertia sericea, *Benth.;* Hibbertia stricta, *R. Br.*

PITTOSPORACEÆ—Bursaria spinosa, *Cav.* Called Christmas-tree locally, because it usually flowers profusely at that period. Pittosporum phillyræoides, *DC.*, at 20 miles.

MALVACEÆ—Hibiscus Wrayæ, *Lindl.* "Port Lincoln Rose." Up to 6 ft. high, and nipped by stock.

STERCULIACEÆ—Lasiopetalum (?) Baueri, *Steetz*, not in flower; Lasiopetalum discolor, *Hook.*

LEGUMINOSÆ—Daviesia brevifolia, *Lindl.;* Hardenbergia monophylla, called "Purple Lilac" in the district; Pultenæa villifera, *Sieb.*, var. australis, *Benth.*

ROSACEÆ—* Rubus rubiginosa, *P. J. Muell.* "Sweet Briar." At say 7 miles.

HALORRHAGIDACEÆ—Halorrhagis digyna, *Labill.*, 2-3 ft. high at 19-20 miles.

MYRTACEÆ—Bæckia Behrii, *F. v. M.* With shorter flower-stalks and shorter recurved point of the leaves, apparently also of less erect growth; 2-3 ft. high in clumps or amongst Xanthorrhœa. Callistemon coccineus, *F. v. M.* Very abundant. Large long masses. Walls of it 6-8 ft. high. Melaleuca decussata, *R. Br.* Pink flowers. Melaleuca parviflora, *Lindl.* (curvifolia, *Schl.*). Everywhere. Called "Black Tea-tree" from its usual dark aspect. Fine rounded shapely trees giving the country a park-like aspect. Melaleuca pustulata, *Hook.* White flowers. Melaleuca uncinata, *R. Br.* Brooms made of the plant, hence the name "Broom-bush."

AIZOACEÆ—Mesembryanthemum crystallinum, *L.:* Tetragonia implexicoma, *Hook.*

CACTACEÆ—* Opuntia monocantha, *Haw.* At Little Swamp.

COMPOSITÆ—Athrixia tenella, *Benth.* * Inula graveolens, *Desf.* "Stinkwort." Very bad. * Onopordon Acanthium, *L.* Very plentiful at the edge of "Big Swamp." Senecio lautus, *Forst.* Vittadinia australis, *A. Rich.*

EPACRIDACEÆ—Astroloma humifusa, *R. Br.;* Leucopogon Richei, *R. Br.;* Lissanthe strigosa, *R. Br.*

BORRAGINACEÆ — Echium plantagineum, *L.* See "Agric. Gaz. N.S.W.," March, 1905. Halgania cyanea, *Lindl.*

SOLANACEÆ—Nicotiana suaveolens, *Lehm.*

MYOPORACEÆ—Myoporum humile, *R. Br.* Sweet-scented flowers.

CHENOPODIACEÆ—Atriplex cinera, *Poir.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.* Called "Sarsaparilla."

PROTEACEÆ—Adenanthos terminalis, *R. Br.* Yellow-flowered, prostrate shrub up to 2 ft. high. Wangary and along the road, 18-19 miles out. Banksia æmula, *R. Br.* Wanilla Forest Reserve. Very handsome. Banksia marginata, *Cav.*, 6-8 ft. high. Grevillea ilicifolia, *R. Br.* "Holly bush," 2-3 ft. high. Greenish-white flowers. At 16 miles. Hakea cycloptera, *R. Br.* Large fruit. Appears local in Port Lincoln district. Hakea rostrata, *F. v. M.*

THYMELÆACEÆ—Pimelea glauca, *R. Br.* In swampy land.

EUPHORBIACEÆ—Adriana quadripartita, *Gaud.*

CASUARINACEÆ—Casuarina stricta, *Ait.*

SANTALACEÆ—Exocarpus cupressiformis, *Labill.*

CONIFERÆ—Callitris propinqua, *R. Br.* Not common.

LILIACEÆ—Thysanotus. Very beautiful, 3 ft. high in clumps of Xanthorrhœa, but apparently not collected. Xanthorrhœe semiplana, *F. v. M.* Common.

TYPHACEÆ—Typha angustifolia, *L.*, in pond near Big Swamp.

Cyperaceæ—Chorizandra enodis, *Nees*. With small dark-coloured spherical heads. Gahnia trifida, *Labill.* At "Eating House" and other places. Known as "Thatching Grass." Black Grass and Thatching Grass often occur together. Mesomelæna deusta, *Benth.* Known as "Black Grass."

Gramineæ—Anthistiria ciliata, *L.* Triodia irritans, *R. Br.*, 20-22 miles out.

Sir Joseph Banks Group

consists of twenty islands, islets, and rocks, in Spencer Gulf. Revesby and Spilsby are the only islands on which water is obtainable and where the vegetation is higher than low bushes ("Australia Directory," p. 193). We visited Revesby.

Revesby (197).

A sandy island for the most part, and with a very coarse-grained granite at the western end. It is three miles long. The tree vegetation seems to be all Myoporum insulare and Casuarina stricta. Of the latter only five remain alive now out of ten formerly said to be growing.

There are said to be only two mallee plants on the island, but I did not see them.

The ripe fruits of Posidonia australis, *Hook.*, *f.*, were especially abundant in Spencer Gulf, off and on the shores of Revesby Island, Port Lincoln, etc. Compare Tepper, these Proceedings, iv., 1-4 and 47-9; also Ascherson, *ib.* v. 37-9.

Frankeniaceæ—Frankenia pauciflora, *DC.*

Malvaceæ—Lavatera plebeja, *Sims.* "Marshmallow."

Zygophyllaceæ—Nitraria Schoberi, *L.* Very large plants.

Geraniaceæ—* Erodium cicutarium, *L'Hér.*

Aizoaceæ—Mesembryanthemum crystallinum, *L.*

Compositæ—Calocephalus Brownii, *F. v. M.*, 2 ft. high and hummocky; Senecio lautus, *Forst.*

Myoporaceæ—Myoporum insulare, *R. Br.*

Chenopodiaceæ—Atriplex cinerea, *Poir.*; Atriplex paludosa, *R. Br.*; Enchylæna tomentosa, *R. Br.*

Polygonaceæ—Muehlenbeckia adpressa, *Meissn.* A small trailing plant, and also found on tallest shrubs.

Cyperaceæ—Scirpus nodosus, *Rottb.*

Gramineæ—Spinifex hirsutus, *Labill.*; Distichlis maritima, *Rafin.*; * Hordeum murinum, *L.*

Althorpes (216).

Althorpe Isles are three in number, the south and largest being four and a half miles from Cape Spencer and twenty-six and a half miles from Cape Borda. "It is of an irregular shape, about six cables across, nearly flat-topped, and 305 ft. high" ("Australia Directory").

CRUCIFERÆ—Lepidium foliosum, *Desv.*

CARYOPHYLLACEÆ—Spergularia rubra, *Cambess.*

MALVACEÆ—Lavatera plebeja, *Sims;* *Malva parviflora, *L.*

LEGUMINOSÆ—Swainsona sp. (in leaf only).

UMBELLIFERÆ—Apium prostratum, *Labill.*

COMPOSITÆ—Podolepis acuminata, *R. Br.;* Senecio lautus, *Forst.*

Marion Bay, Investigator Strait (286).

DILLENIACEÆ—Hibbertia stricta, *R. Br.*

STACKHOUSIACEÆ—Stackhousia monogyna, *Labill.*

LEGUMINOSÆ—Kennedya prostrata, *R. Br.;* Pultenæa tenuifolia, *R. Br.*

COMPOSITÆ—Olearia ciliata, *F. v. M.;* Senecio lautus, *Forst.*

EPACRIDACEÆ—Leucopogon Richei, *R. Br.*

PRIMULACEÆ—*Anagallis arvensis, *L.*

LOGANIACEÆ—Logania ovata, *R. Br.*

SOLANACEÆ—Solanum simile, *F. v. M.*

SCROPHULARIACEÆ—Euphrasia Brownii, *F. v. M.*

MYOPORACEÆ—Myoporum insulare, *R. Br.*

POLYGONACEÆ—Muehlenbeckia adpressa, *Meissn.*

THYMELÆACEÆ—Pimelea glauca, *R. Br.*

LILIACEÆ—Dianella revoluta, *R. Br.*

Port Moorowie, Yorke Peninsula (288).

Immediately east of Gilbert Point.

COMPOSITÆ—Athrixia tenella, *Benth.;* Leptorrhynchos squamatus, *Less.*

GOODENIACEÆ—Velleia paradoxa, *R. Br.*

MYOPORACEÆ—Eremophila crassifolia, *F. v. M.* The remarkable and prominent resinous glands on the branches are not mentioned in the description of this plant in the "Flora Australiensis." The specimens agree in other respects better with Mueller's plate in his "Myoporinous plants," but the description, "Corolla not twice as long as the calyx" (B. Fl., v., 11), does not agree either with the specimens or with Mueller's figure. Myoporum insulare, *R. Br.*

Cape Jervis (316).

This is a wind-swept cape. The soil is poor, and, to add to the troubles of a cultivator, there are rabbits galore. Many plants are viscid.

Ranunculaceæ—Clematis microphylla, *DC.*

Dilleniaceæ—Hibbertia stricta, *R. Br.*

Pittosporaceæ—Bursaria spinosa, *Cav.* Near the coast quite stunted, and clinging to the broken ground.

Sterculiaceæ—Thomasia petalocalyx, *F. v. M.* Near the sea are dense, eaten-down tussocks of 1 ft. high and several feet diameter. Further back the shrubs are 2-3 ft., and with their pink flowers and soft foliage form very beautiful plants well worthy of a place in gardens.

Rhamnaceæ--Spyridium sp.

Leguminosæ—Hardenbergia monophylla, *Benth.* Very broad leaves. Kennedya prostrata, *R. Br.*

Myrtaceæ—Melaleuca parviflora, *Lindl.* Fine spreading tree 2 ft. diameter, 30 ft. high.

Cucurbitaceæ—Cucumis myriocarpus, *Naud.*, or Melothria Muelleri, *Benth.* Probably the former. The two specimens are hardly distinguished in foliage, but the fruits are totally different.

Aizoaceæ—Mesembryanthemum æquilaterale, *Haw.*

Rubiaceæ—Galium umbrosum, *Sol.*

Compositæ—Calocephalus Brownii, *F. v. M.;* * Carduus marianus, *L.* Abundant. * Centaurea melitensis, *L.*, is abundant, as many other weed pests; Erechtites quadridentata, *DC.;* Helichrysum apiculatum, *DC.* Dwarf. Ixiolæna supina, *F. v. M.;* Olearia sp. Dense masses (small-leaved), 4 ft., not in flower.

Goodeniaceæ—Goodenia amplexans, *F. v. M.* Broad-leaved, viscid, stem-clasping, bushy, and spreading, 1 ft.-1 ft. 6 in. A very handsome plant for places where there is but little dust. Goodenia geniculata, *R. Br.* A dwarf plant, radical-leaved, and then runners. Scævola microcarpa, *Cav.*

Campanulaceæ—Wahlenbergia gracilis, *DC.*

Primulaceæ—* Anagallis arvensis, *L.*

Gentianaceæ—Erythræa australis, *R. Br.*

Solanaceæ—* Lycium australe, *F. v. M.* 3-4 ft. Fleshy-leaved.

Proteaceæ—Grevillea lavandulacea, *Schl.;* Hakea rostrata, *F. v. M.;* Hakea rugosa, *R. Br.*

Thymelæaceæ—Pimelea glauca, *R. Br.* Dwarf.

Casuarinaceæ—Casuarina distyla, *Vent.;* Casuarina stricta, *Ait.* One of the few large trees.

Liliaceæ — Arthropodium paniculatum, *R. Br.;* Xanthorrhœa. Not in flower.

Cyperaceæ—Gahnia lanigera, *Benth.* Forming tussocks. Lepidosperma gladiatum, *Labill.;* Lepidosperma laterale, *R. Br.* Forming tussocks.

Gramineæ—* Bromus madritensis, *L.;* Distichlis maritima, *Rafin;* * Hordeum murinum, *L.*

ACACIAS

(in alphabetical order).

A. acinacea, Lindl., 2-3 ft. Kirton Point, Port Lincoln.

A. anceps, R. Br. A coarse round-headed shrub, straggly, of 4-5 ft. high. Has large, sweet-scented flowers; seen growing on the limestone only. Point Kirton, Cape Donington, and Port Elliston (R. S. Rogers).

A. armata, R. Br. Hog Bay (Kangaroo Island), and various other places; very plentiful. Pods viscid, hairy.

A. brachybotrya, Benth. Murray Bridge.

A. calamifolia, Sweet. A tall bushy shrub in flower at Kirton Point; also at Port Lincoln in flower and fruit. Murray Bridge in young bud. At Lake Wangary only 2-3 ft. high. Marion Bay, Yorke Peninsula (R. S. Rogers).

A. dodonæfolia, Willd. A viscid, tall shrub or small tree. Hog Bay (Kangaroo Island), Boston Island, Stamford Hill, and Port Lincoln.

A. longifolia, Willd., Kirton Point. A tall, bushy shrub.

A. montana, Benth. Murray Bridge, neither in flower nor fruit.

A. myrtifolia, Willd. Aldgate.

A. notabilis, F. v. M. Fowler Bay (R. S. Rogers).

A. pycnantha, Benth. Hog Bay, 10-15 ft., glaucous, and affected with galls. Cape Couedie, Murray Bridge, Memory Cove.

A. retinodes, Schl. At Hog Bay (Kangaroo Island), and glaucous. At Aldgate, a medium-sized tree, with sweet-scented flowers, and flourishing in damp situations. The width of the phyllodes varies a good deal.

A. retinodes, Schl., var. *Gillii* (**new var.** Syn. *A. pycnantha*, *Benth.*, var. (?) *angustifolia*, Benth., *B. Fl.*, ii., 365), Port Lincoln to Marble Range (W. Gill, December, 1897). A thin, straggling, wiry shrub of 6 ft. or more, with divaricate angular branches and coriaceous phyllodia, spreading often in a right angle or even reflexed. *Young branches very angular, flexuous, frequently in a regular zigzag line.* Flower-heads solitary on axillary, rather long peduncles, or racemose by suppression of the leaves, and then in a zigzag line as the branchlets, occasionally exceeding the leaves in length. Flowers, pods, and seeds as in the typical *A. retinodes.*

This Acacia has been brought under my notice several times during the last ten years by Mr. Walter Gill, Conservator of Forests of South Australia. The late J. G. Luehmann, following Bentham, always named it *A. pycnantha*, Benth., var. *angustifolia*, Benth., but while not agreeing with Bentham's view I did not wish to pronounce judgment until I had seen the plant growing naturally. This opportunity presented itself to me on the January, 1907, trip. Mr. Gill's notes are, "No higher than 5-7 ft. Has a decidedly drooping habit. Marble Range, December, 1897," "Two miles out on the western road from Port Lincoln. December, 1900." In examining some plants in the Herbarium of the University of Adelaide I found the plant described as, "Wand-like stem, 3 and 4 to 6 ft. high, drooping at the summit. Heath lands, Port Lincoln" (Professor R. Tate, without date).

I found it to be a thin, straggly, wiry shrub of 6 ft. or so. Extends over a considerable area in the Port Lincoln district—*e.g.*, at Green Patch and the Marble Range (January, 1907). I cannot see that it is sufficiently distinct from *A. retinodes*, Schl., to warrant its description as a new species, although its appearance is striking enough. The most striking difference of the variety *Gillii* consists, in my opinion, in the flexuous branches and inflorescence. In some specimens collected by me some of the branches and nearly all the racemes are actually zigzag. The phyllodes spread generally at a right angle from the branches, and are frequently even reflexed. The pedicels on the raceme are also frequently reflexed or spread at a right angle. In *A. retinodes* the branches are straight, the petiole of the phyllodes forms an acute angle with the branch, and the raceme is straight, with more erect pedicels, rarely spreading in a right angle. In *A. retinodes* the raceme is much shorter than the leaves; in the new variety the raceme is often longer than the leaves, at least in the specimens from Port Lincoln, (J. H. M., January, 1907), but the inflorescence seems to be very variable in this new variety. In the Marble Range (W. Gill) specimens the inflorescence is one-headed, the head on rather long, spreading, or reflexed peduncles. This seems to be the normal inflorescence, and the zigzag racemes in the Port Lincoln specimens are merely the upper parts of leafless branches. Of course, all racemes can be regarded as leafless branches with axillary racemes, but the transition state is very apparent in forms of the new variety, while the typical *A. retinodes* has true racemes. The new variety frequents dry situations; the normal species is usually found in depressed and moist situations. The name *Gillii* will commemorate Mr. Walter Gill, F.L.S., and also Mr. Thomas Gill, I.S.O., to whom I have already alluded.

A. rigens, A. Cunn. A very broad-podded form. Port Augusta. Figured in Part xxx. of my "Forest Flora of New South Wales."

A. rupicola, F. v. M. A very ornamental floriferous wattle of 2-3 ft. at Kirton Point and Port Lincoln to Coffin Bay. Cape Donington (R. S. Rogers).

A. salicina, Lindl. Murray Bridge.

A. salicina, Lindl., var. *Wayæ*, **new var.** A specially compact umbrageous shrub of 3-6 ft. high, chiefly distinguished by its habit and by its moniliform pods, which are not fleshy at maturity as in the normal species. The flowers are also frequently less than 20 in the head. A beautiful small variety for cultivation, with bright-yellow flowers borne in great profusion. Port Lincoln; also found at various places on road to Wangary. Near a well at Dutton Bay a bushy shrub of 5-6 ft. Thistle Island. At Kingscote (Kangaroo Island), a shrub of 3-4 ft. Collected by Dr. R. S. Rogers at Port Elliston and Marion Bay.

In the University Herbarium, Adelaide, from Southern Yorke Peninsula, Kellidie Bay, and Ardrossan (the last in immature fruit only and therefore doubtful). All collected by Professor Tate.

This beautiful wattle is named in honour of Sir Samuel Way, Chief Justice and Lieut.-Governor of South Australia, Vice-Patron of the Australasian Association for the Advancement of Science (Adelaide meeting). It is much admired in the Botanic Gardens, Sydney.

A. spinescens, Benth. Murray Bridge.

A. tetragonophylla, F. v. M. Aldgate.

A. verniciflua, A. Cunn. Aldgate.

Additional Acacia Notes.

The following notes are based on specimens in the Adelaide University Herbarium:—

A. Cambagei, R. T. Baker.

Cootanoorinna Creek, S.A., May 10, 1891; Arkaringa Creek, S.A., May 15, 1891; Gidgea; No. 32, Warrina, May, 1891.

All by R. Helms, Elder Exploring Exp. and named by Tate (following Mueller) *A. homalophylla*, A. Cunn., are *A. Cambagei*, R. T. Baker.

I have not seen specimens of *A. homalophylla*, A. Cunn., from South Australia, and the species should be looked for in that State.

A. Merralli, F. v. M.

Camp 66, September 30, 1891; W.A. Elder Exped. and *Acacia* (Tietkens, or Fowler Bay), both labelled by Tate *Meissneri;* should be *A. Merrallii*, F. v. M.

Probably Fowler Bay is correct, as there is a specimen of *A. Merralli* from "near Charra, Fowler Bay, Mrs. A. Richards," labelled *obliqua*.

EUCALYPTUS

(in alphabetical order).

1. *E. calycogona*, Turcz., var. *gracilis*, Maiden (*E. gracilis*, F. v. M., *partim*. See figures and full details in Part iii. of my "Critical Revision of the Genus Eucalyptus"). On Boston Island, Port Lincoln, it attains the largest size I noted on the trip; a tall, graceful Mallee, with smooth bark and narrow leaves, of a height of 30 ft. and a diameter of trunk up to 1 ft. It occurs also at Stamford Hill (not high up), at Memory Cove, and at Murray Bridge, including a form with apparently larger fruits. Timber brown. Fruits, suckers, and very young buds only seen. Found also at Cape Donington (Port Lincoln) and Fowler Bay (Dr. R. S. Rogers).

2. *E. capitellata*, Sm. Mount Lofty Range. My specimens come very near the type (Port Jackson). See my "Critical Revision of the Genus Eucalyptus," Part viii., p. 218.

3. *E. cladocalyx*, F. v. M. (*E. corynocalyx*, F. v. M.). For remarks on the synonymy of this species see Proc. Linn. Soc., N.S.W., xxix., 768. I studied this species pretty carefully from Port Lincoln to Lake Wangary, where, however, the most valuable trees do not grow (the type, however, comes from the Marble Range, close by Lake Wangary). It is, in this district, an inferior species, and the warning is not inappropriate that seed collected from localities such as this will produce inferior trees. It is a White Gum, more or less scaly-barked like the eastern *hæmastoma*. Rather straggling and spreading, a good head of dark-coloured, rather broadish, shiny foliage. Timber whitish, hence "White Gum"; looked upon locally as inferior to Red (*leucoxylon*). "White ants go through it," I was informed locally. At 7-8 miles from Port Lincoln (old road); it often has the grey bark of one of the New South Wales Grey Gums (*punctata*). Timber pale, but slightly brown in the middle. Abundant at 11 miles. It often sheds the greyish outer bark, and then becomes smooth brown all over like the eastern *Angophora lanceolata*. At 12-14 miles we have an association between

it and *Xanthorrhœa semiplana*. The *cladocalyx* does not impress me here. It reminds me of *Angophora lanceolata* in its goutiness and gnarledness. It has a thick, sappy bark of a rich orange colour. I also collected the species at Port Augusta.

4. *E. cneorifolia*, DC. The "Narrow-leaf" of Kangaroo Island. At Hog Bay it has a white stem and is rather tall, up to 40 ft. when allowed to grow singly, but is usually cut down, or of much smaller growth. As a large tree the bark is slightly ribbony, the trunk rough, or box-scaly. It has very narrow suckers and forms a scrub of extraordinary denseness, impenetrable. The timber is red, both of the large trees and the small scrubby form. Collected also at Kingscote. The superficial resemblance between the ripe fruits, in dense clusters, and those of *E. incrassata*, var. *conglobata*, is remarkable. The ripe buds, "egg in eggcup," also display a considerable resemblance to those of var. *dumosa*. The narrowness of the leaves and the redness of the timber, however, sharply separate *E. cneorifolia* from any form of *incrassata*.

5. *E. cosmophylla*, F. v. M. Mount Lofty Range. This appears to be the only species of Eucalyptus endemic to South Australia. The fruits vary much in size, those from $\frac{1}{2}$ in. bare to $\frac{3}{4}$ in. full, being found on the same branch. It is abundant, both shrubs and small trees; bark ribbony, forming a straggly, twisted tree. I have known it to be called "Blue Gum." It is, however, not generally known that *E. cosmophylla* may attain a considerable size. In 1904 Mr. Walter Gill, Conservator of Forests, Adelaide, wrote to me that in the Hundred of Kuitpo he had measured a tree 2 ft. 6 in. in diameter! It had 14 ft. of a trunk before branching, and it then carried a head reaching quite 50 ft. from the ground.

6. *E. diversifolia*, Bonpl. (See Part vii., "Crit. Rev. Eucal.") It is the commonest Eucalypt between Port Lincoln and Lake Wangary, existing in the greatest profusion. The leaves of the seedlings vary a good deal, some of them being stem-clasping and quite broadish. On Thistle Island it is, say, 15 ft. high, and with a stem diameter of 4 in. It has grey, thin bark, which peels a little. The timber is pale throughout, darkening a little towards the centre. The sizes of the fruits vary. Dr. Rogers collected it at Cape Couedie (Kangaroo Island). Tate,[3] following Bentham, refers *E. Baxteri*, "established on Kangaroo Island samples," to this species. At p. 213, Part viii., of my "Critical Re-

(3) Trans. Roy. Soc. S.A. vi., 141 (1883).

vision " I have referred it to *E. capitellata*, Sm., and to this opinion I adhere until a view of better specimens than I have seen in various herbaria shows this opinion to be an erroneous one.

7. *E. fasciculosa*, F. v. M., is at Aldgate a small tree. "*E. largiflorens*, a Gum, 40 ft. high. Trunk grey. Bark corky, $\frac{1}{8}$ in., but thickening to $\frac{1}{4}$ in. in old trees. Western Cove, Nepean Bay (Kangaroo Island), Professor Tate, 1881," is in fruit only, and is, I think, *E. fasciculosa*. I hope the species will be looked for on the Island. A similar specimen by Tate in the herbarium of the University of Adelaide from "The Wells" (Kangaroo Island) is labelled by him "*largiflorens* var. or (?) *hemiphloia*." In the Adelaide University Herbarium is a specimen in bud and flower labelled by Tate "*E. paniculata*, Kankarilla, October 9, 1882," also, "Teatree Gully, December, 1882," and "Willunga Road, February, 1883." This is really *E. fasciculosa*, F. v. M., a species suppressed by Mueller himself in favour of *E. paniculata*, Sm., which is a very different tree. *E. paniculata* should be removed from the flora of South Australia and *E. fasciculosa* substituted therefor.

8. *E. Gunnii*, Hook, f. var. *rubida*, Maiden (*E. rubida*, Deane and Maiden). Large trees near water occur at Aldgate.

9. *E. incrassata*, Labill. For figures of this variable species see "Crit. Rev. Eucal.," Part iv. Specimens collected at Murray Bridge have the fruits slightly corrugated, and, as regards size, intermediate between those of the type and of var. *angulosa*. It does not seem worth while to designate it as a new variety.

(a) Var. *dumosa*, F. v. M. At Hog Bay (Kangaroo Island) this form was known as "Wakeri" (my spelling; I do not know whether it is correct) Gum or Mallee. This form has mallee-like stems, and is 20 ft. high; bark hard or ribbony to smooth, dirty grey; leafy, umbrella-like tops. It is nearest to var. *dumosa*, but the fruits are rather larger and more conoid than those of the type. At Kingscote, on the same island, var. *dumosa* has clean stems, and is, say, 20-25 ft. high. It is abundant, and the principal firewood. The timber is pale-coloured, neither red nor brown. At Murray Bridge it is a "Broad-leaved or White Mallee." It has dirty grey stems, less red in the bark than *E. uncinata*; timber pale. At Memory Cove it is the principal Eucalypt near the beach. It is not rare at Port Lincoln (Kirton Point), but appears to be uncommon on the Lake Wangary Road. At, say, $2\frac{1}{2}$ miles from Port Lincoln (old road) the buds of var. *dumosa* display considerable similarity to those of var. *conglobata*.

(b) Var. *conglobata*. Port Lincoln is the home of this variety, and I hitherto understood it to be always a shrubby form, but it attains the dignity of a medium-sized tree. At Boston Island the largest tree I saw is 2 ft. diameter for a stem of 6 ft.; a spreading, straggly tree. It attains a height of 30-35 ft. with smooth or ribbony stems, many of which are 9 in. to 1 ft. in diameter. Mr. Dabovich, of Port Lincoln, says there are some on the island 50 ft. high. I saw some trees of this height on the island, but not close enough to distinguish the species. At Kirton Point it is a strong, coarse-growing, tall shrub near the sea, but larger away from it. It occurs halfway down Stamford Hill. On the western road from Port Lincoln it seems to first appear at 2½ miles (old road). Timber pale throughout (small saplings).

(c) Var. *angulosa*. This variety was the scarcest on my trip. It occurs at Kirton Point; it is common around the Flinders Monument (Stamford Hill). It was noticed at 18 miles from Port Lincoln, along the western road, with unusually elongated cylindrical fruits.

10. *E. leucoxylon*, F. v. M., is a common tree in South Australia. I collected it at Mount Barker and Aldgate. At Cape Jervis it is a gnarled, spreading tree, say of 20 ft., with a smooth stem. In the Port Lincoln district it bears the name of "Red Gum," and it attains a large size. On the western road it is not very abundant. At 11-12 miles it is common, and on the edges of the Swamp, "Sinclair's Washpool" (19 miles), are fine trees. The red-flowering form appears to be rare. It occurs at 11 miles from Port Lincoln.

11. *E. obliqua*, L'Hér. (See "Crit. Rev. Eucal.," Part ii.) The fruit varies, sometimes approaching ovoid, sometimes nearly hemispherical. There is a good deal of variation in the texture of the bark.

The types of *E. falcifolia*, Miq. (see "Crit. Rev. Eucal.," ii., 61): *E. fabrorum*, Schl. *(op. cit.*, p. 60), come from the Mount Lofty Range.

12. *E. odorata*, Behr. This is a very abundant species and very variable. It has now a rather complicated synonymy.[4] Following are some field notes on the forms seen by me on the trip. It usually goes by the name of "Peppermint." The height to which the scaly or subfibrous bark occurs up the trunk varies a good deal; the timber is brown. Sometimes it is a fairly large tree; often it is only a tall shrub. It may, for the purposes of these notes, be divided

(4) See my paper in these Trans. xxvii., 240 (1903), in part.

into certain forms, which, however, run into each other:—

Form 1. Leaves thicker, and usually narrower; often more or less glaucous. Oil dots not prominent. Fruits nearly sessile, reminding one of those of *incrassata*, var. *dumosa*, and with little or no rim, except when unripe. This form, the type, is nearest to that named *E. cajuputea*,(5) F. v. M. This form includes *E. odorata*, Behr., var. *erythrandra*, F. v. M.(6) This is so named because of its dark-coloured (red) filaments which do not show this colour (or very rarely) when fresh, but which darken with age. I got *Form 1* mostly on the Port Lincoln-Wangary Road. At 7-8 miles it is in mallee form. At 13 miles we have a "Peppermint Mallee" or "Black Mallee." I only got green buds and unripe fruits and suckers. Smooth bark, or a little ribbony, a very little scaly near ground. Wood pale-brown like normal *odorata*. At 13-14 miles I collected a very broad-leaved form, which at the time reminded me of *E. incrassata*, var. *dumosa*. At the same time it has not the fruit-rim of typical *E. odorata*, except perhaps when young. At 14-15 miles are small trees, almost mallee-like. Smooth, ribbony towards butt, with a little scaly bark. Timber brownish towards centre. *E. cajuputea*, F. v. M., appears to be that form of *E. odorata* nearest to *E. polybractea*, R. T. Baker (*E. fruticelorum*, F. v. M.). The oils of *E. odorata* and *E. polybractea* are identical in composition. See "Research on the Eucalypts" (Baker and Smith).

Form 2 (*E. calcicultrix*, F. v. M.). Leaves sap green, thinnish, and oil dots rather prominent. Fruits pedicellate and with marked rims. The juvenile leaves sometimes glaucous! Murray Bridge specimens have leaves with crenulate margins and prominent oil dots; brown, not red, timber. Some of the fruits are pear-shaped (? showing hybridization). This is the ordinary *odorata* of Murray Bridge, and some are large trees; Mr. Cambage and I did not find any tree belonging to the *odorata* group with a red timber. At Cape Jervis at first forms dense, stunted masses of 1-3 ft. Almost mallee-like, suckers narrowish. Oil dots of leaves prominent; variation in width of juvenile leaves remarkable. A little further from the sea it is a small tree of, say, 20-25 ft., forming a belt. It is nearest of all the Mallees to the shore. It is the commonest tree Eucalypt about Port Lincoln. It seems to prefer limestone. It is sometimes a small, straggling tree with black, rough bark. It is also a medium-sized tree of drooping habit. The oil dots are not so prominent as in the Murray Bridge specimens.

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(5) These Trans. xxvii., 242.

(6) *Ib.*, 243.

Form 3. This is a form with purple flowers, for which I propose the name var. *purpurascens*, var. nov. Its partial synonymy is *E. Behriana*, F. v. M., var. *purpurascens*, F. v. M.;(7) *E. purpurascens*, F. v. M.; *E. hemiphloia*, F. v. M., var. *purpurascens; E. Lansdowneana*, Mueller and J. E. Brown.(8) The forms under the above names have puzzled a good many people, because there is absolute transition between white- and pink- (sometimes deep pink) coloured flowers. Following are field notes, and of some value for that reason.

"Red Mallee" seems to be commonest in the Port Lincoln district; it is pink-flowering and very pretty. It is usually a straggling, small tree of 10 ft. and more, with a stem of 3 or 4 in. It is certainly not a variety of *E. hemiphloia*, as has been supposed, from herbarium material. "Pink Mallee"—for so it is also called—is at Kirton Point much like *E. incrassata*, var. *dumosa;* it has a small operculum, but this is never grooved, and it is more pointed and less rounded than that of var. *dumosa*. Pink Mallee is usually more compact in habit than the latter. The pale-pink mallee occasionally attains the height of a tree, *e.g.*, at Kirton Point, where it is 1 ft. in diameter, and at other places as much and more. It is common for a few miles along the western road from Port Lincoln.

I cannot see any morphological difference between the Pink Mallee and the tree known as Peppermint (*odorata*). The Peppermint, the Pink Mallee, and the "White" Pink Mallee (that is to say, Mallee that cannot be distinguished from pink except by its white filaments) are all in flower at the same stage. At 2½ miles on the old road I cut some timber of pink-flowering mallee. It is brown inside. I also cut a piece of white-flowering mallee. I could detect no difference in the two timbers. If we turn to B. Fl., iii., 214, we have the description of *E. hemiphloia*, var. *purpurascens*, from "Lake Wangaroo (Wilhelmi)." The modern spelling of this is Wangary, and most of my specimens were collected and my observations made along the Port Lincoln-Lake Wangary Road.

Then we have *E. Lansdowneana*, F. v. M. and J. E. Brown, figured and described as the "Red-flowering Mallee." It was collected by Mr. Thomas Lansdowne Browne on his "Pandura Run" in the Gawler Ranges. "In the district where found the species is locally

(7) These Trans. xxvi., 12 (1902).

(8) Brown's "Forest Flora of South Australia," part ix., t. 31 (1890).

referred to as the 'Red-flowering Mallee,' but Mr. Browne explains that it is not a mallee proper, as it rises with one stem only, like any ordinary tree." . . . "Imperfect specimens of this species were collected in 1847 near Encounter Bay by C. Stuart, others in 1851 near Port Lincoln by C. Wilhelmi." Luehmann says, "*E. Lansdowneana.* I have seen neither a specimen nor description, and Tate, who has seen the plant, says it is not a tenable species" (Proc. A.A.A.S., Sydney, 1898, p. 535). There is a fragment in the herbarium of the University of Adelaide. The plant, like the rest of the "Pink" or "Red Mallee" of Port Lincoln, is referable to *E. odorata*, of which it is a variety, though not a strong one. The name var. *purpurascens* may be proposed for it, but it must be borne in mind that the pink or purple colouration of the filaments is not constant. The type specimen of *E. Lansdowneana* from the Gawler Range is of a deeper purple than I have seen it anywhere else.

Sometimes *E. odorata* is coarse and broad-leaved; this form is a good deal like *E. Behriana*, but the timber is brown, not red, as in *E. Behriana*. This form is common near the seacoast. Then at Hog Bay (Kangaroo Island) we have a "Peppermint" which is referable to *E. odorata*, though not typical. It is a small tree, and the timber is esteemed for fencing. It has a black-looking bark like *odorata*, very scaly, ribbony, rough branches; timber pale-brown; oil dots of leaves prominent.

We now turn to a very small-fruited form of *E. odorata*, at 10-11 miles (Port Lincoln to Lake Wangary), and also vicinity of Tumby Bay. It is a small-fruited, narrow-leaved Mallee, with pale-brown timber and a ribbony, rough butt. Only green fruits and very young buds were collected, but the smallness of the fruits is an additional instance of the variability of the species. I have dealt with *E. odorata* at some length, because South Australia is the principal home of the species, and it is so puzzling that I made special arrangements to study it.

13. *E. oleosa*, F. v. M., was collected at Murray Bridge, Cape Jervis, and Port Lincoln. At Murray Bridge it was in full flower; flowers large, white to yellow, young tips of branches red, often the bark red, hence the name "Red Mallee." Glaucous buds, pointed operculum, broad, glaucous suckers. At Cape Jervis it was a small tree of 15 ft. It is far less abundant than *E. uncinata* in the district; it it apparently rarely gregarious. Operculum blunt, buds almost ovoid. At Kirton Point it was in full flower, and a

beautiful object, with its large flowers and numerous yellow stamens. Operculum medium, and the fruits varying in shape.

14. *E. rostrata*, Schl. This is a common tree in South Australia, so that brief notes will suffice. At 7-8 miles, junction of old and new roads, Port Lincoln to Lake Wangary, it is a smooth-barked, straggly tree, larger than the local *E. cladocalyx*. Scaly, black-barked at bottom of butt. At 16 miles the trees are larger, forming an avenue on both sides of the road. It is the prevalent gum on the branch road from Wangary to Dutton Bay.

15. *E. uncinata*, Turcz. At Murray Bridge, a graceful-looking, narrow-leaved, "broom-top" mallee. Timber pale red or pink, when fresh. Suckers glaucous and broad in comparison with their width. At Cape Jervis it is very abundant, and, say, 10 ft. high. It occurs sparingly from Port Lincoln to Coffin Bay. At 15-16 miles it is a small Mallee, very ribbony; timber red and tough. Opercula red.

16. *E. viminalis*, Labill. Collected at Aldgate, Mount Lofty Range.

Appendix.

A. *E. amygdalina*, Labill. A specimen in the herbarium of the University of Adelaide labelled by Tate "*E. amygdalina*, Nangwary Forest Reserve and Tarpeena, J. E. Brown and R. Tate, November 22, 1882," is in bud and flower, and is doubtfully that species. It requires further investigation if on that specimen depends the inclusion of the species into the flora of South Australia.

B. *E. Stuartiana*, F. v. M. A specimen in bud only (in threes) from "Bigg Flat, December 9, 1883," is in the herbarium of the University of Adelaide. It was labelled *E. Stuartiana* by Tate. It is most probably *E. Gunnii*, Hook, f. var. *rubida*, Maiden (*E. rubida*, Deane and Maiden). I do not know on what authority Tate includes *E. Stuartiana* in the flora of South Australia. I do not say that it does not occur in that Province, but its occurrence should be proved.

C. *E. goniocalyx*, F. v. M. A specimen in the herbarium of the University of Adelaide, labelled by Tate "*E. goniocalyx*, Teatree Gully," is *E. Cambagei*, Deane and Maiden. I have never seen a specimen of the true *goniocalyx* from South Australia, and recommend its removal from the flora of that Province and substitution of *E. Cambagei*.

D. *E. macrorrhyncha*, F. v. M. A specimen in the herbarium of the University of Adelaide, labelled by Tate

"*E. macrorrhyncha*, F. v. M., (?) Aldgate, R. Tate, January 9, 1883," is *E. obliqua*, L'Hér. If *E. macrorrhyncha* has been admitted to the flora of South Australia on the authority of that specimen, it should be removed.

Summary (Eucalyptus).

1. *E. fasciculosa*, F. v. M., should be added to the flora of South Australia, vice *E. paniculata*, Sm.
2. *E. odorata*, Behr., var. *purpurascens*, Maiden, is a new variety.

3, 4, 5. *E. amygdalina*, Labill., *E. macrorrhyncha*, F. v. M., and *E. Stuartiana*, F. v. M., are doubtful members of the flora of South Australia.

6. *E. Cambagei*, Deane and Maiden, should be added to the flora of South Australia, vice *E. goniocalyx*, F. v. M.

Description of a Hitherto Undescribed Species of Shark from Investigator Strait.

By A. Zietz, F.L.S., C.M.Z.S., etc.

[Read September 8, 1908.]

Scyllium vincenti, sp. nov.

This species belongs to the group which has the nasal valves not confluent and without cirrus. The interspace between the nasal valves is about as wide as the flaps, which are turned up at their posterior margin. A short labial fold round the angle of the mouth, each about one-fifth of the length of the jaw. Teeth small, with a long median cusp and a small cusp on each side. Gill openings narrow, the first the largest, the following smaller, the last one only half the length of the first; the last two are situated above the base of the pectorals. The first dorsal has its origin behind the middle of the total length. Both dorsals are of about equal length. The origin of the anal is a little behind the first dorsal and terminates about the middle of the second dorsal. The lower caudal lobe originates about opposite the termination of the second dorsal. The base of the ventrals at their posterior margin is opposite the origin of the first dorsal. The ventrals terminate in a point. The caudal has a notch at three-quarters of its length and terminates in a rounded flap. The skin is very finely chagreened and glossy; the dermal denticles are three cuspid and very finely grooved. The colour is a reddish-brown above and on the sides, with indistinct darker crossbars, which are widest on the back. The head is uniformly dark-brown above. The rest of the trunk carries scattered, small, and indistinct whitish spots. The fins are darkest in the centre, but their margin is whitish. Under side, dirty white. The largest specimen is about 18 in. long. The first specimen I obtained from a fisherman, who caught it near the northern shore of Kangaroo Island while fishing for schnapper.

A Synopsis of the Fishes of South Australia. Part I.

By A. Zietz, F.L.S., C.M.Z.S., etc.

[Read September 8, 1908.]

Introduction.

The first part of this deals with the Plagiostomi, in relation to which I have adopted Professor T. W. Bridge's classification. In the Teleostei I have followed the classification given by Mr. G. A. Boulenger.(1) Considerable difficulties have been experienced in identifying some species, owing to the absence of important literature on the subject, and also from the fact that none of the specimens identified and described by the late Count de Castelnau were available for comparison.

The only list of South Australian fishes hitherto published was the one by the late Count de Castelnau in the Annual Report of the Acclimatization Society of Victoria for the year 1872, in which twenty-seven species are enumerated. This list was based upon the material collected chiefly in Gulf St. Vincent by the first Curator of the South Australian Museum, Mr. G. Waterhouse. About half a dozen species were subsequently described by Messrs. Ramsay and Ogilby, and also by Mr. de Vis, in the Proc. Linnean Society, New South Wales.

I wish to express my thanks to those who have kindly supplied me with specimens, and particularly to Dr. J. C. Verco, F.R.C.S., etc., who kindly invited me to join him on his dredging trips, which afforded an unusual opportunity for obtaining fresh material. A number of species new to me and also new to science were thereby obtained.

It is intended to publish this synopsis in parts.

Class, **LEPTOCARDII** (Lancelets).

Family, BRANCHIOSTOMATIDÆ.

Genus, Asymetron, Andrews (1893).

A single specimen of a Lancelet was dredged in about 100 fathoms of water about 40 miles east of Cape Spencer. It was placed in a glass tube with seawater, but owing to an accident with the machinery of the small steamer, and the approach of rough weather, it had to be packed away,

(1) See the Cambridge Natural History, etc., vol. vii., 1904.

and was lost sight of for several days. When examining it later it was found to be decomposed. For this reason the species could not be identified.

Class, **CYCLOSTOMATA.**

Order, *PETROMYZONTES.*

Family, PETROMYZONTIDÆ.

Genus, Geotria, Gray (1851).

1. **Geotria australis,** Gray.

Proc. Zool. Soc., Lond., 1851, p. 238, pl. iv., figs. 3 and 4. (Wide-mouthed Lamprey.)

Genus, Mordacia, Gray (1851).

2. **Mordacia mordax,** Rich.

(Male; female unknown.)

Voy. Ereb. and Terr., 1846, p. 62, pl. xxxviii., figs. 3-6. (Short-headed Lamprey.)

Genus, Caragola, Gray.

3. **Caragola,** sp.

Class, **PISCES** (Fishes).

Order, *PLAGIOSTOMI* (Sharks and Rays).

Sub-order, *SELACHII.*

Family, NOTIDANIDÆ.

Genus, Notorhynchus, Ayres (1856).

4. **Notorhynchus indicus,** Agass.

Poiss. Foss. Feuilleton, 1835, p. 71. (Seven-gilled Shark.)

Family, HETERODONTIDÆ.

Genus, Heterodontus, Blainv. (1816).

5. **Heterodontus philippi,** Bl.

Schn. Syst. Ichth., 1810, p. 134. McCoy, Prod. Z. Vict. dec., xii., p. 113. (Port Jackson Shark.)

Family, SCYLLIDÆ.

Genus, Scyllium, Cuv. Régne, An.

6. **Scyllium vincenti,** Zietz.

Trans. Roy. Soc., S.A., 1908, vol. xxxi., p. 287.

Genus, Parascyllium, Gill (1861).

7. **Parascyllium nuchale,** McCoy.

Ann. and Mag. Nat. Hist., 1874, xiii., p. 15, pl. ii.

A single specimen, 12 in. long, washed up at Brighton Beach, Gulf St. Vincent.

Family, HEMISCILLIIDÆ.

Genus, Orectolobus, Bonap. (1836).

8. **Orectolobus barbatus,** Gmel.

Syst. Nat., ed. xiii., 1789, p. 1493. McCoy, Prod. Z. Vict., dec. v., pl. xliii., fig. i. (Carpet Shark.)

Family, CARCHARIIDÆ.

Genus, Mustelus, Link. (1790).

9. **Mustelus antarcticus,** Gunth.

Cat. Fish., viii., 1870, p. 387. McCoy, Prod. Z. Vict., dec. ix., pl. lxxxvii., fig. i. (Sweet William.)

Genus, Galeocerdo, Müll. and Henle (1837).

10. **Galeocerdo rayneri,** McDon. and Bar.

Proc. Z.S., 1868, p. 368, pl. xxxii. (Tiger Shark.)

This fish is enumerated in this list upon the evidence of a number of jaws from specimens caught by local fishermen, and which I referred to this species. The fish figured by Macleay in the Proc. L.S., New South Wales, seems to differ from the one figured by Day in his "Fishes of India." I have never seen this fish in a fresh state.

Genus, Carcharias, Rafin (1810).

11. **Carcharias gangeticus,** Müll. and Henle.

Plagiost., 1838, p. 39, pl. xiii. (Sea Shark.)

Genus, Prionace, Cantor (1850).

12. **Prionace glauca,** Linn.

Syst. Nat., ed. x., 1758, p. 235. Müll. and Henle, Plagiostoma, pl. xi. (Blue Shark.)

Genus, Triacis, Müll. and Henle.

13. **Triacis scyllium,** Müll. and Henle., p. 63, pl. xxvi.

A single specimen, over 3 ft. long, was caught by the late Dr. Wylde off the Semaphore Jetty, Gulf St. Vincent. The type specimen came from Japan.

Genus, Galeus, Cuv.

14. **Galeus australis,** Macleay,

Proc. L.S., New South Wales, vi., 1881, p. 354. McCoy, Prod. Z. Vict., dec. vii., pl. lxiv., fig. ii. (School Shark.)

Family, SPHYRNIDÆ.

Genus, Sphyrna, Rafin (1810).

15. **Sphyrna malleus,** Shaw.

Nat. Misc., McCoy, Prod. Z. Vict., dec. vi., pl. lvi., fig. i. (Hammer-headed Shark.)

Family, ALOPIIDÆ.

Genus, Alopias, Rafin (1810).

16. **Alopias vulpes**, Gmel.

Syst. Nat., ed. xiii., 1789, p. 1496. McCoy, Prod. Z. Vict., dec. ix., pl. lxxxviii. (Thresher Shark.)

I have seen this fish repeatedly leaping high out of the water in front of the steamboat in which we were travelling near Beachport, S.E., on one of Dr. Verco's dredging trips.

Family, LAMNIDÆ.

Genus, Odontaspis, Rafin (1810).

17. **Odontaspis taurus**, Rafin.

Carat. Alc. Nuovi Gen., 1810, p. 10. McCoy, Prod. Z. Vict., dec. vii., pl. lxiv., fig. i. (Grey Nurse.)

Genus, Mitsukurina, Jordan.

18. **Mitsukurina owstoni**, Jordan.

Proc. California Acad. Sci. (3), Zool., vol. i., No. 6, 1898.

One specimen of this rare and highly interesting Japanese deep-sea shark, about 4 ft. long, was netted near the mouth of the River Murray. Mr. A. S. Woodward, the able Curator of the Palæonthological Department of the British Museum, wrote a most interesting account of its close relationship with the extinct *Scapanorhynchus*, and that among the recent species it appears to be nearest allied to *Odontaspis*.

Genus, Isuropsis, Gill (1861).

19. **Isuropsis glauca**, Müll. and Henle.

Plagiost., 1838, p. 69, pl. xxix. (Blue Pointer.)

Genus, Carcharodon, Smith (1837).

20. **Carcharodon carcharias**, Linn.

Syst. Nat., ed. x., 1758, p. 235. McCoy, Prod. Z. Vict , dec. viii., pl. lxxiv. (White Pointer.)

Family, CETORHINIDÆ.

Genus, Cetorhinus, Blainv. (1816).

21. **Cetorhinus maximus**, Gunner.

Trondh. Selskab, iii., 1765, p. 33. McCoy, Prod. Z. Vict., dec. xi., pl. civ. (Basking Shark.)

Only two young specimens, about 8-10 ft. long, were netted near our coast. Attains to a length of more than 30 ft.

Family, SPINACIDÆ.

Genus, ACANTHIAS, Risso (1826).

22. **Acanthias vulgaris,** Risso.

Eur. Mérid., iii., p. 131. Müll. and Henle, p. 83. (Picked Dog Shark.)

Family, PRISTIOPHORIDÆ.

Genus, PRISTIOPHORUS, Müll. and Henle (1837).

23. **Pristiophorus cirratus,** Lath.

T.L.S., ii., 1794, p. 281, pls. xxvi., xxvii., fig. v. (Saw Shark.)

Family, RHINIDÆ.

Genus, SQUATINA, Dum. (1806).

24. **Squatina squatina,** Linn.

Syst. Nat., ed. x., 1758, p. 233. McCoy, Prod. Z. Vict., dec. iv., pl. xxxiv. (Angel Shark.)

Family, RHINOBATIDÆ.

Genus, RHINOBATUS, Bl. Schn. (1801).

25. **Rhinobatus banksii,** Müll. and Henle.

Plagiost., 1838, p. 123. (Shovel-nosed Ray.)

Genus, TRIGONORRHINA, Müll. and Henle (1838).

26. **Trigonorrhina fasciata,** Müll. and Henle.

Plagiost., 1838, p. 124, pl. xliii. (Fiddler.)

Family, RAIIDÆ.

Genus, RAJA, Linn. (1758).

27. **Raja lamprieri,** Rich.

Ereb. and Terror, Pisces, p. 34, pl. xxiii. (Thorn-back Ray.)

Family, TORPEDINIDÆ.

Genus, HYPNOS, Dum. (1852).

28. **Hypnos subnigrum,** Dum.

Rev. Mag. Zool. (2), iv., 1852, p. 279, pl. xii. (Numb Fish or Electric Ray.)

Family, TRYGONIDÆ.

Genus, TRYGON, Müll. and Henle (1838).

29. **Trygon testacea,** Müll. and Henle.

Plagiost., 1838, p. 174, pl. lvii. (Common Sting Ray.)

Genus, Dasyatis, Rafin (1810).

30. **Dasyatis pastinaca,** Linn.

Syst. Nat., ed. xii., 1766, p. 396. Bloch. Ichth., iii., pl. lxxxii. (Smooth Sting Ray.)

Family, MYLIOBATIDÆ.

Genus, Myliobatis, Dum. (1817).

31. **Myliobatis australis,** Macleay.

Proc. L.S., New South Wales, vi., 1881, p. 380. McCoy, Prod. Z. Vict., dec. vii., pl. lxiii. (Eagle Ray.)

Order, *HOLOCEPHALI* (Ghost Sharks).

Family, CHIMÆRIDÆ.

Genus, Callorhynchus, Gronovius.

32. **Callorhynchus antarcticus,** Lacép.

Hist. Poissons, i., p. 400, 1798. McCoy, Prod. Z. Vict., dec. ii., pl. cxii. (Elephant Shark.)

The number of Sharks and Rays inhabiting our coast must be much larger; but owing to the fishermen cutting them up for bait or otherwise destroying them when caught, they are but rarely available for scientific purposes.

A Synopsis of the Fishes of South Australia. Part II.

By A. Zietz, F.L.S., C.M.Z.S., etc.

[Read October 6, 1908.]

Order, *TELEOSTEI* (True Fishes).

Sub-order, *MALACOPTERYGII*.

Family, CLUPEIDÆ.

Sub-family, ENGRAULINÆ.

Genus, Engraulis, Cuv. (1817).

33. **Engraulis antipodum**, Günth.

Cat. Fish., vii., 1868, p. 386. (Anchovy.)

The only time that I observed this fish was at Port Willunga, when great numbers leapt out of the water upon the sand.

Distribution—New South Wales, South Australia, Victoria, Tasmania, New Zealand.

Genus, Etrumeus, Bleek. (1853).

34. **Etrumeus jacksoniensis**, Macleay.

Proc. L.S., New South Wales, iii., 1878, p. 36, pl. iv., fig. i.

Gulf St. Vincent. I once noticed several specimens in a fishshop in Adelaide. Only four specimens are on record —three in the Australian Museum, Sydney, and one in the South Australian Museum.

Sub-family, CLUPEINÆ.

Genus, Clupea, Cuv.

35. **Clupea sagax**, Jen.

(Australian Pilchard or Sardine.)

Gulf St. Vincent and Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania, New Zealand.

Genus, Dorosoma, Rafin (1820).

36. **Dorosoma Erebi**, Günth.

Cat. Fish., vii., 1868, p. 407. Rich. Voy. Ereb. and Terr., pl. xxxviii., figs. 7-10.

Lake Alexandrina, South Australia (Bony Bream).

Distribution—New South Wales, South Australia, Victoria.

Genus, Spratelloides, Bleeker.

37. **Spratelloides delicatulus (?),** Beun.

Proc. Linn. Soc., New South Wales, vol. iv., p. 308.

Gulf St. Vincent. This species is recorded by Macleay from Darnley Island, but Day records a second species, *S. malabaricus*, Chevert Exped., from the west coast of India.

38. **Dorosoma horni,** Zietz.

Report on the work of the Horn Scientific Expedition to Central Australia.

River Finke, Central Australia. (Type in South Australian Museum.)

Genus, Diplomystus, Cope.

Bull. U.S. Geol. Surv., Ferrit., vol. iii., p. 808.

39. **Diplomystus vittatus,** Zietz. M.S.

A single specimen belonging to this most interesting genus, which a few years ago embraced only fossil forms, I found washed up at Encounter Bay, March, 1886. This adds one more to the two species discovered by Mr. D. Ogilby on the coast of New South Wales.

Family, SALMONIDÆ.

Genus, Retropinna, Gill. (1862).

40. **Retropinna retropinna,** Rich.

Voy. Ereb. and Terr., 1848, p. 121, pl. lii., figs. 1-3. (Smelt.)

Lake Alexandrina, South Australia.

Distribution—New South Wales, South Australia, Victoria, Tasmania, New Zealand.

Family, GONORHYNCHIDÆ.

Genus, Gonorhynchus, Cuv. (1817).

41. **Gonorhynchus gonorhynchus,** Linn.

Syst. Nat., ed. xii., 1766, p. 523. Rich. Voy. Ereb. and Terr., pl. xxix., figs. 1-6. (Sand Fish.)

South Australian coast; also known from New Zealand, the Cape of Good Hope, and Japan.

Family, SILURIDÆ.

Sub-family, CLARIIDÆ.

Genus, Cnidoglanis, Günth. (1864).

42. **Cnidoglanis megastomus,** Rich.

Voy. Ereb. and Terr., 1845, p. 31, pl. xxi., figs. 1-3. (Estuary Cat Fish.)

Gulf St. Vincent; also Port Darwin, Northern Territory.

Distribution—North coast of Australia, New South Wales, South Australia, Victoria, Tasmania.

Genus, Copidoglanis, Günth. (1864).

43. **Copidoglanis tandanus,** Mitch.

Exp. Int. Aust., i., 1838, p. 95, pl. v., fig. ii. (Fresh-water Cat Fish.)

River Murray, South Australia.

Distribution—New South Wales, South Australia, Victoria, Western Australia.

Genus, Neoplotosus, Cast.

44. **Neoplotosus waterhousei,** Cast.

Research. Fish. of Australia, p. 45.

Gulf St. Vincent, South Australia (Castelnau).

I have not yet succeeded in finding a fish which corresponds with Castelnau's description.

Genus, Ostophycephalus, Ogilby.

45. **Ostophycephalus duriceps,** Ogilby.

Proc. L.S., New South Wales, vol. xxiv., pp. 154-186,

Gulf St. Vincent, South Australia, washed up (A. Zietz); (type) bad state.

Genus, Neosilurus, Steindachner.

46. **Neosilurus argenteus,** Zietz.

Report on the work of the Horn Scientific Exped. to Central Australia (Fishes). Appendix, pl. xvi., fig. vii.

In the original description I have placed this fish under *Plotosus*, which have eight barbels. The absence of the second dorsal fin would necessitate its removal to the genus *Neosilurus*, with only six barbels. The Central Australian form has eight barbels. For this reason I would suggest to unite this species with *Neosilurus*, and to divide this genus into two groups:—

(a) Species with six barbels—*Neosilurus hyrtlii*, Steind., and *N. australis*, Cast.

(b.) Species with eight barbels—*N. argenteus*, Zietz. This would avoid the creation of a new genus for the Finke River and Cooper Creek fish.

Sub-order, *SYMBRANCHII.*

Family, SYMBRANCHIDÆ, Müll.

Abhandl. Ak. Wiss., Berlin, 1846, p. 193.

Genus, Symbranchus, Bloch.

47. **Symbranchus bengalensis,** Bleek.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—Bengal, East Indian Archipelago, Dampier Archipelago, South Australian coast.

Genus, CHILOBRANCHUS, Rich. (1845).

48. **Chilobranchus rufus,** Macl.

Proc. L.S., New South Wales, vi., 1881, p. 266.

Gulf St. Vincent (Red-banded Shore-eel).

Distribution—New South Wales, South Australia, Victoria, Tasmania.

Sub-order, *APODES.*

Family, ANGUILLIDÆ.

Genus, ANGUILLA, Shaw (1804).

49. **Anguilla australis,** Rich.

Proc. Zool. Soc., 1841, p. 22, and Voy. Ereb. and Terr., pl. xiv., fig. i. (The Common Eel.)

Mount Gambier district, fresh water.

Genus, CONGER, Cuv.

50. **Conger wilsoni (?),** Cast.

(The Conger Eel.) South Australian coast.

This species has also been recorded from Victoria and Tasmania, but I am in doubt if the identification of our fish is correct.

Genus, MURÆNICHTHYS, Bleek. (1853).

51. **Muræenichthys breviceps,** Günth.

Ann. and Mag. Nat. Hist., 1876, vol. xvii., p. 401.

Gulf St. Vincent and Spencer Gulf, Fowler Bay.

Distribution—South Australia, Tasmania.

Sub-order, *HAPLOMI.*

Family, GALAXIIDÆ.

Genus, GALAXIAS, Cuv. (1817).

52. **Galaxias attenuatus,** Jen.

South Australia. In all the rivers and creeks entering the sea. Also recorded from Victoria, Tasmania, New Zealand, Falkland Islands, Terra del Fuego, Magellan, and Peru (?).

53. **Galaxias olidus,** Günth.

Creeks in the Mount Lofty Ranges; only known from South Australia. (Butter Fish.)

54. **Galaxias coxii,** Macl.(?)

Morialta Falls (Glen Stuart), Mount Lofty Ranges. It is with some doubt that I include this fish in my list; it seems to agree with the description and figure; it is found in New South Wales and Victoria, but has not been previously recorded from this State. (Mountain Trout.)

Family, MYCTOPHIDÆ.

Genus, AULOPUS, Cuv. (1817).

55. **Aulopus purpurissatus,** Rich.

Icon. Pisc., 1843, p. vi., pl. ii., fig. iii. McCoy, Prod. Zool. Vict., dec. vi., pls. liv. and lv. (Sergeant Baker.)

South Australian and Victorian coasts, New South Wales, and Western Australia.

Family, SYNGNATHIDÆ.

Genus, SYNGNATHUS, Linn. (1758).

56. **Syngnathus curtirostris,** Cast.

Proc. Zool. Soc. Vict., vol. ii., p. 79.

Spencer Gulf, dredged (Dr. J. C. Verco).

57. **Syngnathus semifasciatus,** Günth.

Cat. Fish., viii., p. 162.

Spencer Gulf, dredged (Dr. J. C. Verco).

Whidbey Island, near Coffin Bay.

Distribution--South Australia, Port Phillip (Victoria), Tasmania.

58. **Syngnathus pœcilolæmus,** Peters.

Günth. Cat. Fish., viii., p. 174.

Gulf St. Vincent and Spencer Gulf, dredged (Dr. J. C. Verco).

59. **Syngnathus pelagicus,** Linn.

Günth. Cat. Fish., viii., p. 165.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—Mediterranean Sea, Atlantic Ocean, Falkland Islands, New Zealand, China, Mauritius, South Australia.

60. **Syngnathus olivacea,** Cast.

Proc. Zool. Soc. Vict., vol. ii., p. 77.

Gulf St. Vincent and Spencer Gulf.

61. **Syngnathus argus,** Rich.

Trans. Zool. Soc., iii. p. 183, pl. vii., fig. ii.

Gulf St. Vincent and Spencer Gulf, Fowler Bay.

Distribution—New South Wales, South Australia.

Genus, ICHTHYOCAMPUS, Kaup. (1853).

62. **Ichthyocampus filum,** Günth.

Cat. Fish., viii., p. 178.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—Western Australia, South Australia.

Genus, LEPTOICHTHYS, Kaup.

Lophobr., p. 51.

63. **Leptoichthys castelnaui,** Macleay.

Proc. Zool. Soc. Vict., vol. ii., p. 77.

Spencer Gulf, dredged (Dr. J. C. Verco).

Distribution—South Australia.

Genus, DORYICHTHYS, Kaup.

Lophobr., p. 58.

64. **Doryichthys heterosoma,** Bleek.

Nat. Tyds. Ned. Ind., ii., p. 440.

Spencer Gulf, dredged; a single specimen (Dr. J. C. Verco).

Distribution—Borneo, South Australia.

Genus, SOLENOGNATHUS, Swains. (1839).

65. **Solenognathus spinosissimus,** Günth.
(Male and Female.)

Near Port Lincoln, Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania.

Genus, PHYLLOPTERYX, Swains. (1839).

66. **Phyllopteryx foliatus,** Shaw.

Gen. Zool., v., 1864, p. 456, pl. clxxx. (Leafy Sea-horse.)

Gulf St. Vincent and Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania.

67. **Phyllopteryx eques,** Günth.

Proc. Zool. Soc., 1865, p. 327, pl. xv. (Spiny Sea-dragon.)

Spencer Gulf.

Genus, HIPPOCAMPUS, Rafin (1810).

68. **Hippocampus novæ-hollandiæ,** Stiend.

S.B. Acad. d. Wiss. Wien, liii., 1866, p. 474, pl. i., fig. ii. (Common Sea-horse.)

Distribution—New South Wales, South Australia, Victoria.

69. **Hippocampus breviceps,** Peters.

M.B. Acad. d. Wiss., Berlin, 1869, p. 710. (Short-snouted Sea-horse.)

Gulf St. Vincent and Spencer Gulf.

Distribution—New South Wales, South Australia, Victoria, Tasmania.

On a Want of Symmetry Shown by Secondary X-Rays

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide.

[Read September 8, 1908.]

(Abstract.)

Experiments were described showing that the secondary X radiation appearing on the emergence side of a plate traversed normally by X-rays, was in general greater than that appearing on the incidence side. Aluminium and celluloid showed the effect well, but copper and iron did not show it until all the softer portions of the secondary radiations had been removed by screens. The results were favourable to the theory that X-rays were of a material nature. See the following paper, p. 301.

On a Want of Symmetry Shown by Secondary X-Rays.

By W. H. Bragg, M.A., F.R.S., Elder Professor of Mathematics and Physics in the University of Adelaide, and J. L. Glasson.

[Read October 6, 1908.]

On the assumption that the Röntgen rays consist of æther pulses it has been shown by J. J. Thomson ("Cond. of Elect. through Gases," p. 323) that it is possible to account for the existence of secondary Röntgen rays by assuming that the primary pulses set in motion electrons over which they pass, and cause them to become new centres of radiation. If the electron easily follows the guiding force of the primary pulse, then the secondary radiation resembles the primary in quality. But if the electron is hampered by attachments to other portions of the atom to which it belongs, then the new pulse has not the same quality as the old; the time of motion of the electron is dragged out, and the pulse produced is softer.

Now, if an electron becomes in this way a centre of radiation the intensity of the secondary effect must be symmetrical about the line of motion of the electron. In particular, the intensity of the secondary radiation must be symmetrical about a plane passing through the electron perpendicular to the primary ray, since this ray contains the line of motion referred to. This deduction forms an integral part of Thomson's theory of secondary Röntgen radiation, and its truth has been assumed in calculations intended to show that experimental results are in agreement with theory. Barkla proves the same deduction in a paper published in "The Philosophical Magazine" of February, 1908.

Now it has recently been shown (Bragg and Madsen, Trans. Roy. Soc., S.A., May, 1908) that the cathode radiations excited by γ rays show a very marked want of symmetry about the plane normal to the exciting ray; and again (Madsen, Trans. Roy. Soc., S.A., July, 1908) that there is a similar want of symmetry in respect to the secondary γ rays. The γ rays and X-rays resemble one another so closely in all their known properties that it is fairly safe to assume any effect found to be true of the one kind to be true also of the other kind, though perhaps to a different degree. In this case indeed Cooksey ("Nature," April

2, 1908) has already shown that the secondary cathode radiations excited by X-rays are not at all symmetrical about the normal plane, the emergence rays being greater than the incidence, as in the case of the γ rays.

It remained, therefore, to examine the secondary X-rays excited by primary X-rays; and the experiments described

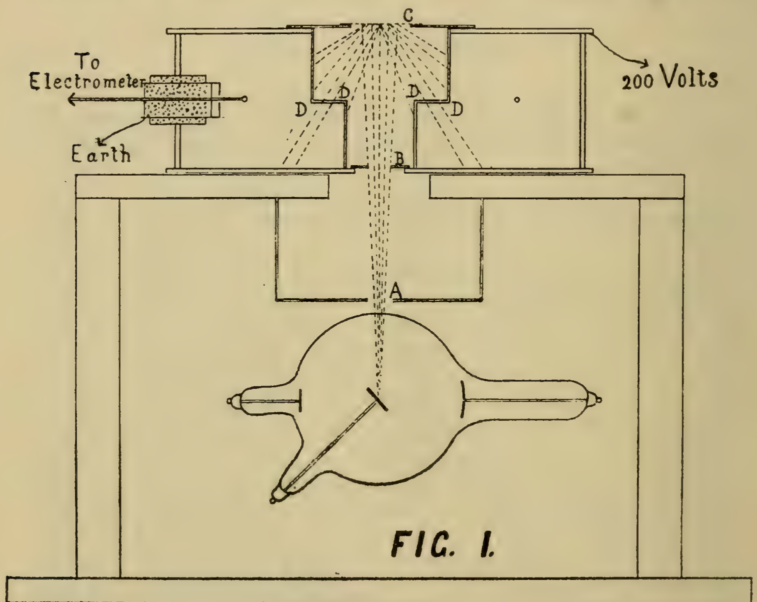


FIG. I.

4 in.

FIG. II.

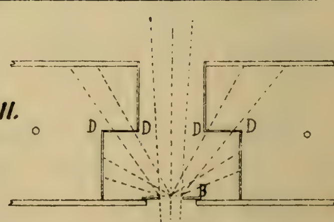
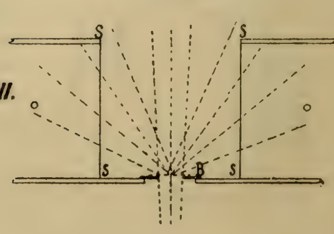


FIG. IV.

FIG. III.



in this paper were made with that object. We find that in general the effect does exist, that it is sometimes very pronounced, and that is in keeping with expectation based on Madsen's study of the secondary γ rays. Hard γ rays show a very large difference between the quantities of emergence and incidence radiation; for soft γ rays the difference is smaller. Since X-rays are to be looked on as a very soft form of γ rays, the difference should be smaller still; and this is what we have found to be the case.

The general form of the apparatus which we have used is shown in fig. i. Variations of the upper portion of it are shown in figs. ii and iii. A small pencil of X-rays passed upwards through apertures in lead plates at *A* and *B*, and then along the axis of the ionization chamber and out into the open. In our first experiments the upper part of the apparatus was arranged as in fig. iii. The primary rays did not pass through the effective part of the ionization chamber, being separated therefrom by the cylindrical screen *S*,*S*, which could be made of various thicknesses and various materials. But if a thin sheet of any substance was laid over the hole at *B*, secondary X-rays spread out therefrom, and some passed through the screen *S*,*S* and caused a deflection in the electrometer. The difference between the deflections *(a)* without and *(b)* with the sheet at *B* was taken as a measure of the emergence secondary X-ray radiation. When the sheet was removed from *B*, and the same or a similar sheet placed in the plane of the top of the screen so as to be struck from below by the primary rays, then the measure of the incidence secondary radiation was obtained as the difference between the deflections *(a)* without and *(c)* with the sheet so placed.

In this way it was easy to show that the expected want of symmetry actually existed, particularly with aluminium, celluloid, or paper as the radiators, substances of small atomic weight. But the experiments were open to some extent to the objection that a was too large compared with $b-c$, and that possibly the excess of emergence over incidence was an apparent effect due to actual variations of a under different circumstances. The current a was in fact due to several causes. There was a small natural ionization leak even when the X-rays were not acting; there was an effect due to primary X-rays which had penetrated the walls of the chamber though they were made of zinc, one-eighth of an inch thick. But the greatest part of a was due to a diffusion of soft rays about the primary beam, much of which came through the hole at *B* at such an angle as to penetrate the screen *S*,*S*; it could be largely cut out by thickening the screen. Again, part of a was due to radiation returned from the open air above the ionization chamber. Some of these radiations might be appreciably interfered with by placing the radiating sheet at B or at the top of the chamber. We were, however, able to satisfy ourselves by special experiments that the want of symmetry was quite real, and that as a matter of fact no valid objection could be made. But we abandoned the first arrangement for a second which, as we expected, would show the want of symmetry more clearly, and which proved better than the first in every way. The first method was exactly the same as that used by Madsen in examining the secondary γ rays; but it was clear that the enormous difference which these rays showed was not going to be repeated in the case of the X-rays.

Our new arrangement was, as shown in fig. i., or, inverted, in fig. ii. Two cylinders of brass, each 2 in. long, but of different diameters—4 in. and 2 in.—were fixed to a connecting piece D, D, shown in plan in fig. iv. The latter resembled a light brass wheel with four spokes, and various thin screens cut in the form of flat rings could be attached to it, filling up all the spaces between the spokes. In fig. ii. the double cylinder is shown as arranged for the measurement of incidence secondary radiations; the radiating sheet was placed at C, supported by a sheet of celluloid lying flat on the top of the cylinder. A hole was cut in the centre of the celluloid sheet big enough to allow the primary beam to pass through without touching the edges; and a fluorescent screen was used to make sure that this was the case. The radiating sheets were of thin metal, about $1\frac{1}{2}$ in. square. In fig. ii. the cylinder is shown as arranged for the measurement of emergence secondary radiations; it hardly requires further explanation.

We expected that this arrangement would show up the want of symmetry better than the former, because the portions of the emergence and incidence beams under comparison would be more nearly normal to the plate. Looking upon the radiations as material we should naturally expect the intensity of the secondary radiation to decrease gradually as its direction increased in inclination to the forward direction of the primary ray. The emergence rays lie, in inclination, between 0 deg. and 90 deg.; the incidence between 90 deg. and 180 deg. In our first arrangement we compared the emergence rays between about 40 deg. and 90 deg. with the incidence rays between about 90 deg. and 140 deg. There should be a larger ratio of emergence to incidence with the newer arrangement, since the emergence rays between about 30 deg. and 50 deg. would be compared with the incidence between about 130 deg. and 150 deg. This proved to be the case; the improvement was considerable. Again with the new arrangement the current with no radiator in position became relatively far smaller. For example, when the radiator was of Al, ·4 mm. thick, and the absorbing screen *D*,*D* of tinfoil (two thin sheets), the currents with and without the radiator at *B* in fig. i. caused deflections of 86 and 26 mm. in ten seconds respectively; the currents with and without the radiator at *B* in fig. ii. were 220 and 35 respectively. There could be very little error, therefore, in taking the incidence and emergence radiations as 60 and 185 respectively; and the want of symmetry is beyond doubt.

It should be observed that the emergence radiation can never be shown to an unfair advantage in these experiments, and is often at a disadvantage, for the radiator, when placed as in fig. ii., cuts down the very primary rays to which the secondary radiation is due. It is not difficult to show that if the thickness of the radiator is so adjusted as to give the maximum emergence current (it can of course be too thick or too thin), then the ratio of this maximum to the maximum incidence current (which can be obtained simply by making the radiator thick enough) is only $2/e$ of the true ratio of emergence to incidence; provided that the secondary rays are as penetrating as the primary, and that we are considering homogeneous radiations. But if, other conditions being the same, the secondary rays are less penetrating than the primary, then the ratio as found is more nearly correct, and is very nearly so when the secondary rays are much less penetrating than the primary, as, for example, when we are considering secondary cathode rays due to X- or γ rays.

We have made a large number of measurements by the method described above, using the following metal sheets as radiators:—Pt, weight per square cm., ·0150 gr.; Sn, ·0096 gr.; Cu, ·0083 gr.; Fe, ·0077 gr.; Al, ·105 gr.; celluloid, ·20 gr. As screens we have used various thicknesses of Sn, Cu, and Al.

The proportion of emergence to incidence radiation differs considerably for the different radiators, but is much the same for different screens or different thicknesses of screen, except that the proportion tends to increase slightly as the screen is made thicker; and the tendency is most pronounced in the case of those metals which give out a quantity of soft secondary radiation. For example, Fe and Cu show little difference between incidence and emergence radiations until the screen is so thick that only a small fraction of either of the radiations can pass through. The results vary somewhat with the state of the bulb; and since these variations are comparable with those which are met with on changing the nature of the screens, we are not now in a position to discuss smaller variations in detail. We must content ourselves with quoting a few results in order to show the want of symmetry, which is a persistent effect. When, for example, two tinfoils were used as screen (weight per square cm. of each, ·0056), we obtained the following figures, which represent movements of the scale in mm. during 10 secs.:—

Radiator.	Sn	Cu	Fe	Al
Emergence Current	176	140	39	185
Incidence Current	122	119	15	60

With four tinfoils the figures were:—

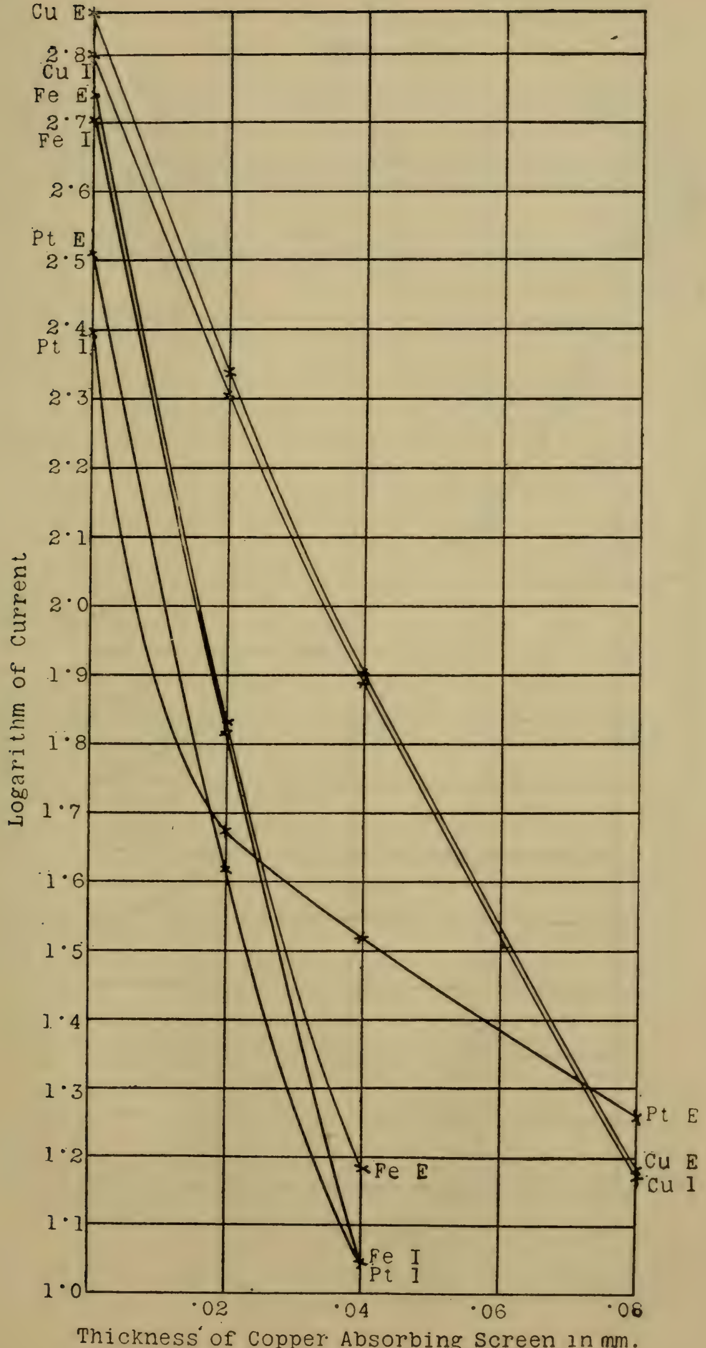
Radiator.	Sn	Cu	Fe	Al
Emergence Current	143	24	23	116
Incidence Current	87	1	0	34

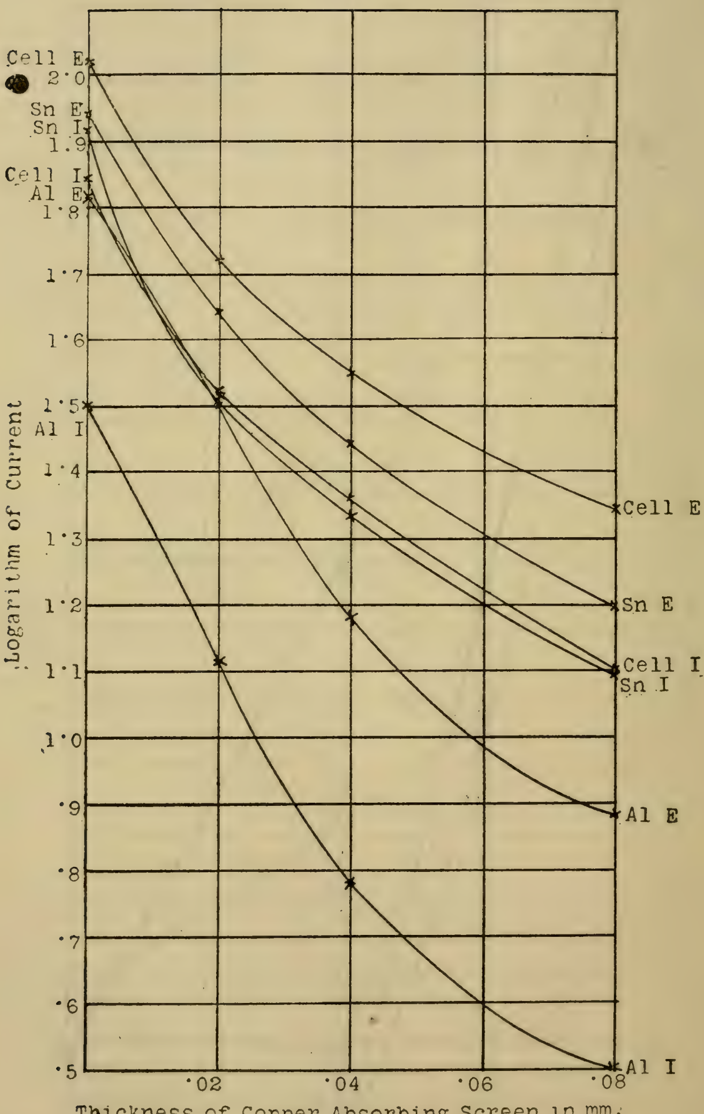
Again, using a copper screen ·002 cm. thick we found:—

Radiator.	Pt	Sn	Cu	Fe	Al	Celluloid.
Emergence Current ...	86	140	361	118	80	138
Incidence Current ...	65	104	364	118	32	93

Putting together a number of results for Cu screens of different thicknesses we obtain the logarithmic curves of absorption shown in the accompanying figures. It should be observed that some of the results thus shown were obtained at different times, so that too much must not be built upon a comparison between them; only the relative positions of the emergence and incidence curves of each substance are sufficiently correct, and the form of each curve as showing the homogeneity or otherwise of the various radiations. One figure shows the emergence (E) and incidence (I) curves for Pt, Cu, and Fe; the other the corresponding curves for Sn, Al, and celluloid.

The experiments described in this paper show that a very marked want of symmetry occurs in the case of secondary X-rays, the emergence rays being generally greater than the incidence. This is another instance of the close parallelism between X- and γ rays. On a material theory of X- and γ rays the effect is easily explained, and is to be classed with the scattering to which β and also, as lately shown clearly by Geiger, α rays are subject. But if the X- and γ rays consist of energy bundles of very small volume, as suggested by J. J. Thomson, then these bundles must be capable of deflection in going through atoms—that is to say, swung out of their paths by the electrical forces to be found within the atoms, just as neutral pairs would be in virtue of their elec-


Cu E
2·8
Cu I
Fe E
2·7
Fe I
2·6
Pt E
2·5
2·4
Pt I
2·3
2·2
2·1
2·0
1·9
1·8
1·7
1·6
1·5
1·4
1·3
1·2
1·1
1·0
Logarithm of Current
·02
·04
·06
·08
Thickness of Copper Absorbing Screen in mm.
Pt E
Cu E
Cu I
Fe E
Fe I
Pt I


Cell E
2·0
Sn E
Sn I
1·9
Cell I
Al E
1·8
1·7
1·6
1·5
Al I
1·4
1·3
1·2
1·1
1·0
·9
·8
·7
·6
·5
·02
·04
·06
·08
Logarithm of Current
Cell E
Sn E
Cell I
Sn I
Al E
Al I
Thickness of Copper Absorbing Screen in mm.

trical fields. It seems hard to understand the distinction between such bundles and entities generally classed as material.

In the course of this investigation we have made a number of experiments on the quantities and qualities of the secondary radiations. This subject has been fully treated by Barkla, some of whose recent papers have not yet reached us, and any discussion we gave might be merely a duplication of part of his enquiry. There is, however, one point to which we should like to refer.

Very hard γ rays follow a density law of absorption, treating all atoms alike, except in respect to weight. Soft γ rays are not independent of atomic groupings of matter, and are far more strongly absorbed by heavy atoms than by light after allowance has been made for weight. The same is generally true of X-rays; but in the case of very soft X-rays there is a tendency to revert to the density law again. For instance, X-rays that have passed through the glass of the bulb are soft to copper, silver, tin, and so on, but hard to aluminium, carbon, and low atomic weight generally. No doubt those rays which are soft to such light atoms have already been absorbed by the glass. But secondary X-rays from most substances are softer than anything emerging from the bulb and contained in the primary ray. The difference is not very great when the absorption is measured with the aid of screens made of substances of the higher atomic weights, because to these the primary rays are soft already. But if the screens are made of aluminium, still more of filter paper, the difference now seems to be very great, for the secondary rays are soft even to low atomic weights. For example, in one experiment a sheet of copper weighing ·018 gr. per square cm. caused a drop of ·401 in the logarithm (to base 10) of the primary rays, and only of ·447 in the case of the emergence secondary rays from copper, of ·645 in the case of platinum rays, and ·805 of iron rays. But when four filter papers weighing ·02 gr. per square cm. were used as screen, the drop in the case of the primary rays was ·010—only one-fortieth of the drop caused by a copper screen of nearly equal weight. In the case of the secondary rays, however, the same screen caused a drop in the case of copper rays of ·100, platinum rays ·053, and iron rays of ·188—that is to say, for these soft rays the filter papers are much more nearly on an equality with copper, weight for weight, than they were for hard rays. It is interesting to bear this in mind when considering the very large quantities of secondary ionization which some substances seem to give. The ionization is always measured in air, which of course consists of atoms not very different in weight from those contained in filter papers. Consequently primary rays, and secondary rays which differ very little from the primary, are very penetrating to air, and cause relatively small ionizations therein. But secondary rays from Cu and Fe are softened so much as to bring them within reach, so to speak, of air, which rapidly converts them into cathode rays, so that there is a very large ionization. For the cathode rays produced from these secondary rays have probably but little less energy than those produced from the primary; the speed of the cathode ray does not differ very greatly with the penetration of the primary X-ray, so far as experiments have shown. The very large secondary radiations, which some substances appear to give, therefore owe their magnitude largely to the fact that the air in which they are measured is sometimes ten to twenty times as favourable to them as to the primary rays which produced them. In this way we may account to some extent for the startling results obtained by Crowther in the case of arsenic and bromine ("Phil. Mag.," Nov., 1907).

Descriptions of New Australian Hesperiadæ.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read October 6, 1908.]

The following insects are here described in order to allow them to be figured in Messrs. Waterhouse and Lyell's work on the Australian *Lepidoptera* to be published early next year.

I intend to revise the whole of the Australian *Hesperiadæ* next year, and will then supplement my remarks on the family.

Hesperilla polysema, n. sp.

♀, 36 mm. Head, thorax, and abdomen dark-fuscous. Palpi whitish (antennæ broken). Legs dark-fuscous (imperfect). Forewings elongate, moderate, costa slightly arched at base, thence straight, termen rounded, oblique; dark-brownish-fuscous, somewhat shining; markings white, faintly ochreous-tinged; a moderate cuneiform spot in end of cell; ovoid spot lying on vein 1, just before tornus; a moderately large, round spot lying between veins 2 and 3, at about $\frac{3}{4}$ from base of wing; a smaller, but similar spot immediately above; a row of three moderate subcostal spots, placed obliquely, at $\frac{3}{4}$ from base; 2 small rounded spots, one above the other, below and just beyond the 3 subcostal spots; cilia whitish or white, barred with fuscous at extremities of veins. Hindwings with termen round; colour as in forewings, but without markings; cilia as in forewings. Underside:—Colour as above, but all margins minutely irrorated with ochreous scales; markings of upperside reproduced in whitish, an additional small fleck just above spot on vein 1. Hindwings as forewings, excepting that the whole of the wing is minutely irrorated with ochreous scales; markings white, edged with fuscous; an irregular spot in end of cell; a round spot just below middle of vein 8; an irregularly-curved series of seven spots at about $\frac{2}{3}$ from base; upper one smallest, round; 1st, 2nd, and 4th slightly nearer to base than the remainder; 4th, 5th, and 6th somewhat elongate, others rounded; cilia of both wings as above.

Not very near any other known Australian species, but approaches *atralba*, Tepp. The type being a ♀ does not admit of its being placed in its correct genus; it may possibly be a *Trapezites*.

Chillagoe, North Queensland. One specimen; taken in February, by Mr. F. Dodd.

Type in Coll. Lyell.

HESPERILLA LEUCOSTIGMA, M. and L., *var.* PARASEMA, *nov. var.*

Having received further specimens of this species I think it advisable to give the Northern form a varietal name as above. It differs from the typical *leucostigma* by the absence in both sexes of the cellular spot, or at the least very faintly indicated. I have not met with intermediate forms.

All the specimens under review were taken at Cairns and Kuranda, Queensland.

Type in Coll. Lower.

HESPERILLA TYMBOPHORA, M. and L.

♀, 32 mm. Head, palpi, antennæ, thorax, and abdomen dark-fuscous, palpi whitish beneath, antennæ annulated with ochreous beneath, thorax and abdomen clothed with fine ochreous hairs. (Legs broken.) Forewings elongate, moderate; costa slightly arched at base, thence straight; termen bowed, oblique; dark-fuscous, with purple reflections; basal hairs dull-orange; markings pale-yellow; a moderate spot in end of cell, indented on either side; a moderate quadrate spot at base of veins 2 and 3; a smaller and more elongate spot immediately above and slightly beyond; a subcostal series of 3 small dots placed obliquely at $\frac{3}{4}$ from base; cilia deep-dull orange, barred with black at extremities of veins. Hindwings without markings; colour and cilia as in forewings. Underside of both wings dull-fuscous, more or less minutely irrorated throughout with yellowish, especially hindwings; markings of upperside reproduced on forewings, hindwings with a very obscure curved series of 3 or 4 dull-ochreous spots at $\frac{2}{3}$ from base.

Mount Kembla, New South Wales. One specimen.

Type in Coll. Waterhouse.

HESPERILLA MONOTHERMA, LOW.

Telesto monotherm, Low. T.R.S.S.A., p. 169, 1907.

I think it better to regard this species as the Northern form of *ornata*, Leach. The name is misprinted *monotherm*.

TELICOTA BRACHYDESMA, n. sp.

♂, 28 mm. Head, palpi, thorax, and abdomen dark-fuscous, more or less densely clothed with orange hairs, palpi beneath dull-orange or yellow. Antennæ dark-fuscous. Legs dull-orange, somewhat infuscated. Forewings elongate, moderate; costa nearly straight, termen oblique, hardly rounded; dark-brownish-fuscous, with orange markings; a rather thick costal streak from base to middle of cell, leaving extreme costal edge fuscous; cell filled in with orange; 3 narrow cuneiform interneural subcostal streaks at $\frac{4}{5}$; between these and costal streak are 3 more very narrow interneural streaks, only separated by veins; 5 somewhat quadrate spots, placed obliquely, 1st, lying close to stigma, between veins 1 and 2, narrower than two following; 2nd, immediately above, lying between veins 2 and 3, slightly indented on outer edge; 3rd, immediately above second, somewhat cartridge shaped; 4th and 5th, immediately above and touching the cuneiform subcostal streaks, the whole forming a continuous band, a patch of dull orange lying on vein 1 from base to stigma, somewhat suffused at extremities; a moderate dorsal streak from base to extremity of first of 5 spots; stigma blackish, entire, very narrow, about $\frac{1}{2}$ mm., oblique, extending from vein 1 to vein 4, edged on either side with blackish; cilia black, around tornus becoming orange. Hindwings with termen moderately rounded, somewhat prominent at tornus, colour as in forewings; basal hairs dull-orange; a small roundish spot at posterior extremity of cell; a moderate orange submedian band, edges somewhat crenulate, extending from vein 1 to vein 6, continued on vein 1 as a fine streak nearly to termen and more broadly towards base of wing; cilia orange. Forewings beneath dull-orange, markings of upperside except stigma reproduced; the 5 spots edged on either side narrowly with black; dorsal half of wing blackish; basal third of cell blackish. Hindwings dull-reddish-orange; markings of upperside obscurely reproduced; submedian band edged narrowly on either side with black; an elongate pale-yellowish cuneiform streak filling up space between veins 1 and 2; dorsum broadly blackish, with some orange ferruginous scales near tornus.

♀, 32 mm. Head, etc., as in ♂; forewings dark-brownish-fuscous, somewhat purplish-tinged; markings, except stigma, as in ♂, *subcostal and cellular marks absent;* 3 narnow interneural streaks hardly traceable in some specimens; cilia as in ♂. Hindwings with colour as in forewings; cellular spot not indicated; submedian band more irregularly edged than in ♂, and inclined to be separated by veins; cilia as in ♂.

This insect, which can immediately be separated from its congeners, is at once known by the *very narrow stigma and abbreviated postmedian band.* It is nearest *bambusæ*, Mre.—in fact, I am strongly inclined to think that it may possibly represent the Australian form of that insect. It approaches *augias*, Linn., but the postmedian band is never continued along the veins as in that species.

Kuranda and Cooktown, Queensland; six ♂ and one ♀; taken in March and April.

Types in Coll. Waterhouse.

TELICOTA EURYCHLORA, n. sp.

♂, 32 mm. Head, thorax, and abdomen dark-fuscous, densely clothed with greenish-yellow hairs, palpi ferruginous yellow; beneath whitish-yellow. Antennæ fuscous, annulated with whitish, club beneath orange, apiculus well developed. Legs orange-yellow. Forewings elongate, triangular, costa straight, termen oblique; dark-brownish-fuscous, with orangé-yellow markings; a broad costal streak from base to end of cell, intersected by veins on posterior half, and leaving costal edge narrowly fuscous; whole of cell filled in with orange-yellow; 3 narrow cuneiform interneural subcostal spots, posterior edges excised, at $\frac{4}{5}$ from base, lying between veins 6 and 9, placed obliquely; an oblique series of 5 quadrate spots at $\frac{3}{4}$ from base, reaching from vein 1 to vein 6, all excised on either side, 2 upper small, lower 3 rather large; a moderately thick dorsal streak from base to $\frac{3}{4}$; a patch, scales, and hair lying above vein 1, from base nearly to stigma; stigma narrow, fuscous, oblique, from vein 1 to vein 4, bisected by veins 2 and 3, edged posteriorly by dark-fuscous; cilia dark-fuscous, becoming ochreous-orange around tornus. Hindwings with termen rounded, slightly prominent at tornus; colour as in forewings; markings orange-yellow; dorsal and basal hairs orange-yellow; an ovoid spot in posterior end of cell; a rather broad postmedian band extending from vein 1 to vein 6, lower edge crenulate, upper edge irregular, continued as a fine streak along vein 1 to termen, sometimes a small elongate spot just above vein 6; cilia orange, becoming fuscous towards costa. Underside of forewings dull-orange-yellow; markings of upperside, except stigma, reproduced; basal third of cell dark-fuscous; dorsum fuscous throughout; posterior edges of lower 2 quadrate spots suffusedly edged with dark-fuscous. Hindwings dull-orange-yellow, with a somewhat greenish tinge, markings of upperside faintly reproduced in dull-orange; an elongate cuneiform streak of rather bright-orange lying between veins 1 and 2.

♀, 32 mm. Head, etc., as in ♂; markings as in ♂, but ground colour darker; subcostal markings suffused with fuscous, anterior half of cell filled with ground colour, the 3 large quadrate spots less excised at edges. Hindwings as in ♂. Underside of both wings as in ♂, but more tinged with dull-greenish-yellow.

This species is easily recognized by the colouration and absence of markings of hindwings. It is nearest *augias*, Linn., but is a much larger insect, and although *augias* shows some geographical range of variation it does not approach the species under notice so as to be confused with it.

Ballina, New South Wales (Richmond River); taken in February. Mr. Waterhouse informs me that so far as he knows this species is confined to the above district.

Types in Coll. Waterhouse.

ERYNNIS TRICHOPEPLA, n. sp.

♂ ♀, 38-46 mm. Head, palpi, thorax, and abdomen bright-orange-yellow; palpi and thorax beneath pale-yellow; posterior segments of abdomen ringed with blackish above, beneath wholly yellow. Antennæ dark-fuscous, club reddish-yellow. Legs bright-yellow. Forewings elongate, triangular, *costa straight*, termen oblique, gently rounded; blackish-fuscous, with bright-orange markings; a broad costal streak, leaving extreme costal edge fuscous, from base posterior extremity of cell, intersected by veins at posterior extremity; cell filled in with orange, except a small patch at posterior extremity; 3 obliquely-placed elongate cuneiform spots between veins 6 and 9, posterior extremity excavated and finely continued along both edges of veins to termen; an oblique series of 5 somewhat quadrate spots from vein 1 to vein 6, posterior edges strongly excised and continued as fine lines along both edges of veins, nearly or quite to termen, excisions filled in with black, anterior edges of 5 spots irregularly crenulate; a broad dorsal streak from base to beneath middle of 1st quadrate spot; an elongate patch of hairs lying on vein 1 near base; cilia orange, strongly mixed with fuscous on upper half of termen. Hindwings with termen rounded; tornus prominent; colour as in forewings; markings orange; a moderately large tuft of orange-yellow hairs springing from base of vein 7; vein 1 similarly haired from base to posterior edge of postmedian band; an ovoid spot in posterior extremity of cell; a rather broad postmedian band, edges irregularly crenulate, extending from vein 1 to vein 7, broadest on vein 1, where it is continued as a fine line to termen and more thickly to base; cilia orange-yellow. Underside orange-yellow, distinctly mixed with greenish, especially along termen; markings of upperside reproduced in orange; *basal* third of cell blackish; a series of 7 well-defined black spots at posterior extremities of apical and quadrate spots, 4th and 5th spots also edged anteriorly by a small black spot; dorsum and wing below vein 1 wholly black. Hindwings pale-greenish-yellow; markings of upperside reproduced in pale-orange;

cellular spot edged posteriorly with black; postmedian band edged on either side with well-defined black spots; a large roundish black patch edged with orange at tornus.

The sexes do not differ except in size.

We (Meyrick and Lower) formerly called this insect *palmarum*, Mre. (T.R.S.S.A., p. 110, 1902), but the true *palmarum* of Moore is, so far as I know, not found in Australia.

An idea prevalent amongst some of my *confrères* that this insect is *Olivescens*, of Herrich-Schæffer, but his figure and especially the description certainly *do not* apply to this insect; but I shall reserve my criticisms until I revise the group.

Mackay, Townsville, Queensland; nine specimens; taken in February and March.

Types in Coll. Lower.

Apaustus hetero bathra, n. sp.

♂ ♀, 20-24 mm. Head and thorax dark-fuscous, thorax clothed with yellowish hairs, palpi fuscous, mixed with orange, beneath yellow. Abdomen dark-fuscous, more or less densely clothed with orange, sometimes showing segmental rings, beneath wholly yellow. Antennæ dark-fuscous, annulated beneath with yellow; club of ♂ beneath yellow, apiculus black; club of ♀ black, apiculus black. Legs yellow. Forewings elongate, triangular; blackish-fuscous, with orange markings; a broad costal streak, from base to posterior extremity of cell; cell filled in with orange; a confluent patch (indicating the usual 3 subapical spots) beneath costa at $\frac{3}{4}$; an oblique of 5 quadrate spots extending from vein 1 to vein 6, 2 upper small, and meeting the apical patch, 3 lower very much larger, with irregular edges; cilia black, becoming orange around tornus. Hindwings with termen rounded; colour as in forewings, basal and dorsal hairs yellow; markings orange; a small spot at posterior extremity of cell; a moderately broad, postmedian band, edges, somewhat crenulate from vein 1 to vein 6, continued along vein 1 almost to base; cilia yellow, orange at base. Underside of forewings with area along termen greenish-yellow; markings of upperside reproduced in orange, dorsum and wing below vein 2 blackish; basal half of cell black. Hindwings yellowish-green; markings of upperside reproduced in orange; cellular spot edged posteriorly with black; postmedian band edged on either side with narrow black lunules; a blackish elongate streak along dorsum, becoming blotch-like at termen.

Differs from its Australian congeners by the absence of stigma in ♂; the club of the antennæ affords a fairly accurate guide in the determination of the species, but until we are in possession of more material from other localities I would not insist on this character being of any specific value; but in the other species of the genus known to me the club of the ♀ on underside is *yellow*, as is also the ♂.

Mackay, Cairns (Kuranda), Cooktown, and Cape York; twenty-five specimens; taken between February and April.

The species show no variation.

Types in Coll. Lower.

LIBYTHEIDÆ.

Libythea geoffroyi, Godt.

By an unfortunate error I confused the sexes of this species when commenting (T.R.S.S.A., p. 169, 1907) on the same. The ♂ is the lilac-blue form, the ♀ is tawny-yellow. My former remarks were *vice versa.*

New Australian Tortricina.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read October 6, 1908.]

TORTRICIDÆ.

Capua epipepla, n. sp.

♂, 14 mm. Head, palpi, and thorax pale-ochreous. Antennæ whitish. Legs ochreous-whitish. Forewings elongate, moderate, costa arched, termen nearly straight; 7 and 8 long-stalked; pale-ochreous, irregularly strigulated with fuscous-ferruginous, and with fuscous-ferruginous markings; costal fold rather broad, dull-ochreous; basal patch obsolete, only indicated by a small patch of apparently raised scales on dorsum at $\frac{1}{3}$; median patch rather narrow, very oblique from middle of costa to middle of wing, thence becoming confused and blotch-like, terminating just above tornus, below which the ground colour is mixed with ferruginous-fuscous; a moderate, somewhat triangular costal patch, from $\frac{3}{5}$ costa to apex, lower edge terminating on middle of termen; between this and median patch is a thick streak of ground colour, which becomes a quadrate spot on costa; an extreme apical streak of ground colour. Hindwings whitish-ochreous, darker posteriorly; cilia pale-ochreous.

Cooktown, Queensland. One specimen; in November.

Capua (?) tripselia, n. sp.

♂, 14 mm. Head and antennæ fuscous. Palpi ochreous-fuscous. Thorax grey-whitish, with a posterior fuscous quadrate spot. Legs ochreous-whitish, posterior pair paler. Abdomen grey. Forewings rather broad, costa strongly arched, apex obtuse, termen bowed; pale-grey-whitish, irrorated throughout with fine fuscous strigulæ; markings well defined; brownish-ochreous; outer edge of basal patch from beyond $\frac{1}{5}$ costa to $\frac{1}{3}$ dorsum, becoming blotch-like on lower half and containing a dull leaden spot immediately above dorsum; anterior edge of median patch from before middle of costa to middle of dorsum; posterior edge from middle of costa, thence very obliquely curved to tornus, causing the patch to appear narrow on costa, thence rapidly dilated to tornus; a moderately broad, elongate, triangular patch on apical fourth of costa and termen, continued obliquely along termen to above tornus; a narrow streak of ground colour along termen, from apex to termination of patch; cilia grey-whitish. Hindwings and cilia grey-whitish.

I doubtfully refer this species to *Capua* on account of the form of the palpi, which are somewhat approximated to the face, and veins 7 and 8 of forewings being extremely long-stalked.

Kuranda (Dodd) and Cooktown (Olive). Three specimens; in September.

POLYLOPHA ELAPHRIS, n. sp.

♂, 12 mm. Head and palpi white, second joint of palpi beneath at base, sharply dark-fuscous, terminal joint fuscous. Antennæ and thorax fuscous. Abdomen ochreous. Anterior and middle legs whitish, tibiæ irregularly spotted with fuscous, tarsi banded with fuscous; posterior legs whitish-ochreous, tarsi white. Forewings elongate, moderate, costa gently arched, termen straight; surface with raised scales; 7 and 8 separate, both to costa; white, with fuscous markings; three spots on costa, first, smallest, at base; third, largest, at $\frac{1}{5}$; a dull-fuscous shade, thickly irrorated with fuscous and dark-fuscous spots throughout, extending from base along dorsum to just beyond $\frac{2}{3}$, limited on upper edge by cellular vein, on which are placed 3 or 4 dark-ferruginous spots, almost meeting costal spots; a moderately large dark-fuscous spot in middle of wing, resting on upper edge of shade; a broad, irregular fuscous shade along termen, narrowing towards tornus, with a darker-fuscous median shade, which is curved in on termen in middle and there becoming black, thence continued suffusedly to tornus; space between median shade and termen spotted with white; a more or less interrupted ferruginous-fuscous line along termen; cilia dark-fuscous. Hindwings brownish-ochreous; cilia grey, with a fuscous median line.

North Queensland. Two specimens, received from Mr. Dodd; taken in December.

ACANTHOTHYSPODA, n. g.

Thorax smooth. Antennæ of ♂ ciliated (1). Palpi moderate, somewhat appressed to face, second joint roughly scaled, terminal joint short, distinct. Posterior coxæ and tarsi clothed with thick spinous scales, forming a dense mass. Abdomen clothed with long, coarse hairs, especially laterally, beneath smooth. Forewings elongate, costa simple, 7 and 8 separate, 7 to termen. Hindwings elongate, trapezoidal, 6 and 7 from a point, 3, 4, and 5 approximated at base.

Type *elæodes*.

A. ELÆODES, n. sp.

♂, 14-15 mm. Head, palpi, and thorax dull-green, palpi tinged with ferruginous. Antennæ ochreous. Abdomen dull-grey, thickly clothed above and on sides with long black hairs (absent in ♀), beneath smooth. Legs blackish, anterior and middle tibiæ banded with ochreous-white, posterior pair wholly blackish, with a prominent thick patch of spine-like scales on coxæ (absent in ♀). Forewings elongate, moderate, costa hardly arched, termen nearly straight, hardly oblique; pale-dull-greenish, with ferruginous-fuscous markings; wing more or less crossed by waved oblique strigulæ; outer edge of basal patch obscure, from $\frac{1}{6}$ costa to $\frac{1}{5}$ dorsum; median patch rather narrow, well developed, very oblique, from about middle of costa to dorsum just before tornus, barely reaching dorsum in ♀; a moderately large rhomboid patch in middle, just before termen, edged on anterior edge by a fine line of silvery-grey; costa between base and outer edge of basal patch strongly strigulated; costa between outer edge of median patch and apex with three somewhat small quadrate spots, separated by spots of whitish, each containing a minute blackish spot, last of the three costal spots continued as a fine line to middle of termen; a small spot at apex; cilia ferruginous-fuscous, with a blackish basal line.

Cooktown and Cairns (Dodd), Queensland. Two specimens; in October. I have a specimen from New Guinea, which appears to be this species, but not being in the best of condition admits of some doubt.

EPITRICHOSMA, n. g.

Thorax smooth. Antennæ in ♂ ciliated. Palpi moderately porrected, second joint triangularly scaled, terminal joint exposed, short. Abdomen with tufts of lateral hairs posteriorly. Forewings elongate, moderate, with raised scales; costa in ♂ with a patch of more or less curled hairs from base to middle, longer on basal half. Middle and posterior tibiæ roughly haired. All veins separate, 7 to termen. Hindwings with veins 3, 4, and 5 approximated at base; 6 and 7 separate.

Differs from *Acanthothyspoda* by hairy costa and separation of all veins.

Type *neurobapta*.

E. NEUROBAPTA, n. sp.

♂, 14 mm. Head, palpi, antennæ, thorax, and abdomen pale-yellowish-ochreous. Abdomen orange-yellow, with tufts of long yellow hairs, placed laterally on posterior segments. Forewings elongate, moderate, costa gently arched, apex rounded, termen rounded; costal hairs yellow; pale-yellow. darker towards base; all veins more or less outlined with ferruginous; basal patch obsolete; median patch ferruginous, rather obscure, edges irregularly waved, anterior edge from before middle of costa to middle of dorsum; posterior edge from $\frac{2}{5}$ costa to beyond middle of dorsum; costal edge between posterior edge of median patch and apex with 4 or 5 equidistant ferruginous spots; a fine interrupted line of ferruginous along termen; cilia pale-yellow. Hindwings transparent; pale-greyish, sprinkled with yellow; all veins outlined with orange-yellow; dorsal hairs bright-orange-yellow; cilia grey-whitish, with a yellowish basal line.

Kuranda, Queensland. One specimen; in December.

Leptarthra hemicosma, n. sp.

♂, 12 mm. Head, face, and palpi bright-yellow, basal joint of palpi fuscous externally, crown fuscous-reddish. Antennæ fuscous-reddish. Thorax fuscous-reddish, patagia bright-yellow. Abdomen dark-fuscous. Legs fuscous, tarsi banded with whitish. Forewings elongate, moderate, costa gently arched, apex rounded, termen nearly straight; 3 from angle, 8 and 9 approximated at base; bright clear yellow, costa very finely strigulated throughout with reddish-fuscous; a large reddish-fuscous apical patch, occupying posterior $\frac{2}{5}$ of wing, anterior edge limited by a curved fine waved fuscous line, from costa at $\frac{3}{5}$ to dorsum beyond middle; within the patch are two or three short longitudinal streaks of paler and scattered fuscous strigulations; an interrupted blackish line along termen; cilia light-reddish-fuscous. Hindwings and cilia smoky-brown; cilia with a greyish basal line.

Very like some species of *Chrysoryctis (Tineidæ)*. The approximation of veins 8 and 9 at base I regard as specific only; in all other respects it agrees with *Leptarthra*, Low.

Kuranda, North Queensland. Two specimens; in October (Dodd).

L. metallocosma, Low.

Tortrix metallocosma, Low.

Having obtained further specimens for examination I refer the above to *Leptarthra*.

Dichelia lunifera, n. sp.

♀, 10 mm. Head, palpi, and thorax reddish-fuscous, palpi whitish internally. Antennæ fuscous. Legs greyish, tibiæ and tarsi infuscated. Abdomen grey. Forewings elongate, moderate, costa gently arched, termen oblique; reddish-fuscous, somewhat coppery-tinged; some black scales along costa; a somewhat lunate black mark in middle of wing; a few black scales along termen; cilia fuscous, mixed with coppery-reddish. Hindwings grey; cilia grey, with a pale-fuscous subbasal line.

This species may be an extreme form of *atristrigana*, Meyr., but the ground colour of that is greyish-fuscous or dark-fuscous, without any coppery tinge, and the markings more complicated.

Broken Hill, New South Wales. One specimen; in November.

TORTRIX EUPLECTRA, n. sp.

♂, 16-18 mm. Head and palpi dull-ochreous-fuscous, palpi paler beneath. Thorax grey, with four indistinct transverse fuscous lines. Antennæ fuscous. Anterior and middle legs greyish, posterior pair silvery-white, all tibiæ and tarsi banded with fuscous. Abdomen greyish-ochreous. Forewings elongate, moderate, costa gently arched, termen nearly straight; smoky-fuscous, more or less finely strigulated with darker; costa strigulated with short oblique white marks, arranged in pairs, the separation being effected by fine lines of ground colour, the one nearest apex is curved outwards and continued to middle of termen, where it meets a similar but narrower streak from costa beyond; outer edge of basal patch irregularly waved, from costa at $\frac{1}{5}$ to dorsum at $\frac{1}{3}$; a broad, fuscous, median patch, edges nearly straight; anterior from middle of costa to middle of dorsum, posterior from $\frac{5}{6}$ costa to tornus, upper $\frac{2}{3}$ much darker, and the 3 pairs of white costal marks within the patch, which are filled with leaden-metallic, are very oblique, and reach $\frac{1}{3}$ across wing, touching each other at termination; ground colour between basal and median patch ochreous-whitish; an elongate streak of dull-ochreous-whitish above tornus; a somewhat rounded spot of similar colour just above, only separated by a bar of darker ground colour; a fuscous line along termen; cilia ferruginous, spotted with darker. Hindwings smoky-fuscous; cilia grey, with a fuscous line at base.

Brisbane and Mackay, Queensland. Two specimens.

GRAPHOLITHIDÆ.

PHRICANTHES MACROURA, n. sp.

♂, 18 mm. Head, palpi, and thorax whitish, palpi and thorax beneath white. Antennæ fuscous. Legs whitish, anterior and middle tarsi banded with fuscous. Abdomen fuscous. Forewings elongate, moderate, costa hardly arched, termen slightly oblique; 7 and 8 separate, both to costa;

white, with brownish-fuscous markings; costa obliquely strigulated throughout with short equidistant marks, posteriorly becoming better defined, the last six separated by whitish ground colour; a more or less interrupted blackish submedian longitudinal streak, darkest on basal third and edged below throughout by its own width with ferruginous-fuscous, extending from base to $\frac{3}{4}$, ground colour above whitish; a patch of pale-fuscous along termen, rather broad at apex, thence curved inwards and rapidly attenuated to tornus; an elongate blackish spot in patch above middle, edged above by a streak of whitish; a small blackish spot on termen above middle; several fine, somewhat dot-like transverse strigulæ on posterior half of wing; a narrow fuscous shade along dorsum; cilia whitish, with a ferruginous median line and some scattered black points. Hindwings fuscous; cilia fuscous, with a paler basal line.

North Queensland. One specimen; in January.

Palæobia peltosema, n. sp.

♀, 12 mm. Head, palpi, and thorax very pale-greenish-white, palpi beneath whitish. Antennæ pale-greenish-white, fuscous-tinged. Abdomen greyish-fuscous. Legs whitish, anterior and middle tarsi banded with fuscous. Forewings elongate, moderate, costa hardly arched, termen rather strongly sinuate beneath apex, apex somewhat produced; pale-greenish-white, finely stigulated throughout with light-fuscous, paler towards base of costa; costa obliquely strigulated with short fuscous marks; a rather large triangular fuscous patch on costa, extending from just beyond middle and continued nearly to apex, apex of patch reaching nearly $\frac{3}{4}$ across wing; in the patch are 4 or 5 small oblique pairs of whitish marks; a fine fuscous, interrupted line along termen; cilia greyish-fuscous, with a sharp tooth of fuscous at apex, being the continuation of the triangular patch. Hindwings thinly scaled; pale-fuscous; cilia grey, with a fuscous subbasal line.

Mackay, Queensland. One specimen; in November.

Strepsiceros lasiophora, n. sp.

♂ ♀, 16 mm. Head, palpi, antennæ, and thorax dark-brownish-fuscous, palpi paler internally and beneath. Abdomen pale-fuscous. Anterior and middle legs fuscous, tarsi banded with white, posterior legs whitish, banded with fuscous. Forewings elongate, moderate, rather narrow, termen nearly straight, hardly oblique. Costal fold of ♂ rather broad, extending from base to near middle, and containing a large tuft of ochreous wool-like hairs; brownish-fuscous, darker in ♂, and irrorated with dull leaden metallic scales, more or less arranged in transverse series; costa shortly and obliquely strigulated with dark-fuscous; various irregular dark-fuscous transverse lines; an irregular patch of pale-fuscous in middle of wing (absent in ♀); a somewhat triangular patch of dark-fuscous on dorsum near tornus; a small fuscous spot on costa near apex, from which proceeds a narrow waved transverse line of same colour to dorsum, at tornus edged on either side by a dull leaden metallic line; a second, similar, but more distinct waved line, from a fuscous spot at apex, along termen; cilia dark-fuscous on upper $\frac{2}{3}$, pale-fuscous below, mixed throughout with leaden metallic points. Hindwings 3 and 4 stalked, 5 widely remote from 4; 6 and 7 separate; thinly scaled, fuscous, paler towards base.

Very closely allied to *Macropetana*, Meyr., but apparently distinct by the large costal tuft and absence of three sharply-defined black streaks above tornus, which are rarely absent in that species.

Townsville, Queensland. Five specimens; in March (Dodd).

The Strength of South Australian Timbers.

By Professor R. W. Chapman, B.A., B.C.E.

[Read October 6, 1908.]

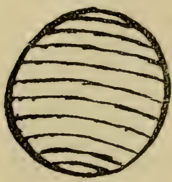
The only previously recorded tests upon the strength of South Australian timbers are some carried out by Professor Warren at the University of Sydney, and chronicled in his book on "Australian Timbers," published in 1892. These tests were on specimens of Sugar Gum, Blue Gum, Box, and Red Gum, supplied by the South Australian Conservator of Forests. Although unfortunately we have not in this State timber for export, it is very desirable that we should have a knowledge of the properties of the timbers indigenous to the country, and during the year some 200 tests upon the mechanical strength of South Australian timbers have been made at the University on specimens supplied by Mr. Gill, Conservator of Forests. The following timbers are represented: —

Botanical Name.	*Colloquial Name.*
Eucalyptus rostrata	Red Gum
,, *fasciculosa*	Pink Gum
,, *obliqua*	Stringy Bark, Messmate
,, *vimmalis*	Manna Gum, White Gum
,, *leucoxylon*	Blue Gum
,, *rubida*	White Gum, Candle Bark
,, *hemiphloia*	Box Gum
,, *odorata*	Peppermint Gum
,, *cambagei*	Bastard Box
,, *capitulata*	Stringy Bark, Messmate
,, *corynacalyx*	Sugar Gum
Pinus insignis	

All of these are indigenous to South Australia, with the exception of *Pinus insignis*.

Most of the timber came either from Kuitpo or Wirrabara, and was sent in pieces about 7 ft. long and 6 in. by 4 in. The greater part of it came in a fairly green state in July, 1907. A few tests were made soon after its arrival, but most of it was stacked in the laboratory and no further experiments made until February this year. As the summer was hot and dry the timber, especially small pieces cut ready for testing, became well dried by the time the strength tests were made. The timber contained a percentage of moisture (estimated on the weight of the dry wood) ranging from 20 to 50 per cent. on arrival, but by February this had decreased in the smaller specimens to 10 or 12 per cent. The moisture in the smallest pieces has not gone below 9 per cent.

During the process of drying the timber contracted very considerably across the grain. The amount of this contraction was measured on a number of pieces that had been turned to a cylindrical form in the lathe in July, 1907. By February, 1908, instead of being round, the section of every one was an oval, as shown rather exaggerated in the figure. Contraction had taken place in both directions, but much more in the direction parallel to the rings than in the direction at right angles to them. The average results of a number of such measurement were as follow:



Timber.	Percentage of Moisture Compared with the Dry Weight.		Percentage of Contraction in terms of Original Diameter.	
	On July 7, 1907.	On Feb. 18, 1908.	Parallel to Rings.	Radial to Rings.
Red Gum ... ... (*E. rostrata*)	37	9	5·6	2·5
Stringy Bark ... ... (*E. obliqua*)	22	11	7·8	2·1
Pink Gum ... ... (*E. fasciculosa*)	25	10	4·3	2·5
Blue Gum ... ... (*E. leucoxylon*)	26	13	6·2	1·6
Manna Gum ... ... (*E. vimmalis*)	50	12	10·3	2·5
White Gum ... ... (*E. rubida*)	24	11	6	1·7

The contraction was of a very different character in different woods. With Pink Gum and Blue Gum, for example, it was very uniform, and the wood remained smooth and even. But with Red Gum the different rings of growth appear to contract very unevenly, with the result that the specimens became marked with longitudinal ridges. This wood warps badly, as do also Manna and White Gum.

The weights of specimens of those woods that had been stored in the laboratory for over twelve months, and contained about 12 per cent. of moisture, averaged as follow: —

Timber.	Weight in Pounds per cubic foot.
Pink Gum	70·5
Red Gum	51
Manna Gum	52·9
Bastard Box	65·8
Stringy Bark	54·3
Sugar Gum (matured) ...	70·7
Peppermint Gum ..	70·8
Box Gum	66·8
Blue Gum	58
Rubida (White Gum) ...	60·5

The amount of moisture contained in timber has a great influence upon the strength. The more moisture the timber contains the weaker it is, as has been clearly shown by the experiments conducted by the United States Forestry Department, and this is equally true, whether the moisture is the natural sap or is water absorbed. The experiments carried out by Mr. Julius on behalf of the Western Australian Government have shown that the same is true for our Australian timbers. It thus becomes important in chronicling the results of tests upon timber that the percentage of moisture should be determined for each specimen, in order that comparisons may be of value. Accordingly, such determinations were made for most of the pieces tested. A thin section was cut out across the test piece, near the place where fracture occurred, within twenty-four hours of the experiment. This section was weighed and then placed in a drying-oven, where it was kept at a temperature of 115 deg. Cent. for four hours, when it was again weighed. Experiments showed that it was unnecessary to keep it in the oven more than four hours to get a determination sufficiently close for the purpose, as a longer period of drying made a difference of only 1 per cent.

The experiments were made with a Riehlé screw-testing machine, capable of exerting and measuring forces up to 100,000 ℔., and each timber was subjected to five different classes of tests—I., Transverse strain to determine its strength as a beam; II., direct tension; III., shearing along the grain; IV., compression along the grain; V., compression across the grain.

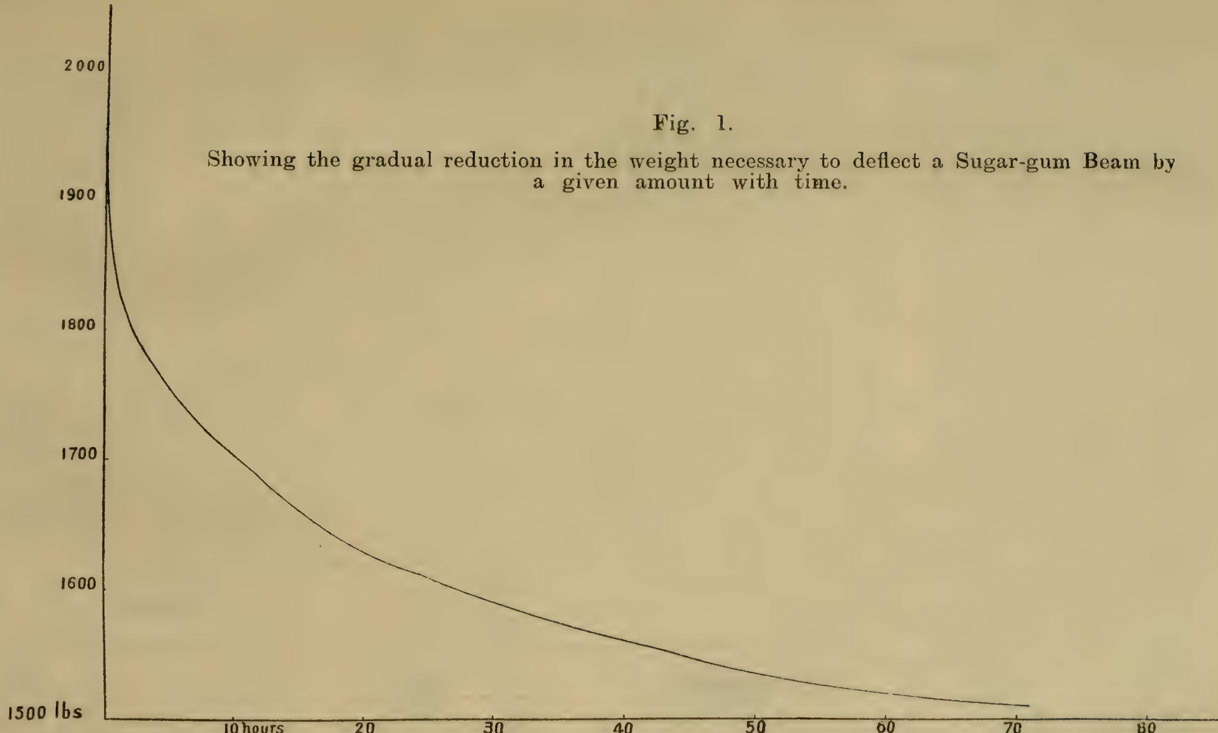
I.—Beam Experiments.

The timbers used for these tests were a little over 6 ft. long, the depths of the beams ranging from $3\frac{1}{2}$ to $5\frac{1}{2}$ in. In most cases the supports were placed uniformly 70 in. apart, and the beams were loaded at the middle so that the deflection was produced at the rate of $\frac{1}{8}$ in. per minute. On one side of the beam at the middle a vertical engraved scale of polished nickel was tacked. Across the front of this was stretched a fine thread, stretched with a piece of elastic between two small nails placed half-way up the beam, directly over each support. As the polished nickel acted as a mirror the position of the thread on the scale could be read with great accuracy.

The amount of deflection produced by a load on a timber beam depends upon the time that the load remains on the beam, even when the load is only a small proportion of that which is required to break the beam. As a consequence the modulus of elasticity deduced from experiments in a testing-machine, where the load is increased gradually and continuously, is likely to be much higher than should be reckoned on in practice when computing the deflection of a beam under a load that is likely to remain on for a considerable time. The curve shown in fig. 1 illustrates the result of an experiment on a beam of Sugar Gum, taken from a tree twenty-nine years old. The beam was $3\frac{1}{2}$ in. wide, $3\frac{3}{4}$ in. deep, with a span of 70 in. Its ultimate breaking load in the centre was 4,180 ℔. This beam was loaded with 1,960 ℔., and the deflection was ·67 in. This deflection was now kept constant, and the load required to produce it was measured at intervals. At the end of six minutes the load had dropped down to 1,900 ℔. In one hour it was only 1,830 ℔. In twenty-four hours it was down to 1,615 ℔., and at the end of three days, when the specimen had to be removed from the machine to make room for other experiments, the load required to produce this deflection of ·67 in. was only 1.510 ℔. Similarly, when a constant load is allowed to remain on a beam for any considerable time, the deflection produced continually increases. So in using the ordinary tabulated values of the modulus of elasticity for computing the amount of deflection of a beam under practical loadings, allowance must be made for this time effect, and the actual value used for the modulus of elasticity should not be more than half the usual tabulated value as deduced from the ordinary tests.

Fig. 1.

Showing the gradual reduction in the weight necessary to deflect a Sugar-gum Beam by a given amount with time.



II.—Tension Tests.

The strength of most woods under direct tension is so high compared with its strength in other ways, that wood seldom fails in this manner in actual structures, and so these tests are not of such practical importance as the others. A number of tests were made upon specimens turned in the lathe to a diameter of about $1\frac{1}{4}$ in., the length of the specimen being 22 in. over all and 10 in. inside the grips. The stretching of the wood under tension was measured between two points, originally 8 in. apart, by means of a Goodman extensometer, enabling measurements to be made to the $\frac{1}{10000}$ of an inch, and from these readings the modulus of elasticity was computed.

III.—Shearing Along the Grain.

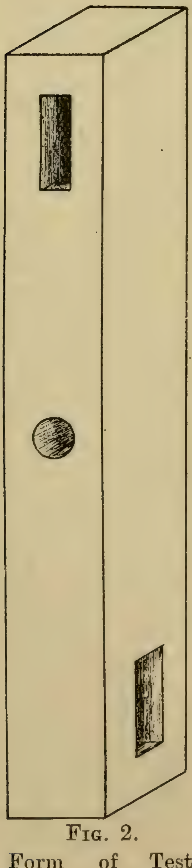


Fig. 2.
Form of Test Piece for Shearing Experiments.

The failure of wood by shearing or detrusion along the grain is one of the commonest methods of failure in actual structures, but the determination of the shearing strength depends a good deal upon the way in which the experiments are made. The method adopted is the standard method in the United States Forestry Department. The test piece is cut in the form of a block 2 in. square and 16 in. long (as shown in fig. 2). This is pierced by two morticed holes, each $\frac{1}{2}$ in. wide and 2 in. deep, one at each end of the block in directions at right angles. The block is held by a bolt passing through the centre. A steel key, $\frac{1}{2}$ in. wide, is passed through each mortice in turn, and pulled until it forces out the wood at the end of the mortice. In order that the key may press evenly over the wood a small steel bearing piece is fitted into the bottom of the mortice; this has a curved back upon which the steel key presses.

When the mortice cuts across the rings of growth at right angles the shearing resistance is much less than when the direction of the mortice is parallel to the rings. In the tables appended, however, the average results are given.

IV.—Compression Along the Grain.

Tests were made upon blocks 8 or 12 in. long, cut off the uninjured ends of the beams after they had been broken at the centre. The ends were cut off square in a lathe and the blocks subjected to compression along their length. Failure occurred in every case by the fibres buckling over along a plane inclined to the axis of the block, the greatest slope of this plane being always parallel to the rings. In this test the whole of the fibres of the test piece are subjected to a uniform stress, and the test is regarded by some experimenters as the best test for comparing the strengths of timbers.

V.—Compression Across the Grain.

For this test blocks 8 in. long were used and 3 to 4 in. thick. Each block was laid on its side on the table of the testing-machine and subjected to compression by means of a castiron block 4 in. wide, reaching across the whole width of the specimen. There is no definite stress at which failure occurs in tests of this nature, and the general method is to record the stress at which the iron block crushes into the wood—first to an amount of 3 per cent., and secondly to an amount of 15 per cent. of the depth of the specimen.

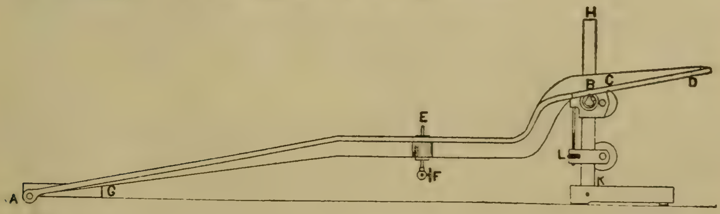


Fig. 3.

Apparatus for Measuring in Cross-compression Tests.

For this purpose the apparatus illustrated in fig. 3 was devised. *AD* is a stiff metal arm turning freely about a pin at *A*, supported on the block *G*, that rests on the edge of the table. A vertical insulated pin, *EF*, passes through the middle of the arm, being free to move downwards through the arm, but is pressed upwards by a strong spiral spring. It is tipped with platinum at the top, *E*, and a wire can be attached at *F*. The pin at *A* rests beyond the edge of the table; its centre is on the same horizontal plane as the surface of the table, and also in a straight line with *E* and three nicks, *B*, *C*, *D*, on the underside of the arm. The distances, AB, AC, and AD, are, respectively, 20·61, 21·25, and 24·25 in. A vertical support, HK, rests on the table and carries a knife-edge which can fit into any one of the nicks, B, C, or D, and its height can be finely adjusted by the screw L. When the specimen is placed on the table ready for testing, this apparatus is placed alongside and parallel to it. An electric battery is connected up to F and also to a binding screw attached to the castiron plate that is to crush into the specimen. In the circuit is an electric bell. The knife-edge supported by HK is then placed in the nick B, and the height of the arm adjusted until E makes contact with the underside of the castiron plate. As soon as contact is made the bell rings, and the position can be adjusted very accurately. Then the knife-edge is moved out until it rests in the nick C. This lowers E exactly 3 per cent. of its original height, whatever that may have been. The machine is now set to work until the plate crushes down so as to again make contact with E, when the bell rings and the record is taken. HK is then slid back till the knife-edge rests in the nick D, and this lowers E exactly 15 per cent. of its original height. Crushing again proceeds until contact is made once more and the bell again rings.

The results of the experiments so far made are given in the tables that follow. For purposes of comparison the average results of tests upon American Oak are given at the bottom of each table, quoted from Professor Johnson's work on "Materials of Construction."

The experiments made are not sufficiently numerous to enable fair general average values of the strengths to be deduced, but are given as the first instalment of what it is hoped to make a much more complete series of tests, to be carried out as opportunity offers. It is of obvious importance that we should have as complete a knowledge as possible of the properties of our local timber in order to decide upon what trees to grow for the extensive schemes of replanting forest trees that must be undertaken in the future. The specimens of the Pink Gum *(Eucalyptus fasciculosa)* that have been sent to me are magnificent timber, and, so far as I know, no other tests have been made upon this species. In every form of test it gave splendid results, and the timber is remarkably dense and uniform. The specimens of Sugar Gum, taken from matured forest trees, also gave very fine results, although the timber is not of such a uniform texture as the Pink Gum. Tests were made of this timber from trees fourteen and twenty-nine years old, and although the results were not so good as those from the mature tree they showed that even at this age the timber is strong enough for all ordinary engineering purposes, although it probably will not have the same lasting properties. Manna Gum and White Gum *(E. rubida)* appear to be the poorest of our timbers.

I am indebted to Mr. Gill for so willingly supplying me with the necessary timber, and also for the interest he has taken in the work, which has been done at intervals as other work permitted. My thanks are also due to Mr. W. E. Gray for assistance with the experiments.

BEAM EXPERIMENTS (S.A. TIMBERS).

Timber.	No. of Tests.	Average Percentage of Moisture.	Modulus of Rupture.	Modulus of Elasticity.	Remarks.
			Lbs. per sq. inch.	Lbs. per sq. inch.	
Blue Gum ...	7	14	10,550	1,598,300	
Manna Gum ...	2	16	9,880	1,426,000	
Pink Gum ...	2	13	12,578	1,596,000	
Stringy Bark—					
(*a*) *E. obliqua*...	1	13	14,040	1,979,000	
(*b*) *E. capitulata*	2	11	14,343	1,915,500	
Red Gum ...	6	12	11,373	1,220,000	
Box Gum ...	4	16	13,900	2,058,000	
Sugar Gum ...	3	15	15,662	2,215,009	From matured tree, Wirrabara
,, ,, ...	1	15	9,717	1,544,000	From tree 29 years old, Bundaleer
,, ,, ...	2	12	15,575	2,234,000	From tree 14 years old, Malvern
Peppermint Gum	4	17	13,600	2,374,000	
Bastard Rox ...	5	11	12,240	1,637,000	
White Gum (*E. rubida*) ...	1	12	8,391	1,550,000	
Pinus insignus ...	1	11	3,504	1,059,000	Grown at Wirrabara
American Oak ...		12	11,500	1,800,000	

Strength of South Australian Timbers in Direct Tension.

Timber.	No. of Tests.	Average Percentage of Moisture.	Ultimate Strength in pounds per square inch.	Modulus of Elasticity.	Remarks.
				Lbs. per sq. inch.	
Blue Gum ...	4	13	10,675	2,519,000	
Manna Gum ...	1	52	6,400	695,000	
" " ...	1	12	9,151	1,530,000	From Kuitpo
Pink Gum ...	1	26	10,430	1,900,000	"
" " ...	1	10	12,029	2,600,000	"
Stringy Bark (*E. obliqua*) ...	2	11	14,100	2,784,000	"
Red Gum ...	1	37	9,141	1,113,000	
" " ...	3	10	7,005	1,299,000	
Box Gum ...	2	11	11,257	3,119,000	
Sugar Gum ...	2	10	7,204	1,314,000	From matured tree, Wirrabara
Peppermint Gum	2	13	8,079	2,636,500	
Bastard Box ...	2	10	8,660	2,227,000	
White Gum (*E. rubida*) ...	2	12	6,759	1,652,000	
American Oak ...		12	10,000		

Shearing Strength of South Australian Timbers.

Timber.	No. of Tests.	Average Percentage of Moisture.	Shearing Strength per square inch.	Remarks.
Blue Gum ...	2	26	834	
,, ,, ...	4	10	1,162	
Manna Gum ...	2	25	808	
,, ,, ...	2	10	943	
Pink Gum ...	2	25	1,264	
,, ,, ...	2	10	1,539	
Stringy Bark (*E. obliqua*) ...	2	23	1,064	
,, ,, ...	2	11	1,448	
Red Gum ...	2	22	1,243	
,, ,, ...	2	10	1,554	
Box Gum ...	2	9	1,710	
Sugar Gum ...	4	9	1,762	From matured tree
,, ,, ...	2	11	1,661	From tree 29 years old
,, ,, ...	2	11	1,106	From tree 14 years old
Peppermint Gum	2	10	1,335	
Bastard Box ...	2	10	1,657	
White Gum (*E. rubida*) ...	2	22	488	
American Oak ...		12	1,000	

Strength of South Australian Timbers in Compression Along the Grain.

Timber.	No. of Tests.	Average Percentage of Moisture.	Ultimate Strength in Compression.	Remarks.
Blue Gum ...	5	16	6,853	
Manna Gum ...	2	17	5,378	
Pink Gum ...	3	13	8,600	
Stringy Bark—				
(*a*) *E. obliqua*...	2	13	7,967	
(*b*) *E. capitulata*	1	11	8,700	
Red Gum ...	5	12	6,202	
Box Gum ...	4	18	8,176	
Sugar Gum ...	5	16	8,400	From fully matured tree
,, ,, ...	4	15	6,953	From tree 29 years old
,, ,, ...	2	12	7,933	From tree 14 years old
Peppermint Gum	4	18	8,068	
Bastard Box ...	2	31	6,160	
White Gum (*E. rubida*) ...	2	12	6,399	
Pinus insignus ...	2	12	3,753	
American Oak ...		12	8,000	

STRENGTH OF SOUTH AUSTRALIAN TIMBERS IN COMPRESSION ACROSS THE GRAIN.

Timber.	No. of Tests.	Average Percentage of Moisture.	Load Required to produce 3% Deformation	Load Required to produce 15% Deformation.	Remarks.
			Lbs. per sq. inch.	Lbs. per sq. inch.	
Blue Gum ...	5	16	4,628	Over 6,025	One specimen beyond limits of machine
Pink Gum ...	2	12	4,899	Over 7,033	Beyond limits of machine
Red Gum ...	2	11	3,529	5,303	
Box Gum ...	5	17	4,243	5,681	
Sugar Gum ...	2	16	2,940	Over 6,630	Beyond machine limits (matured timber)
,, ,, ...	2	15	3,246	4,866	Tree 29 years old
,, ,, ...	2	12	2,717	3,862	Tree 14 years old
Peppermint Gum	2	18	3,196	6,446	
Bastard Box ...	1	30	3,085	5,185	
White Gum (*E. rubida*) ...	2	12	1,890	3,024	
Manna Gum ...	2	13	1,692		
Pinus insignus ...	2	11	896	1,164	
American Oak ...		12	1,980		

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part IX.

By Jos. C. Verco, M.D. (Lond.), F.R.C.S. (Eng.).

[Read October 6, 1908.]

Plates XIV. to XVIII.

Turbo jourdani, Kiener. Pl. xviii., f. 32, 33.

This very rare shell was named and described by Kiener in 1839 in the Rev. Zool. Soc. Cuvier, p. 324, and figured in the Mag. de Zool. de Guérin, 1840, Moll., pl. ix. To neither of these works have we access.

In 1843 Deshayes, in his edition of Lamarck's Anim. s. Vert., vol. ix., p. 224, says it belonged to the collection of Mons. Jourdan, after whom it was named.

In 1846 Philippi, in the Conch. Cab., ed. ii., Band ii., Abt. ii. and iii., p. 56, pl. xiii., f. 4, gives a description and figure, with the remark that he had never seen the species.

In 1848 Reeve, in Conch. Icon., Sp. 41, pl. xiii., writes: "Of this species there are two examples in the British Museum."

In 1873 Fischer, in Coq. Viv., Genus Turbo, p. 11, pl. xviii., gives a description and an excellent illustration of the smooth form.

In 1887 G. B. Sowerby, in the Thes. Conch., vol. v., p. 192, Sp. 8, pl. vi., f. 62, figures the form, which is validly spirally ribbed in the spire-whorls and obsoletely in the body-whorl.

The rarity of the shell is evident from the fact that all the above references but two are to the single shell belonging to M. Jourdan. Its habitat was the very indefinite one of "Australia" and "New Holland."

In 1888 Mr. M. M. Maughan found an immature example on the beach of Moonta Bay, in Spencer Gulf. It was identified by Prof. Tate, who held the opinion very strongly that it had been transported thither in ballast. Mr. Maughan saw no ballast about the beach, nor did he at any time gather any foreign shells there, although he did much collecting in the Bay. But no second specimen was ever taken.

In July, 1888, Mr. T. C. Watson, of Streaky Bay, South Australia, gave Mr. W. T. Bednall three specimens, the largest and best of which, containing the operculum, he presented to the South Australian Museum. It is nearly full-grown, but has had all the coloured external layer removed by erosion except near the aperture, where the mahogany tint and darker lines are still preserved.

On August 1, 1893, the late Prof. Tate, at a meeting of the Royal Society of South Australia, exhibited a specimen obtained in a subfossilized state from the silt of the Port Adelaide Creek at a depth of 24 ft. (Trans. Roy. Soc., S. Austr., vol. xvii., p. 354). This proved the existence at no very remote period of time of this species on the shores of South Australia, and located it in our extra-tropical southern coastline rather than in the tropical waters of Australia.

In 1905 Mr. A. Zietz kindly presented me with an immature bleached individual, which he had received from Fowler Bay.

In December, 1907, Dr. Torr and I searched the West Coast of this State at Port Elliston, Venus Bay, Smoky Bay, Streaky Bay, Scales Bay, Murat Bay, and Denial Bay, and LeHunte Bay, without finding a fragment of this species. But on St. Francis, the largest island in Nuyts Archipelago, we discovered its habitat, and gathered a score of examples in a state of greater or less dilapidation. Although Peron and Baudin called here and carried home many shells from this island and St. Peter's, they seem to have overlooked this Turbo. St. Francis lies some thirty-two miles from Murat Bay, and seventeen miles from the nearest point on the mainland. It has a number of reefs running out into the sea in a southerly, south-westerly, and westerly direction, with small sandy intervening bays. The southern swell is constantly breaking on these rocks and rolling as a surf into the tiny bays. The Turbos were found wedged between the piled-up boulders on the leeside of the reefs and in the crevices of rocks, and their opercula were cast up on the sandy beaches. It is really an ocean island, and is surrounded by water of thirty fathoms in depth.

We sought for living individuals, but unsuccessfully. Mr. Arnold, who has lived there for many years, found only one, just below watermark, on a rock face on the north of the island, some years ago. He says the animal is of a red colour.

On the top of the rocks were large quantities of opercula and fragments of *Turbo stamineus*, Martyn, which had been taken by gulls from the reefs at low water, and smashed so as to permit them to eat the shellfish; but we did not find a single fragment or operculum of *T. jourdani* among these remnants. Again, although immature *T. stamineus* were common among the abundant rock-shells cast up on the shore, we collected only two tiny *T. jourdani*. We concluded, therefore, that this rare species lives at a greater depth than *T. stamineus*, hence the gulls cannot get them, and they are but seldom washed up. Dr. Torr explored the reefs in water up to his breast, secured by a safety-line to prevent him from being carried away by the undertow of the swell; but though *T. stamineus* was obtained in abundance, not a single example of *T. jourdani* was taken. This deeper habitat probably accounts for its rarity in collections.

Since writing the above Mrs. J. F. Irvine, of Ingleside, Tasmania, tells me she has two fairly good specimens, sent to her some years ago by Captain Irvine. They came from Rottnest Island, off the western coast of Western Australia. Dr. Torr also informs me that an individual was taken alive by Mr. Kopp, when he was keeper of the lighthouse at Cape Borda, Kangaroo Island, at low tide, between Cape Borda and Snug Cove, on the shore of Investigator Strait.

The operculum was unknown to Kiener. It is of an oval shape, paucispiral, the largest having only five whorls, with the nucleus at a distance from the wider end of about one-fifth of the long diameter, proportionately much nearer the margin than in any other of our Turbos. The internal surface is slightly concave, with a low rounded cushion where the new spiral touches the old; beyond this is a shallow, rapidly-widening, slightly spiral depression, extending to the border. The external surface is smooth and polished. One margin, in an example 81 mm. in its long diameter, is 16 mm. in thickness, and the opposite is 5 mm., with a gradual slope between. A low spiral fulness runs obliquely across the outer face corresponding with the depression on the other side.

Turbo gruneri, Philippi. Pl. xviii., f. 36, 37.

Philippi, in Zeit. fur Malak, 1846, p. 98, gives the type locality as "The Colony of Adelaide, New Holland." It occurs all along our South Australian coastline, as would be expected since it is found in Victoria, and in Western Australia as far round as Swan River (Sowerby). It has been dredged alive in 12, 13, 15, and 16 fathoms in Investigator Strait and in the open sea outside Backstairs Passage.

The operculum is elliptical and thick, paucispiral, with a chitinous layer on its inner surface. The outer surface is smooth, but shows some curved earlike processes, similar to but not nearly so valid as those found on the opercula of *T. stamineus*.

This character would place it between the *T. undulatus*, Martyn, which is smooth on the outside, and *T. stamineus*, which is markedly auriform and prickly. (Pl. xviii., f. 38, 39, and 34, 35.)

Gibbula legrandi, Petterd.

Fossarina legrandi, Petterd, Journ. of Conch., 1879, p. 104. *Gibbula legrandi*, Petterd, Tate and May, Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 404, pl. xxiv., f. 21, 22; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1902, vol. xv., part 2, p. 133.

Beachport, shell sand (Verco).

Gibbula galbina, Hedley and May.

Gibbula galbina, Hedley and May, Records of the Austr. Mus., vol. vii., No. 2, 1908, p. 114, pl. xxii., f. 2. *Type locality.* —100 fathoms, off Cape Pillar, Tasmania.

Taken in 110 fathoms off Beachport, two examples dead, one specimen in 130 fathoms off Cape Jaffa.

Minos petterdi, Crosse.

Fossarina petterdi, Crosse, Journ. de Conch., 1870, p. 303; 1871, p. 323, pl. xii., f. 1; Tryon, Man. Conch., 1887, vol. ix., p. 275, pl. lii., f. 20, 21; Pritchard and Gatliff, Roy. Soc., Vict., 1902, vol. xiv. (N.S.), part 2, p. 94.

Minos petterdi, Crosse; Hutton, Proc. Linn. Soc., New South Wales, 1884, p. 369; Lodder, Proc. Roy. Soc., Tasm., 1900, Cat. Tasm. Shells (p. 12 of reprint); Tate and May, Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 403.

Fossarina simsoni, Tenison-Woods, Proc. Roy. Soc., Tasm., 1876, pp. 149, 150; Tenison-Woods, Proc. Roy. Soc., Vict., 1881, vol. xvii., p. 81; Tryon, Man. Conch., 1887, vol. ix., p. 275.

Glenelg Beach (W. L. Bragg); Henley Beach; St. Francis Island (Verco).

Rissoina rhyllensis, Gatliff and Gabriel.

Rissoina rhyllensis, Gatliff and Gabriel, Proc. Roy. Soc., Vict., 1908, vol. xxi. (N.S.), p. 367, pl. xxi., f. 8. *Type locality.* —Western Port, Victoria.

Dredged in Gulf St. Vincent, several; in 25 fathoms Thorny Passage, one alive, and one dead; one dead in 49 fathoms off Beachport, in 55 fathoms off Cape Borda, and in 90 fathoms off Cape Jaffa; in 110 fathoms off Beachport, forty, some quite fresh; in 130 fathoms off Cape Jaffa, seventeen good and poor; and in 150 fathoms off Beachport, thirteen, fairly good. It seems, therefore, to live in about 100 fathoms, and to be less frequent in the shallower and deeper water.

Rissoina lintea, Hedley and May.

Rissoina lintea, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 117, pl. xxiii., f. 11. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged at the same stations as the preceding species, but in smaller numbers.

Turritella kimberi, n. sp. Pl. xv., f. 14, 15.

Shell thin, long, narrow, imperforate, of ten whorls without the protoconch, which is absent. Another individual shows a long tapering protoconch of four smooth convex white whorls. Sutures deep. Spire-whorls well rounded; with equidistant, low, spiral ribs, six in the penultimate, the infrasutural one being the least valid, the upper slope of the rib very steep and short, nearly vertical, the lower long and sloping; the intercostal furrows appearing in the throat as opaque white capillary spiral lines. The body-whorl has ten spirals; base convex. Aperture slightly oblique, elliptical; outer lip thin, uniformly convex; inner lip a scarcely perceptible glaze on the body-whorl; columellar lip nearly straight, narrowly reflected; basal lip slightly effuse. Colour translucent white.

Dim.—Length, 7·7 mm.; breadth, 1·7; length of aperture, 1·4 mm.; width, ·9.

Locality.—Type, Backstairs Passage, 20 fathoms, with eight others fresh but dead. Port Willunga, one (Kimber).

Type in Dr. Verco's collection.

Obs.—It may reach 8·5 mm. in length.

Diagnosis.—*Turitella parva*, Angas, differs in its brown colour and its light chestnut sutural band, its three keels on the whorls, its subquadrate aperture, and in its columella thickened and produced at the base.

Seila attenuata, Hedley, superficially resembles it, but differs in its anterior notch.

Seila attenuata, Hedley.

Seila attenuata, Hedley, Proc. Linn. Soc., New South Wales, 1900, vol. xxv., part 1, p. 91, pl. iii., f. 9, 9*a*. *Type locality.*—Middle Harbour, Sydney. Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1906, vol. xviii. (N.S.), part 2, p. 60., Ocean Beach, Point Nepean.

Newland Head, 20 fathoms, one dead; Backstairs Passage and Gulf St. Vincent, eighteen.

Ovula formosa, Adams and Reeve.

Ovula formosa, Adams and Reeve, Voy. Samarang, p. 22, pl. vi., f. 6; Tryon, Man. Conch., vol. vii., 1885, p. 251, pl. iv., f. 15, 16, "Borneo, Japan."

Dredged one example, during many years' dredging in waters from Beachport to the Neptunes, including Gulf St.

Vincent and Spencer Gulf. This was identified for me by Mr. Hedley, who suggested that as a tropical form it had migrated round the western coast of Australia to South Australia, not being found on the eastern coast. This was supported by the securing of a second specimen in better condition, in 30 fathoms, off St. Francis Island, in the Great Australian Bight, during one day's dredging.

Septa petulans, Hedley and May.

Septa petulans, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 118, pl. xxiii., f. 14. *Type locality.*—Pirate's Bay beach, near Cape Pillar, Tasmania; also 100 fathoms off Cape Pillar.

I found a specimen some years ago on the beach at Eagle Hawke Neck, Tasmania, which is identical with the type (*teste* Hedley). Also dredged broken in 200 fathoms off Beachport.

Cymatium columnarium, Hedley and May.

Cymatium columnarium, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 119, pl. xxiii., f. 15. *Type locality.*—100 fathoms off Cape Pillar, Tasmania.

Dredged in 40 fathoms off Beachport, one good; in 60 fathoms north-west of Cape Borda, one immature; in 100 fathoms off Beachport, one good (identified by C. Hedley from the type); in 110 fathoms off Beachport, one good; in 130 fathoms off Cape Jaffa, one good, immature; in 150 fathoms off Beachport, one poor, and in 200 fathoms off Beachport, two poor.

Pyrene plexa, Hedley.

Columbella plexa, Hedley, Proc. Linn. Soc., New South Wales, 1901, part 4, p. 702, f. 25. *Type locality.*—Port Jackson: Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 112, 100 fathoms off Cape Pillar, Tasmania.

Dredged in 104 fathoms, 35 miles south-west of Neptune Islands, fourteen examples.

Arcularia mobilis, Hedley and May.

Arcularia mobilis, Hedley and May, Records Austr. Mus., vol. vii., No. 2, p. 121, pl. xxiii., f. 16, with var. *costata*, f. 17. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged in 100 fathoms off Beachport, one immature; in 130 fathoms off Cape Jaffa, twelve, some good, mostly poor; in 150 fathoms off Beachport, two nearly mature; in 200 fathoms off Beachport, one immature. No examples were taken alive. They do not quite conform either to the type or the variety. As regards the axial costæ they are intermediate, and the spirals are sharper, and wider apart than in either form.

One shell, taken in 150 fathoms off Beachport, is much more attenuate than the type. This measures 7 mm. by 4 mm., whereas that is 6 mm. by 2·9 mm.

Arcularia grandior, n. sp.

Plate xv., f. 16, 17.

Shell large and solid. Whorls nine. Protoconch $2\frac{1}{4}$ turns, smooth; apex scarcely exsert; first whorl depressedly convex, second vertically flatly convex. Spire-whorls convex, shouldered; the angulation starting in the first whorl close to the suture, proportionately more distant from it and less acute in each succeeding whorl, in the penultimate just above the middle. Suture distinct, undulating, narrowly margined. Body-whorl scarcely shouldered. Aperture axially obliquely ovate; outer lip simple, thin, in profile slightly centrally concave; columella concave, obtusely angled at the commencement of the canal which deviates well to the left and is recurved; inner lip, a smooth glaze, complete; notch marked. Sculpture bold; axial costæ, 16 in the penultimate, extending from suture to suture, acute, concavely rounded, as wide as the interspaces, and narrowing over the base to the notch; spirals valid, sharp, concavely rounded, as wide as the spaces, crossing and transversely tuberculating the axials, three in the first whorl, six principals in the penultimate with three intercalated secondaries, 20 altogether in the body-whorl extending validly to the notch; irregular crowded interstitial accremental striæ.

Dim.—Length, 32·5 mm.; of body-whorl, 13 mm.; width, 15 mm.

Locality.—Dead in blue clay in 110 fathoms off Beachport, 3 large; 100 fathoms, 3 fragments; 150 fathoms, 3 fresh, juvenile; 200 fathoms, 2 fresh, juvenile; off Cape Jaffa, in 300 fathoms, 2, juvenile; off Cape Borda, in 55 fathoms, 1 embryonic.

Type in Dr. Verco's collection.

Obs.—A second individual, figured (pl. xv., f. 17), is rather less elate, and the angled shoulder is more persistent. The type is stained blue, but another example is of a light-yellowish-brown tint.

Coralliophila elaborata, H. and A. Adams.

Coralliophila elaborata, H. and A. Adams, Proc. Zool. Soc., Lond., p. 433. *Type locality.*—"Sandwich Islands." Gatliff and Gabriel, Proc. Roy. Soc., Vict., 1908, vol. xxi. (N.S.), part 1, p. 369, "San Remo and Lorne."

Taken at St. Francis Island, west coast of South Australia, alive in a rock pool, and dead in numbers. Some specimens are quite white, but others are of a deep bluish-purple in the aperture and on the columella, and the colour is faintly visible through the shell. The largest example is 26 mm. long, and 16 mm. in its greatest diameter.

This species was kindly identified by Mr. Gatliff, from Victorian specimens, compared with the British Museum type by Mr. Gabriel, with Mr. E. A. Smith's help.

Coralliophila rubrococcinea, Melvill and Standen.

Coralliophila rubrococcinea, Melvill and Standen, Proc. Zool. Soc., Lond., 1901, p. 401, pl. 21, f. 2. *Type locality.*—"Persian Gulf." Gatliff and Gabriel, Proc. Roy. Soc., Vict., 1908, vol. xxi. (N.S.), part 1, p. 368, "Port Fairy and San Remo, Victoria."

Port MacDonnell Beach.

Identified by Mr. Gatliff, as in the previous species.

Trophon columnarius, Hedley and May.

Trophon columnarius, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 121, pl. xxiv., f. 22. *Type locality.*—100 fathoms off Cape Pillar, Tasmania.

Dredged in 40 fathoms off Beachport, three good (one identified by C. Hedley, from type in Austr. Mus.).

Trophon molorthus, Hedley and May.

Trophon molorthus, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 122, pl. xxiv., f. 23. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged in 150 fathoms off Beachport, five; in 200 fathoms, five; also, in 130 fathoms off Cape Jaffa, three: all dead shells; identified by C. Hedley, from type in Austr. Mus., Sydney.

Marginella columnaria, Hedley and May.

Marginella columnaria, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 120, pl. xxiii., f. 19. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged in Gulf St. Vincent at depths below 25 fathoms, one alive, six good, ten poor; in Backstairs Passage, 22 fathoms, five alive, and in 12, 15, 17, and 20 fathoms, eight dead; in 40 fathoms off Beachport, three good, three poor; in 45 fathoms east of Neptune Islands, one good, immature; in 55 fathoms north-west of Cape Borda, two good and four immature; and in 90 fathoms off Cape Jaffa, one very poor. This species seems, therefore, to live chiefly at about 20 fathoms, and beyond 60 fathoms to be found only in poor condition.

Limæa parvula, sp. nov. Pl. xv., f. 10 to 13.

Shell small, thin, white; obliquely oval. Umbos central, inflated, projecting approximate. Hinge-margin straight;

dorsal area transversely elongate, narrowly triangular. Anterior dorso-lateral angle obtuse, about 135 deg.; posterior about 100 deg. Anterior border slightly concave for about one-fourth of its length, then uniformly slightly convex. Posterior border much shorter, at first sub-concave, then nearly straight. Ventral border semicircular, joining the anterior border with a more open sweep than the posterior. Surface convex; with sixteen radial ribs, smooth, rounded, nearly as wide as the interspaces, with several intercalated riblets. Concentric striæ granulate the intercostal spaces, and form sublenticular costulæ on the sides, more marked on the anterior, near the dorsal border.

The cartilage-pit is sub-central, and triangular crossing the dorsal area to the umbo, concave. Hinge-plate narrow near the pit, widest at the angles; teeth about seven on each side, diverging, extending slightly along the lateral borders.

Interior slightly furrowed by the ribs. Ventral border squarely denticulated.

Dim.—Umbo-ventral diameter, 3·5 mm.; 3·7 mm., including the umbo; antero-posterior, 3 mm.

Hab.—Type locality, 104 fathoms, 35 miles south-west of Neptune Islands, 40 valves; 90 fathoms off Cape Jaffa, 1 valve.

Type in Dr. Verco's collection.

Mytilicardia crassicosta, Lamarck.

Cardita crassicosta, Lamarck, Anim. S. Vert., 1819, vol. vi., pt. 1, p. 24, No. 13.

Cardita citrina, Lamarck, *op. cit.*, p. 637, No. 21.

Cardita crassicostata, Reeve; Conch. Icon., 1843, vol. i., pl. 2, f. 7, *a*, *b*, *c*, *d*, *e*.

Cardita tridacnoides, Menke; Moll. Nov. Holl., 1843, p. 39, No. 222.

Dredged alive at all depths from 8 fathoms to 24, in both Gulfs and Straits. Very young individuals have been taken alive in 45 fathoms off Beachport and east of the Neptunes, and in 55 fathoms off Cape Borda. Small valves occur in numbers in 100 and 110 fathoms off Beachport, and in 130 fathoms off Cape Jaffa. It would appear as if very few mature shells are found above 15 fathoms, though the range of the smaller individuals extends to over 50 fathoms.

Some small specimens are of a uniform rosy-pink colour; others have the dorsal two-thirds of the posterior half of a very dark-brown internally. The ventral border may be quite straight, or very deeply excavate in front of its centre. There may be a sort of dorsal fin just in front of the posterior-dorsal angle, due to expansion of a radial rib. The shell may be elongate transversely and low umbo-ventrally, or short and very high. The ribs may be acute and scaly, or may become nearly obsolete, especially behind the umbo-ventral ridge.

It may attain a transverse length of 65 mm., 10 mm. more than that of Lamarck's type. This may vary considerably in proportion to the umbo-ventral height, as may also the prominence of the curved costal scales.

Mytilicardia calyculata, Linnæus.

Chama calyculata, Linnæus; Syst. Nat., 1767, p. 1138.

Cardita calyculata, Lamarck; Anim. S. Vert., 1819, vol, vi., part 1, p. 24.

Cardita aviculina, Lamarck; *op. cit.*, p. 26, No. 20.

Cardita excavata, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 100, pl. xvii., f. 1-3.

Mytilicardia tasmanica, Tenison-Woods; Proc. Roy. Soc., Tasm., 1876, p. 161.

Taken on the beach at Venus Bay, West Coast of South Australia; very rarely dredged.

Mytilicardia concamerata, Chemnitz.

Cardita concamerata, Reeve, Mon., t. 9, f. 42.

Thecalia macrotheca, A. Adams and Angas, Proc. Zool. Soc., Lond., 1864, p. 39.

Mytilicardia concamerata, Chemnitz, Tate, Trans. Roy. Soc., S. Austr., vol. ix., 1886, p. 100.

The habitat is given as "under stones at low tide," "Rapid Bay, South Australia" (Coll. Angas). But there were no specimens in Tate's collection. I have not taken it anywhere, nor has any collector other than Angas recognized it. It does not appear to have been recorded from Victoria, Tasmania, or Western Australia. Possibly some shells from elsewhere were by mistake placed among those in Angas's collection from South Australia.

Venericardia dilecta, E. A. Smith.

Pl. xiv., f. 8.

Cardita dilecta, E. A. Smith; Challenger Rep., Zool., 1885, vol. xiii., p. 213, pl. xv., f. 4, 4*a*. *Dim.*—Length 8 mm., height 6 mm., diameter 5·5. *Hab.*—"Off East Moncœur Island, Bass Strait," in 38 to 40 fathoms.

This has been dredged in Backstairs Passage in 17 fathoms, two alive and many valves; in 22 fathoms, two alive and forty-eight valves; and in Gulf St. Vincent, depth unnoted, many alive and dead; in 25 fathoms off Beachport, two poor valves; in 45 fathoms east of the Neptune Islands, one alive and eighteen valves; in 55 fathoms off Cape Borda, two poor valves; in 100 fathoms off Beachport, eight valves in poor and nine in moderate condition; in 130 fathoms off Cape

Jaffa, one whole shell and one valve, both in poor condition. This species would seem to live in water up to 45 fathoms, but not beyond. Its limit in shallow water below 17 fathoms is unknown.

My examples are 8·2 mm. by 6·7, and 8·1 by 6·9 mm., and are, therefore, proportionately somewhat higher than the type, but otherwise correspond. One is 9·25 mm. by 7·5, a large specimen.

Venericardia dilecta, E. A. Smith. Var. **excelsior,** var. nov. Pl. xiv., f. 9.

It closely resembles *C. dilecta*, Smith; but is rather more ventricose, is less equilateral, the umbo being more anterior, the post-dorsal border is longer and less sloping, the umbo-ventral depth is greater, the ribs are not quite so valid, the ventral margin is more curved, it has not the pink tinge about it, it is blotched and articulated with a darker brown.

Dim.—Length, 7·8 mm.; height, 7·3 mm.

Hab.—55 fathoms off Cape Borda, one valve; 100 fathoms off Beachport, six alive, and more than 750 valves quite fresh; 130 fathoms off Cape Jaffa, four alive, thirty-three valves quite fresh; 150 fathoms off Beachport, one alive, 750 valves; 200 fathoms off Beachport, forty-nine valves, and one alive. The proper habitat of this shell is evidently from 100 to 150 fathoms, only one valve having been found at a less depth. This circumstance, with the hiatus of about 50 fathoms between it and *V. dilecta*, almost suggests its right to be considered a separate species.

It is much more orbicular than my specimens of *V. dilecta*, and still more so than the type. Curiously enough Mr. Smith's artist has drawn a figure which, instead of corresponding with the dimensions in his text, measures exactly 26·5 mm. both in height and length, so as to represent an orbicular shell, instead of 26·5 in length and 19·9 in height, which are the proportions of his described type.

Some of my specimens are quite white, and some have concentric bands of a less opaque white in them.

Type in Dr. Verco's collection.

Venericardia amabilis, Deshayes.

Cardita amabilis, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 102, pl. xvii., f. 8. 9, *Hab.*—"New Zealand"; Tate and May, Proc. Linn. Soc., New South Wales, 1901, part 3, p. 434, "South coast of Tasmania"; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904. vol. xviii. (N.S.), part 1, p. 232, "Western Port, Victoria."

Dredged alive in Spencer Gulf in 17 fathoms and 20 fathoms, about two-thirds full-grown size; in 25 fathoms off Beachport, one small individual alive, also two valves full grown; in 40 fathoms off Beachport, one alive, immature, and 152 valves, the largest being 22 mm. antero-posteriorly and 19·5 mm. umbo-ventrally; in 45 fathoms east of Neptunes, four valves; in 49 fathoms off Beachport, nine valves, half grown; in 62 fathoms north-west of Cape Borda, two valves; in 90 fathoms off Cape Jaffa, five alive up to 10 mm. in length, and 104 valves up to 12 mm.; in 100 fathoms off Beachport, one alive, immature, and 140 valves up to 13 mm. in length; in 130 fathoms off Cape Jaffa, very many valves; in 150 fathoms off Beachport, 107 valves; in 200 fathoms off Beachport, fifty-two valves up to 10 mm. in length. Its range in depth is considerable, up to 100 fathoms in life, and up to 200 fathoms as valves in quantity.

The smaller individuals appear to be comparatively longer; thus the measurements are 9·75 antero-posteriorly, 8·25 umbo-ventrally, 5·50 sectionally; then 12·5, 11·25, 8·25, and 17·5, 17·5.

This shell has been previously recorded for South Australia by Prof. Tate in Trans. Roy. Soc. S. Austr., 1888, vol. xi., p. 68, as *C. beddomei*, E. A. Smith, Chall. Rep. Zool., 1885, vol. xiii., p. 211, pl. xv., f. 5. But our shell is identical with shells from Tasmania and Victoria sent as *C. amabilis*, Desh., and I cannot recognize any specific distinction between our species and the description and figure of Deshayes, or between those of Deshayes and Smith. I think *V. beddomei* will prove to be a synonym of *V. amabilis*.

Cardita gemmulifera, Tate, Trans. Roy. Soc. S. Austr., 1892, vol. xv., p. 130, pl. i., fig. 9, is only a mild variant of the above, and cannot be granted specific position.

Venericardia quoyi, Deshayes.

Cardita quoyi, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 103, no plate: *Hab.*—"New Holland"; Tate and May, Proc. Linn. Soc., New South Wales, 1901, part 3, p. 434, "Badger Island," Tasmania; Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xviii. (N.S.), part 1, p. 232, "Flinders, Western Port," Victoria.

Cardita rosulenta, Tate; Trans. Roy. Soc., S. Austr., 1887, vol. ix., p. 69, pl. v., f. 3, "Encounter Bay and Backstairs Passage."

Dredged alive in Eastern Cove, Kangaroo Island, one specimen in 11, in 14, and in 19 fathoms; also in Backstairs Passage, two in 13 fathoms, two in 16 to 18 fathoms, three in 20 fathoms, and one in 22 fathoms. Valves only were taken in good condition in 25 fathoms off Beachport, two, and in 40 fathoms, twenty-four valves; in 55 and 60 fathoms off Cape Borda, eighteen; in 110 fathoms off Beachport, six; in fair condition in 130 fathoms off Cape Jaffa, six; in 150 fathoms off Beachport, one; and in 200 fathoms, two.

Venericardia squamigera, Deshayes.

Cardita squamigera, Deshayes; Mag. Zool., 1853, p. 10; Reeve, Conch. Icon., pl. iv., f. 14: *Hab.*—"Unknown"; Tate, Trans. Roy. Soc., S. Austr., 1888, vol. xi., p. 68, "Spencer Gulf, off Kangaroo Island."

Dredged alive in Gulf St. Vincent, Spencer Gulf, and in Backstairs Passage; four in 10 fathoms, five in 12, one in 15, two in 17, seven in 20, five in 22 fathoms. Valves were taken, but only of small size, as follows:—Seventeen in 55 fathoms and one in 62 fathoms off Cape Borda; one in 110 fathoms off Beachport; and two in 300 fathoms off Cape Jaffa. I have not collected it on any of our beaches.

It attains a length of 25 mm., with a height of 19 mm., nearly three times the dimensions given by Tate, *viz.*, three-eighths of an inch by a quarter of an inch, or 9 mm. by 6.

Venericardia bimaculata, Deshayes.

Cardita bimaculata, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 101, pl. xvii., f. 4, 5: *Hab.*—"New Zealand, Coll. Cuming;" Tate, Trans. Roy. Soc., S. Austr., 1892, vol. xv., p. 134, records it for South Australia, and says "it is not admitted by Prof. Hutton in his revised list of New Zealand Mollusca" as living in New Zealand; Tate and May, Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 434, for Tasmania: Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xviii. (N.S.), part 1, p. 232, "Port Phillip and Western Port."

Cardita gunni, Deshayes; Proc. Zool. Soc., Lond., 1852, p. 101, *Hab.*—"Van Diemen's Land" (Coll. Cuming).

Cardita atkinsoni, Tenison-Woods; Proc. Roy. Soc., Tasm., 1876, p. 27, *Hab.*—"Long Bay, Tasmania."

This species varies greatly in shape; one may be 15·25 mm. antero-posteriorly, 12 mm. umbo-ventrally, and 7·75 in section, and another 13·75, 12·25, and 9·75 in its respective measurements. The difference is not due to age, for each form can be traced from minute to full size. But intermediate grades occur. The ribs may vary from 15 to 23.

Dredged alive in Gulf St. Vincent, Spencer Gulf, Investigator Strait, and Backstairs Passage. Seven in 5 fathoms, sixty-two in 5 to 10 fathoms, twenty-seven in 10 to 15 fathoms, 134 in 15 to 20 fathoms, and sixty-four in 22 to 23 fathoms, one in 45 fathoms, off the Neptunes. Fifteen to 20 fathoms seems to be, therefore, its proper station, though one was taken alive in 40 fathoms off Beachport. Valves only were taken, sixty-five in 40 fathoms, eighteen in 55 fathoms, twelve in 60 fathoms, thirty in 100 fathoms, thirty-one in 130 fathoms, three in 150 fathoms, ten in 200 fathoms, and five in 300 fathoms.

Venericardia lutea, Hutton.

Cardita lutea, Hutton; Man. New Zealand Moll., 1880, p. 159: *Venericardia lutea*, Hutton, Hedley, Trans. New Zealand Inst., vol. xxxviii., 1905, p. 72, pl. i, f. 6.

Dredged 14 fathoms off Ardrossan, sixteen alive and several valves; 15 fathoms off Wallaroo, four alive and seven valves; 20 fathoms Gulf St. Vincent, two alive.

Venericardia columnaria, Hedley and May.

Venericardia columnaria, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 125, pl. xxv., f. 37-40. *Type locality*.—100 fathoms, off Cape Pillar, Tasmania.

The South Australian shells are not quite so produced anteriorly as the type, and may have twenty-six ribs. They may reach 8·8 mm. in length and 7·7 mm. in height. Younger shells are comparatively more transverse. The colour is white, tinged with brown on the margins beyond the hinge plate; there may be brownish smears at both ends internally, or the pallial line and the muscle scars may be painted brown; or the outer surface may be faintly brown, most marked at the umbos.

Dredged in 40 fathoms off Beachport, five valves; in 49 fathoms, twelve valves; in 100 and 110 fathoms, very many valves; in 150 fathoms, seventy-six valves; and in 200 fathoms, seventeen valves; in 130 fathoms off Cape Jaffa, very many valves and one perfect shell. Its habitat is apparently from 100 to 150 fathoms.

Venericardia delicata, n. sp. Pl. xvi., f. 18, 19.

Shell rather thin, transversely oval, subequilateral. Umbos in front of centre, directed forward, rather prominent, approximate. Post-dorsal border sloping, barely concave, anterior concave. Front margin well curved, ventral less, posterior wider, somewhat truncately convex. Radial ribs twenty-four, narrower than their interspaces, high, closely and finely transversely scaled, denticulating the margins. Very fine accremental striæ crowd the intercostal spaces, a larger one corresponding with each scale. Lunule narrowly cordiform, smooth, prominent in the centre. Left valve with two diverging cardinal teeth, tiny anterior lateral tooth in front of lunule; right valve with wide triangular cardinal, socket in front of lunule, minute posterior lateral. Interior white glistening, rayed by ribs, margins denticulated.

Dim.—Antero-posterior diameter, 8·5 mm.; umbo-ventral, 7·2 mm.

Colour—Sparsely irregularly dotted outside with brown. A living example is of a light greyish tint, spotted with brown disposed somewhat concentrically, and has the lunule chestnut brown; and is 6·3 mm. long, 5 mm. high, and 3·8 mm. in section.

Hab.—Type, 130 fathoms off Cape Jaffa, with several valves; 90 fathoms, two alive and eighty-four valves; 300 fathoms, many valves; 110 fathoms off Beachport, six valves; 150 fathoms, twenty-four valves; 200 fathoms, twenty-three valves; 104 fathoms, thirty-five miles south-west of Neptune Islands, one alive, and many fresh valves.

Diagnosis.—It is most like *Venericardia bimaculata*, Deshayes; but is a more delicate shell, has more and narrower ribs, which are much more closely and finely scaled. The same features distinguish it from *V. quoyi*, Desh., and *V. difficilis*, Desh.

Type in Dr. Verco's collection.

Carditella exulata, E. A. Smith.

Carditella exulata, E. A. Smith; Challenger Rep., Zool., 1885, vol. xiii., p. 215, pl. xv., f. 6, 6*a*. *Type locality.*—"Off Nightingale Island, Tristan d' Acunha, 100 to 150 fathoms." *Dim.*—Length 4 mm., height 2·75, width 2 mm.

Our shells were taken in 130 fathoms off Cape Jaffa, four valves; 110 fathoms off Beachport, six valves; the beach at MacDonnell Bay in shell sand, many valves and one living individual; and at Kingston, Lacepede Bay, shell sand, many valves. I cannot detect any specific difference between these examples and Mr. Smith's, from his description and figure, except that ours are smaller, measuring 2·8 mm. by 1·8 mm. Some valves have the posterior part internally and the region of the lateral teeth stained brown. Tristan d'Acunha lies in about 12 deg. west longitude, and 37½ deg. south latitude, in the middle of the Atlantic Ocean. Beachport is in about 139½ deg. east longitude, and 37½ deg. south latitude. The latitude in which the type shells and ours were taken is, therefore, exactly the same; as is also the depth, 100 to 150 in the one case, and 110 in the other. These two circumstances might to some extent explain their identity. It will be noted, however, that most of our specimens were taken on the beach, where also the only living individual was secured. If the identification is correct, the distance between the two stations of 162 parallels of longitude, which at that latitude may be computed as about 9,000 miles, is very interesting.

Carditella subtrigona, Tate.

Carditella subtrigona, Tate, Trans. Roy. Soc., S. Austr., vol. ix., p. 70, pl. iv., f. 10. *Type locality.*—Streaky Bay, Great Australian Bight; Tate, *op. cit.*, vol. xiv., p. 268.

Dredged alive at all depths from 17 to 24 fathoms in Gulf St. Vincent, Investigator Strait, and Backstairs Passage, as far out as Newland Head.

It may reach 10 mm. in length and 10 mm. in height. When young the shell is comparatively longer antero-posteriorly than when adult, the umbos seem to project more dorsally, and the sectional diameter is less, so that the juvenile form might be mistaken for another species. To the characters given by Tate may be added that the shell may be white with dark-brown muscle scars and hinge-plate and pallial line, and in addition some have all the inner ventral part from above the pallial line to the margin a deep purple-brown. Rarely the whole shell has a light purple tint.

Carditella elegantula, Tate and May.

Carditella elegantula, Tate and May, Proc. Linn. Soc., New South Wales, vol. xxvi., 1901, part 3, p. 434. *Type locality.*—Blackman's Bay, Tasmania.

Dredged alive in Backstairs Passage in 22 fathoms and in 18 fathoms; also in Investigator Strait, 22 fathoms; dead in Spencer Gulf; Port Willunga (Mr. Kimber).

Carditella valida, n. sp. Pl. xvi., f. 22 to 24.

Shell solid, obliquely transversely oval, somewhat produced anteriorly. Umbos prominent, curved forward, acute, approximate, with a minute prodissoconch cap. Post-dorsal border markedly convex; anterior concave; ventral convex, more curved in front than behind, crenulate. About nineteen valid axial ribs, rounded, interspaces very narrow. Valid close-set concentric round cords cross the costæ, scarcely visible in the interspaces. The right valve has a wide triangular cardinal tooth, an anterior lateral separated by a groove from the margin, and a posterior marginal lateral. The left valve has two diverging cardinals, of which the posterior is the larger, a posterior lateral separated by a groove from the margin and an anterior marginal lateral. The internal ventral border is well denticulated. Lunule cordiform, depressed, smooth. Escutcheon long, lanceolate. Ligament visible externally. Colour brownish, especially over the posterior third. Internally brown in the posterior part fading anteriorly, lateral teeth brown, and inside the ventral margin. It may be wholly white, or of a very light purple tint.

Dim.—Antero-posterior diameter, 3·7 mm.; umbo-ventral, 3·6 mm.

Hab.—Encounter Bay (Tate); Gulf St. Vincent, under 22 fathoms, several alive and many valves. Taken in small numbers and poor condition in 25, 40, 62, 110, and 130 fathoms, from Beachport west to the Neptune Islands.

Diagnosis.—It was recorded by Tate for South Australia as *C. infans*, E. A. Smith, in Trans. Roy. Soc., S. Austr., vol. ix., 1886, p. 100, and listed by Adcock in his Handlist, 1893, No. 146. Mr. Hedley has sent me Smith's species, obtained from the type locality, and it appears to have less curved dorsal borders and fewer ribs, which are scaled, and not corded.

It very closely resembles *C. elegantula*, Tate and May, of which it may prove to be only a variety, in which case its name will indicate the difference, for it has fewer and higher ribs, with bolder and less crowded concentric cords, and is somewhat less oblique.

Type in Dr. Verco's collection.

Carditella vincentensis, n. sp. Pl. xvi., f. 20, 21.

Shell solid, roundly trigonal. Umbos projecting, approximate, curved forward. Dorsal borders converge at about a right angle; posterior straightly convex, anterior slightly excavate. Lunule elongate-cordate, depressed, smooth, its centre prominent, and seen as a convexity in the profile of the shell. Escutcheon well marked, elongate, bevelled edges, left valve overlapping the right. Twenty-two flattened rounded ribs, the posterior straight, the anterior concave forwards, interstices linear. Well-marked concentric liræ cross the ribs and spaces. Right valve has a central triangular cardinal tooth, a long anterior lateral tooth separated from the margin by a groove, and a thin posterior marginal lateral. The left valve has two diverging cardinal teeth, a posterior lateral separated from the margin by a groove, and an anterior marginal lateral tooth. The lateral teeth and sockets are microscopically vertically striate. Ventral border well denticulated internally. Colour white, reddish-brown tint on the posterior third of the shell, deepest at the posterior inferior angle.

Dim.—Antero-posterior diameter, 3 mm.; umbo-ventral, 2·85 mm.

Hab.—Gulf St. Vincent, Spencer Gulf, and Backstairs Passage, 20 and 22 fathoms, several alive and many valves.

Variations.—The posterior dorsal border may be quite straight. The colour may be wholly white, the brown tint may be continued across the middle to the front border, or it may be disposed in radially elongate spots on the ribs.

Diagnosis.—From *C. elegantula* by its straighter posterior border, by the prominence of the centre of its lunule, by being more equilateral, and by its colour.

Type in Dr. Verco's collection.

Cuna atkinsoni, Tenison-Woods, sp.

Kellia atkinsoni, Tenison-Woods, Proc. Roy. Soc., Tasm., 1877 (1876), p. 158. *Type locality.*—Long Bay, Tasmania.

Carditella atkinsoni, Tenison-Woods, Tate and May, Proc. Linn. Soc., New South Wales, vol. xxvi., 1901, part 3, p. 435, pl. xxvii., f. 107.

Cuna atkinsoni, Tenison-Woods, Hedley and May, Records Austr. Mus., vol. vii., No. 2, 1908, p. 113, 100 fathoms off Cape Pillar, Tasm.

Dredged Gulf St. Vincent, under 22 fathoms, many whole and valves; 110 fathoms off Beachport, one valve; 130 fathoms off Cape Jaffa, five good valves.

Some examples have very fine concentric striæ and fewer marginal denticulations; others seem very solid, probably from senility; and one variety is much narrower and more solid, and has a broad solid hinge-plate; but the examples were too few to create a new species from them.

Cuna hamata, Hedley and May.

Cuna hamata, Hedley and May. Records Austr. Mus., vol. vii., No. 2, 1908, p. 124, pl. xxv., f. 33-36. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged off Beachport in 40 fathoms, one alive, eighty-six good valves; 49 fathoms, ten poor valves; 100 fathoms, fifteen good valves; 150 fathoms, sixty-five good valves; north-west of Cape Borda, 62 fathoms, ten poor valves; off Cape Jaffa, 130 fathoms, thirty-nine good valves. It has evidently a wide range in depth, though none were taken in 200 or 300 fathoms.

During life it is of a translucent horn colour, opaque white when dead.

Cuna obliquissima, Tate, sp.

Cardita obliquissima, Tate, Trans. Roy. Soc., S. Austr., vol. ix., 1887, p. 70, pl. v., f. 9. *Type locality.*—22 fathoms, Encounter Bay.

Dredged at different depths in Gulf St. Vincent and Backstairs Passage; seven miles south-west of Newland Head in 20 fathoms, one alive, of faint pink tint; off Beachport in 40 fathoms, twelve good valves; in 49 fathoms, seventeen poor valves; off Cape Borda in 55 fathoms, one whole and twenty-five good valves; in 62 fathoms, four whole and three valves, all poor; off Beachport in 110 fathoms, nine valves, in moderate condition; in 150 fathoms, two valves, moderate. This lives chiefly in water up to 25 fathoms, and is in poor state above 60 fathoms, and not found above 150.

In addition to the stout "four or five radial riblets" on the posterior slope noted by Tate, living shells show fine axial riblets over the whole surface, quite to the anterior margin. The "distant concentric grooves" do not correspond in direction with the fine microscopic accremental striæ, but cut them obliquely from the front downwards and backwards, and each one slightly notches the ventral margin on its outer aspect, the notches of successive grooves being more anterior. In very young living shells the grooves are very deep at the anterior margin, so as to form distinctly projecting lamellæ here. The prominent prodissoconch is well preserved as a tiny concentrically hollowed cap.

Cuna delta, Tate and May, sp.

Carditella delta, Tate and May, Trans. Roy. Soc., S. Austr., vol. xxiv., 1900, p. 102.

Cuna delta, Tate and May, Verco, Trans. Roy. Soc., S. Austr., vol. xxxi., 1907, p. 109. See references there.

Dredged also in 104 fathoms, thirty-five miles south-west off Neptunes, and in 130 fathoms off Cape Jaffa, one valve at each station. Its habitat is evidently in the shallower water, not beyond 22 fathoms.

Cuna cessens, n. sp. Pl. xiv., f. 4 to 7.

Shell rather thin, trigonal, almost equilateral. Umbonal angle rather less than a right angle. Apex capped by a minute prodissoconch. Dorsal borders nearly straight, tne posterior barely excavate, the anterior barely convex. Anterior and posterior ventral angles well marked. Ventral border convex, not crenulated. Exterior dull, rough, sordid, with about ten obsolete radials; and several concentric imbrications or growth-rests, besides obsolete accremental striation. Anterior and posterior sides somewhat excavate into long lunule and escutcheon, the posterior more deeply than the anterior. The right valve has a large triangular cardinal tooth, and a small posterior above and behind the ligamental pit. The left valve has a large anterior cardinal, and a depression behind the socket of the right wedge tooth for the ligament, separated by a tooth, and a small one above and behind the pit. Each valve has a marginal lateral, and a lateral separated from the margin by a groove. The internal ventral border is not denticulate. The interior is white with the ribs and imbrications visible through the shell. Colour is a dull light horn tint.

Dim.—Antero-posterior diameter, 1·8 mm.; umbo-ventral, 2·1 mm.; sectional, ·9 mm.

Dredged in Backstairs Passage, 22 fathoms, several alive and valves.

Diagnosis.—Its closest ally is *C. delta*, Tate and May; but it is less solid, has a wider umbonal angle, has a smaller sectional diameter, has the concentric rest gradations, and no marginal denticulations.

Type in Dr. Verco's collection.

Cuna concentrica, Hedley.

Cuna concentrica, Hedley, Mem. Austr. Mus., vol iv., 1902, p. 315; Verco, Trans. Roy. Soc., S. Austr., vol. xxxi., p. 109, *q.v.*

Cuna edentata, n. sp. Pl. xiv., f. 1 to 3.

Shell ovate-trigonal, white, glossy, solid. Anterior and posterior lateral borders nearly straight, the latter rather shorter. Ventral border convex, slightly produced anteriorly. A small prominent prodissoconch cap, about three-fourths of a circle. Exterior has crowded concentric valid ribs, but no radial sculpture. The right valve has a large central triangular tooth, a minute anterior, at the extremity of the long antero-lateral tooth, which is separated by a groove from the margin, a marginal postero-lateral, with a minute cardinal tooth above it, and above that a marginal socket for the left posterior cardinal. The left valve has a large anterior cardinal tooth, and a small posterior behind the cartilage-pit, a long low postero-lateral tooth separated by a groove from the margin, and a marginal antero-lateral.

The inner ventral border is not dentated, whence the name.

Dim.—Antero-posterior diameter, 1·6 mm.; umbo-ventral, 1·9 mm.

Hab.—Gulf St. Vincent, dredged several.

Diagnosis.—It is very like *C. concentrica*, Hedley, but the smooth internal ventral border distinguishes it.

Type in Dr. Verco's collection.

Cuna comma, n. sp. Pl. xvii., f. 29 to 31.

Shell solid, white, glossy, obliquely pyriform, with a distinct three-quarter circle prodissoconch. Antero-lateral border convex; postero-lateral concave below the umbo, then straight, much shorter; ventral border convex produced anteriorly. Outer surface closely concentrically ribbed, no radial sculpture. The right valve has a large central curved cuneate tooth in front of the cartilage-pit, and a small posterior tooth just below the umbo, with a little socket outside and below it. The left valve has a large curved anterior tooth, a lamina in front of the cartilage-pit, a small posterior tooth behind the pit, and a small socket above and in front of it. The antero-lateral in the right valve and the postero-lateral in the left are separated from the margin by a groove to receive the corresponding marginal lamina of the other valve. The internal ventral border is not denticulated.

Dim.—Antero-posterior diameter, 2·6 mm.; umbo-ventral, 3·2 mm.

Hab.—Dredged alive in 22 fathoms in Backstairs Passage, and in 20 fathoms off Newland Head; also in Gulf St.

Vincent, very many; in 40, 45, 49, 55, 62, 110, and 130 fathoms, from Beachport to the Neptune Islands, but mostly in poor condition.

Diagnosis.—From *C. concentrica*, Hedley, by its curved lateral and non-denticulated ventral borders; from *C. edentata*, by its larger size and curved lateral borders; from *C. atkinsoni*, by the character of the hinge and the non-denticulated border.

Type in Dr. Verco's collection.

Condylocardia subradiata, Tate, sp. Pl. xvii., f. 25 to 28.

Carditella subradiata, Tate, Trans. Roy. Soc., S. Austr., vol. xi., 1888, pl. xi., f. 7. *Type locality.*—Shell sand, Royston Head.

Dredged off Royston Head, 20 fathoms, one alive, large; Backstairs Passage, 22 fathoms, one alive and six valves; off Beachport in 40 fathoms, fourteen valves; in 49 fathoms, very many valves, good; in 110 fathoms, nine whole and very many valves; in 90 fathoms off Cape Jaffa, many valves; east of North Neptune Island in 45 fathoms, one whole, three valves, all poor; north-west of Cape Borda in 62 fathoms, five alive and many valves, good; thirty-five miles south-west of Neptune Islands in 104 fathoms, four valves, poor. It seems to live in water from 20 to 100 fathoms.

Its generic location has been changed. Tate did not allude to its dentition in his description, and only the external surface was figured. His type, which is the only example in his collection, was fixed on a card to show the outer surface, and was regarded by him as a left *Carditella* valve, produced posteriorly; but it proves to be a right *Condylocardia* valve, produced anteriorly. It has a distinct prodissoconch scale, separated by a narrow groove from the hinge-plate below. A large subcentral cartilage pit is bounded in front by a comparatively long diverging cardinal tooth, and behind by a thinner, lower, and shorter diverging lamina. The long antero-lateral tooth is separated from the margin by a groove, and the postero-lateral tooth is marginal.

Two other valves have furnished the illustrations of the hinge of this species, which may be more fully described thus: accepting Bernard's conclusion for his genus that the anterior is the produced side. The right valve has a diverging front cardinal tooth, and a long antero-lateral separated from the margin by a groove; this receives the antero-lateral marginal lamina of the left valve; this lamina is continued as a sort of hook round the dorsum of the right cardinal, and as a diverging left cardinal down its posterior side, where it rests on a low narrow shelf at the base of, and forms the socket of, the right cardinal and also the anterior wall of the central cartilage pit. The left valve has a posterior diverging cardinal tooth, and a long postero-lateral tooth separated from the margin by a groove, which receives the postero-lateral marginal lamina of the right valve. The socket of this cardinal is completed by a diverging tooth in the right valve, lying anterior to it, where it rests on a low ledge, and so forms also the posterior wall of the cartilage pit; this is completed dorsally by a horizontal projection forwards from the right posterior cardinal just beneath the edge of the prodissoconch, where there is a horizontal groove in each valve.

Condylocardia compressa, Hedley and May, sp.

Cuna compressa, Hedley and May. Records of the Australian Museum, vol. vii., No. 2, 1908, p. 124, pl. xxiv., f. 29, 30, 31, 32. *Type locality.*—100 fathoms, off Cape Pillar, Tasmania.

Dredged off Beachport in 40 fathoms, three alive and ninety valves; in 49 fathoms, one whole and fifty valves; in 110 fathoms, one whole, twenty-seven valves, several of them poor; in 150 fathoms, twenty-five valves, rather poor; in 200 fathoms, two valves, poor; north-west of Cape Borda in 62 fathoms, twenty-three valves; and off Cape Jaffa in 130 fathoms, one valve. In 40 fathoms would appear to be its real habitat.

It comes very close to *C. subradiata*, Tate, but its greater number of less valid ribs and its more transverse shape when young distinguish it.

I suggested to Mr. Hedley that this species is a *Condylocardia* and not a *Cuna;* and he has re-examined the dentition and concurs in its generic transference. It is comparatively a gigantic species for the genus, which contains (with the exception of *C. subradiata*, Tate) only minute shells.

Condylocardia ovata, Hedley.

Condylocardia ovata, Hedley, Proc. Linn. Soc., New South Wales, 1905, part 4, vol. xxx., p. 539, pl. xxxi., f. 5, 6; Verco, Trans. Roy. Soc., S. Austr., 1907, vol. xxxi., p. 109.

Condylocardia trifoliata, Hedley.

Condylocardia trifoliata, Hedley, Proc. Linn. Soc., 1906, vol. xxxi., p. 475; Verco, Trans. Roy. Soc., S. Austr., 1907, vol. xxxi., p. 109.

Condylocardia pectinata, Tate and May.

Carditella pectinata, Tate and May, Trans. Roy. Soc., S. Austr., 1900, vol. xxiv., p. 103. *Type locality.*—"Derwent Estuary, Tasmania" (W. L. May); Proc. Linn. Soc., New South Wales, 1901, vol. xxvi., part 3, p. 435, pl. xxvii., f. 96, 97.

Condylocardia pectinata, Tate and May, sp., Hedley, Mem. Austr. Mus., 1902, vol. iv., part 5, p. 318, "63-75 fathoms, off

Port Kembla, and in Sydney Harbour;" Pritchard and Gatliff, Proc. Roy. Soc., Vict., 1904, vol. xvii. (N.S.), part 1, p. 231, "Dredged off Rhyll, Western Port."

Dredged in 22 fathoms Backstairs Passage, several; also alive and valves in Spencer Gulf and Gulf St. Vincent at unrecorded depths. Taken on Kingston Beach whole and as valves.

Condylocardia porrecta, Hedley.

Condylocardia porrecta, Hedley, Proc. Linn. Soc., New South Wales, 1906, vol. xxxi., part 3, p. 475, pl. xxxviii., f. 24. *Type locality.*—"Mast Head Reef, Queensland."

Dredged Gulf St. Vincent below 22 fathoms, several alive. One small individual has only twelve ribs.

Condylocardia australis, Bernard.

Condylocardia australis, Munier-Chalmas (*nomen*). Bernard; Etudes Comparatives sur La Coquille des Lamellibranches Condylocardia, Paris, 1896, p. 12, pl. vi., f. 4. *Type locality.*—Ile St. Paul (M. Velain).

Dredged Gulf St. Vincent, several whole and valves.

The South Australian shell is scarcely as transverse as that figured, and is more crenulated at the margin, but Bernard describes his as "*margo ventralis crenatus*," and this character varies in our specimens, as do also the wideness and roundness of the radial ribs.

St. Paul Island, if that situated in the Atlantic is referred to, is very distant; but no further than several other accredited specimens extend.

Condylocardia crassicosta, Bernard.

Condylocardia crassicosta, Bernard; Etudes Comparatives sur La Coquille des Lamellibranches Condylocardia, Paris, 1896, p. ii., pl. vi., f. 1. *Type locality.*—Stewart Island (M. Filhol), New Zealand, taken in 35 fathoms.

Dredged in Backstairs Passage 22 fathoms, several alive; also in Spencer Gulf and Gulf St. Vincent. Received from Mr. C. J. Gabriel, under the name of *C. pectinata*, taken at Frankston, Port Phillip, and Westport Bay. It differs from *C. pectinata* in the smaller number of ribs, seven to ten only, in their greater height, and in the shape of the shell.

EXPLANATION OF PLATES.

Plate XIV.

1. *Cuna edentata*, Verco, exterior.
2, 3. ,, ,, ,, interior.
4. ,, *cessens*, Verco, exterior.
5. ,, ,, ,, side view.
6, 7. ,, ,, ,, hinge.
8. *Venericardia dilecta*, E. A. Smith, exterior.
9. ,, ,, ,, var. *excelsior*, Verco, exterior.

Plate XV.

10. *Limæa parvula*, Verco, exterior.
11. ,, ,, ,, interior.
12, 13. ,, ,, ,, hinge.
14. *Turritella kimberi*, Verco.
15. ,, ,, ,, protoconch.
16. *Arcularia grandior*, Verco.
17. ,, ,, ,, a variant to show the aperture.

Plate XVI.

18. *Venericardia delicata*, Verco, interior.
19. ,, ,, ,, exterior.
20. *Carditella vincentensis*, Verco, exterior.
21. ,, ,, ,, interior.
22. ,, *valida*, Verco, exterior.
23, 24. ,, ,, ,, hinge.

Plate XVII.

25. *Condylocardia subradiata*, Tate, type shell, exterior
26. ,, ,, ,, ,, interior.
27, 28. ,, ,, ,, not the type shell, showing the hinge.
29. *Cuna comma*, Verco, exterior.
30, 31. ,, ,, hinge.

Plate XVIII.

32, 33. *Turbo jourdani*, Kiener, operculum.
34, 35. ,, *stamineus*, Martyn, ,,
36, 37. ,, *gruneri*, Philippi, ,,
38, 39. ,, *undulatus*, Martyn, ,,

Further Notes on Australian Coleoptera, with Descriptions of New Genera and Species. No. XXXVIII.

By the Rev. T. Blackburn, B.A.

[Read October 6, 1908.]

CARABIDÆ.

Lithostrotus.

Mr. Sloane, in a note to his tabulation of Australian *Lebiid* genera (Pr. Linn. Soc., N.S.W., 1898, p. 494), suppresses his *Lestianthus* as a synonym of *Lithostrotus*, but without any discussion, nor can I find that he has entered into the matter elsewhere. I cannot now remember whether I have held communication with him on the matter privately, but in any case I think his decision may be accepted, although there are slight differences between his diagnosis and mine which might suggest a doubt on the subject. It seems clear that his *species (L. sculpturatus)* is not identical with my *L. cærulescens.* I have recently met with an example of *Lithostrotus* which does not seem referable to either of the above species, and which therefore must be regarded as a third member of the genus.

L. planior, sp. nov. Minus elongatus, minus convexus; capite quam prothorax parum angustiori; sat nitidus; læte cyaneus, antennis palpis tibiisque rufescentibus; supra pilis erectis sparsim vestitus; capite prothoraceque supra minus fortiter minus sparsim punctulatis; hoc leviter transverso, canaliculato, sat anguste marginato, cordiformi, antice subtruncato, angulis posticis acutis dentiformibus; elytris minus fortiter striatis; striis (his postice sat obsoletis) confertim subtiliter punctulatis, interstitiis planis sat latis uniseriatim sat fortiter sparsius punctulatis. Long., $2\frac{2}{5}$ l.; lat., 1 l. (vix.).

Differs from *L. cærulescens*, Blackb., *inter alia*, by its distinctly less convex form, by its considerably brighter cyaneous colouring, by its head less coarsely and less sparsely punctulate, and by the sculpture of its elytra, which are distinctly striate with the striæ very distinctly, finely, and closely punctulate, the interstices being flat and even, and each bearing a single row of about 10 or 12 strong punctures (much larger than those of the striæ). This species is probably more nearly allied to Mr. Sloane's species than to *L. cærulescens*, but is not likely (on account of several disagreements with the description) to be identical with it, *e.g.*, Mr.

Sloane describes the elytral interstices of his *sculpturatus* as "closely punctulate," which *per se* seems to settle the matter.

New South Wales: Blue Mountains; elevation, 3,000 ft.

LAMELLICORNES.

SERICOIDES.

Platydesmus.

P. (Haplonycha) obscuricornis, Blanch. I have recently met with a *Platydesmus* on the Blue Mountains (New South Wales), which, I feel no doubt, is the true *P. (Haplonycha) obscuricornis*, Blanch. I used the name, with hesitation, in a former paper (Tr. R.S., S.A., 1907, p. 270) for a species of the genus which is closely allied to this Blue Mountain one, but certainly not identical. The present insect is larger, and has its antennal flabellum black or very dark piceous (in both these characters agreeing with Blanchard's description), also has the antennal flabellum of the male longer, the head more closely and less coarsely punctured, and the puncturation of the pronotum distinctly stronger and closer, and the basal joint of the hind tarsi considerably shorter in proportion to the 2nd joint. This discovery leaves the *P. obscuricornis* of my former paper without a name, and accordingly I name and describe it as follows:—

P. punctulaticeps, sp. nov. Mas. Leviter ovatus; sat nitidus; supra subglaber, lateribus ciliatis; subtus pilosus; subiridescens, colore variabilis (ferrugineus, plus minusve picescens); antennis 9-articulatis, rufis, flabello 3-articulato minus elongato (quam clypeus parum longiori) haud arcuato; capite minus crebre minus subtiliter punctulato; prothorace quam longiori ut 13 ad 8 latiori, antice fortiter angustato, supra subtilius minus crebre punctulato, lateribus leviter arcuatis pone medium nonnihil sinuatis, angulis anticis acutis posticis (superne visis) subrectis, basi marginata utrinque sinuata; scutello fere lævi; elytris sat fortiter punctulato-striatis, striis haud geminatim ordinatis, interstitiis sat fortiter convexis sparsim punctulatis; pygidio subtilius minus crebre punctulato; tibiis anticis extus tridentatis (dentibus 2 inferioribus magnis, altero subobsoleto); tarsorum posticorum articulo basali 2° æquali; coxis posticis quam metasternum multo brevioribus.

Feminæ antennarum flabello quam clypeus multo breviori.

The relation of this species to *P. obscuricornis*, Blanch., has been discussed above, under the name of that insect.

New South Wales: Sydney.

The tabulated statement of the distinctive characters of the known *Platydesmi* must now be altered as follows: —

A. Antennal flabellum piceous-black ...	obscuricornis, *Blanch.*
A.A. Antennal flabellum red or testaceous.	
B. Antennal flabellum has only three laminæ.	
C. Basal 2 joints of hind tarsi scarcely differing in length.	
D. Pronotum coarsely punctulate	sulcipennis, *Macl.*
DD. Pronotum finely punctulate	punctulaticeps, [*Blackb.*
CC. Basal joint of hind tarsi notably shorter than 2nd joint.	
D. Prothorax fully twice as wide as long	major, *Blackb.*
DD. Prothorax notably less transverse	inamœnus, *Blackb.*
BB. Antennal flabellum has four laminæ	inusitatus, *Blackb.*

In a paper which I had the honour of reading before the Royal Society (South Australia) last year I continued my revision of the Australian *Sericoid Lamellicornes* by treating of the group of genera of which *Scitala* may be regarded as the typical member, and also of several aberrant genera which appear to me to follow that group more naturally than to occupy any other place in the aggregate. They complete that portion of the aggregate which consists of winged species having simple claws. In a former paper (Trans. R.S., S.A., 1898, p. 32, etc.) I furnished a tabular statement of the characters of the Australian *Sericoides*, in which I placed at the end of the table seven genera differing from all those preceding them in respect of certain strongly marked characters, inasmuch as they present one or more of the following peculiarities, *viz.*, absence of wings suitable for flight, claws not simple, and prosternal sutures open. The genus distinguished by the lastnamed character *(Mœchidius)* I have since regarded as better placed before the other six of those genera than as the last of the seven, and accordingly I placed it in my present revision as the last of the genera discussed in my paper of 1907. There now remain, therefore, only the genera having claws not simple, which are the "other six" referred to above, and also another genus *(Anacheirotus)* founded by me subsequently (Tr. R.S., S.A., 1900, p. 39) for a very remarkable *Lamellicorn* taken by Herr Koch in Central Australia, and Macleay's genus *Odontotonyx*. The first of these genera *(Callabonica)* calls for some special remark, since I characterized its claws originally (in 1895) as appendiculate, but in 1898 placed it among genera with simple claws, accidentally omitting to add a note setting forth the reasons for the change. The fact is its claws are intermediate in form, and should be called, I think, "subappendiculate."

Their basal part is compressed (and wide on its broader face) and becomes somewhat suddenly narrower a little before the middle (more conspicuously in the front than in the hind claws), but without the sharp distinction between the basal and apical parts that constitutes true appendiculation. In the strict sense, therefore, they must be called simple. *Anacheirotus* was sufficiently discussed by me in a former paper *(loc. cit.)*, and I need not repeat what I then wrote, but it will be well to furnish a fresh tabular statement of the characters distinctive of the *Sericoid* genera still remaining for treatment in this revision, inasmuch as one of them had not been discovered when my former tabulation was written, and I have been able to identify in the Australian Museum another genus *(Odontotonyx)* which in my former revision I was obliged to pass over as unrecognizable.

A. Claws (strictly regarded) simple; membranous wings aborted ... ... Callabonica.
AA. Claws appendiculate or bifid.
  B. Body without membranous wings ... Pseudoheteronyx.
  BB. Winged species.
    C. Antennæ with only 7 joints ... ... Nepytis.
    CC. Antennæ with more than 7 joints.
      D. Anterior 4 tarsi of male strongly dilated ... ... Neoheteronyx.
      DD. Tarsi of male normal.
        E. Tarsi with a large membranous appendage at base of claws Odontotonyx.
        EE. Tarsi not as E.
          F. Form strongly depressed ... Eurychelus.
          FF. Form notably more convex.
            G. Labrum extremely small and inconspicuous ... ... Anacheirotus.
            GG. Labrum strongly developed ... ... Heteronyx.

The known species pertaining to the 8 genera tabulated above are very unevenly distributed, the first 7 genera together containing less than 12 species, while *Heteronyx* is of all the Australian *Lamellicornes* the richest in known species.

Callabonica.

The generic characters have been discussed above under the heading *"Sericoides."* I have not seen any additional specimens referable to *Callabonica* since my original description was written.

Pseudoheteronyx.

I have two new species to be added to this genus. The now known species may be distinguished as follows:—

A. Antennæ of only 8 joints.
  B. Elytra sparsely punctulate (about 12 punctures from suture reach middle of width) ... ... baldiensis, *Blackb.*

BB. Elytra closely punctulate (12 punctures from suture not nearly reaching middle of width) ... ... creber, *Blackb.*
AA. Antennæ of 9 joints.
B. Prothorax twice as wide as long ... laticollis, *Blackb.*
BB. Prothorax decidedly less transverse ... ... helæoides, *Blackb.*

P. creber, sp. nov.. Sat brevis; fortiter convexus; postice dilatatus; minus nitidus; supra sat glaber, subtus et in pedibus pilis fulvis minus sparsim vestitus; niger, antennis palpis tarsisque picescentibus; clypeo crebre ruguloso, antice sinuato-truncato; fronte leviter vix crebre punctulata; prothorace quam longiori fere duplo latiori, antice leviter angustato, supra fortiter crebre punctulato (in parte postico-laterali confluenter subtiliter ruguloso), angulis posticis rotundato-obtusis, lateribus leviter arcuatis, basi media parum lobata; elytris ut prothoracis discus punctulatis, haud striatis; pygidio sparsim punctulato; tibiis anticis extus fortiter 3-dentatis; labro a clypeo obtecto; antennis 8-articulatis; coxis posticis metasterno (hoc sat brevi) longitudine sat æqualibus, quam segmentum ventrale secundum sat longioribus; unguiculis appendiculatis. Long., $6\frac{1}{4}$ l.; lat., $3\frac{1}{2}$ l.

This species is a little more elongate than its previously described congeners, with the metasternum slightly longer. As my specimen is unique I have not been able to examine its concealed parts, but I have no doubt of its wings being obsolete. There are considerably more than 20 punctures down the length of its pronotum, and something like 35 across the width of an elytron.

New South Wales (Mount Kosciusko); taken by Mr. H. J. Carter.

P. laticollis, sp. nov. Brevis; fortiter convexus; modice nitidus; supra fere glaber pilis erectis fulvis sparsissime vestitus; subtus et in pedibus pilis fulvis nonnullis vestitus; niger, antennis palpis tarsisque picescentibus; clypeo crebre ruguloso, antice (superne viso) truncato; fronte minus crebre punctulata; prothorace quam longiori plene duplo latiori, antice leviter angustato supra sparsim acervatim subgrosse vix profunde punctulato, angulis posticis (superne visis) bene determinatis fere rectis; lateribus leviter arcuatis, basi parum lobata; elytris vix manifeste striatis, sparsim sat grosse punctulatis; pygidio sparsissime punctulato; tibiis anticis extus fortiter 3-dentatis; labro a clypeo obtecto; antennis 9-articulatis; coxis posticis metasterno (hoc brevi) longitudine sat æqualibus, quam segmentum ventrale secundum sat longioribus; unguiculis appendiculatis. Long., 6 l.; lat., $3\frac{3}{5}$ l.

Somewhat close to *P. helæoides*, Blackb.; its clypeus viewed from directly above is seen to be truncate (that of *P. helæoides* sinuate or subemarginate); its prothorax is by measurement fully twice as wide as long (that of *P. helæoides* decidedly less transverse); the hind angles of its prothorax viewed from above are quite sharp and almost rectangular (those of *P. helæoides* decidedly blunt); its elytra are all but non-striate, very faint striæ being traceable only from a particular point of view, and there can hardly be said to be distinct continuous interstices between the striæ from any point of view; in *helæoides* 10 distinct striæ are seen, with quite strongly convex interstices—the striæ, however, being rather depressions between ridges than furrows actually impressed on the derm of the elytra, and both striæ and interstices are rendered irregular in places by the foveate rugulosity of the sculpture. In *P. laticollis* about 10 punctures reach from base to apex of pronotum and about 12 from suture to lateral margin of elytra.

New South Wales; taken at Walgett by Judge Docker; sent to me by Mr. Carter.

Nepytis.

As I am not quite sure that I have seen the unique species that represents this genus, I cannot make any confident assertion about its generic validity. I found in Tasmania some years ago a dead and much broken *Lamellicorn* which I believe to be the species in question, but, unfortunately, it is without antennæ, and this particular mutilation renders the specimen incapable of certain identification, as the most distinctive character attributed to the genus is that its antennæ have only 7 joints. I do not regard that character alone as sufficient for separation from *Heteronyx*, although I have not as yet seen any *Heteronyx* with so few antennal joints, but if the specimen referred to above is really *Nepytis*, there are other distinctive characters that establish the validity of the genus. In view of the uncertainty of the identification it is, however, not worth while to go further into the matter here.

Neoheteronyx.

The 4 anterior tarsi of the male in the unique known species of this genus are most remarkable, resembling those of a *Harpalus*. I have nothing to be added here to my former notes concerning it.

Odontotonyx.

This genus is readily distinguished among those having the claws not simple by the large membranous appendage at the base of the claws. The unique species has elytra nitid, glabrous, and strongly striate.

Eurychelus.

I doubt whether this genus can be permanently retained as distinct from *Heteronyx*. There does not appear to me to be any better character for it than its depressed parallel form and the occurrence on its elytra of a fairly distinct pattern, due to the presence of small patches of whitish pubescence, the derm beneath the patches being also usually of a lighter colour than the general surface. Regarded as a *Heteronyx* the described species (*E. marmoratus*, Blanch.) finds its place in the 1st Group (*vide* my tabulation, to follow), and it stands next to *H. Bovilli*, Blackb., differing from it *inter alia multa* by the very much closer punctuation of its dorsal surface. I have examined a large number of specimens of *Eurychelus* from various localities in New South Wales and Victoria (all of them, I believe, in mountainous regions), and am unable to regard them as representing more than one species, which, however, seems to be variable in several respects, especially size (long., $3\frac{3}{4}$-$5\frac{1}{2}$ l.) and colouring, the usual colour being ferruginous marbled with slightly lighter patches bearing short whitish hairs. In many specimens the disc of the pronotum is blackish. In the most highly coloured example before me the elytra are piceous, with most of the suture as well as the paler blotches very conspicuously testaceous, and the legs bright ferruginous. Some examples from Mount Kosciusko (sent by Mr. Carter) are darker than the usual type—one of them with black elytra—and the marbling of the elytra is more or less obsolete. The sculpture scarcely varies—only, I think, to the extent of the pronotum being a little less closely punctured in some specimens than others, but the varieties are found in company with each other, and are very likely to be the sexes.

Anacheirotus.

I have not seen any more species or specimens of this genus since I characterized it eight years ago. It is probably found only in the dry central regions of Australia which are seldom visited by entomologists. The validity of the genus will probably stand permanently, for it is scarcely likely that intermediate forms will be found linking the small inconspicuous labrum of *Anacheirotus* with the large prominent labrum of a typical *Heteronyx*.

Heteronyx.

This genus might reasonably claim to be the most perplexing to the student in the whole range of the Australian

Coleoptera, its hundreds of species being all of them obscure insects of uninteresting appearance, closely allied *inter se*, almost devoid of reliable distinctive colouring, and burdened with numerous names attached by the earlier authors to descriptions that are practically useless. I wrote a revision of the genus as then known to me in Proc. Linn. Soc., N.S.W. (1888 and 1889), but that work now stands in need of being superseded by a new revision, owing to the large number of additional species that have found a place in collections during recent years, most of which are as yet undescribed. The paper of which I now offer the first portion is an attempt to meet that want, and will complete the series of papers on the Australian *Sericoides* which I have laid before the Royal Society of South Australia during the last three years.

In my former revision of *Heteronyx* (founded by M. Guérin-Méneville, 1830) I entered somewhat fully into the history and synonymy of the genus. Subsequent investigation has not materially affected the conclusions set forth in that paper, although it has added information of certain generic forms that have since been characterized, and has yielded additional information about synonymy. The statement that I did not know any Australian *Sericoides* except *Heteronyx* having in combination elytra of normal length, antennæ of 8 or 9 joints, and claws not simple cannot, of course, now be repeated in the present tense, inasmuch as I have since formed 3 new genera (*Pseudoheteronyx*, *Neoheteronyx*, and *Anacheirotus*) having those characters, for certain species that have come into my hands since I made the statement referred to. Moreover, a recent examination of the collection of Mr. W. S. Macleay, in the Macleay Museum at Sydney, points to the probability of the name *Cotidia* being a synonym of *Heteronyx* (*vide* Tr. R.S., S.A., 1907, p. 244). I have already in this paper pointed out that the genus *Callabonica* was erroneously placed by me (*vide* Tr. R.S., S.A., 1895, p. 36) beside *Heteronyx*. With these qualifications the general remarks on the characters and synonymy of *Heteronyx* (which, however, did not include reference to *Callabonica*, a name of later date) in my former revision of the genus do not appear to me to need alteration. For the characters of the recently added genera (mentioned above) it is easy to refer to their diagnoses in former volumes of our Transactions, and their relation to *Heteronyx* is indicated also in tabular form in Tr. R.S., S.A., 1898, p. 34, and 1900, p. 40. It will be convenient here to recapitulate briefly the conclusions in respect of synonymy set forth in my former revision, but it is unnecessary to burden this paper with a repetition of the reasons already stated which led me to those conclusions. I expressed the opinion that the generic names which I can ascertain to have been regarded by Lacordaire and other authors as synonyms of *Heteronyx* ought to be treated as follows:—

Caulobius and *Haplopsis* as distinct valid Australian genera.

Homaloplia and *Philochlænia* as not occurring in Australia at all (the species which Lacordaire rightly regarded as incorrectly referred to them are not *Heteronyces*, as he took them to be).

Sericesthis as a valid distinct genus, though possibly one or two of the species Boisduval referred to it may have been *Heteronyces*.

Silopa and *Hostilina* as synonyms of *Heteronyx*.

Melolontha as not occurring in Australia, although the name was applied by early authors to some species of *Heteronyx*.

Cotidia (referred to above) also seems to be probably a synonym of *Heteronyx*.

I pass now to some general remarks on the grouping of the *Heteronyces* in aggregates. I have failed to find any character that will avail for this purpose so as to produce "natural" groups, *i.e.*, groups the members of which can be rightly regarded as on the whole more nearly allied to each other than they are to the members of other groups. Whether the structure of the antennæ, or of the labrum and clypeus, or of the claws, or of the coxæ (in all of which organs the diversity of form is very great and extremely interesting) be taken as the basis of classification, the result is always that species closely agreeing in facies are widely separated, and if the species resembling each other in facies be grouped together, each of the groups so formed is found to contain the widest possible diversity of structure in almost every organ of the body. I therefore arrive at the conclusion that, to me at any rate, the grouping of the *Heteronyces* must be a mere matter of convenience for the purpose of identification, and consequently I content myself with the effort to place the species in aggregates which will serve best to that end. This view of the matter is similar to that which I expressed in my former series of papers on the genus, and in the main my recent study of the subject, founded on a vastly increased quantity of material, has confirmed in my judgment the conclusions I then set forth as to the method that it is best to follow in forming these artificial groups. I have found, however, that one important modification of my former scheme is desirable. While still convinced that the character lending itself best to the formation of primary groups and doing least violence to natural affinities is the relation of the labrum to the clypeus, I have found that it is undesirable to retain the second of the three primary groups for which I employed it in my former series of papers, and which was characterized as having the relation to each other of the labrum and clypeus intermediate between their relation in the other two groups. The first essential in the artificial grouping of an extensive series of species is to form the primary aggregates in such fashion that there can be no doubt at all in distributing the species among them. In my former classification I divided the species into those having the labrum entirely below the level of the clypeus, those having the summit of the labrum on a level with the clypeus, and those having the clypeus below the level of the summit of the labrum. Working through the long series of undescribed species now in my hands, I have found that the transition of the position of the summit of the labrum is very gradual, so that in not a few species that would have to be placed in the intermediate group the relation of the labrum to the clypeus would differ very little indeed from its relation in species that would fall into one or other of the other two groups. I therefore propose to abolish the second primary group altogether, and to distribute its species between what I formerly called the first and the third groups, expressing, however, the characters that distinguish those groups (now the first and second) in altered terms, for the comprehension of which a little explanation is necessary. In a very large majority of the *Heteronyces* (including the whole of the group formerly called the third) the relation of the labrum to the clypeus is such that if the head be looked at somewhat obliquely from behind, the middle part of the free outline of the head is the labrum, and that that part is a convex curve distinct from the curve of the clypeus on either side of it, so that the free outline of the head appears trilobed, or at least trisinuate. There is the greatest possible specific diversity in the nature of this outline in other respects—the middle lobe or arch (*i.e.*, the labrum) varying from being much more than a third of the whole free outline, to being little more than a narrow inequality in the curve of the free outline (in some instances conspicuous only from certain points of view), and from being but little projected forward (so that the summits of the clypeal curves reach forward considerably more than it does) to being a conspicuous proboscis-like lamina protruding from the front of the head; but in all the species which I group together by this character there is the invariable threefold convexity of the free outline of the head when that segment is looked at from the required point of view (more or less obliquely from behind). In the other primary group of *Heteronyces* this threefold convexity of the free outline of the head (which I call in the following pages the "trilobed outline") is altogether wanting. In the majority of its species the whole labrum is much below the level of the clypeus, so that the whole free outline of the head is clypeus (as in *Scitala* and most other *Sericoid* genera), while in some species the labrum (the head being regarded obliquely from behind) is visible in a deep emargination of the clypeus where its outline appears as a *concave* curve; in some species the ends of the labrum only are visible projecting from the outline as two more or less conspicuous processes, and in some the clypeus has a deep angular cleft in which the labrum is not any part of the outline from any point of view that looks obliquely at the head from behind; but always the free outline of the head has no appearance of threefold convexity. When the *Heteronyces* are thus divided into primary groups there are scarcely any species at all about whose location there can be the slightest doubt. The only instances known to me are those of a few small species in each group in which from a certain point of view the outline is in a sense trilobed, but the middle lobe (the labrum) from that point of view presents a truncate apex. In two or three of these species the trilobed appearance is caused merely by the labrum being projected so far forward without overtopping the front margin of the clypeus that it comes into view. These species belong to the first group. In the other species referred to the labrum overtops the front margin of the clypeus, and the truncate appearance of its apex when viewed obliquely from behind is due to an exceptional structure of the labrum itself, and consequently these insects stand in the second group. It may here be noted that the first group contains no species in which the labrum overtops the front margin of the clypeus. For the sake of brevity in tabulating I call the lobes of the trilobed outline simply "middle lobe" and "lateral lobes," omitting the words "of the trilobed outline," and also in comparing the width of the lobes omit the words "in width" (*e.g.*, "middle lobe more than ½ lateral lobes," meaning that it is more than ½ as wide as each lateral lobe).

For the formation of secondary groups I take the number of joints in the antennæ—a character which does not call for any further remark. Finally, I divide each of the aggregates resulting from the use of the two characters already mentioned into two groups, according as the claws of the hind tarsi are bifid or appendiculate, and on this division it will be necessary to furnish some notes, inasmuch as there is wide diversity in the form of the claws which I call bifid, and it is not difficult to arrange a series of *Heteronyces* in such fashion that the appendiculate form seems to pass very gradually to the bifid, requiring a definite statement (if the terms are to be of value for identification of species) of exactly what is covered by each term. If a species with typically appendiculate claws be examined it will be seen that each hind claw consists of two pieces—a basal compressed piece (which approximates in form to a parallelogram) and a much more slender apical piece attached to the external apex of the basal piece. Transition from that typically appendiculate build of claw to the bifid may be said to begin by a tendency of the inner apex of the basal piece to be prolonged more or less at an angle to the axis of the basal piece, and that tendency becomes gradually in successive species more pronounced until the prolongation becomes a well-defined sharp process not much less than half the size of the whole apical piece. When the point is reached of the prolongation being more than a trifling prominence of the inner apex of the basal piece (say, less than a quarter of the projection of the apical piece) I call the claw bifid, as it then seems to end in two processes not very greatly different in size. A variation of this latter form is found in some species where the apical piece itself is extremely small and the inner apex of the basal piece is produced like a triangular tooth scarcely at all smaller than the whole apical piece. Next we find a form in which the claw appears to consist of a single piece ending in a sharp slender curved process and having a tooth-like process projecting from its inner margin at a greater or less distance from the base, and finally the genuinely bifid form is reached where the apex of the claw is seen to be split into two somewhat equal portions—usually both small. Thus it will be seen that, in the following pages, an appendiculate claw is taken to be one having a basal compressed piece of which the apex is more or less truncate, and the inner apical angle not or very little projected, and a slender piece attached to the external apical angle of the basal piece, and that all other claw structure is regarded as bifid. It should be noted that in many species of *Heteronyx* the claws when appendiculate look from some points of view as if they were simple, and therefore require to be examined carefully.

The shape of the labrum calls for close attention in discriminating the species of *Heteronyx*. This organ presents—I think in all the species—the common character of being so formed that its dorsal surface may be regarded as two planes meeting each other, one of which (I call it the lower plane) is inclined from the line of junction with the other (which I call the upper plane) hindward and downward (the insect being laid on its back) towards meeting the labium; the upper plane is inclined from the line of junction upward or horizontally towards the front edge of the clypeus. But outside this common feature of the labrum there is the greatest possible diversity. In some species the upper and lower planes meet at an angle, the line of junction in some species even being defined by a fine transverse carina; while in others the two planes meet in a rounded manner. In some species the upper plane is horizontal, in others perpendicular, or inclined in diverse ways to the horizontal. In some species the labrum is entirely below the level of the clypeus, in others it overtops the clypeus. In some species having the labrum entirely below the clypeus, but more or less perpendicular, it appears when viewed from the front as an arch of uniform height, in others as an arch much more strongly curved on the upper than the lower edge, in others as a triangle, and in others again as an elongate erect lamina.

The puncturation of the various segments of the body is, of course, a character of great importance in distinguishing the species of this genus—but it is obviously difficult to express in terms that lend themselves to a tabular statement where the difference in puncturation is not very great. In the following pages I have in some cases endeavoured to meet that difficulty by counting the number of punctures occupying a given space, and I have also made use of a difference that is easily traceable in the type of puncturation on the elytra. In many species the punctures are isolated round holes, normally impressed on the surface, while in others they appear as impressions of more or less triangular form, more deeply sunk at the base than at the apex, with the result that if the elytra be viewed obliquely from behind the front limit of the punctures seems to be raised in a granuliform manner. The term "squamose" has been commonly applied to that latter style of sculpture from its causing a more or less scale-like appearance from some points of view, and I have made use of the term in the following pages. It is desirable, however, to remark that I limit the term to those elytra in which the *prevailing* character of the sculpture is squamose; there are some species in which the general puncturation is distinctly of the non-squamose type, but on which, nevertheless, when they are viewed obliquely from behind a few granules can be seen—usually about the base and suture. It is perhaps well to note here that where a number of punctures is mentioned as occupying a given distance, the meaning is that that number of punctures averagely spaced *would* occupy that distance if they ran regularly in line. Thus the statement that about ten punctures from the apex reach to the middle of pronotum means that the punctures are so spaced that if ten of them averagely spaced were placed on a straight line down the middle of the pronotum they would reach to about the middle of the segment; as a fact, the punctures very seldom do run in straight lines, and where the puncturation is sparse a right line down the middle of the pronotum might actually touch very few of the punctures, passing between most of them.

This expedient of indicating specific characters by counting the punctures is, of course, available only in the case of the difference of puncturation being considerable, and, moreover, does not serve for notifying the relative *fineness* or otherwise of the punctures. It is, however, essential, if the distinctive characters of a great number of species such as compose *Heteronyx* are to be intelligently cast into a tabular form, that no character be passed over which can by any means be indicated with definite clearness, and therefore I have adopted the expedient of selecting certain species as standard species with which others may be compared, choosing those which are the most widely distributed and the most easily identified. There are three *Heteronyces* which from their distribution might be confidently expected to be present in any collection including a fair number of species from New South Wales, Victoria, South Australia, and Western Australia, all of which can be named without much difficulty—at any rate, can be identified with the insects to which I in this revision apply the names. *H. obesus*, Burm., is found in all the places named above, and has no very close ally known to me. *H. jubatus*, Blackb., is a common species in New South Wales, Victoria, and South Australia, and is easily identified by the characters given in my former revision (Proc. Linn. Soc., N.S.W., 1889, p. 662) or in the tabulation to follow in this present revision, and, moreover, its only near allies (*H. fallax*, Blackb., and *H. striatipennis*, Blanch.) have elytra similarly punctured. *H. elongatus*, Blanch., is common in New South Wales, and is at once identified among its nearer allies by the conspicuous pencil of long fine setæ at the inner apex of each elytron. I shall not hesitate, therefore, to indicate distinctions of puncturation by comparison with those species. For the sake of brevity I shall not hold it necessary to quote the authors' names when I have occasion to refer to those species.

It is, perhaps, well to specify that the ventral segment, which in this memoir I call the "first" or "basal," is that which is (except in a very few species) partially overlapped by the hind coxæ, and that consequently the "second" ventral segment is the first which is entirely free of the hind coxæ. These are the first and second that are visible on the middle line.

I now pass to the discussion of the species of *Heteronyx*, which I divide into 8 groups, as follow:—

A. Front outline of head (viewed obliquely from behind) not presenting a threefold convexity.
  B. Antennæ consisting of only 8 joints.
    C. Claws bifid ... ... Group I.
    CC. Claws appendiculate ... ... Group II.
  BB. Antennæ consisting of 9 joints.
    C. Claws bifid ... ... Group III.
    CC. Claws appendiculate ... ... Group IV.
AA. Front outline of head (viewed obliquely from behind) presenting a threefold convexity.
  B. Antennæ consisting of only 8 joints.
    C. Claws bifid ... ... Group V.
    CC. Claws appendiculate ... ... Group VI.
  BB. Antennæ consisting of 9 joints.
    C. Claws bifid ... ... Group VII.
    CC. Claws appendiculate ... ... Group VIII.

Some of the above groups lend themselves to further division into subgroups, which will be found characterized under the headings of the several groups. In the present paper I am able to deal with only the species of the first two groups, but I hope to offer a paper to the Society next year completing this revision of the genus.

It is well to add the note that I am unable to specify any satisfactory character by which the sex of a *Heteronyx* can be confidently determined. The ventral segments in the male form a flat surface, so that their outline viewed from the side appears as a straight line. That outline is convex, I think, only in females. In some species the basal joint of the hind tarsi shows slight sexual distinctions, but so slight as to be valueless for description.

Group I.

The *Heteronyces* of this group are comparatively few in number, and they are all rare in collections. I have before me more than one specimen of only three species, and more than two specimens of only one species. I cannot associate with this group any of the names given by the earlier authors except Blanchard's name *rubescens*, and I should not have ventured on that identification if I had not been assisted by the possession of specimens from the original locality (Kangaroo Island). Blanchard, unfortunately, does not describe the claws of any of his *Heteronyces*. *H. rubescens*, in my former revision, was placed in the "intermediate" (now abolished) main division of the genus, on account of its labrum being slightly visible as part of the free outline of the head, but appearing (when so seen) concave, and not rising to the level of the clypeus. The following tabulation shows the distinctive characters of the species of this group:—

A. Lateral gutter of pronotum distinctly expanded and flattened out close to front margin.
  B. Hind projection of hind claws much smaller than the whole apical piece.
    C. Hind projection of hind claws much nearer to apex of claw than to base of claw.
      D. Elytra not or scarcely granulate.
        E. Punctures of elytra well defined and isolated.
          F. Elytral punctures somewhat close (many more than 17 across an elytron).
            G. Basal edging of pronotum conspicuously thickened and raised at its ends ... fulvohirtus, *Blackb.*
            GG. Basal edging of pronotum uniform or nearly so litigiosus, *Blackb.*
          FF. Elytral punctures very few (about 17 across an elytron) rudis, *Blackb.*
        EE. Punctures of elytra indistinct (in antero-lateral part lost in subconfluent rugulosity) ... dispar, *Blackb.*
      DD. Elytra uniformly and conspicuously granulate ... ... rubescens, *Blanch.*
    CC. Hind projection of hind claws scarcely nearer to apex of claw than to base of claw ... ... Tepperi, *Blackb.*
  BB. Hind projection of hind claws not or scarcely smaller than the whole apical piece.
    C. Middle part of summit of labrum projects from perpendicular front of clypeus.
      D. Elytra non-striate outside subsutural stria.
        E. Elytra granulate.
          F. Prothorax very little narrowed in front ... ... squalidus, *Blackb.*
          FF. Prothorax much narrowed in front ... ... Doddi, *Blackb.*
        E. Elytra not granulate ... ... Bovilli, *Blackb.*
      DD. Elytra with 6 or 7 quite distinct striæ ... ... anomalus, *Blackb.*
    CC. Middle part of summit of labrum closely applied to perpendicular front of clypeus ... ... labralis, *Blackb.*
AA. Lateral gutter not expanded in front advena, *Blackb.*

H. litigiosus, sp. nov. Sat elongatus, postice parum dilatatus; sat nitidus; brunneus, antennis palpisque testaceis; pilis cinereis brevibus minus dense vestitus; clpeo confluenter ruguloso, antice (minus leviter) emarginato; labro summo clypei planum nullo modo attingenti; fronte sat grosse nec crebre punctulata, fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 11 ad 6 latiori, antice modice angustato, supra fortiter nec crebre punctulato (puncturis circiter 14 in segmenti longitudine), lateribus leviter arcuatis, angulis anticis acutis minus productis posticis (superne visis) acutis retrorsum directis, basi fortiter bisinuata, margine basali æqualiter elevato; elytris concinne sat fortiter punctulatis (trans elytron puncturis circiter 25); pygidio sparsim sat grosse nec profunde punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2^um^ sat longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2^us^ multo breviori (3° sat æquali); unguiculis leviter bifidis. Long., 5 l.; lat., 2½ l.

Near *H. fulvohirtus*, Blackb., but distinguishable as indicated in the tabulation. It also differs by its more strongly emarginate clypeus, its frons much less closely punctulate, its elytra less coarsely and less sparsely punctulate. The claws of this species are not strongly removed from the appendiculate type, but the basal piece is too strongly dentiform at its inner apex to allow of the claws being called appendiculate. If they were regarded as appendiculate the quite strongly subangularly emarginate clypeus would readily distinguish this species from those near which it would fall in the tabulation of Group II.

Western Australia; Nullabor Plains (given to me by Mr. French).

H. rudis, sp. nov. Minus elongatus, postice vix dilatatus; sat nitidus; testaceo-brunneus, pilis fulvis brevibus minus dense vestitus; clypeo confluenter ruguloso, antice in media parte minus perspicue emarginato; labro summo clypei planum nullo modo attingenti; fronte fortiter vix crebre punctulata; fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 19 ad 11 latiori, antice leviter angustato, supra sparsius inæqualiter subgrosse punctulato (puncturis circiter 12 in segmenti longitudine), lateribus leviter arcuatis pone medium (superne visis) subsinuatis, angulis anticis acutis modice productis posticis (superne visis) acutis sat fortiter retrorsum directis, basi fortiter bisinuata, margine basali sat æqualiter elevato; elytris concinne grosse punctulatis (trans elytron puncturis circiter 17); pygidio leviter sparsim minus fortiter punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2^{um} paullo longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2^{us} sat breviori quam 3^{us} paullo longiori; unguiculis leviter bifidis. Long., 4 l.; lat., $2\frac{1}{5}$ l.

A very coarsely and sparsely punctured species, in this respect resembling *H. crassus*, Blackb. (Group VI.), but having elytral sculpture still coarser. Its claws resemble those of the preceding species *(H. litigiosus)*. If the claws were regarded as appendiculate its coarse, sparse puncturation would readily distinguish this species from those near which it would fall in Group II.

Western Australia; Murchison district.

H. dispar, sp. nov. Modice elongatus, postice parum dilatatus; sat nitidus; brunneus, antennis palpisque dilutioribus, pilis fulvis brevibus minus dense vestitus; clypeo confluenter ruguloso, antice (minus leviter) emarginato; labro summo clypei planum nullo modo attingenti; fronte fortiter nec crebre punctulata; fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 18 ad 11 latiori, antice leviter angustato, supra sparsius sat fortiter punctulato (puncturis circiter 14 in segmenti longitudine), lateribus sat rotundatis pone medium (superne visis) subsinuatis, angulis anticis acutis sat productis posticis (superne visis) vix acutis vix retrorsum directis, basi fortiter bisinuata, margine basali sat æqualiter elevato; elytris confuse (fere subsquamose) minus fortiter punctulatis (trans elytron puncturis circiter 28), puncturis per asperitatem obscuram minus perspicuis; pygidio sparsim nec fortiter punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2^{um} sat longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2^{us} parum breviori quam 3^{us} sublongiori; unguiculis leviter bifidis. Long., 4 l.; lat., 2 l.

This species, with the preceding two, and *fulvohirtus*, Blackb., and *rubescens*, Blanch., form a small aggregate of species evidently allied naturally *inter se*, but with very good distinctive characters, as indicated in the tabulation. Of the 5, this species and *H. litigiosus*, Blackb., are the two nearest to each other. They are quite distinct, however, by the prothorax of *H. dispar*, with its sides quite strongly rounded and its hind angles (viewed from above) notably blunter, as well as by the sculpture of the elytra, on which the punctures in *dispar* are indistinct owing to an ill-defined roughness of the derm, so that in parts it is not easy (in the antero-lateral part quite impossible) to pick out the individual punctures, they having quite a blurred appearance. The difference between the puncturation of the pronotum and that of the elytra consequently is very great in *dispar*, the latter appearing close and obscure, in strong contrast to the sparse, well-defined appearance of the former. The claws of *dispar* are much like those of *litigiosus;* if they were to be regarded as appendiculate the clypeus and frons resembling those of *litigiosus* would readily prevent the confusion of the species with any of those in Group II.

South Australia; Eucla.

H. squalidus, sp. nov. Minus elongatus, postice leviter dilatatus; sat nitidus; brunneus, antennis palpisque testaceis; pilis fulvis brevibus minus dense vestitus; clypeo brevi, confluenter ruguloso, antice vix sinuato late truncato-rotundato, labro summo clypei planum haud attingenti; fronte subgrosse sat crebre punctulata; fronte clypeoque planum fere æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 19 ad 11 latiori, antice minus angustato, supra fortiter minus crebre punctulato (puncturis circiter 16 in segmenti longitudine), lateribus arcuatis, angulis anticis acutis minus productis posticis (superne visis) obtusis, basi obsolete bisinuata, margine basali sat æqualiter elevato; elytris subtiliter granulatis, subtiliter sat crebre squamose punctulatis (trans elytron puncturis circiter 30); pygidio sparsius subtilius punctulato; coxis posticis quam metasternum paullo brevioribus quam segmentum ventrale 2^{um} sat longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2^{us} sat breviori, quam 3^{us} sat longiori; unguiculis bifidis. Long., 4 l.; lat., 2 1-10 l.

Easily distinguished from all the species placed before it in the tabulation by the base of its pronotum scarcely sinuate, as well as by the obtuse (though quite distinct) hind angles of that segment. The sculpture of its elytra resembles that of *H. rubescens*, Blanch., but is finer and closer. It differs from *rubescens*, *inter alia*, by the notably closer and stronger puncturation of its pronotum.

Central Australia (Dr. Symonds). The type is in the South Australian Museum.

H. Doddi, sp. nov. Minus elongatus, postice leviter dilatatus; sat nitidus; brunneus, antennis palpisque dilutioribus; pilis fulvis brevibus minus dense vestitus; clypeo confluenter ruguloso, antice (minus leviter) emarginato; labro summo clypei planum nullo modo attingenti; fronte crebre subgrosse punctulata; fronte clypeoque ut plana sat disparia visis (illa leviter convexa); antennis 8-articulatis; prothorace quam longiori ut 7 ad 4 latiori, antice sat fortiter angustato, supra fortiter vix crebre punctulato (puncturis circiter 16 in segmenti longitudine), lateribus sat rotundatis, angulis anticis acutis sat productis posticis (superne visis) obtusis, basi obsolete bisinuata, margine basali æqualiter elevato; elytris subtiliter granulatis, sat subtiliter sat crebre squamose punctulatis (trans elytron puncturis circiter 27); pygidio leviter sparsim punctulato; coxis posticis quam metasternum paullo brevioribus, quam segmentum ventrale 2um sat longioribus; tibiis anticis extus sat fortiter tridentatis; tarsorum posticorum articulo basali quam 2us multo (quam 3us manifeste) breviori; unguiculis bifidis. Long., $3\frac{1}{2}$ l.; lat., $1\frac{4}{5}$ l.

This is a very distinct species, but evidently allied to *H. squalidus*, Black. Apart from its smaller size, it differs from that insect in many respects—notably by the quite strong emargination of the middle of its clypeal outline, and in the much greater anterior narrowing of its prothorax. Its elytral sculpture is a little less fine and less close. The claws of both are unmistakably bifid.

Southern Queensland (Dodd). Given to me by Mr. Griffith.

H. anomalus, sp. nov. Minus elongatus, postice sat fortiter dilatatus; sat nitidus; rufus, capite supra elytris segmentisque ventralibus piceis; pilis brevibus fulvis minus dense vestitus; clypeo fronteque grosse crebre sat rugulose punctulatis, illo antice nullo modo emarginato; labro summo clypei planum nullo modo attingenti; fronte clypeoque ut plana sat disparia visis (illa leviter convexa); antennis 8-articulatis; prothorace quam longiori ut 15 ad 8 latiori, antice mox pone marginem sat fortiter antrorsum angustato, supra sat fortiter sat crebre punctulato (puncturis circiter 22 in segmenti longitudine), lateribus leviter rotundatis, angulis anticis vix acutis leviter productis posticis (superne visis) rotundato-obtusis, basi vix bisinuata; elytris striatis, fortiter sat crebre punctulatis (trans elytron puncturis circiter 24), interstitiis convexis; pygidio sat fortiter sat crebre subrugulose punctulato; coxis posticis quam metasternum multo brevioribus, quam segmentum ventrale 2um parum longioribus; tibiis anticis extus minus fortiter tridentatis; tarsorum posticorum articulo basali quam 2us parum breviori, 3° sat æquali; unguiculis bifidis. Long., 4 l.; lat., 2 l.

This species has scarcely the facies of a *Heteronyx*, being of more robust build and brighter colouring than is usual in the genus, but I can find no structural character by which to separate it; its being unique in my collection, however, is a hindrance to the exploration of its characters. It is the only species known to me appertaining to this group and having decidedly striate elytra. The striation, however (as usual when present in *Heteronyces*), is of a special type, not affecting the elytral puncturation, and consisting of the intervals between obscure longitudinal obtuse ridges rather than true striæ. The prothorax has a massive appearance, being scarcely narrowed till close to the front margin, where it becomes *much* narrower suddenly. The labrum projects from the perpendicular front of the clypeus only feebly.

New South Wales; Tamworth district (Musson).

H. labralis, sp. nov. Modice elongatus, postice sat dilatatus; sat nitidus; brunneo-testaceus; pilis brevibus fulvis minus dense vestitus; clypeo fronteque grosse sparsim punctulatis, illo antice truncato sat fortiter reflexo; labro summo a superficie clypei antica perpendiculari haud projecto; fronte clypeoque ut plana multo disparia visis (illa convexa); antennis 8-articulatis; prothorace quam longiori ut 15 ad 8 latiori, antice sat angustato, supra sat crebre vix fortiter punctulato (puncturis circiter 20 in segmenti longitudine), lateribus sat rotundatis, angulis anticis sat acutis sat productis posticis (superne visis) rotundato-obtusis, basi obsolete bisinuata, margine basali fere æqualiter elevato; elytris concinne subtilius punctulatis (trans elytron puncturis circiter 30); pygidio (exempli typici unici) haud observato; coxis posticis quam metasternum multo brevioribus, quam segmentum ventrale 2um vix longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali 2° sat æquali, quam 3us paullo longiori; unguiculis bifidis. Long., 4 l.; lat., 2 l.

The summit of the labrum applied (and I think soldered) to the perpendicular front face of the clypeus easily distinguishes this species. Apart from that character it would stand in the tabulation beside *Bovilli*, Blackb., from which it differs *inter alia multa* by the much closer punctuation of its dorsal surface. The omission of description of the pygidium is due to that segment being unnaturally drawn up under the elytra in such fashion that it could not be examined without damaging the specimen.

New South Wales; Picton. Given to me by Mr. Griffith.

Before passing to the consideration of Group II. it seems desirable to remark on two or three species described by the earlier authors, which seem to be possibly attributable to this group.

H. spadiceus, Burm. The description of the clypeus does not indicate quite clearly (though I take it to have that meaning) that the clypeus is overtopped by the labrum; if that is the case this species falls into my Group V. or VI., if not, it belongs to this or the second group, in neither of which have I seen any species presenting the characters Burmeister indicates, *viz.*, labrum conspicuous in front of the clypeus, surface entirely grabrous and nitid. Long., 4 l. (from Western Australia).

H. unguiculatus, Burm. This species probably belongs to the present group, although it is not quite clear whether it may not be a member of Group V. In Group I. its front tibiæ with only two distinct external teeth separate it strongly from all the species known to me, except *Tepperi*, Blackb., from which it differs, *inter alia*, by its claws *"tief gespalten"* at the apex.

H. rotundiceps, Blanch., seems to be a member of either this group or Group II., according as its claws (which are not described), are bifid or appendiculate. It appears to be distinguished from all the species known to me of those groups by its being an iridescent insect, and iridescence is so extremely rare in *Heteronyx* that I should not be surprised if the species is wrongly attributed to this genus.

Group II.

The known species attributable to this group are even less in number than those of Group I., and they are quite as rare in collections. They seem to fall naturally into a common aggregate with the exception of *H. fortis*, Blackb., *subfortis*, Blackb., and *lilliputanus*, Blackb., the robust subquadrate form and glabrous (or nearly so) subopaque dorsal surface of the former two giving them a somewhat aberrant appearance, and the last named by its diminutive size and other characters having a facies not in the least suggestive of a place among the other species of this group. I regret having to record here an error in the description of *H. insignis* (Proc. Linn. Soc., N.S.W., 1888, p. 1332), by which its antennæ were said to be 8-jointed, and that (with its other characters) would place it in this group. Its antennæ have 9 joints, and I can account for the mistake only by supposing that after I had examined the antennæ I intended to place it among those with 9-jointed antennæ awaiting description, but by some oversight placed it among those with only 8 joints in their antennæ. It is a member of Group IV.

The following is a tabular statement of some of the distinctive characters of the *Heteronyces* of this group:—

A. Hind angles of prothorax (viewed from above) quite defined (size moderate, 3 l. or more).
- B. Elytra having an apical row of granules bearing stout bristles ... tristis, *Blackb.*
- BB. Apex of elytra not as B.
  - C. Clypeus and frons present a continuous surface.
    - D. Head and pronotum uniformly confluently and asperately punctulate ... ... torvus, *Blackb.*
    - DD. Pronotum smoothly and not closely punctulate ... ... hispidulus, *Blackb.*
  - CC. Clypeus on a plane quite different from that of frons.
    - D. Elytra non-striate and uppermost tooth on front tibiæ obsolete ... ... brevicollis, *Blackb.*
    - DD. Species not combining the two characters of D.
      - E. Apical part of elytra deplanate in front of its membranous border.
        - F. Front face of labrum distinctly wider than its distance from summit of clypeus ... ... frontalis, *Blackb.*
        - FF. Front face of labrum distinctly narrower than its distance from summit of clypeus ... ... nitidus, *Blackb.*
      - EE. Elytra not deplanate in its apical part.
        - F. Elytra distinctly substriate.
          - G. Elytral puncturation rugulose ... ... fortis, *Blackb.*
          - GG. Elytral puncturation smooth ... ... subfortis, *Blackb.*
        - FF. Elytra non-striate (the subsutural stria of course excepted) ... ... spretus, *Blackb.*

AA. Hind angles of prothorax entirely rounded off (size very small, less than 2 l.) ... ... lilliputanus, *Blackb.*

H. hispidulus, sp. nov. Minus elongatus, postice leviter dilatatus; sat nitidus; piceus, antennis palpisque rufis; pilis brevibus fulvis minus dense (et supra capillis elongatis erectis nonnullis) vestitus; clypeo confertim ruguloso, antice late rotundato vix sinuato, labro summo clypei planum haud attingenti; fronte crebre sat grosse rugulosa; fronte clypeoque planum sat æqualem efficientibus; antennis 8-articulatis; prothorace quam longiori ut 22 ad 13 latiori, antice sat fortiter angustato, supra sparsius sat fortiter punctulato (puncturis circiter 15 in segmenti longitudine), lateribus pone mediam partem sat fortiter rotundatis, angulis anticis acutis sat productis posticis (superne visis) leviter obtusis, basi leviter bisinuata, margine basali ad latera magis elevato: elytris granulatis, squamose nec crebre punctulatis (trans elytron puncturis circiter 20); pygidio puncturis (his capillas erectas ferentibus) sparsis impresso; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2um sat longioribus; tibiis anticis extus fortiter tridentatis; tarsorum posticorum articulo basali quam 2us sat breviori quam 3us nonnihil longiori; unguiculis appendiculatis. Long., 5¼ l.; lat., 2¾ (vix.).

This species is easily identified by the characters indicated in the tabulation.

Western Australia; Coolgardie.

H. subfortis, sp. nov. Minus elongatus, robustus, postice parum dilatatus; minus nitidus; piceus, pedibus rufescentibus, antennis palpisque testaceis; supra sat glaber; clypeo confertim subtilius ruguloso, antice late nec sinuatim rotundato; labro summo clypei planum nullo modo attingenti; fronte crebre subtilius punctulata; fronte clypeoque ut plana valde disparia visis, sutura clypeali subcarinata; antennis 8-articulatis; prothorace quam longiori ut 7 ad 4 latiori, antice sat fortiter angustato, supra subtiliter vix crebre punctulato (puncturis circiter 21 in segmenti longitudine), lateribus sat arcuatis, angulis anticis acutis sat productis posticis (superne visis) sat acute rectis retrorsum leviter directis, basi fortiter bisinuata, margine basali sat æqualiter elevato: elytris concinne sat crebre subtilius nec rugulose punctulatis (trans elytron puncturis circiter 25), striis circiter 4 obsolete impressis; pygidio crebrius subtilius punctulato; coxis posticis quam metasternum sat brevioribus, quam segmentum ventrale 2um sat longioribus: tibiarum anticarum dentibus inferioribus 2 obtusis sat magnis, altera fere carenti; tarsorum posticorum articulo basali quam

2us parum breviori, quam 3us parum longiori; unguiculis appendiculatis. Long., $4\frac{1}{5}$ l.; lat., $2\frac{1}{5}$ l.

This species is a near ally of *H. fortis*, Blackb., differing from it widely, however, by its less opaque surface and by the uppermost external tooth of the front tibiæ scarcely indicated and the surface of its elytra without any rugulosity; in *fortis* the uppermost tooth being acute and quite normally defined and the surface of the elytra quite strongly, though not coarsely, rugulose. Other distinctions will be found by comparing the descriptions of the species. The present insect probably varies in colour.

New South Wales; Mulwala (given to me by Mr. Sloane).

LONGICORNES.

Demonassa.

D. capitalis, sp. nov. Elongata; picea, pube ferruginea et alba variegata; illa in capite ad latera et circum oculos, in pronoto maculatim, in elytris basin versus et maculatim pone medium, et in sternis abdomineque maculatim disposita; hac in pronoto ad latera posita, in elytris fasciam latam antemedianam et pone medium maculas multas facienti, metasternum fere totum vestienti, in abdominis lateribus et in tarsis disposita; fronte inter oculos fere parallela vix manifeste punctulata; prothorace fere ut *D. dichotomi*, Newm. (*i.e.*, cristis 2 bifidis discoidalibus et tuberculis parvis multis instructo); elytris basin versus tuberculis multis instructis (e his tuberculo quam ceteri majore mox pone basin inter suturam humerumque mediano sat elevato), ante medium grosse sparsim punctulatis (puncturis inter pubem nigris apparentibus), mox pone medium subtilius punctulatis, in parte tertia apicali fere lævibus, ad apicem fortiter bispinosis, in parte postica dimidia costa lata obtusa longitudinali lævi instructis; antennis (exempli typici) quam corpus sat longioribus pube ferruginea et alba plus minusve vestitis, subtus ciliatis. Long., 12 l.; lat., 4 l.

Resembles *D. dichotoma*, Newm. Apart from the distinct colouring and pattern of its pubescence it differs from that species, *inter alia*, by its forehead nearly parallel-sided between the eyes, by the principal tubercle of the elytra being very much smaller and placed much closer to the base, by the puncturation of the front half of the elytra much coarser and less close, by the hind part of the elytra almost punctureless, and by the apex of its elytra strongly bispinose.

North Queensland (Cairns); sent by Mr. French.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

(Incorporated)

FOR 1907-8.

Ordinary Meeting, November 5, 1907.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Motion.—Dr. Rogers, M.A., proposed—"That the Government be asked to provide funds for the appointment of a Government Botanist, with the special object of obtaining an expert knowledge of the endemic vegetation of this State for economic purposes." Dr. Rogers pointed out that of the three great branches of natural science the Government of the State had only seriously promoted that of geology. Towards the elucidation of the native flora, except in the branch of forestry, it had provided no financial assistance. A careful study of the flora of the State might not only lead to the discovery of valuable fodder plants and medicinal agents, but sound botanical knowledge was essential to the thorough understanding of its geological problems. Not only was this State in the unfortunate position of having no public authority to supply botanical information to the community, but South Australians were in the invidious position of being unable to exchange scientific courtesies with botanists in other parts of the world. The motion was seconded by Mr. W. Howchin, F.G.S., and carried.

Nomination.—Mr. William Pope, Solicitor, Adelaide.

Exhibits.—Mr. A. H. C. Zietz, F.L.S., Assistant Director of the S.A. Museum, exhibited a skin of a young black-eared cuckoo *(Misocalius palliolatus)*, which is fed by the red throat *(Sericornis brunnea)*, and a stem of *Hylacola cauta*, all from the neighbourhood of Meningie; also, three ground spiders, new to South Australia, from the same district. Mr. Zietz also exhibited a double-yolked swan's egg; a piece of shelly travertine, from a raised sea beach on the Coorong. At the time of Mr. Zietz's visit the Coorong was full of crabs; he also noticed gypsum on the samphire flats. Dr. Rogers, M.A., showed sketches of several orchids in which the blossoms were white. Many orchids show this albinism, amongst these several *Caladenias* and *Glossodia niger*. The President mentioned that the same colourless condition occurs amongst the mollusca. The President exhibited several shells; a very fine specimen of *Pleurotomaria proteus*, in which the deep slit in the outer margin was pointed out, and a *Murchisonia lloydi* and a *Turritella runcianata;* also, two blades of a pigmy whale *(Neobalacua marginata)*, from an animal found stranded on Thistle Island. Miss Bundey showed several Jamaica mats, made from the inner bark of the "lace-tree."

Ordinary Meeting, April 7, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Ballot.—William Pope, Solicitor, as a Fellow.

By-law.—It was proposed by Mr. Howchin, and carried—"That by-law, section iv., paragraph 8, should in future read 'September 15,' instead of September 30, in every year."

Nominations.—J. P. V. Madsen, D.Sc., and W. Noel Benson, B.Sc., both of the University of Adelaide.

Exhibits.—Mr. J. G. O. Tepper, F.L.S., of the Museum, two cases of butterflies, from Queensland, partly from Mr. Bell's collection, and partly those presented to the Museum by Mr. Samuel Dixon. Mr. J. McC. Black exhibited an umbelliferous plant *(Apium leptophyllum*, North), found by Mr. Griffith at the Finniss, and a grass *(Isachne australis*, Brown) from Myponga. Dr. Pulleine exhibited a large spider *(Phlogius crassipes*, Koch), from Orroroo, found in the ground occupying cracks or other holes, the entrance of which it covers with webbing. This spider is said to whistle, but this characteristic has not been fully established.

Papers.—"New Australian Lepidoptera of the Families *Noctuidæ* and *Pyralidæ*," by A. Jefferis Turner, M.D.; "The Ionization remaining in Gases after removal from the Influence of the Ionizing Agent," by J. P. V. Madsen, D.Sc.; "An Experimental Investigation of the Nature of the Gamma Rays," by Professor W. H. Bragg, M.A., F.R.S., and J. P. V. Madsen, D.Sc. Dr. Madsen, by means of diagrams on the blackboard, showed how he had arrived at the conclusions set forth in his paper. Prof. Bragg explained at some length that his and Dr. Madsen's investigations of the gamma rays tended to show that these rays are material, and that the "Ether Pulse Theory" is no longer tenable. Prof. Rennie, D.Sc., drew the attention of the meeting to the important nature of the work that was being carried on by Prof. Bragg, and which would probably revolutionize many of the scientific ideas of to-day.

ORDINARY MEETING, MAY 5, 1908.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

BALLOT.—J. P. V. Madsen, D.Sc., B.E., Lecturer at the University of Adelaide, and W. Noel Benson, B.Sc., Lecturer at the University of Adelaide, were elected Fellows.

THE PRESIDENT laid on the table a letter from Mr. Dodwell, of the Commonwealth Meteorological Department, inviting Fellows and members to the Observatory to inspect the seismograph which was being installed there.

EXHIBITS.—Mr. J. G. O. TEPPER, F.L.S., laid on the table a bound volume of "Separata" of descriptions of new Australian plants not contained in Bentham's "Flora Australiensis," by the late Baron Ferdinand von Mueller. Mr. TEPPER also exhibited a trombone, showing the work of larvæ of *Aulacophora hilaris* (Boisd.), a small beetle of the Family *Chrysomelidæ*. A leaf covered with web of *Stenopsocus stigmaticus*, a species of the Family *Psosidæ (Copeognathidæ)*, which infests many trees and plants without seemingly being injurious. The mature insect is 1-20th of an inch across open wings, belonging to the same Family as the wingless and spring-tails, the latter found in pools after rain. Male and female galls of *Brachyscelis ovicoloides*, a genus of Coccidæ. Dr. PULLEINE exhibited a trap-door spider of very unusual appearance, possibly a new species. From a sketch on the blackboard Dr. Pulleine showed the peculiar shape of the cephalothorax and the position of its eight eyes.

PAPERS.—"Notes on the Geology of the Mount Lofty Ranges, chiefly the portion East of the Onkaparinga River," by W. G. WOOLNOUGH, D.Sc., F.G.S., University of Sydney; "An Experimental Investigation of the Nature of the Gamma Rays," part ii., by Prof. W. H. BRAGG, M.A., F.R.S., and J. P. V. MADSEN, D.Sc. In the discussion which followed the reading of Dr. Woolnough's paper, Mr. HOWCHIN stated that he could not agree with the author's generalization on the geology of the Mount Lofty Ranges, and particularly in relation to the geological section which Dr. Woolnough had made from Mount Lofty to the River Murray. The section showed the Mount Lofty Ranges to consist of a monoclinal series of beds, the older members being on the west and the newer on the east. No such regular succession of beds existed, as the series was broken by the exposure of an important pre-Cambrian axis, from which the beds dipped west and east, causing a repetition of the respective beds on each side of the geological axis.

ORDINARY MEETING, JUNE 2, 1908.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

NOMINATION.—W. G. Woolnough, D.Sc., F.G.S., of Sydney University, as a Corresponding Member.

NEW BY-LAWS.—A sub-committee appointed by the Council on April 25, 1908, to consider the way in which the Society's finances should be managed, recommended that the following By-laws be added to those already adopted:—

Section V.—Finance—

(1) All investments made by the Society in stock or other securities shall be in the name of "The Royal Society of South Australia (Incorporated)," and no dealings in or transfers of the same shall be made except under the seal of the Society.

(2) The receipt of the Treasurer shall be a sufficient receipt for all interest or other revenue accruing from such investments.

(3) All subscriptions and other moneys received by the Treasurer shall be deposited in the name of "The Royal Society of South Australia (Incorporated)," in such Bank or Banks as the Council may from time to time determine, and all cheques drawn upon such Bank or Banks shall be signed by the Secretary and Treasurer.

(4) The Treasurer shall prepare annually a statement of receipts and expenditure, and a Balance-sheet, which shall be submitted to the Auditors for audit prior to the Annual Meeting of the Society. (Signed) WALTER RUTT, Convener; W. H. SELWAY. May 15, 1908.

Proposed by Prof. RENNIE, D.Sc., seconded by Mr. SAMUEL DIXON—"That the meeting accept and confirm the By-laws as recommended by the sub-committee." Passed.

EXHIBITS.—Mr. W. HOWCHIN, F.G.S., exhibited some specimens from the quarries near Aldgate Railway Station, which have an important bearing on the age of the Mount Lofty beds. Mr. Howchin has already published his geological observations on this locality, maintaining that at Aldgate and elsewhere the Cambrian grits, etc., rest unconformably on an older pre-Cambrian floor. The exhibits presented at the meeting, Mr. Howchin stated, demonstrated that view to be correct. Aldgate Creek (near the Pound) runs over a coarse variety of granite known as pegmatite, forming a part of the pre-Cambrian complex. In a recent visit to the Aldgate quarries Mr. Howchin discovered, in one of these, a band of coarse angular fragments of pegmatite interbedded with ordinary felspathic grits of the neighbourhood. This proves that the pegmatites from which this band of broken fragments was derived formed the hard rocks of the shore line when the Cambrian deposits were in process of formation, thus establishing a geological uncomformity of great interest. Mr. J. G. O. Tepper, F.L.S., exhibited a black beetle *(Blatta)* found in the pipeclay some distance below the surface at Teatree Gully, the upper portion of a nest of a trapdoor spider, with circular lid, and also the fruit of the Yucca, which Mr. Tepper informed the meeting requires the agency of an unknown moth to mature. Mr. Tepper further exhibited a specimen of "knotted" schist, from the neighbourhood of Lyndoch, Hundred of Barossa. The bed from which the specimen was obtained is usually bounded by quartzite on one side and mica or gneissic schist on the other, and exhibits a general north-easterly strike. It is seen in Section 511, on the western side of the Barossa Creek, and passes north through Sections 509 and 510. A hornblende schist makes a small outcrop at the north-west angle of Section 3,146 and in Section 3,141.

Paper.—"Notes on South Australian Marine Mollusca, with Descriptions of New Species," Part viii., by J. C. Verco, M.D., F.R.C.S.

Ordinary Meeting, July 7, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Ballot.—W. G. Woolnough, D.Sc., lecturer at the University of Sydney, was elected a Corresponding Member.

Endowment and Research Fund.—Mr. W. Howchin, F.G.S., proposed a vote of thanks to the President, Dr. Verco, for his generous gift of £1,000, and also to Mr. Thomas Scarfe, the other generous donor to this fund. Prof. R. W. Chapman, M.A., B.C.E., in supporting the motion, said that in a new country research work, such as this Society is doing, needed encouragement and support. The hon. treasurer, Mr. W. Rutt, C.E., reminded the members that an anonymous gift of 10s. had been made to the fund, and suggested that that donor should be included in the motion. Carried.

Exhibits.—Mr. Ashby showed a singing toad from

Western Australia *(Bufo occidentales musicales)*, the skin of a new species of little green pigeon, from Port Keats, N.T. *(Chalcophaps occidentales*, North), and a fine specimen of *Voluta Bednalli*, from the same district. Also a puff-ball from Blackwood, which when bursting takes the form of a globose network. Dr. Pulleine exhibited five stone axes from Queensland, one of which, the largest, was from the Leichhardt Ranges. These axes are generally found when clearing the forest lands. Mr. W. Howchin, F.G.S., remarking on these, said that the rock selected by the natives is a basic igneous rock, chosen on account of its hardness and toughness, and was probably used in barter between tribes. It was also stated at the meeting that a quarry originally worked by the natives had been discovered in Gippsland.

Mr. W. Howchin, F.G.S., read the discussion which took place at a meeting of the Geological Society of London upon the occasion when his paper on Glacial Beds of Cambrian Age in South Australia, was read.

Papers.—"Notes on Some Species of the Isopod Family *Sphæromidæ* from South Australia," by W. H. Baker, F.L.S. "Secondary Gamma Rays," by J. P. V. Madsen, D.Sc., B.E.

Ordinary Meeting, August 4, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Ballot.—Mr. Howard Whitbread was elected to act as Auditor during Mr. Smeaton's illness.

Exhibits.—Mr. W. Howchin, F.G.S., exhibited (by the courtesy of Mr. J. W. Jones) a portion of the core of a bore on Mr. Ind's property, near Paradise Bridge. The specimen, obtained at 160 ft., was a good example of glauconite, or green earth (a hydrous silicate of iron, alumina, and potash). Geologically it represents the lowest member of the Eocene beds in South Australia, and is found at the base of the series at Aldinga and in the Kent Town bore. Its occurrence in the neighbourhood of Paradise shows that the sea in Lower Tertiary times extended to what is now practically the base of the hills. Glauconite is forming at the present day in the deep seas at a depth from about 100 to 1,000 fathoms, and is often found deposited in the shells of the foraminifera; the shells weather away, and the glauconite grains have the form of internal casts of the shells. Mr. A. G. Edquist exhibited two examples of *Lepidurus*—fresh-water crustaceans. They are found only in rainwater pools that dry up. The eggs undergo a process of desiccation before they will incubate.

The animal breathes with its feet, which are kept in constant motion, thus helping it to swim.

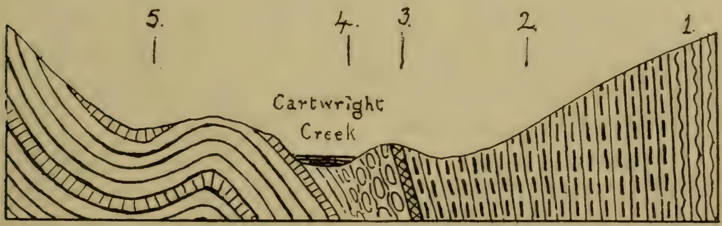
Papers.—"Secondary Röntgen Rays," by Prof. W. H. Bragg, M.A., F.R.S. "Description of Australian Curculionidæ, with Notes on Previously-described Species, Part vi. Sub-family *Leptopsides*," by A. M. Lea, Government Entomologist, Tasmania. "New Australian Lepidoptera," No. 25, by Oswald B. Lower, F.E.S., Lond.

Ordinary Meeting, September 8, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Exhibits.—Mr. W. N. Benson, B.Sc., exhibited Cambrian Glacial Till, from Cartwright Creek, twenty-seven miles N.N.W. of Broken Hill. [The following particulars bearing on this exhibit were supplied by Mr. Benson.]

The following series occurs dipping to N.E.:—1. Knotted mica-schist. 2. Mica-schist with angular included fragments of schist and quartzite and boulders of quartzite, quartz, and granite. Estimated thickness, about 300 yards. 3. Band of limestone, up to 20 ft. in width, and pinching out occasionally. 4. Band about 60 ft. thick, of large boulders, up to 4 ft. in diameter, of granite, quartzite, and schist, in a schistose or gritty matrix. 5. Knotted mica-schist with interbedded quartzite bands.



The correlation of the series 2, 3, and 4 (described by Mr. J. B. Jaquet in 1893 as schistose conglomerate), with lower Cambrian glacial beds of South Australia, is based on —(a) Their lithological character; (b) nature and mode of occurrence of the interbedded limestone; (c) thickness of the series. Data are not yet sufficient for correlation on stratigraphical grounds. What little is known is confirmatory. The importance of their determination as glacial beds is:—

(1.) It determines the age of the Barrier Range crystalline schists, and fixes an horizon in them which may be correlated with a portion of the Mount Lofty Lower Cambrian series.

(2.) It shows the identity of the Barrier Range crystalline schists with the slates and slaty conglomerates of the same area among which Mr. Mawson has proved that the glacial beds occur.

(3.) It shows the identity of the plane of schistosity and bedding-plane in Cartwright Creek.

New South Wales is unique among the Australian colonies, so far as is at present known, in possessing distinct evidence of the three great ice ages—Cambrian, Permo-carboniferous, and Pleistocene.

Papers.—"Synopsis of the Fishes of South Australia," Part i., by A. H. C. Zietz, F.L.S., C.M.Z.S. "Description of a Hitherto Undescribed Species of Shark from Investigator Strait," by the same author. "A Contribution to the Botany of South Australia," by J. H. Maiden, Hon. Secretary of the Royal Society of New South Wales.

Annual Meeting, October 6, 1908.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

The Annual Report and Balance-sheet were read and adopted.

Election of Officers and Members of Council.—J. C. Verco, M.D., F.R.C.S., proposed by Prof. W. H. Bragg and seconded by Mr. W. Howchin, was unanimously elected President; Vice-Presidents, Prof. E. H. Rennie, D.Sc., and Rev. Thos. Blackburn, B.A.; Hon. Treasurer, W. Rutt, C.E.; Retiring Members, W. Howchin, F.G.S., and W. B. Poole, were re-elected.

Exhibits.—Mr. A. H. C. Zietz, F.L.S., C.M.Z.S., showed a number of fishes to illustrate his paper.

Papers.—"Notes on South Australian Marine Mollusca, with Descriptions of New Species," Part ix., by J. C. Verco, M.D. "The Strength of South Australian Timbers," by Prof. R. W. Chapman, M.A., B.C.E. "Descriptions of New Australian *Hesperiadæ*," by Oswald B. Lower, F.E.S., Lond.; "Australian *Tortricina*," by the same author. "Addendum to Prof. W. H. Bragg's Preliminary Note on the Secondary Röntgen Rays," by Prof. W. H. Bragg, M.A., F.R.S. "Further Notes on Australian Coleoptera, with Descriptions of New Genera and Species," No. xxxviii., by Rev. Thos. Blackburn, B.A. "Synopsis of South Australian Fishes," Part ii., by A. H. C. Zietz, F.L.S., C.M.Z.S.

ANNUAL REPORT, 1907-8.

The Council has the pleasure to report that during the year the work of the Society has included some important papers by Prof. Bragg and Dr. Madsen, of the University of Adelaide, recording their investigations of the nature and forms of electric radiations. Both these gentlemen are soon to leave this State—Professor Bragg to undertake research work at the University of Leeds, England, while Dr. Madsen returns to his "Alma Mater," the University of Sydney. The Council regrets the loss to the Society of two such valued members, but wishes them success and advancement each in his particular work.

Papers have been received from Dr. Verco in continuation of his classification and descriptions of the Marine Mollusca of South Australia, and from Dr. W. G. Woolnough, of the University of Sydney, on the still debatable geological formations of the Mount Lofty Ranges. Mr. Zietz has given a synopsis of the Fishes of South Australia, and Mr. W. H. Baker has contributed further descriptions of the Crustacea of the same Province, while the Rev. Mr. Blackburn and Mr. A. M. Lea have each continued his classification and descriptions of the Coleoptera, and Dr. Jefferis A. Turner and Mr. Oswald B. Lower of the Lepidoptera.

Many curious and interesting specimens in natural history have been exhibited by members during the year.

As a necessary corollary to this varied work the publications of the Society are increasingly in demand for exchange with learned Societies in all parts of the world. The list of exchanges now includes the names of 184 Societies; of these eighty-four are European and forty American. It is intended, as soon as shelving accommodation is provided for the Library, to bind the publications of these Societies as rapidly as means will permit. In the meantime the Council has regretfully to state that the Library, which every year is becoming increasingly valuable, is still in a chaotic condition, owing to the want of these shelves.

The Clarke Memorial Medal has been awarded to Mr. W. Howchin, F.G.S., by the Royal Society of New South Wales, in recognition of his long-continued scientific labours, and more particularly on account of his important discoveries of evidences of a great ice age in earlier [lower] Cambrian times in Australia, and also for his original work on extinct forms of Foraminifera.

Endowment and Research Fund.—This fund has received generous recognition at the hands of our President (Dr. Verco) and of Mr. Thomas Scarfe, who have each given

£1,000 for the purposes for which this fund is intended. This money has been invested in the inscribed stock of the State. A previous initial sum of 10s. had been received from an anonymous donor.

Membership.—Hon. Fellows, 9; Corresponding Members, 6; Fellows, 70; Associate, 1.

Obituary.—Thomas Drury Smeaton, member from 1857. Professor Rennie says of Mr. Smeaton, who was born within the sound of Bow Bells: "In early life he was articled to a London engineer. After finishing his course he came to Adelaide under engagement to the South Australian Company. On his arrival in 1853, there being no opening for him as an engineer, he was taken into the service of the Company's financial institution—the Bank of South Australia. Mr. Smeaton remained in the Bank till 1884, having at various times filled the position of Inspector, Assistant Manager, and Manager. On his retirement he settled at Blakiston, and in 1905 removed to Mount Lofty. He spent most of his leisure in literary and scientific pursuits. His reading was comprehensive, and he was a keen and close observer. There were few scientific subjects with which he was not more or less acquainted. He was a mathematical genius, and had an accurate knowledge of experimental optics and acoustics. He devoted a considerable portion of his time to the study of botany and of certain parts of zoology, and acquired a fine collection of South Australian Hydrozoa and Polyzoa. A country walk with him was a delightful experience, so keen was he to see all there was to be seen, and so willing to impart to others the information he had gained by his own close observation. He early joined the Adelaide Philosophical Society, which was affiliated with the Public Library, and which was the forerunner of the Royal Society of South Australia. Mr. Smeaton was the author of many interesting papers, and few subjects seemed out of his reach. Among other papers he contributed one on the Rainbow, published in an early issue of 'Nature.' He was a member of the Adelaide Hospital Board for some years, and was one of the originators of the Good Samaritan Fund, the honorary secretarial duties of which he discharged for a long period. Mr. Smeaton possessed a keen sense of humour, and was a charming companion. He died at Mount Lofty on February 18, 1908, at the age of seventy-six years. His loss is greatly felt by those who during his life were fortunate enough to be included amongst his friends."

Adopted, Annual Meeting, October 6, 1908.

Jos. C. Verco, *President.*
G. G. Mayo, *Hon. Sec.*

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Revenue and Expenditure for 1907-8.

Dr.	£ s. d.	£ s. d.
October 1, 1907.		
To Balance		317 16 4
,, Subscriptions—		
Royal Society	66 8 3	
Field Naturalists' Section ...	20 16 6	
Microscopical Section	6 5 0	
Malacological Section ...	2 7 6	
		95 17 3
,, Grants from Government		
On Subscriptions	83 8 0	
For Printing Reports on Scientific Investigations in South Australia	150 0 0	
		233 8 0
,, Sale of "Transactions"		1 15 3
,, Interest on S.A. Government Stock	25 1 4	
,, Savings Bank	7 12 5	
		32 13 9
		£681 10 7

Cr.	£ s. d.	£ s. d.
By "Transactions"—		
Printing	92 15 6	
Illustrating	24 18 0	
Publishing	9 10 7	
		127 4 1
,, Grants—		
Field Naturalists' Section ...	14 0 0	
Microscopical Section ...	6 0 0	
Malacological Section ...	1 0 0	
Epidiascope Committee ...	15 15 0	
		36 15 0
,, Library—		
Cataloguing, etc.	5 6 3	
Carriage of Books	0 6 9	
		5 13 0
,, Caretaking and Lighting ...		8 2 6
,, Printing, Postage, and Stationery		10 8 6
,, Advertising		3 2 3
,, Exchange on Cheques ...		0 3 0
,, Furniture		2 1 6
,, Transfer of Stock		0 5 0
,, Transferred to Endowment Fund		0 10 0
,, Balance, September 30, 1908		487 5 9
		£681 10 7

Examined and found correct,

Howard Whitbread,
J. S. Lloyd, F.I.A.S.A. } Auditors.

Walter Rutt, Treasurer.

ENDOWMENT FUND.

Dr.	£	s.	d.	Cr.	£	s.	d.	£	s.	d.
To Transferred from General Account	0	10	0	By £2,000 S.A. 3¾ per cent. Inscribed Stock (at par). Certificates in custody of Secretary	2,000	0	0			
,, Donation from Mr. Scarfe	1,000	0	0	Less Commission returned ...	2	10	0			
,, Donation from Dr. J. C. Verco, S.A. 3¾ per cent. Inscribed Stock (at par)	1,000	0	0					1,997	10	0
				,, Balance				3	0	0
	£2,000	10	0					£2,000	10	0

SUMMARY OF BALANCES.

	£	s.	d.		£	s.	d.
Revenue and Expenditure Account	487	5	9	In Savings Bank	257	12	5
Endowment Fund	3	0	0	,, Bank of Australasia	232	13	4
	£490	5	9		£490	5	9

Examined and found correct,

Howard Whitbread,
J. S. Lloyd, F.I.A.S.A. } Auditors.

Walter Rutt, Treasurer.

DONATIONS TO THE LIBRARY

For Year 1907-8.

TRANSACTIONS, JOURNALS, REPORTS, ETC.

Presented by the respective Editors, Societies, and Governments.

Austria and Germany.

Basle—Naturforschende Gesellschaft zu Basel, Neue Capillar- und Capillaranalytische Untersuchungen, Band xix., Heft 2.

Berlin—Königl. Preuss. Meteor. Instituts Veröffentlichungen der Ergebnisse der Beobachtungen an den Stationen, 1904; Ordnung i., ii., 1902; Ordnung ii., iii., 1906. Veröffentlichungen der Ergebnisse der Niederschlagsbeobachtungen, No. 197, Jahr 1905. Ergebnisse der Gewitterbeobachtungen, No. 195, Jahre 1903-5. Berichte für 1907.

——— Königl. Preuss. Akademic der Wissenschaften zu Berlin, Sitzungsberichte, 1907, Nos. 39-53; 1908, Nos. 1-23.

——— Deutsches Meteorologisches Jahrbuch, Heft 1, 1906.

——— Gesellschaft für Erdkunde, Zeitschrift der, 1907, Nos. 7-10; 1908, Nos. 2-6.

——— Berliner Gesellschaft für Anthrop., Ethnol., und Urgeschichte. Ergänzungsblätter zur Zeitschrift für Ethnologie, Jahrgang 39, Heft 4, 5, 6, 1907; Jahrgang 40, Heft 1-4, 1908.

Breslau—Aus der Zeitschrift für Ethnologie, by H. Basedow, 1907, Heft 4, 5; 1908, Heft 2.

Freiburg—Naturforschenden Gesellschaft zu Freiburg, Berichte der, Band xv.

Göttingen—Königl. Gesellschaft der Wissenschaften zu Göttingen, Math. Phys. Klasse, Nachrichten von der, 1907, Heft 4, 5; 1908, Heft 1, 2. Geschäftliche Mitteilungen, 1906, Heft 2; 1907, Heft 2; 1908, Heft 1.

Hamburg—Mitteilungen aus dem Naturhistorischen Museum, Jahrgang xxiv., 1906.

——— Verhandlungen des Naturwissenschaftlichen Vereins, 1906, Dritte Folge xiv.; 1907, Dritte Folge xv.

——— Abhandlungen aus dem Gebiete der Naturwissenschaften, herausgegeben vom Naturwissen. Verein in Hamburg, Band xix., Heft 1, 2.

Heidelberg—Berichte über Land- und Forstwirtschaft in Deutsch Ostafrika, Band iii., Heft 4.
Leipzig—Städtischen Museums für Völkerkunde, Veröffentlichungen des, Heft 1, 2. Jahrbuch, Band i., 1906.
München—K. B. Akademie der Wissenschaften zu München, Math. Phys. Klasse, Sitzungsberichte der, 1907, Heft 3; Abhandlungen, Band xxiii., zweite Abteil; Band xxiv., erste Abteil.
Nürnberg—Naturhistorischen Gesellschaft zu Nürnberg, Abhandlungen der, Band xvi. Jahresbericht, 1905.
Trencsen—Jahresheft des Naturwissenschaftlichen Vereins des Trencsener Comitates, 1906-7.
Vienna—Kaiserliche Akademie der Wissenschaften in Wien, Sitzung. der Math., Naturwiss., Jahrgang 44, Nos. 1-27, 1907.
——— Verhandlungen der Oestreichischen Kommission für die Internationale Erdmessung, Dec., 1906; March, 1907.
——— Annalen des K. K. Naturhistorischen Hofmuseums, Band xxi., Nos. 2-4.
——— Verhandlungen der K. K. Geologischen Reichsanstalt, Jahrgang 1907, Nos. 11-18; 1908, Nos. 1-6.
——— K. K. Zoologische-Botanische Gesellschaft in Wien, Jahrgang 1907, Band lvii., Heft 6-10; Jahrgang 1908, Band lviii., Heft 1-5.

AUSTRALIA AND NEW ZEALAND.

Adelaide—Public Library, Museum, and Art Gallery, Annual Report, 1906-7.
——— School of Mines and Industries, Annual Report, 1906; Prospectus for 1908.
——— Catalogue of Minerals in the Technological Museum of the South Australian School of Mines and Industries, compiled by H. Basedow, 1907.
——— Department of Mines, Review for year ended June 30, 1907. Short Review for half-year to December 31, 1907; June 30, 1908.
——— The Mines of South Australia, A Record, Fourth Edition, February, 1908.
——— Woods and Forests Department, Annual Progress Report, 1906-7.
——— Adelaide Observatory, Meteorological Observations for 1905.
——— Adelaide Chamber of Commerce, Annual Report, the 57th, 1907.

Adelaide—Northern Territory of South Australia, North and Eastern Coasts, Report by Government Geologist, 1907.

Brisbane—Queensland Department of Mines, Geological Survey, Publications, Nos. 204, 214, 216.

——— Queensland Flora, Extracts, vol. xix., part 5; vol. xx., parts 2, 4, 5; vol. xxi., part 1.

——— Royal Society of Queensland, Proceedings, vol. xx.

——— Queensland Museum, Annals, No. 8.

——— The Queensland Naturalist, vol. i., No. 1.

Melbourne—Victoria Department of Agriculture, Journal, vol. v., parts 10-12; Index to vol. v., vol. vi.; parts 1-9. Report for 1905-7.

——— Department of Mines, Geological Survey Records, vol. ii., parts 2-4. Memoirs 1908, No. 6.

——— Mines and Water Supply, Annual Report, 1907.

——— Victorian Yearbook, 1906-7. Three copies.

——— Australasian Institute of Mining Engineers, vol. xii., 1907.

——— Royal Society of Victoria, Proceedings, vol. xx. (New Series), parts 1, 2; vol. xxi. (New Series), part 1.

——— Victorian Geographical Journal, vol. xxv., 1907.

——— National Museum, Memoirs, No. 2.

——— The Victorian Naturalist, vol. xxiv., Nos. 7-12; vol. xxv., Nos. 1-5.

——— Society of Chemical Industry of Victoria, vol. viii., Nos. 1, 2.

——— The Australian Commonwealth—Its Resources and Productions, 1908.

——— Meteorology of Australia, Commonwealth Bureau of Meteorology, Bulletin, Nos. 1, 2.

——— Official Yearbook of the Commonwealth of Australia, No. 1, 1901-7.

Launceston—The Progress of the Mineral Industry of Tasmania, Quarterly Reports, September, 1907; December, 1907; March, 1908; June, 1908.

——— The Department of Mines, Geological Survey Bulletin, Nos. 1-3.

Perth—Meteorological Observations, 1906.

——— Department of Mines, Report, 1907.

——— Western Australian Natural History Society Journal, No. 4.

——— Geological Survey Bulletin, Nos. 27-30.

Perth—Government Gazette, Supplement, 1907, Nos. 62, 66; 1908, Nos. 3, 7, 12, 20, 25, 32, 36, 39.

Sydney—Department of Mines, Annual Report, 1907. Geological Survey. Problems of the Artesian Water Supply of Australia, October, 1907.

——— Department of Mines and Agriculture, vol. xviii., parts 10-12, vol. xix., parts 1-9. Miscellaneous Publications, 1899, No. 313. 1894, Paddy's Lucerne. Geological Survey, Memoirs, Nos. 4 and 6 and Maps. Palæonotology, Memoirs, Nos. 10, 13, part 2. Mineral Resources, No. 12.

——— Royal Society of New South Wales, Reprints, vol. xxxvii., July, 1903.

——— Linnean Society of New South Wales, Proceedings, vol. xxxii., parts 3, 4; Nos. 127, 128. Vol. xxxiii., parts 1, 2; Nos. 129, 130.

——— Linnean Society of New South Wales, From the Proceedings, The Flora of Norfolk Island, part 1. Abstract of Proceedings, September-November, 1907; March to July, 1908.

——— Australian Museum, Report the 53rd, June, 1907; Records, vol. vi., No. 6; vol. vii., Nos. 1, 2.

——— Public Library, Report of Trustees, 1907.

——— Botanic Gardens and Domains, Report, 1906.

——— New South Wales Naturalists' Club, Journal and Magazine, vol. i., part 11.

——— Fisheries of New South Wales, Annual Report of Commissioners, 1907.

——— Department of Fisheries, Additions to the Fish Fauna, No. 1. Note on Small Collection of Fishes from Sowarow Island. Preliminary Note on The Wafer. The Edible Fishes of New South Wales, 1908.

——— The Forest Flora of New South Wales, vol. iii., parts 7-10, vol. iv., part 1.

——— University Calendar, 1908.

——— Royal Anthropological Society of Australia, Journal, vol. ix., No. 10; vol. x., Nos. 1, 3, 4.

Auckland—Auckland Institute and Museum, Annual Report, 1907-8.

Wellington—New Zealand Institute, Transactions, vol. xxxix., 1906.

————— New Zealand Geological Survey, Bulletin, New Series, Nos. 4, 5.

Wellington—Mines Department, Dominion Laboratory, Annual Reports, the 40th and 41st. Report made at International Exhibition, Christchurch. Analyses of New Zealand Coals, 1906-7.

——— Colonial Museum, Bulletin, No. 2.

——— The Lesson of Evolution, by Frederick Wollaston Hutton, F.R.S.

BELGIUM AND HOLLAND.

Brussels—Société Entomologique de Belgique, Annales de la, tome li., 1907.

——— Société Royale de Botanique de Belgique, Bulletin, tome xliii., fasc. 1-4.

——— Société Royale Zoologique Malacologique de Belgique, Annales de la, 1906, tome xli.; 1907, tome xlii.

——— Congrès International pour l'étude des Régions Polaires, Rapport d'ensemble, September, 1906, part 1.

——— La Seconde Expedition Antarctique Belge, par Henryk Arctowski, Extrait du Bulletin de la Société Belge d'Astronomie. Nos. 11, 12, 1907.

——— Commission Polaire Internationale, Procès Verbaux des Séances, 1908.

——— Observatoire Royal de Belgique, Annuaire Astronomique, 1908.

——— L'Observatoire Royal de Belgique, Annales de, tome iii., fasc. 3; tome x.; tome xi., fasc. 1.

Haarlem—Archives du Musée Teyler, Series 2, vol. xi., part 1.

Liège—Société Royale des Sciences, Mémoires, Series 3, tome vii.

Batavia—Koninkligke Natuurkundige Vereeniging, deel lxvii.

CANADA.

Halifax—Nova Scotian Institute of Sciences, Proceedings and Transactions, vol. xi., part 2, 1903-4.

Ottawa—Department of the Interior, Geological Survey, Annual Report, Palæontology, etc., vol. xvi. and Maps, 1904. General Index to Reports 1855-1906. Sheets of Maps. Reports, Nos. 958, 968. Summary Report, 1907, Nos. 949, 953, 977, 971, and Maps. Annual Report on Mineral Industries, Nos. 959, 979, 988, 992. The Falls of Niagara, 1905-6.

DENMARK.

Copenhagen—Geografisk Tidskrift, 19de Bind, 1907-1908, Hefte 4-6.

ENGLAND, IRELAND, AND SCOTLAND.

London—Conchological Society, Journal, vol. xii., Nos. 4-7.
——— Entomological Society, Transactions, 1907.
——— Royal Colonial Institute, vol. xxxix., 1907-8.
——— Linnean Society of London, Proceedings, Session 119th, November, 1906-June, 1907. List of Members, 1907-8.
——— Royal Society of London, Yearbook, 1908. Proceedings, Mathematical and Physical Sciences, Series A, vol. lxxix., Nos. A533, 534; vol. lxxx., Nos. A535-543; vol. lxxxi., Nos. A544-546. Biological Sciences, Series B, vol. lxxix., Nos. B534, 535; vol. lxxx., Nos. B536-541.
——— Royal Microscropical Society of London, Journal, 1907, parts 5, 6; 1908, parts 1-4.
——— The British Museum, General Guidebook. Eight Guidebooks. List of British Plants and Ferns. Catalogue of Lepidoptera, vol. vi. and Plates. Monograph on the Culicidæ, vol. iv.
——— National Physical Laboratory, Report, 1907.
——— Royal Gardens, Kew, Bulletin, 1907.
——— The State Correspondent, etc., vol. xiii., Nos. 9-12; vol. xiv., Nos. 2-8.
——— The Periodical, 1907, Nos. 41-46.
——— Electrical Engineering, vol. xi., No. 13.

Liverpool—Biological Society, Proceedings and Transactions, vol. xxi., 1906-1907.

Manchester—Literary and Philosophical Society, Memoirs and Proceedings, vol. lii., parts 1, 2.

Cambridge—Philosophical Society, Proceedings, vol. xiv., parts 3-5. List of Fellows, etc.
——— University Library, Report of the Library Syndicate, 1907.

Belfast—Natural History and Philosophical Society, Proceedings, 1906-1907.

Dublin—Royal Dublin Society, Economic Proceedings, vol. i., Nos. 11, 12. Scientific Proceedings, vol. xi., Nos. 13-28. Scientific Transactions, vol. ix., No. 6.
——— Royal Irish Academy, Proceedings, vol. xxvii., Nos. 3-9, Section A; vol. xxvi., No. 10, Section B; vol. xxvii., Nos. 1, 2, Section B; vol. xxvii., Nos. 1-5, Section C, and Appendix. Abstract of Minutes, Session 1907-8. List of Members, 1908.

Edinburgh—Royal Physical Society, Proceedings, vol. xvii., pp. 121-198.

——— Royal Society of Edinburgh, Proceedings, vol. xxvii., pp. 161-432. Vol. xxviii., Nos. 1-6., pp. 1-512.

——— Geological Society, Transactions, vol. ix., parts 1, 2.

Glasgow—Geological Society, Transactions, vols. x.-xii.

France.

Caen—Société Linnéenne de Normandie, Bulletin, Series 5, vol. x., 1906.

Nantes—Société des Sciences Naturelles de l'Ouest de la France, Bulletin, tome vi., No. 4; tome vii., Nos. 1, 2.

Paris—Société Entomologique de France, Bulletin, 1907, Nos. 13-21; 1908, Nos. 1-12. Annales, 1907, vol. lxxvi., trim. 3, 4.

——— La Feuille des Jeunes Naturalistes, Nos. 444-454.

——— Revue des Etudes Ethnologiques et Sociologiques, No. 2, February, 1908.

——— Notes and Contributions à la Geologie Parisienne, Notes, No. 4; Contributions 1, 2.

——— Service Technique des Eaux et de l'Assainissement, Derivation des Sources du Loing et du Lunain, November, 1906.

Lyons—Association Française pour l'Avancement des Sciences, Extrait 1906.

Rennes—L'Université de Rennes, Travaux Scientifiques, 1906, tome vi., parts 1, 2.

Tours—Société de Géographie, Revue, 1907, No. 1, trim. 1; Annale 24.

Italy.

Florence—Società Entomologica Italiana, Bulletino 38; trim. 3-4.

Milan—Società Italiana di Explorarioni Geografiche e Commerciali, Anno 22, fasc. 22; Anno 22, fasc. 1-11.

——— Società Italiana di Sienza Naturali e del Musco Civico de Storia Naturale, vol. xlvi., fasc. 2-4; fog. 6½, 7.

Pisa—Società Toscana di Scienza Naturali, Memorie, vol. xxiii. Processi Verbali, vol. xvi., Nos. 4, 5; vol. xvii., Nos. 1-4.

Portici—Laboratoria di Zoologia Generale e Agraria, Bolletino, 1907, vol. i.; 1908, vol. ii.

India.

Calcutta—Department of Agriculture in India, Memoirs, Botanical Series, vol. i., No. 6; vol. ii., Nos. 1-4. Chemical Series, vol. i., Nos. 5, 6. Entomological Series, vol. i., No. 6; vol. ii., Nos. 1-5.

——— Indian Museum, Annual Report, 1906-7. Natural History Section, Records, vol. i., parts 1-4. Memoirs, vol. i., parts 1, 2, Text and Plates. Plague of Rats in India. Investigator, An account of Littoral Holothurioidiæ.

——— Survey of India, A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet, parts 1-3.

——— Pag Sam Jon Zang. History of the Rise, Progress, and Downfall of Buddhism in India, by Sumpa Khan-Po. Yeçe Pal Jor, 1908.

Madras—Government Museum, Bulletin, vol. v., No. 3.

Japan.

Tokyo—Imperial University of Tokyo, College of Science, vol. xxi., Articles 7-12; vol. xxiii., Articles 1-9; vol. xxiv., vol. xxxv., Article 19.

——— Imperial Earthquake Investigation Committee, Bulletin, vol. ii., No. 1. Publications, Nos. 22A, 22C.

——— Asiatic Society of Japan, Transactions, vol. xxxv., parts 1, 2.

Mexico.

Mexico—Sociedad Cientifica, Memorias y Revista, tomo xxiv., Nos. 6-12; tomo xxv., Nos. 1, 2; tomo xxvi., Nos. 1-3.

——— Instituto Geologico de México, Boletin, No. 23, avec 43 Planches. Parergones, tomo ii., Nos. 1-3.

Norway and Sweden.

Bergen—Museums Aarbog, 1907, Hefte 3; 1908, Hefte 1. Aarsberetning, 1907.

Stockholm—Geologiska Föreningens Förhandlingar, Band xxix.

Stavanger—Museum, Aarshefte, 17de Aargang, 1906.

Trondhjem—Kongelige Norske Videnskabs Selskabs Skrifter, 1906, 1907.

Upsala—Kungl. Vetenskaps Societeten i Upsala, Bibliographia Linnæana, Part 1, Liv. i.

Upsala—Entomologisk Tidskrift Journal, Aargang 28, Haft 1-4.

——— Nova Acta Regiæ Societatis Scientiarum Upsaliensis, Serei iv., vol. i., fasc. ii.

Russia.

Dorpat—Bulletin Biologique, deux année, No. 1.

St. Petersburg—Academie Impériale de Sciences de St. Petersbourg, Bulletin, 1907, Series 6, Nos. 12-18; 1908, Series 6, Nos. 1-5, 8-11; 1906, Series 5, tome xxiv., Nos. 4, 5. Mémoires, vol. vii., No. 8; vol. viii., Nos. 1-6.

——— Comité Geologique, Bulletins, 1905, vol. xxiv., Nos. 1-10; 1906, vol. xxv., Nos. Nos. 1-10; 1907, vol. xxvi., Nos. 5-7; 1908, vol. xxvii., No. 1. Mémoires, New Series, liv. 16, 21, 23-27, 29, 31, 33; 1907, liv. 22, Planches et Cartes, liv. 34, 35; 1908, liv. 32.

——— Russischen Kaiserlichen Mineralogischen Gesellschaft zu St. Petersbourg, Verhandlungen der, Band. xliv., Lief. 2, Series 2.

——— L'Institut des Mines de l'Imperatrice Catherine II. à St. Petersbourg, Annales, vol. i., No. 1.

——— Musée Geologique Pierre le Grand, Travaux, vol. i., liv. 1-5.

Kiev—Société des Naturalistes, Mémoires, tome xx., liv. 3.

Moscow—Société Impériale des Naturalistes, Bulletin, 1906, Nos. 3, 4. Mémoires, tome xvii., liv. 1.

Switzerland.

Geneva—Société Physique et de Histoire Naturelle, 1907, vol. xxiv.

Lausanne—Société Vaudoise des Sciences Naturelles, Bulletin, vol. xliii., Nos. 159-161; vol. xliv., No. 162.

Neuchatel—Société Neuchateloise des Sciences Naturelles, Bulletin, tome xxxiii., Année 1904-5; tome xxxiv., Année 1906-7.

Zürich—Annotationes Concilii Bibliographici, vol. iii., Anno 1907.

South America.

Lima—Cuerpo de Ingenieros de Minas de Peru, Boletin, Nos. 47-56.

——— Sociedad Geografica di Lima, Boletin, Ano 16, tomo xix., trim. 1.

Monte Video—Museo National, Anales, vol. vi., tomo 3, entrega 2.

Rio de Janiero—Observario, Boletin Mensal, July, 1906-June, 1907. Annuario 1907, An. 23.

San Paulo—Revista da Sociedade Scientifica de Sao Paulo, 1907, vol. ii., Nos. 5-8.

Brazil—Bibliotheca, The Brazil of To-day, by Arthur Dias.

South Africa.

Albany—Museum, Records, vol. ii., part 2.

Cape Town—South African Museum, Annals, vol. iv., part 8; vol. v., part 5; vol. vi., part 1; vol. vi., part 1. Report, 1907.

——— South African Association for the Advancement of Science, Report, 1907.

——— South African Philosophical Society, Transactions, vol. xviii., parts 1-3.

Sandwich Islands.

Honolulu—Bernice Panahi Bishop Museum, Occasional Papers, vol. iii., No. 2.

Egypt.

Cairo—Société Entomologique d'Egypte, Bulletin, 1st year, 1908, January-March.

United States of America.

Baltimore—The Johns Hopkins University, Maryland, Geological Survey, Pliocene and Pleistocene, 1906. Physical Features, St. Mary's County, and Atlas; Calvert County and Atlas, 1907. Circulars, 1906, No. 10; 1907, Nos. 1-9; 1908, No. 1. Studies, Historical and Political Science, Series 14, Nos. 11, 12; Series 15, Nos. 1-12.

——— American Chemical Journal, vol. xxxvii., Nos. 2-6; vol. xxxviii., Nos. 1-6; vol. xxxix., Nos. 1, 2.

Boston—Society of Natural History, Proceedings, vol. xxxiii., Nos. 3-9, pp. 43-485, Plates 12-38. Table of Contents of vol. xxxiii.

Boston—American Academy of Arts and Sciences, Proceedings, vol. xlii., Nos. 19-29; vol. xliii., Nos. 1-16.

——— California Academy of Sciences, Proceedings, Zoology, 4th Series, vol. i., Nos. 1-6.

——— University of California, Publications, Archæology and Ethnology, vol. iv., Nos. 3-4; Index to vol. iv.; vol. v., No. 1; vol. ii., No. 5; vol. vi., Nos. 1-3; vol. vii., No. 2; vol. viii., Nos. 1-3. College of Agriculture, Bulletins, Nos. 179-182. Zoology, vol. iii., Nos. 5-10, pp. 53-340, plates 9-23; vol. iv., Nos. 3-7, pp. 87-393; plates 4-24. Botany, vol. ii., Nos. 12, 13, 16, pp. 237-308; 319-354; plates 21-29; vol. iii., Nos. 1, 3, 4; pp. 1-302, 331-340. Entomology, vol. i., Nos. 1, 2, pp. 1-198. List of Titles, 3rd Series, vol. i., No. 1.

Cambridge—Museum of Comparative Zoology, Harvard College, Report, 1906-7. Bulletin, vol. xlviii., No. 4; vol. xlix., Nos. 5, 6; vol. li., Nos. 5-12; vol. lii., Nos. 2, 3.

———— Harvard University Museum, Louis Agassiz, by Professor William James, December 30, 1896. An address at the Opening of the Geological Section of the Harvard University Museum, by Alexander Agassiz, LL.D., June 12, 1902.

Chicago—Field Columbian Museum, Report, vol. iii., No. 1, Title-page of vol. ii. Publications: Ornithological Series, No. 125, vol. i., No. 3; Zoological Series, vol. vii., Nos. 4, 5; vol. viii., Nos. 115, 121-124; Botanical Series, vol. ii., Nos. 4-6, 124-126; Geological Series, vol. ii., No. 10; vol. iii., Nos. 5, 6.

——— Academy of Sciences, Bulletin, No. 4, plate 2; vol. vi.

——— The Pacific Scientific Institution, Publications, Special Series, No. 2.

——— Augustana Library Publications, No. 6.

Indiana—Academy of Science, Proceedings, 1906.

Kansas—University, Bulletin, vol. iv., Nos. 1-6.

——— Academy of Science, Transactions, vol. xx., part 2; vol. xxi., part 1.

Michigan—Academy of Science, Report, 9th, 1907.

——— Reprints from Science, N.S.; Nos. 688, 689.

Missouri—Botanical Gardens, Annual Reports, Nos. 11-18, 1900-1907.

St. Louis—Academy of Science, Transactions, vol. xv., No. 5; vol. xvi., Nos. 1, 2, 4-7.

New York—Public Library Bulletin, vol. xi., Nos. 8-12; vol. xii., Nos. 1-7.

——— Studies from the Rockefeller Institute for Medical Research, vol. vi., 1907; vol. vii., 1907.

——— American Museum of Natural History, Bulletin, 1906, vol. xxii.; 1907, vol. xviii., part 4; vol. xvii., part 5; vol. xv., part 2; vol. xxiii. Memoirs, Whole Series, vol. xi., part 2; vol. iii., part 4; vol. iv.; vol. ix., part 4; vol. xiv., part 2, 1905-8. Guide Leaflets, 1907, No. 26; 1908, No. 28. Annual Report of the President, 1906. Memoirs, Anthropology, vol. i., parts 1-3.

——— Academy of Sciences, Annals, vol. xvii., parts 2, 3; vol. xviii., part 1.

——— The Museum of the Brooklyn Institute of Arts and Sciences, Bulletin, vol. i., Nos. 10-13.

——— American Museum Journal, vol. vii., Nos. 6-8; vol. viii., Nos. 1-5.

Ohio—Scientific Laboratories, Denison University, vol. xiii., Articles 1, 4-6.

—— Laboratory Bulletin, Oberlin College, No. 13.

—— Wilson Bulletin, Oberlin College Library, Nos. 59-61, 1907.

Philadelphia—Zoological Society, Annual Report of Board of Directors, 36th.

——— Academy of Natural Sciences, Proceedings, vol. lviii., part 3; vol. lix., parts 1-3.

——— American Philosophical Society, Proceedings, vol. xlv., No. 184; vol. xlvi., Nos. 185-187. Transactions, vol. xxi., parts 4, 5.

Washington—Smithsonian Institution, U.S. National Museum, Bulletin, No. 50, part 4; No. 53, part 2; Nos. 57-60. Proceedings, vol. xxxii. Contributions, vol. x., parts 5-7. Annual Report, 1907; Annual Report of Board of Regents, 1906. Bureau of American Ethnology, Bulletin, No. 30, part 1. Annual Report, 25th. Bulletin of the University of Texas, No. 88, Catalogue, 1906-7.

——— United States Geological Survey, Monographs, vol. l. Professional Papers, No. 57, B113, D34; No. 53, B91, O57. Mineral Resources, 1905, 1906.

Washington—Department of the Interior, Annual Report, No. 28.

——— Bulletin, Nos. 279, 286, 287-294, 296, 297, 300, 303-321, 323-327, 330, 331, 333, 334, 336, 339.

——— Water Supply and Irrigation Papers, Nos. 182, 183, 187-217.

——— Topographic Maps, Atlas Sheets, Nos. 86, 56, 65.

——— United States Department of Agriculture, Yearbook, 1906. Reprint from Yearbook of 1906. North American Fauna, No. 26, Bulletin, No. 32.

——— Academy of Sciences, Proceedings, vol. ix., pp. 275-558; vol. x., pp. 1-160.

Trenton—New Jersey, Archæologia, Nova Cæsara, by C. C. Abbott, M.D., No. 2.

Philippine Islands—Division of Science, Bureau of Mines, The Mineral Resources of the Philippine Islands, 1908.

LIST OF FELLOWS, MEMBERS,

ETC.,

OCTOBER, 1908.

Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers published in the Society's Transactions.

Any change in the address should be notified to the Secretary.

Date of Election.

Honorary Fellows.

1893. *Cossman, M., Rue de Maubeuge, 95, Paris.
1897. *David, T. W. Edgeworth, B.A., F.R.S., F.G.S., Prof. Geol., Sydney University.
1876. Ellery, R. L. J., F.R.S., F.R.A.S., Gov. Astron., the Observatory, Melbourne, Victoria.
1890. *Etheridge, Robert, Director of the Australian Museum of New South Wales, Sydney.
1905. Gill, Thomas, I.S.O., Under-Treasurer, Adelaide.
1905. *Hedley, Chas. H., Naturalist, Australian Museum, Sydney.
1892. *Maiden, J. H., F.L.S., F.C.S., Director Botanic Gardens, Sydney, New South Wales.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *Wilson, J. T., M.D., Prof. of Anatomy, Sydney University.

Corresponding Members.

1881. Bailey, F. M., F.L.S., Colonial Botanist, Brisbane, Queensland.
1907. *Basedow, Herbert, Breslau University, Germany. (Fellow from 1901.)
1880. *Foelsche, Paul, Inspector of Police, Palmerston, N.T.
1893. Stretton, W. G., Palmerston, N.T.
1905. Thomson, G. M., F.L.S., F.C.S., Dunedin, New Zealand.
1908. *Woolnough, Walter George, D.Sc., F.G.S., Lecturer on Geology in the University of Sydney. (Fellow from 1902.)

Fellows.

1895. *Ashby, Edwin, Royal Exchange, Adelaide.
1902. *Baker, W. H., F.L.S., Glen Osmond Road, Parkside.
1908. Benson, W. Noel, B.Sc., University of Adelaide.
1907. Black, J. McConnell, Alfred Street, Norwood.
1887. *Blackburn, Rev. Thomas, B.A., Woodville.
1886. *Bragg, W. H., M.A., F.R.S., Prof. of Mathematics and Physics, University of Adelaide.
1883. Brown, H. Y. L., F.G.S., Gov. Geologist, Adelaide.
1893. Brummitt, Robert, M.R.C.S., Gilberton.
1904. Brunkskill, George, Semaphore, S.A.
1906. Bundey, Miss Ellen Milne, 148, Molesworth Street, North Adelaide.

1907. *Chapman, R. W., M.A., B.C.E., Prof. of Engineering, University, Adelaide.
1904. Christie, William, Adelaide.
1879. *Cleland, W. L., M.B., Ch.M., J.P., Colonial Surgeon, Resident Medical Officer Parkside Lunatic Asylum, Lecturer in Materia Medica, University of Adelaide.
1895. Cleland, John B., M.D., Perth, Western Australia.
1907. *Cooke, T. W., D.Sc., Lecturer, University, Adelaide.
1907. Darling, John, Kent Terrace, Norwood.
1887. *Dixon, Samuel, Bath Street, New Glenelg.
1902. Edquist, A. G., Hindmarsh.
1904. Gordon, David, Gawler Place, Adelaide.
1880. *Goyder, George, A.M., F.C.S., Analyst and Assayer, Adelaide.
1896. Greenway, Thos. J., Adelaide.
1904. Griffith, H., Hurtle Square, Adelaide.
1896. Hawker, E. W., F.C.S., Adelaide.
1899. *Higgin, A. J., F.I.C., Assistant Lecturer on Chemistry, School of Mines, Adelaide.
1891. *Holtze, Maurice, F.L.S., Director Botanic Gardens, Adelaide.
1883. *Howchin, Walter, F.G.S., Lecturer on Geology and Palæontology, University, Adelaide.
1902. Iliffe, Jas. Drinkwater, B.Sc., Prince Alfred College, Kent Town.
1893. James, Thomas, M.R.C.S., Moonta.
1897. *Lea, A. M., Gov. Entomologist, Hobart, Tasmania.
1884. Lendon, A. A., M.D. (Lond.), M.R.C.S., Lecturer on Forensic Medicine and on Chemical Medicine, University, Adelaide, and Hon. Physician, Children's Hospital, North Adelaide.
1856. Lloyd, J. S., Alma Chambers, Adelaide.
1888. *Lower, Oswald B., F.E.S. (Lond.), Broken Hill, New South Wales.
1908. *Madsen, J. P. V., D.Sc., B.A., Lecturer, University of Adelaide.
1905. *Mawson, Douglas, B.Sc., B.E., Lecturer on Mineralogy and Petrology, University, Adelaide.
1874. Mayo, Geo. G., C.E., Hon. Secretary, 116, Franklin St., Adelaide.
1907. Melrose, Robert Thomson, Mount Pleasant.
1897. *Morgan, A. M., M.B., Ch.B., Angas Street, Adelaide.
1907. Muecke, Hugo, C.E., Grenfell Street, Adelaide.
1884. Munton, H. S., North Terrace, Adelaide.
1886. Poole, W. B., Savings Bank, Adelaide,
1908. Pope, William, Solicitor, Adelaide.
1907. Pulleine, R. H., M.B., C.M., Adelaide.
1907. Purdue, R. F., Mining Agent, Launceston, Tasmania.
1904. Reissmann, Charles, M.A., M.D. (Cantab), B.Sc. (Lond.), etc., Adelaide.
1885. *Rennie, Edward H., M.A., D.Sc. (Lond.), F.C.S., Professor of Chemistry, University of Adelaide.
1905. *Rogers, R. S., M.A., M.D., Flinders Street, Adelaide.
1869. *Rutt, Walter, Chief Assistant Engineer, Adelaide.
1891. Selway, W. H., Treasury, Adelaide.
1893. Simson, Augustus, Launceston, Tasmania.
1900. Smeaton, Stirling, B.A., C.E., Engineer-in-Chief's Office, Adelaide.

1871. SMITH, ROBERT BARR, Adelaide.
1881. *STIRLING, EDWARD C., C.M.G., M.A., M.D., F.R.S., F.R.C.S., Professor of Physiology, University of Adelaide, Director of S.A. Museum.
1906. SNOW, F. H., Mutual Chambers, Adelaide.
1907. SWEETAPPLE, H. A., M.D., Park Terrace, Parkside.
1904. TAYLOR, WILLIAM, St. Andrews, North Adelaide.
1886. *TEPPER, J. G. O., F.L.S., Entomologist, S.A. Museum. (Corresponding Member since 1878.)
1897. *TORR, W. G., LL.D., M.A., B.C.L., Brighton, South Australia.
1894. *TURNER, A. JEFFERIS, M.D., Wickham Terrace, Brisbane, Queensland.
1902. VANDENBERGH, W. J., F.R.S.L., F.R.S.E., F.R.M.S., J.P., Barrister and Solicitor, Pirie Street, Adelaide.
1889. VARDON, JOSEPH, J.P., Gresham Street, Adelaide.
1878. *VERCO, JOSEPH C., M.D., F.R.C.S., Lecturer on the Principles and Practice of Medicine and Therapeutics, University of Adelaide.
1883. WAINWRIGHT, E. H., B.Sc. (Lond.), Wellington Road, Maylands.
1878. WARE, W.L., J.P., Adelaide.
1859. WAY, RIGHT HON. SIR SAMUEL JAMES, Bart., P.C., D.C.L., Chief Justice and Lieutenant-Governor of South Australia, Adelaide.
1907. WEBB, NOEL A., Barrister, Waymouth Street, Adelaide.
1904. WHITBREAD, HOWARD, Currie Street, Adelaide.
1886. *ZIETZ, A. H. C., F.L.S., C.M.Z.S., Assistant Director South Australian Museum, Adelaide.

ASSOCIATE.

1904. ROBINSON, MRS. H. R., "Las Conchas," Largs Bay, South Australia.

APPENDICES.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

TWENTY-FIFTH ANNUAL REPORT OF THE COMMITTEE

For the Year Ended September, 1908.

Your Committee reports with much gratification that this Section of the Royal Society has completed twenty-five years of its existence. When the Section had attained its majority a celebration was held to commemorate the event, and a résumé of its history was given by Mr. W. H. Selway, who had held the office of Secretary for nearly the whole of the time. Now that the Section has attained to a quarter of a century of years a period has been reached which deserves special mention as a record, not merely in matter of time, but also because during the past four years the membership has increased to nearly double the active field workers. Also, during that time some of the members have distinguished themselves by special work in scientific circles, and their association with the Section has added much to its prestige. All branches of natural history have their devotees, and while the departments of geology, entomology, and ornithology have workers, the popular branch of botany still claims the largest number of supporters.

Evening Meetings.

At the evening meetings, which have been well attended, notes of travel have been given by members who had the opportunity during the year of visiting New South Wales, Victoria, Queensland, and Western Australia, while extended tours have been taken in our own State covering portions of the Barossa Ranges, the Murray Flats, Mount Lofty Ranges, and other places of local interest.

Special subjects have been dealt with by Mr. Stirling Smeaton, B.A., on "Mutual Aid in the Animal Kingdom," by Dr. Angas Johnson on "Microbes," by Mr. J. M. Black on "Noxious Weeds and other Introduced Plants," and by Mr. R. E. Stanley on the "Basic Principles of Rock Classification."

At these meetings Exhibits of special interest in the various branches of science have been submitted.

Excursions.

Thirteen excursions have been held during the year, and as these were limited to Saturday afternoons the time at the disposal of members restricted the area of operations to within a few miles of the city. Much of the ground is revisited, and the spread of settlement is gradually adding to the difficulty of finding fresh fields for investigation within easy distance of the city.

The first excursion for the year was to Gaudy's Gully, on October 12. The gully is situated above Burnside, towards Magill, and being unfrequented offers many advantages to collectors.

On October 26 the National Park, at Belair, was visited. While it is gratifying to know that a small portion of the Park has been set aside and fenced as a special reserve for native flora, it is still hoped that the Park Commissioners will arrange to have a larger portion of the unfrequented parts fenced in so as to be free from molestation.

On November 9, 10, and 11, a party visited the neighbourhood of Kangarilla and Dashwood's Gully, but no official report was made or published of the excursion.

On November 30 Bridgewater was visited and Cox Creek traversed for some distance; the country in this vicinity is amongst the most picturesque in our hills.

On December 14 a drive was undertaken to Norton Summit, *via* the Green Hill Road and Summertown. At various points the excursionists alighted from the drag and revelled in the luxuriant profusion of native flowers. This was the last of the field excursions during the early summer months.

On February 15 the members were asked to make a marine excursion for dredging in the shallow waters of the Port Adelaide river. This was the most popular fixture of the year. The dredgings proved interesting and instructive.

The usual Easter excursion was arranged to include a visit to Yankalilla, but the means of travel to such a long distance presented difficulties, and the official excursion was abandoned.

During the winter months excursions were made to Blackwood on May 20, Largs Bay on May 30, National Park on June 20, and Brighton on July 18.

August 15 was the first of the early Spring engagements. Stonyfell was visited, and some of the earliest flowering plants and shrubs showed signs of the approaching warmer weather.

September 1 was the date fixed for visiting Golden Grove. The rain, however, was so persistent that the journey had to be postponed to the 12th. The beautiful display of wattle blossom showed how appropriate the name "Golden Grove" was to this locality, and the new camping-place was voted a great success. This locality will probably receive further attention.

There has been a marked improvement in the attendance at the excursions, and it is known that specialists have been successful in securing a number of rare species and some new records.

The membership has increased by fourteen, and now stands at a total of 120.

Regret is felt at the death of Mr. T. D. Smeaton, who, while not a member of the Section, always took a keen interest in the work by supplying information to members individually from his vast store of natural history knowledge, and also by contributing many short papers by way of correspondence. A vote of sympathy with Mr. Stirling Smeaton, B.A., in his long-continued illness was passed, and the hope expressed that he would soon recover to renew his work for the Section.

In addition to the work of the Fauna and Flora Committee in its efforts to secure a portion of Kangaroo Island as a reserve, Dr. R. S. Rogers, M.A., Mr. E. Ashby, Miss Archer, and the Hon. Secretary compiled an illustrated article, based on photographs taken by Miss Archer (during a bicycle trip taken alone across the island), and a map showing the proposed reserve, which were published in the Adelaide *Observer*. Copies of the paper were distributed amongst scientific and influential people and officials and Ministers in the States, to scientific societies in the Commonwealth and in England, France, Germany, and America. Gratifying acknowledgments were received of this action, but much remains to be done to secure this country in the interests of science.

Monthly Meetings.

October 15, 1907.—Lecture, Mr. S. Smeaton, B.A., "Mutual Aid in the Animal Kingdom."

December 3.—Notes of Travel—Mr. W. H. Selway, "On the Blue Mountains, N.S.W."; Mr. J. W. Mellor, "Queensland"; Mr. M. S. Clark, "Western Australia."

May 19, 1908.—"Microbes," Dr. E. Angas Johnson.

June 16.—Papers on Easter Tours, by Mr. J. G. O. Tepper, F.L.S.; "Barossa," Mr. J. W. Mellor; "Murray Bridge," Messrs. H. H. D. Griffith and W. H. Selway.

July 21—Paper, Mr. J. McC. Black, "Some Noxious and Other Introduced Plants."

August 18.—Mr. R. E. Stanley, "Basic Principles of Rock Classification."

Excursions.

October 12, 1907, Gaudy's Gully; October 26, National Park, Belair; November 9, 10, and 11, Kangarilla; November 30, Bridgewater; December 14, Summertown; February 15, 1908, Outer Harbour; April 16, Easter Excursion to Mount Lofty; May 16, Blackwood; May 30, Largs Bay; June 20, National Park, Belair; July 18, Brighton; August 15, Stonyfell; September 12, Golden Grove.

J. McC. Black, Chairman.

E. H. Lock, Hon. Secretary.

September 22, 1908.

TWENTIETH ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE OF THE FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA FOR THE YEAR ENDED SEPTEMBER, 1908.

The Kangaroo Island Reserve.

In the *Gazette* of December 26, 1907, was published a proclamation setting apart the Cape Borda Lighthouse Reserve of about 67 square miles for lighthouse purposes, and also for the purpose of the protection and preservation of the fauna and flora.

On January 11, 1908, several gentlemen waited upon the Commissioner of Crown Lands, urging that the area should be extended to the 300 miles originally asked for, subject to the existing leases. The Commissioner, in a reply dated February 5, stated that the area promised was considered sufficient for the purposes advocated. In March, and again in April, Mr. Ashby wrote at great length to the Acting Premier, setting out the reasons for the granting of the extended area, referring to the much larger areas that had been set apart in the other States, in New Zealand, and in America, and asking whether it was the intention of the

Government to vest the promised Reserve in Trustees. Replies were received to the effect that the area could not be increased, that the vesting of the Reserve in the Marine Board was a temporary arrangement, and that later on consideration would be given to the matter of vesting the land in a more suitable body. There has been a tacit understanding that the whole question would be re-opened after the return of the Premier from England.

The alarming increase of foxes all over Australia renders more urgent than before the necessity for granting the larger area asked for, as it is quite clear that within a very few years the ground birds will be extinct if their enemies continue to increase as they have done in the past few years.

The Committee is much disappointed in being still unable to report the fulfilment of the promises made by the Government two years ago, but hopes that something may shortly be done.

The Protection of Kangaroos.

In September last a letter was written to the Commissioner of Crown Lands recommending that the following areas should be proclaimed a Kangaroo District, namely, the counties of Adelaide, Light, and Hindmarsh, together with the western portion of the County of Sturt, comprising the Hundreds of North Rhine, South Rhine, Tungkillo, and Kanmantoo, and in November a reply was received that the request had been complied with, as evidenced by a proclamation in the *Gazette* of November 21, 1907.

The Birds Protection Act.

Emus and swans have recently been added to the schedule of birds to be protected during the whole year.

Samuel Dixon, Chairman.

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Statement of Receipts and Expenditure for the Year ended September 16, 1908.

Dr.	£	s.	d.	Cr.	£	s.	d.
September, 1907—Credit Balance	3	1	6	Stamps	4	12	3
Subscriptions for 1907-8	17	15	0	Printing	7	10	5
	0	5	0	Plan of Kangaroo Island	0	5	0
September 16, 1908—Grant from the Royal Society	14	0	0	Envelopes	0	4	0
				Caretaker	1	5	0
				Subscriptions paid to Royal Society	20	16	6
				Balance	0	8	4
	£35	1	6		£35	1	6

	£	s.	d.
September 16, 1908—Balance in General Account	0	8	4
Balance in Excursion Account	2	19	1
	£3	7	5

We certify that the General Account, as above, is correct; Bank Passbook has not been produced.

J. S. Lloyd
Walter D. Reed } Auditors.

S. Walters, Hon. Treasurer.

September 19, 1908.

MALACOLOGICAL SECTION

OF THE

Royal Society of South Australia (Incorporated).

ANNUAL REPORT, 1907-8.

There are twelve members on the roll of the Section, and ten meetings were held during the past year, at which the average attendance was five. The shells dealt with comprised the following genera:—*Nerita*, *Eulima*, *Rissoa*, *Scala*, *Natica*, *Cardita*, and *Carditella*. Two papers were contributed to the Transactions of the Royal Society by the Chairman of the Section (Dr. J. C. Verco, M.D., F.R.C.S., etc.), entitled "Notes on South Australian Marine Mollusca, with Descriptions of New Species," Nos. VIII. and IX.

Balance-sheet, 1907-8.

Receipts.

	£	s.	d.
Grant from Royal Society	1	0	0
Subscriptions	2	7	6
Sale of Lists	0	1	3
Credit balance	0	6	2
	£3	14	11

Expenditure.

	£	s.	d.
Postages and Notice Cards	0	5	6
Subscriptions to Royal Society	2	7	6
Balance in hand	1	1	11
	£3	14	11

F. R. Zietz, Hon. Sec. and Treas.

September 15, 1908.

MICROSCOPICAL SECTION

OF THE

Royal Society of South Australia (Incorporated).

ANNUAL REPORT, 1907-8.

OFFICERS.—Chairman, Mr. W. Fuller; Vice-Chairman, Mr. W. B. Poole; Hon. Secretary, Mr. H. A. Whitehill; Assistant Secretary, Mr. E. J. Bradley; Auditors, Messrs. T. Godlee and S. Smeaton, B.A.

Your Committee has to report that the conclusion of the Fifth Session of this Section since its reinstitution shows that satisfactory progress has been made. The attendance at the meetings has been good and the contributions of varied interest.

On September 24, 1907, the Section had the pleasure of inspecting the admirable rulings which have been recently produced by Mr. H. J. Grayson, of Melbourne, for micrometric and test purposes. A series of bands ruled from 1,000 to 120,000 lines to the inch was shown, which in point of quality and mounting represented the finest work hitherto accomplished in this direction.

On March 24, 1908, was exhibited a remarkable collection of new microscopes and apparatus recently acquired by members, no less than five complete instruments of value being shown. Veterinary Surgeon Desmond showed a superb Zeiss photomicrographic stand with all accessories and furnished with apochromatic lenses; Mr. A. W. Marshall, a new model "Edinburgh" microscope, by Watson, with Scöp mechanical stage and universal condenser; Mr. Roach, a Bansch & Comb instrument of excellent model; Mr. Baker, a Zeiss monocular erecting prism microscope; and Mr. H. W. H. Hale, a Zeiss III E stand with semi-apochromatic lenses of very fine order. Mr. Dollman also showed a new water immersion 1/10th, which he reported was of exceptional value in photography.

An important feature of the year's proceedings has been the inauguration of the Episcope and Projection apparatus recently acquired by the Royal Society and its affiliated Sections, the acquisition of which has given much satisfaction, and especially to the members of the Microscopical Section, with which, indeed, the idea of obtaining the instruments originated. The success in obtaining these instruments is in the main the result of the incessant efforts of our chairman, Mr. W. Fuller, who, upon the suggestion that a projection lantern be obtained, drew attention to the new instruments of Zeiss, and who, together with Mr. E. J. Bradley, the secretary, formed a delegation to the other societies affiliated with the Public Libraries Board and sought their co-operation. Mr. Fuller is to be congratulated upon the successful issue of his efforts to further the interests of this Section and microscopy in general. Mr. Fuller also undertook the care of the instruments upon their arrival in Adelaide, and the task of erecting them.

During the year Rule 1 was altered to read "Joint Secretaries," in place of "Secretary."

The following meetings and excursions have been held during the session:—

September 24, 1907.—Annual general meeting. Exhibition of micrometric and test rulings by Mr. H. J. Grayson, of Melbourne, from 1,000 to 120,000 lines per inch, together with short address by Mr. Hale descriptive of their production.

October 22.—Paper by Mr. W. B. Poole, together with illustrative exhibits upon the life history of the curl-leaf parasite of the peach-tree. Demonstration of mounting simple objects by Mr. E. J. Bradley.

November 26.—Exhibition of polariscope attachment for microscope and choice mineral specimens, by Mr. W. Fuller. Liquid mounts of thirty years' standing, showed by Mr. Poole, who gave a short résumé of older methods of preparing and mounting.

February 15, 1908.—Dredging excursion.

March 24.—Mr. E. J. Bradley resigned assistant secretaryship owing to his continued absence from town, and a motion was passed recording appreciation of his valuable services to the Section. Exhibition of newly-acquired microscopes by members.

April 25.—Excursion to Semaphore.

April 28.—Exhibits of subjects of general interest and discussion.

May 26.—Exhibit of various specimens mounted by Mr. E. J. Bradley.

June 23.—Paper on "Odours in Potable Waters," by Mr. W. Fuller. Mr. H. W. H. Hale was appointed Joint Hon. Secretary.

July 28.—Paper by Mr. W. B. Poole upon "Julius Rheinberg's 'Multiple-colour Illumination Process, with

Various Preparations Demonstrated by this Method." Exhibit of light filters and monochromatic screens, with reference to their value in the improvement of the performance of microscopic lenses, by Mr. Hale.

August 25.—Demonstration of the recently arrived Episcope and Projection apparatus by the President of the Section, Mr. W. Fuller, who explained the optical principles involved in the construction and performance of these instruments and the method of operating, exhibiting a large number of microscopic and photomicrographic preparations, the work of members of the Section.

HAROLD W. H. HALE, } Joint Hon. Secretaries.
H. A. WHITEHILL, }

MICROSCOPICAL SECTION

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

BALANCE-SHEET, SESSION 1907-8.

Receipts.

	£	s.	d.
Balance from 1906-7	3	19	0
Subscriptions, 1907-8	6	5	0
Grant from Royal Society	6	0	0
	£16	4	0

Expenditure.

	£	s.	d.
Printing and Postage	3	17	0
Advertising	0	8	6
Telegrams	0	3	3
Subscriptions paid to Royal Society	6	5	0
Balance in hand	5	10	3
	£16	4	0

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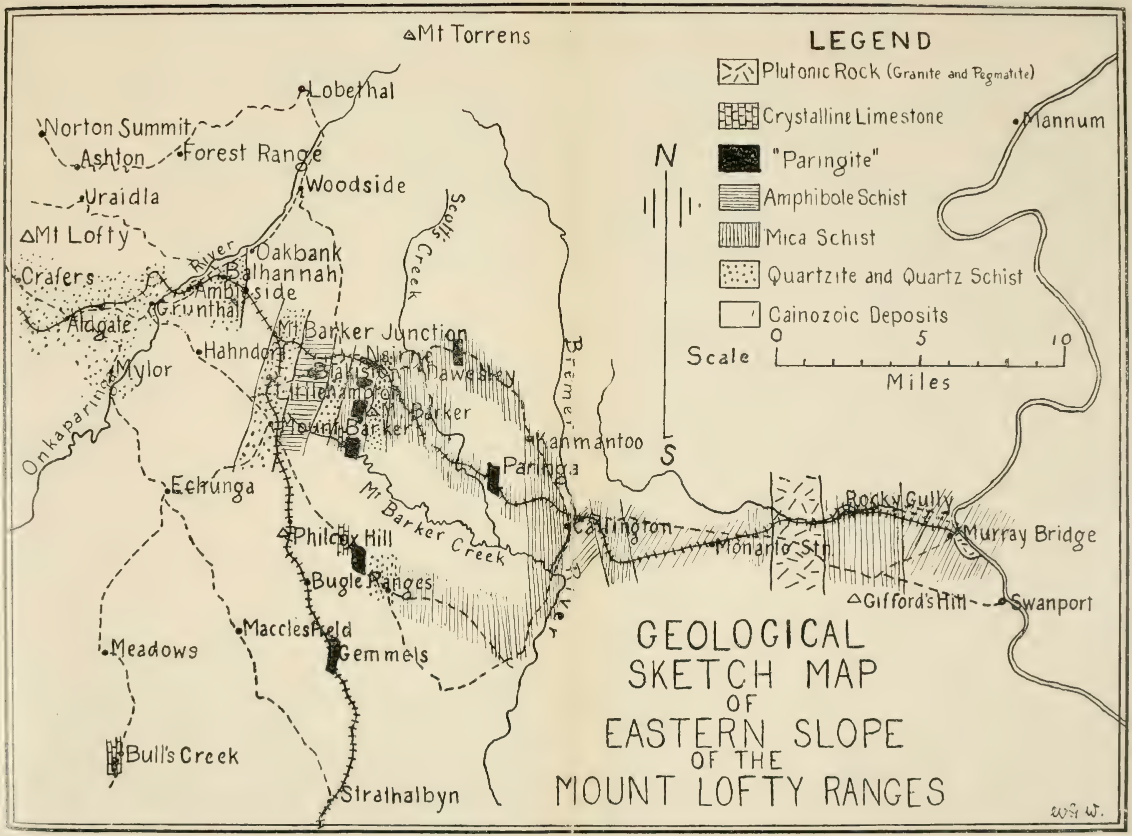

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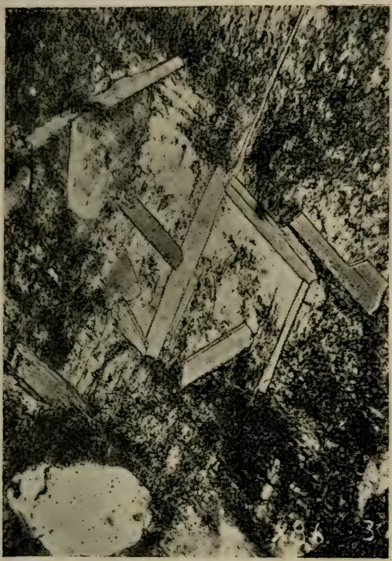

Fig. 1.

Fig. 2.

Fig. 3.

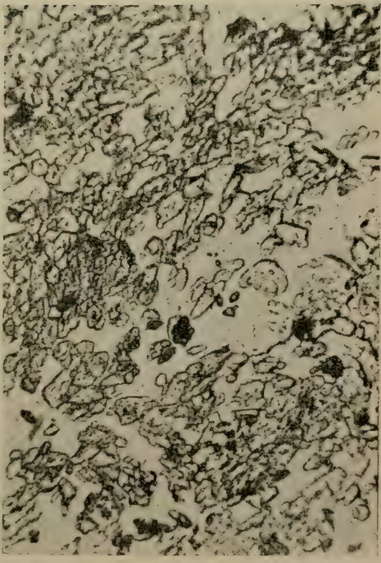

Fig. 4.

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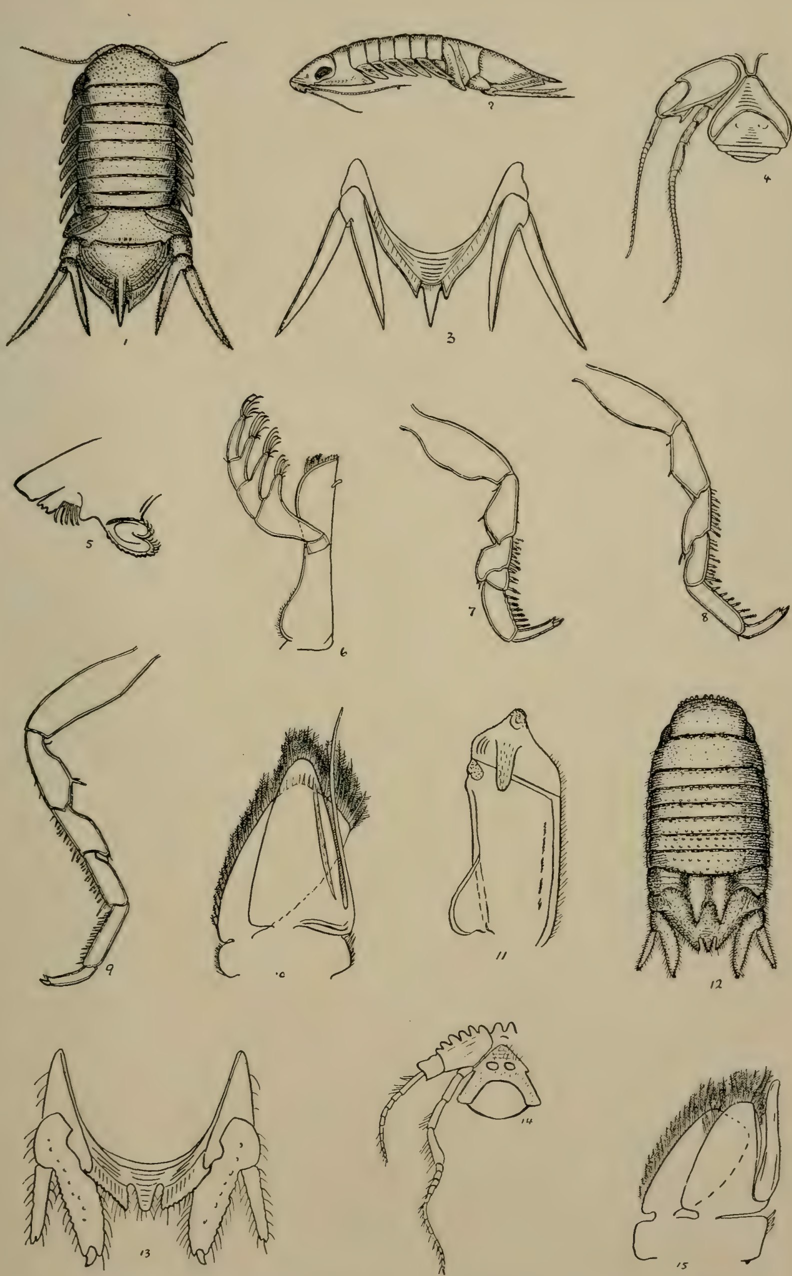

CYMODOCE LONGICAUDATA, *n. sp.* CYMODOCE TUBERCULOSA, *Stebbing.*

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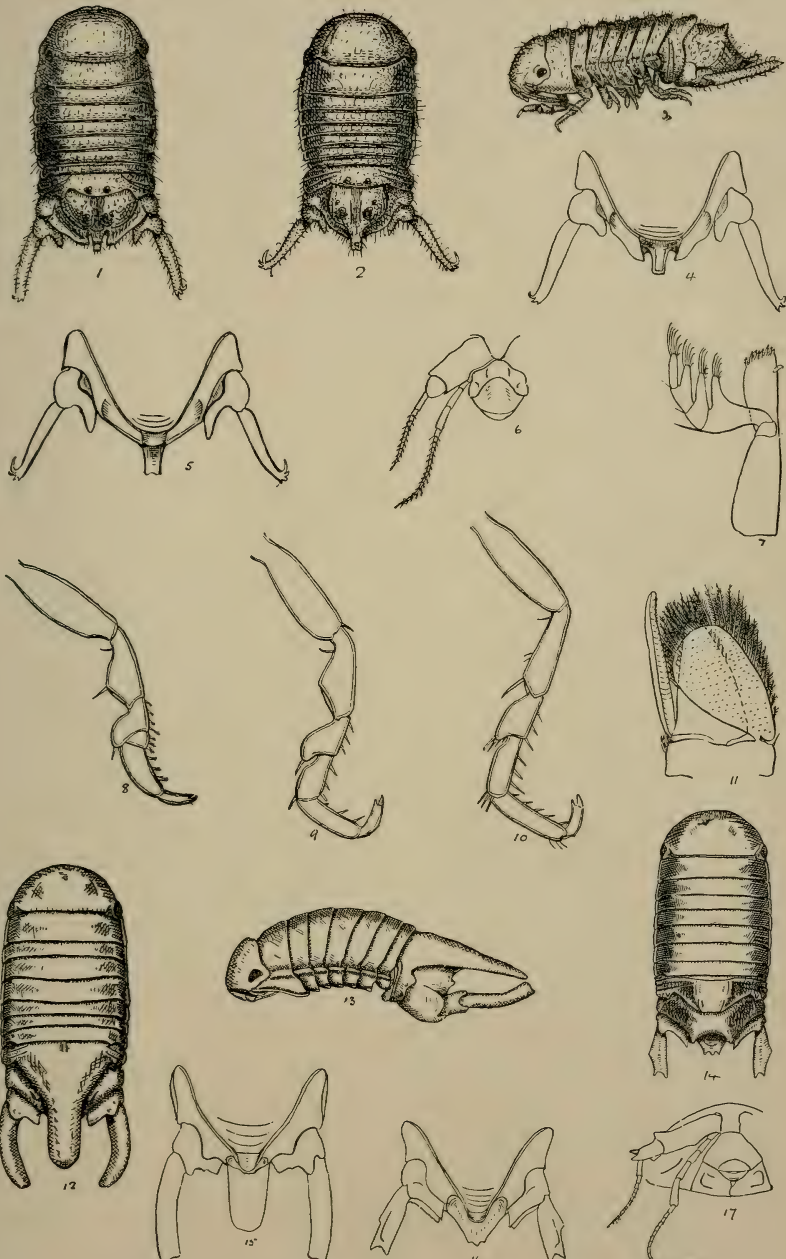

CYMODOCE HAMATA, *n. sp.* CILICÆA CURTISPINA, *Haswell.*

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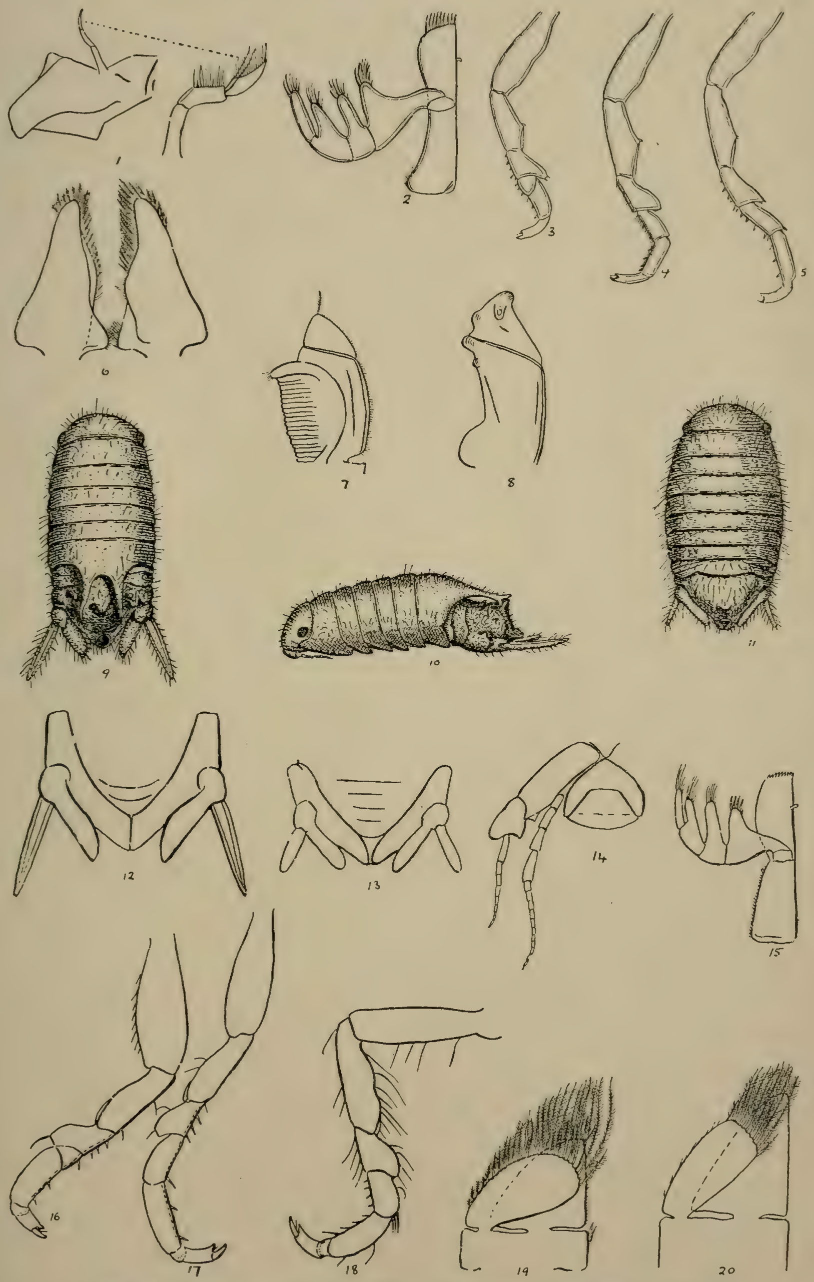

CILICÆA CURTISPINA *(continued)* DYNAMENE RAMUSCULA, *n. sp.*

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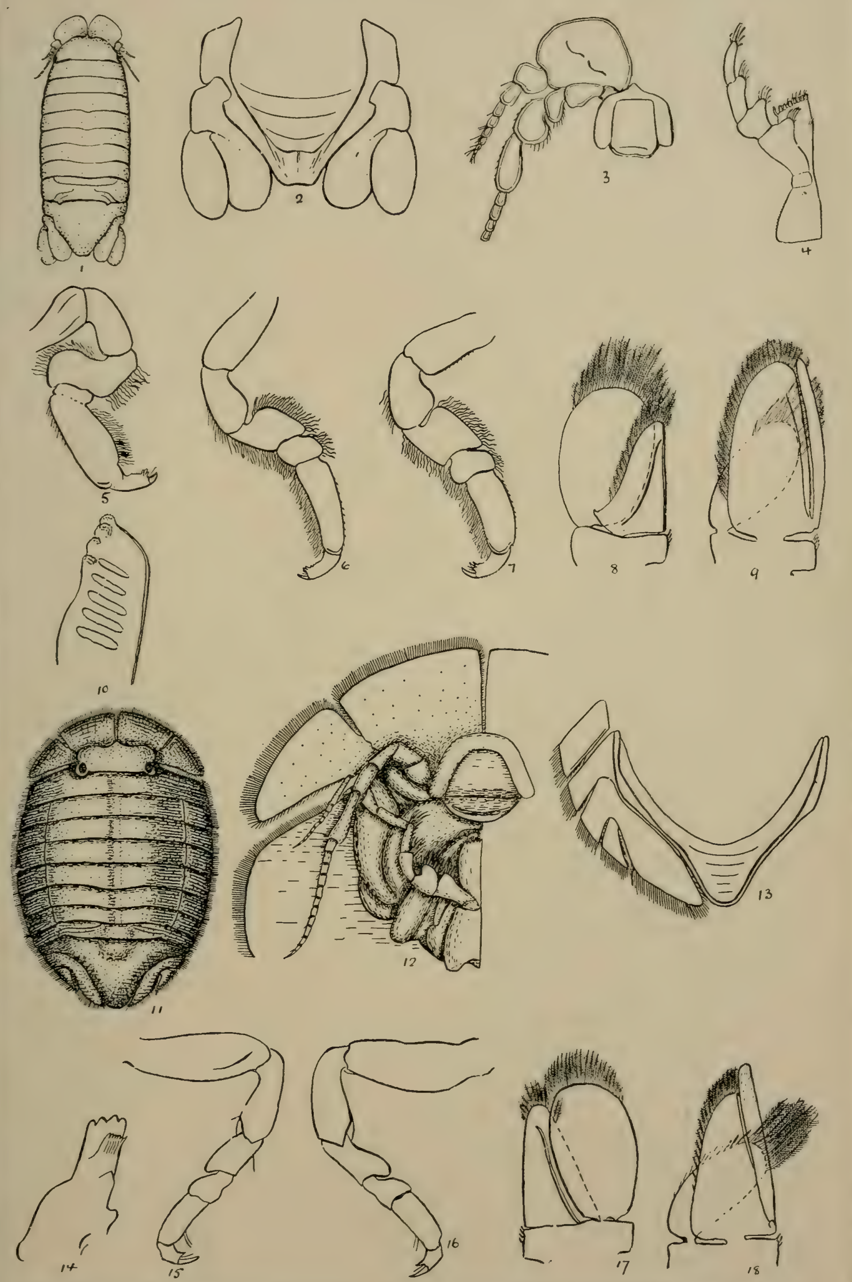

AMPHOROIDEA ANGUSTATA. *n. sp.* AMPHOROIDELLA ELLIPTICA, *n. sub. gen.*, *n. sp*

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MORULOIDEA LACERTOSA, *n. gen., n. sp.* DYNAMENOPSIS OBTUSA, *n. gen., n. sp.*

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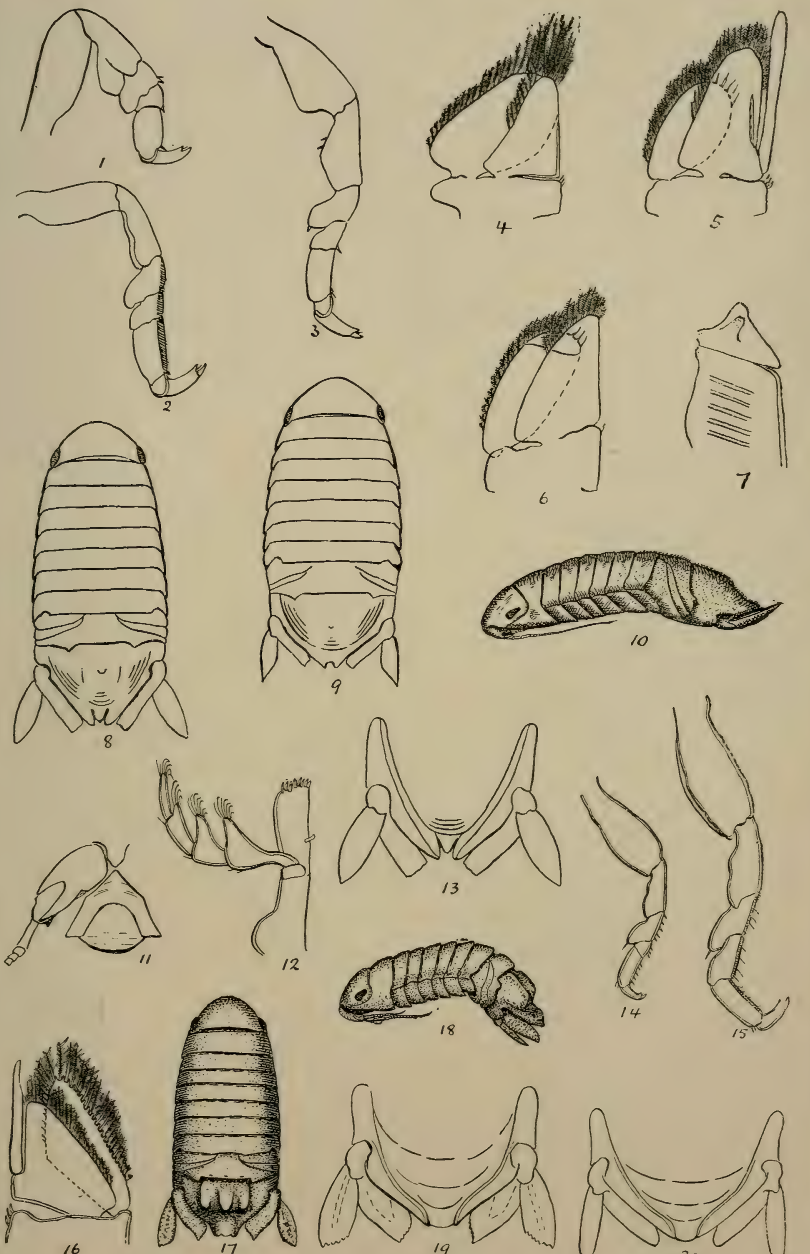

DYNAMENOPSIS OBTUSA *(continued)*. CIRCEIS TRIDENTATA. CIRCEIS TRILOBATA, *n. sp.*

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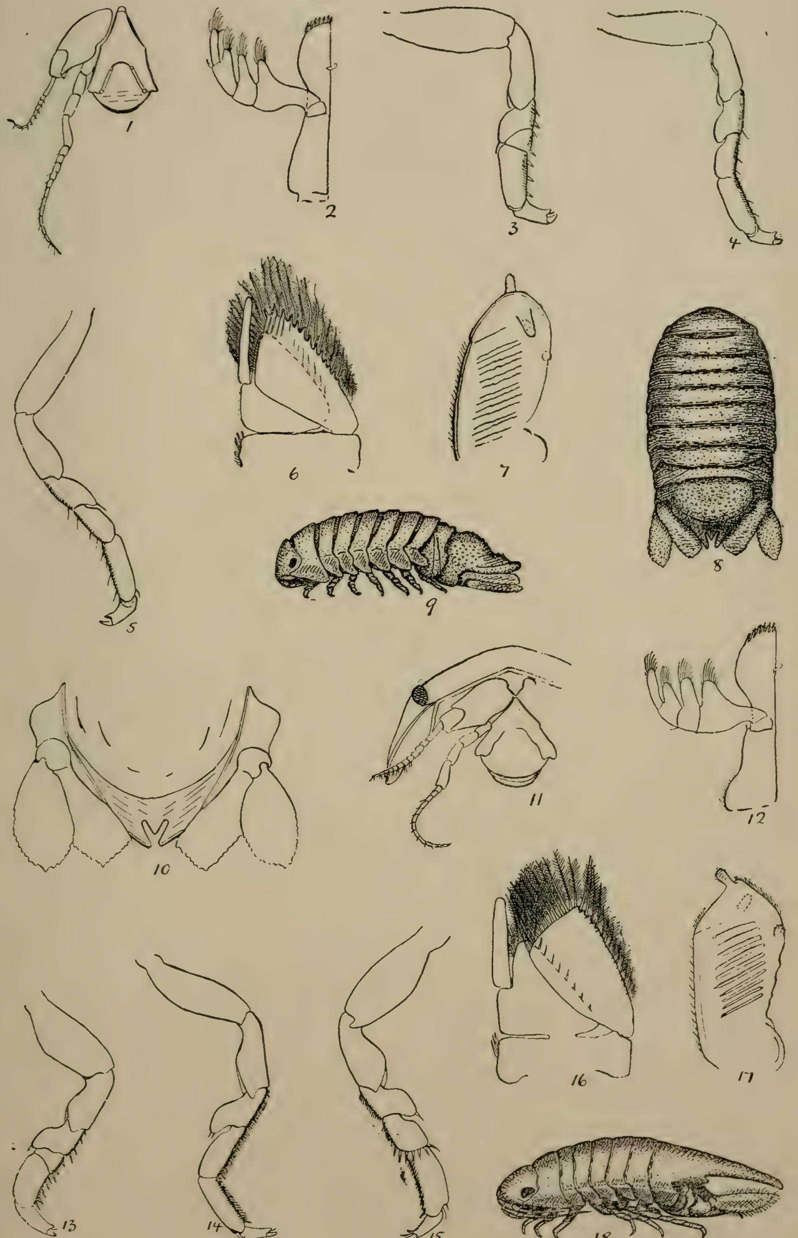

CIRCEIS TRILOBATA *(continued)* CIRCEIS OBTUSA, *n. sp.* HASWELLIA EMARGINATA, *Haswell.*

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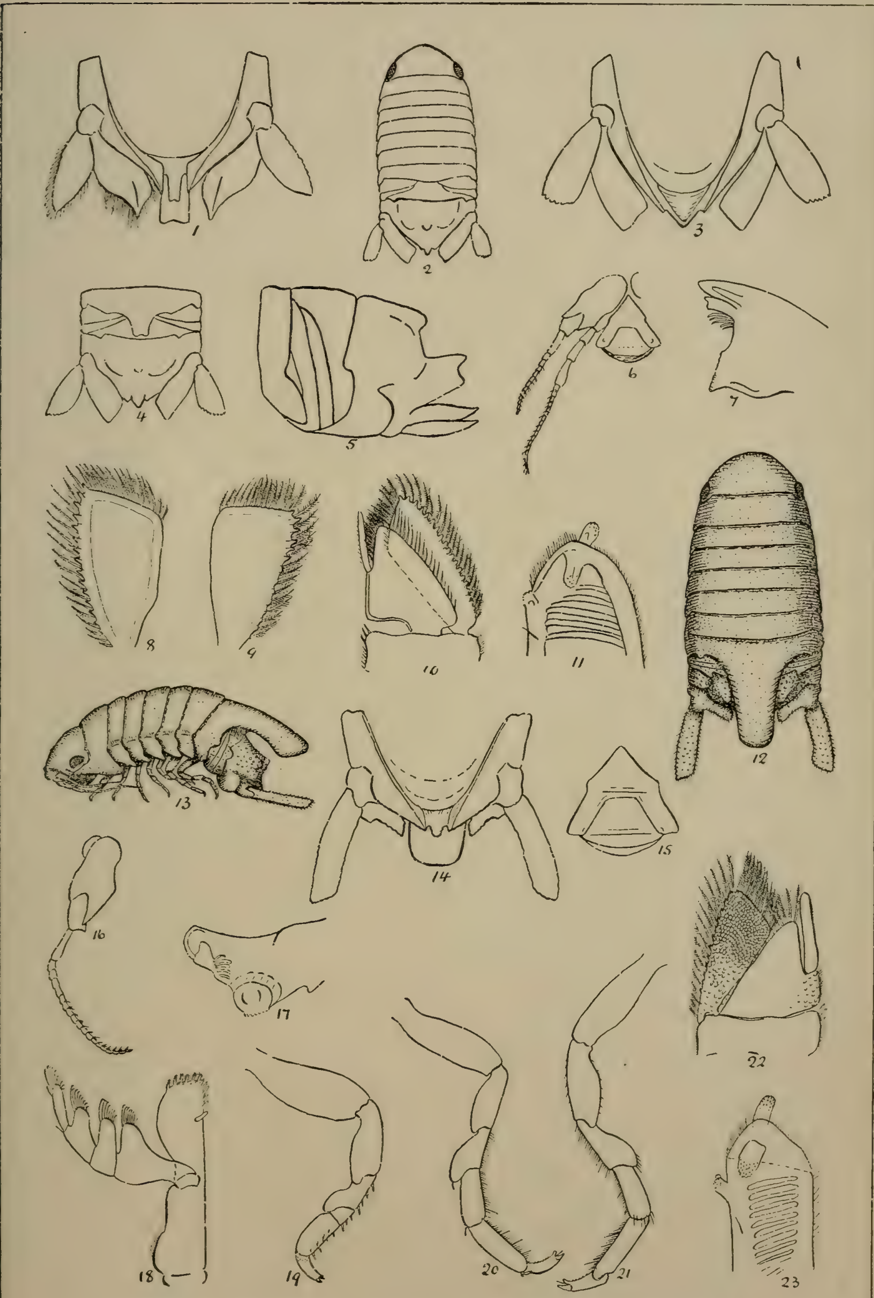

HASWELLIA EMARGINATA *(continued.)* HASWELLIA CILICIOIDES, *n. sp.*

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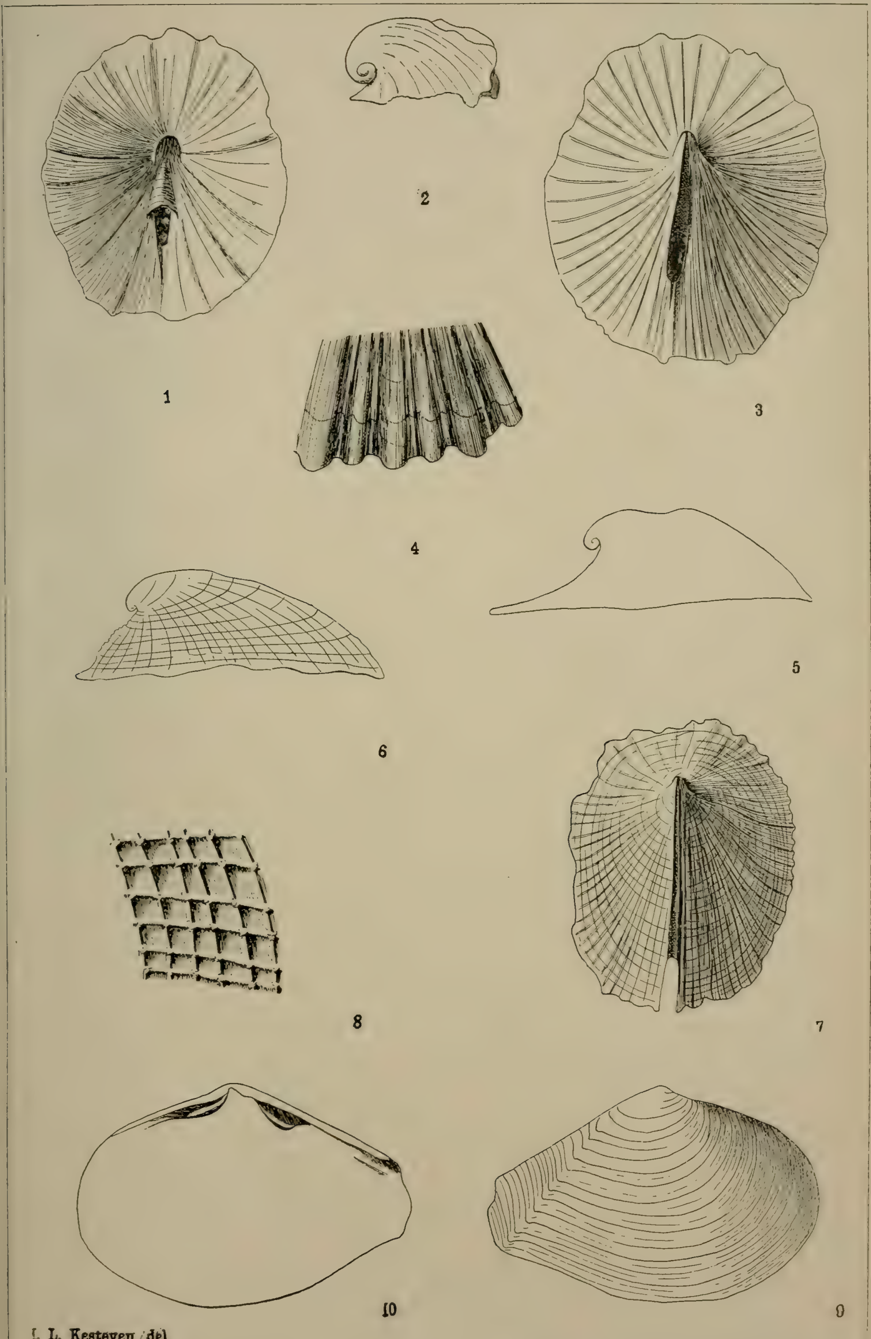

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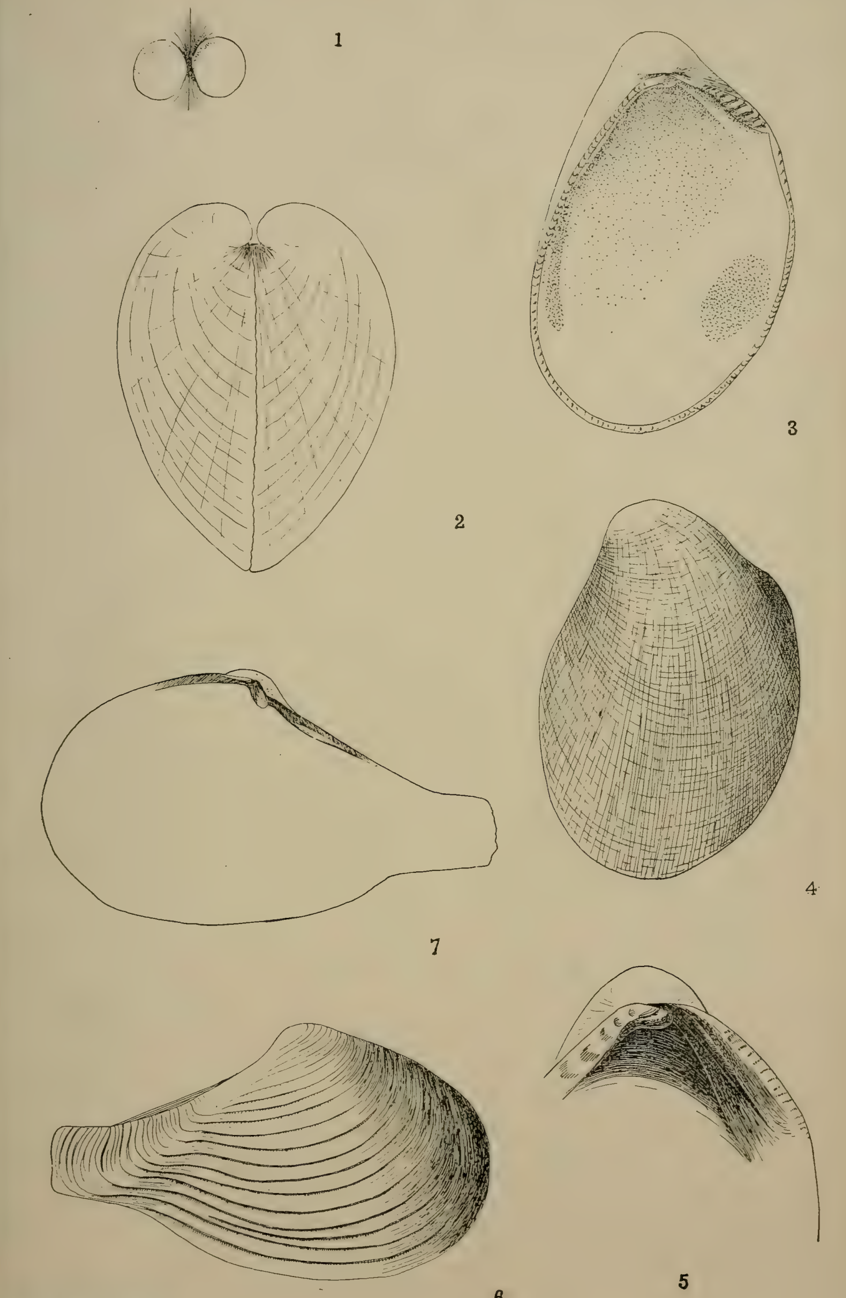

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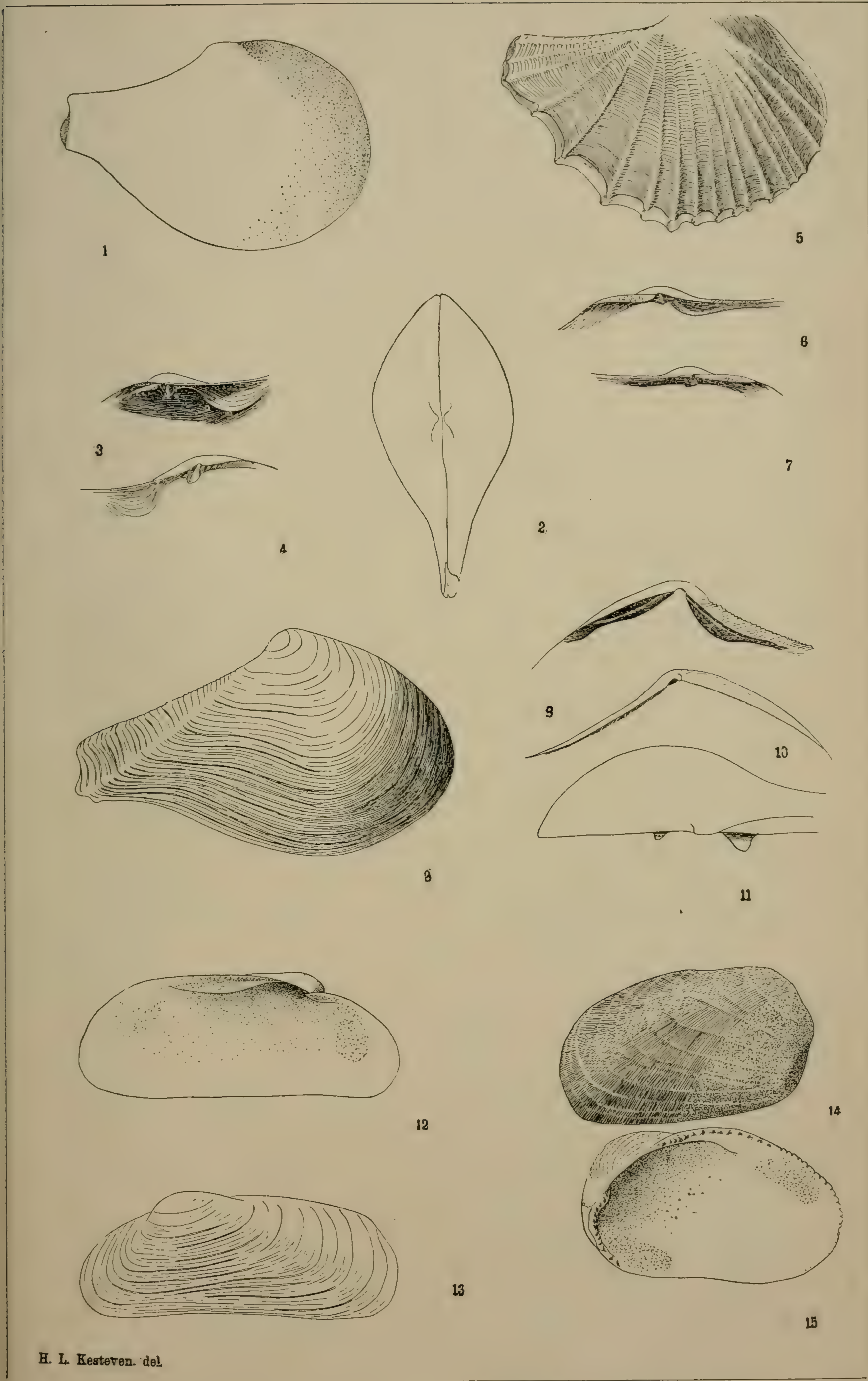

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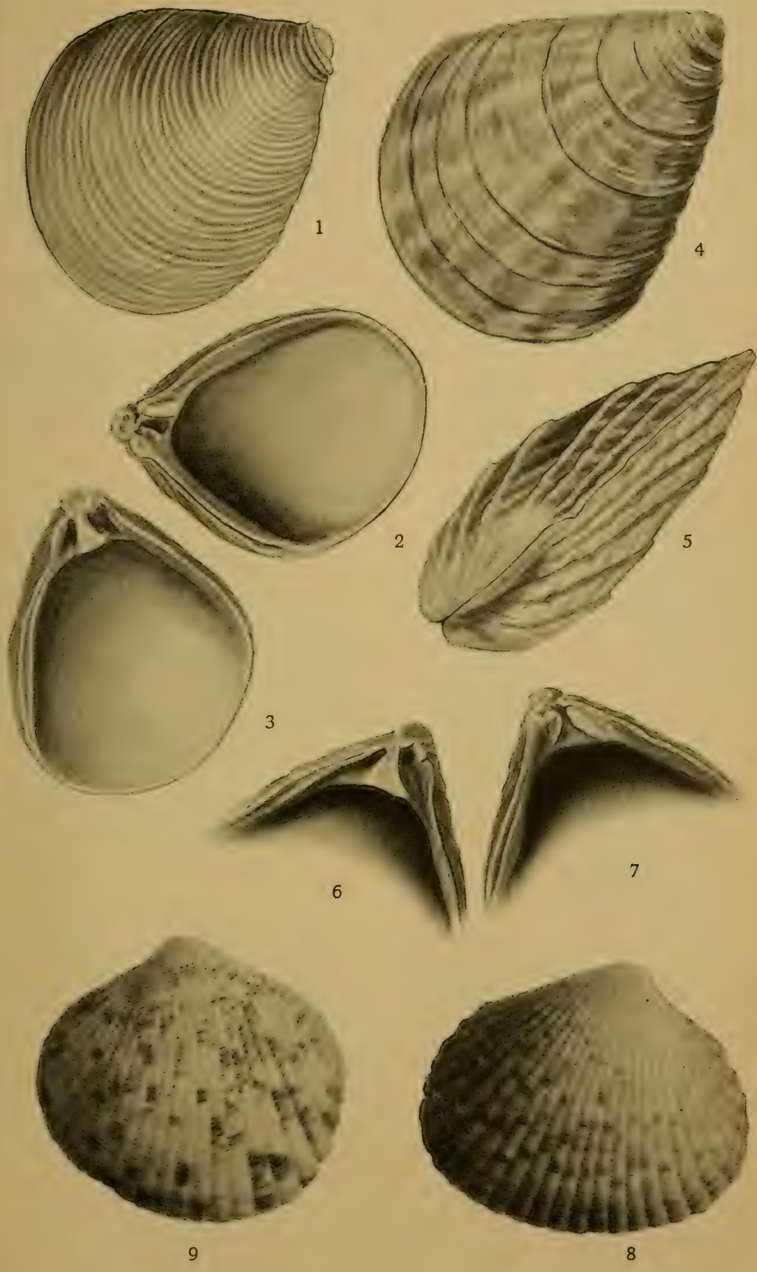

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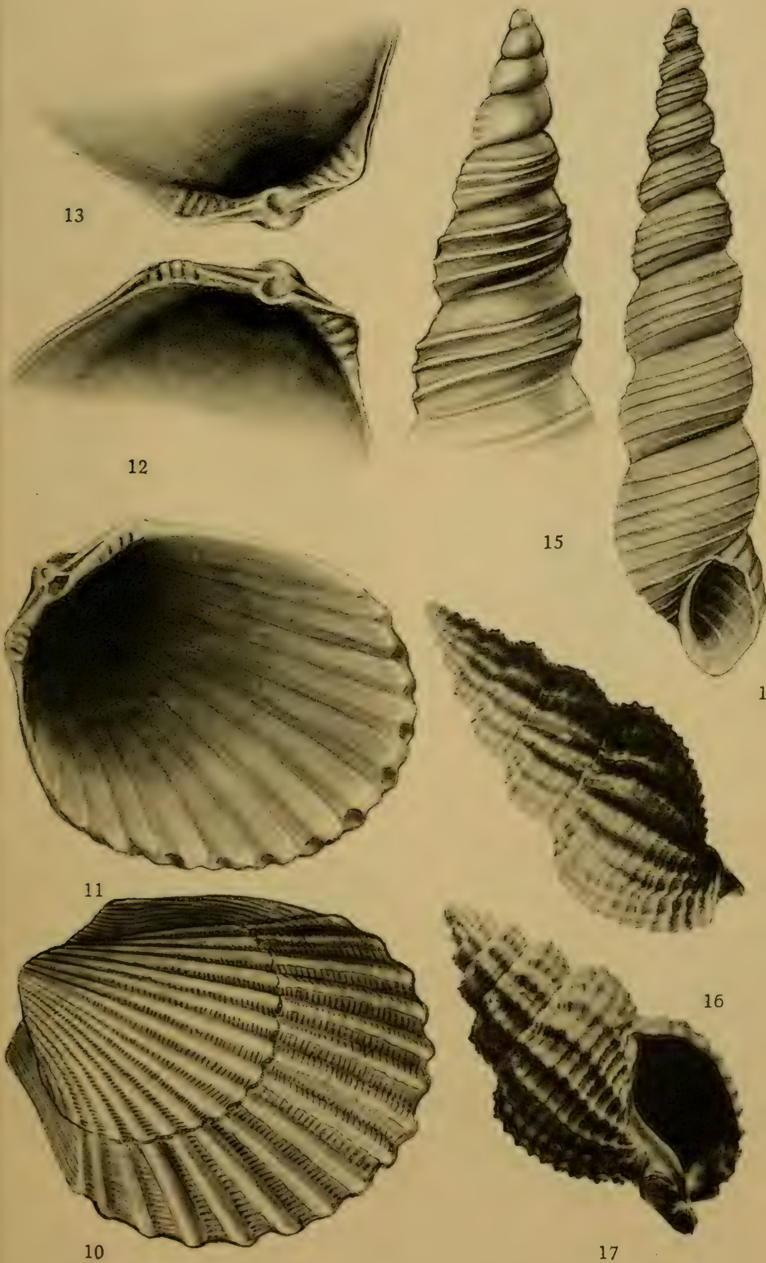

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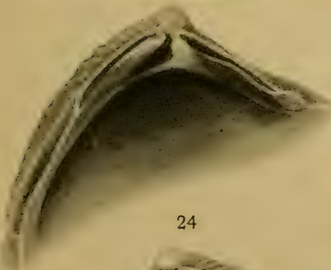

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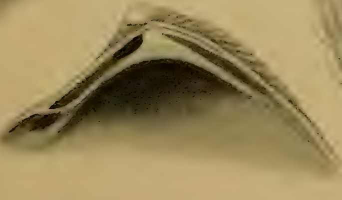

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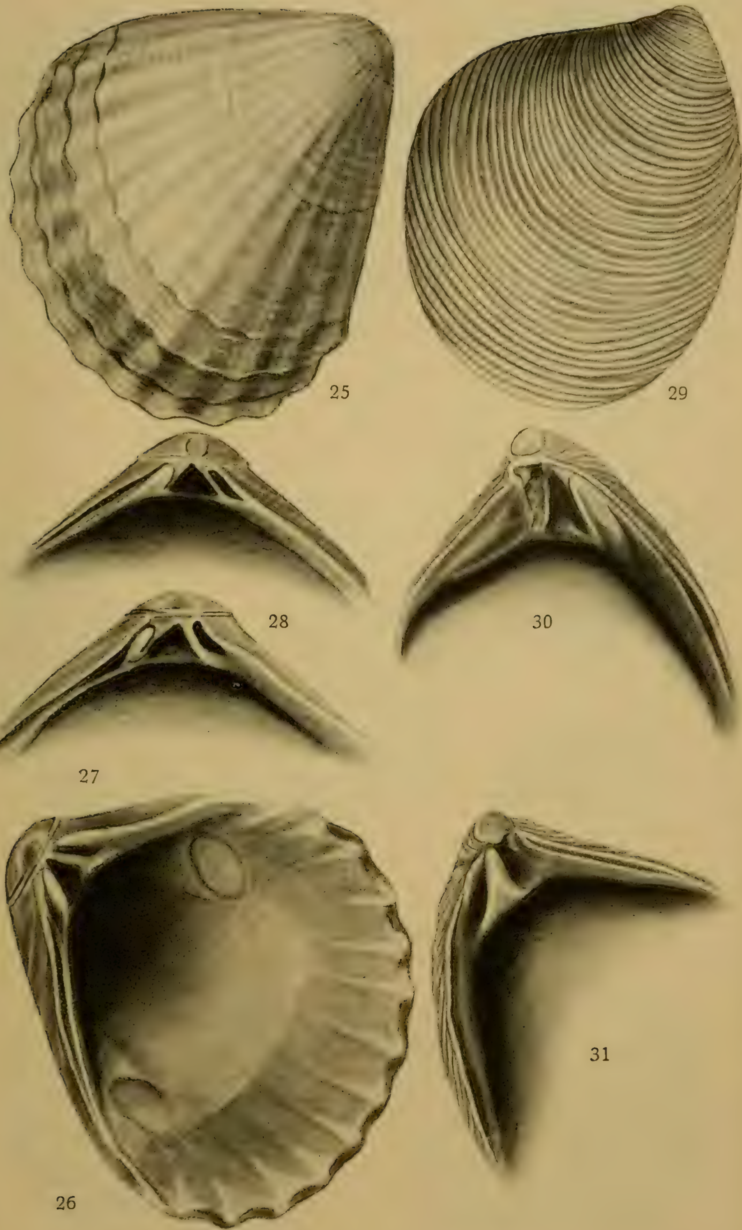

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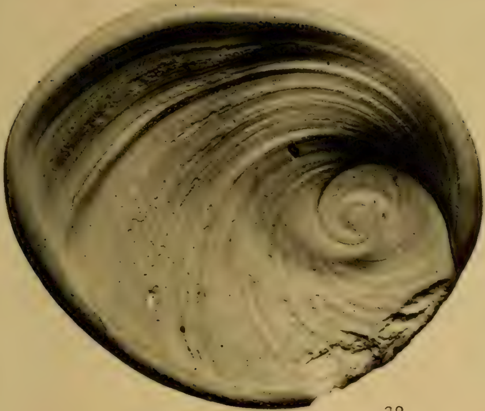

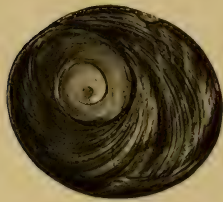

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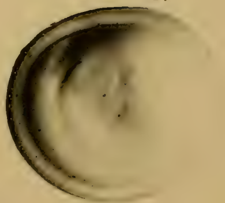

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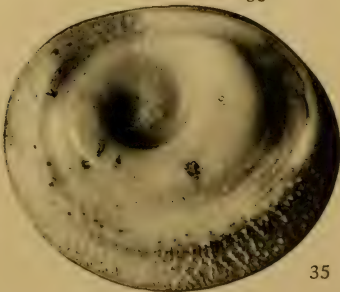

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