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Art. I.—*Preliminary Notice of Victorian Earthworms, Part II. The genus Perichæta.*

(With Plates II, III, IV, V, VI, VII.)

By W. Baldwin Spencer, M.A.

Professor of Biology in the University of Melbourne.

[Read March 10, 1892.]

This account includes the description of twenty-two species of the genus Perichæta, which have up to the present time been collected in Victoria. Two of these, *Perichæta dorsalis* and *bakeri*, have been previously described by Mr. J. J. Fletcher, who obtained them from Gippsland. My own collection has been made in different parts of Victoria, and especially in the South Eastern district, where Gippsland is peculiarly rich. As in the case of the genera Cryptodrilus and Megascolides, so in that of Perichæta, the forms described are at present, for the sake of convenience, referred to the one genus, though this will undoubtedly have to be broken up, and at the same time, certain forms provisionally as yet referred to it, may have to be placed under other existing genera. With this, Mr. Fletcher and myself will deal in our extended monograph. Sufficient details only are now given to serve for the identification of the species.

We have in Victoria only one species which is really widely distributed—this is *P. dorsalis,* which was first described by Fletcher from Warragul, Gippsland. Since then it has been obtained in West and South Gippsland, from the Otway district, from the Grampians, and from Creswick and Castlemaine. It is not only widely spread, but is also abundant in numbers, almost always forming the majority of specimens of any collection in West or South Gippsland especially. It is interesting to note that an allied form, *Perichæta stirlingi,* is apparently prevalent in South Australia.

The distribution of the former species is in marked contrast to that of most. Certain forms, such as *P. tanjilensis* and *yarraensis*, are characteristic of the Upper Yarra Valley especially. *Perichæta fielderi*, a very well marked form, has only come from Fern Tree Gully and Sassafras Gully and the hills outside Narre Warren, all of which localities lie within a small compass. *P. bakeri, copelandi*, and *obscura*, are characteristic of the Warragul district in Gippsland, and *P. dendyi* is an interesting form recorded as yet only from Healesville. *P. lateralis* has been found only in North West Victoria and is closely allied to the South Australian species *P. stirlingi*.

For valuable assistance in collecting, I am again indebted to Dr. Dendy, Rev. W. Fielder, and Messrs. French, Frost, Shephard, Hall, Steel, Mann, Copeland, Brittlebank, D. le Souëf, R. H. Anderson and H. Giles.

Unless otherwise stated, the description always refers to spirit specimens. Such structures as the accessory copulatory ones are only evident after preservation, and examination of numerous specimens shows that spirit exerts a uniform action upon these.

(1) *Perichæta copelandi*, sp. n. (Figs. 52, 53, 54, 76). Length of spirit specimen 5 inches, $\frac{3}{8}$ inch broad. Number of segments about 175.

Dark purple colour dorsally, with a darker median line.

Prostomium completely dovetailed into the peristomium, and marked by a median groove.

Clitellum not strongly marked, occupying segments 13–17, but not always the anterior part of 13 or the posterior of 17.

Setæ. The first setigerous segment has 10 on each side, after this and to the posterior end of the clitellum the number varies from 15–17. Behind segment 20, it varies from 23–25. On the last 6 or 7 segments the setæ are difficult to see. Dorsal and ventral median lines free of setæ.

Male pores on papillæ in segment 18, at the level of the interval between the two inner setæ of each side.

Oviduct pores on segment 14 anterior to, and at the level of the interval between the two inner setæ of each side.

Spermathecal pores, 5 pairs placed on the line between segments 4–9, very slightly dorsal of the level of the innermost setæ.

Accessory copulatory structures. A pair of elliptical tumid patches between segments 16 and 17, at the level of the interval between the inner two setæ of each side. A pair between segments 17 and 18, at the level of the interval between the second and third setæ of each side; a pair at the same level between segments 18 and 19, and another between segments 19 and 20. The male openings lie ventral of these structures and not dorsal, as in the case of the similar ones present in *P. bakeri*. A series of pairs of small elliptical patches marked by distinct pores on the very anterior margins of segments 9–13, each one slightly dorsal of the innermost setæ of its side. These patches in segment 9 are enlarged and include the openings of the spermathecæ. An additional pair, with similar relationships, may be present on segment 8.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores not visible externally.

Alimentary canal. Gizzard present in segment 5. No true calciferous glands, but vascular swellings are present in segments 9–15. Large intestine commences in segment 17.

Circulatory system. Single dorsal vessel, with the last pair of hearts in segment 12. No supra-intestinal vessel present.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs in segments 10 and 11, into which the ciliated rosettes open.

Prostates long, coiled, and tubular, occupying segments 18–22.

Sperm sacs, three pairs attached respectively to the posterior wall of segment 9 and the anterior of segments 12 and 13. Saccular in form.

Ovaries in segment 13, with oviducts opening into the same segment.

Spermathecæ, 5 pairs present in segments 5–9, each consisting of a large sac and short diverticulum.

Habitat. Warragul district. I have associated with this characteristic Gippsland perichæte the name of Mr. Hugh Copeland, to whom I am much indebted for frequent and valuable assistance in collecting.

(2) *Perichæta obscura*, sp. n. (Figs. 4, 5, 6, 70). Length of spirit specimen $2\frac{3}{4}$ inches, about $\frac{1}{8}$ inch broad. Number of segments 90–100.

Prostomium completely dovetailed into the peristomium.

Clitellum complete, and extending over segments 14–16, together with the posterior part of 13.

Setæ, from 9–11 on each side in front of the clitellum; behind this, 10–12 each side. Dorsally and ventrally there is a median space free of setæ.

Male pores on segment 18 on papillæ, on a level with the second seta on each side.

Oviduct pores on segment 14 anterior to, and very slightly ventral of, the level of the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the second setæ of each side.

Accessory copulatory structures. A pair of elliptical tumid patches between segments 16 and 17, at the level of the interval between the two inner setæ of each side. A pair at the same level on the anterior part of segment 18, and another between segments 17 and 18, at the level of the interval between the second and third setæ of each side. A swollen tumid ridge occupies the posterior part ventrally of segment 18, and the anterior of segment 19, extending outwards as far as the level of the third seta of each side. A ridge on the posterior part of segment 19, and anterior of segment 20, extending outwards as far as the level of the second seta of each side. These structures, and especially the two on each side immediately in front of the male openings, are very characteristic.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present, but vascular swellings in segments 12–15; those in 14 and 15 being especially large. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single; last heart in segment 12. Those in segments 10, 11, 12 large; those in segments 7, 8, 9 small. Supra-intestinal vessel in segments 9–12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs in segments 10 and 11, into which open the rosettes.

Prostates tubular, coiled, extending through segments 17, 18, and 19.

Sperm sacs, two pairs attached respectively to the anterior wall of segment 12, and the posterior of segment 9.

Ovaries in segment 13, the oviducts opening into the same segment.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a sac, with a diverticulum half the length of the sac.

Habitat. Warragul, Fern Tree Gully.

(3) *Perichæta sylvatica*, sp. n. (Figs. 34, 35, 36, 68). Length of spirit specimen 3 inches, less than $\frac{1}{8}$ inch broad. Number of segments about 100.

Prostomium not completely dovetailed into the peristomium (about three-quarters). The peristomium marked by a fairly distinct median ventral cleft.

Clitellum occupying segments 14, 15, 16, with the posterior part of 13, and the anterior of 17.

Setæ, 12 on each side, except in the first two setigerous segments, where there are 10.

Male pores on segment 18, slightly ventral of the level of the second setæ.

Oviduct pores on segment 14 ventral of, and very slightly anterior to, the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, each at the level of the innermost seta.

Accessory copulatory structures. Two pairs of faintly marked circular patches on segments 16 and 17, at the level of the interval between the two inner setæ of each side. A pair of well marked elliptical patches on segment 10. posterior to, and at the level of, the interval between the second and third setæ of each side.

Dorsal pores present, the first between segments 5 and 6.

Alimentary canal. Gizzard in segment 5. Three pairs of well marked calciferous glands present in segments 10, 11, and 12. Large intestine commencing in segment 15.

Circulatory system. Dorsal vessel single, the last heart in segment 12.

Excretory system. Plectonephric.

Reproductive system. Testes in segments 10 and 11, rosettes opening into the same segments.

Prostates small, flattened and bilobed, but with a single duct. In segment 18.

Sperm sacs, two pairs, one attached to the anterior wall of segment 12, the other to the posterior wall of segment 9. Saccular in form.

Ovaries in segment 13, the oviducts opening into the same segment.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a sac, with a diverticulum about the same length as the latter.

Habitat. Fern Tree Gully.

(4) *Perichæta hoggii*, sp. n. (Figs. 28, 29, 30, 80). Length of spirit specimen 4½ inches, ⅛ inch broad. Number of segments about 125.

Prostomium not completely dovetailed into the peristomium (about one-half). The latter has a distinct median ventral cleft.

Clitellum occupying the posterior part of segment 13, together with the segments 14, 15, 16, and the anterior part of segment 17.

Setæ, except the first two segments, 12 on each side.

Male pores on papillæ in segment 18, at the level of the innermost seta on each side.

Oviduct pores on segment 14 ventral of, and anterior to, the level of the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 8 and 9, at the level of the innermost setæ.

Accessory copulatory structures. Paired tumid patches slightly anterior to, and at the level of, the innermost setæ in segments 20, 21 and 22. A median ventral ridge, occupying the space between the two innermost papillæ, is present on segments 17 and 19. On segments 20, 21, and 22, median ventral ridges are usually present, connecting the circular patches across the median line.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. True calciferous glands in segments 10, 11, 12. Large intestine commencing in segment 15.

Circulatory system. Single dorsal vessel. Last heart in segment 12. Small hearts in segments 6–9.

Excretory system. Plectonephric.

Reproductive system. Testes in segments 10 and 11, with rosettes opening into the same segments.

Prostates small, flattened, and bilobed with a single duct.

Sperm sacs, two pairs; one attached to the anterior wall of segment 12, the other to the posterior wall of segment 9.

Ovaries in segment 13, oviducts opening into the same segment.

Spermathecæ, 5 pairs, in segments 5–9. Each with a sac and diverticulum more than three-quarters the length of the former.

Habitat. Mt. Macedon and Healesville (Dr. Dendy).

The first specimens were found at Mount Macedon, whilst collecting with Mr. H. R. Hogg, to whom I am indebted for valuable assistance, and whose name is associated with this form.

(5) *Perichæta hallii* (Figs. 40, 41, 42, 69). Length of spirit specimen $1\frac{2}{3}$ inches, a little more than $\frac{1}{16}$ inch broad. Number of segments about 100.

Prostomium not completely dovetailed into the peristomium (about three-quarters). The peristomium with a distinct median ventral cleft.

Clitellum not very strongly developed, lighter coloured than the surrounding parts, and occupying segments 13–17.

Setæ somewhat difficult to see. In front of clitellum, 12 or 13 on each side; behind, 12–16 on each side.

Male pores on very strongly marked papillæ on segment 18, the openings being slightly dorsal to the level of the innermost setæ. Between the papillæ is a deep depression extending on to segments 17 and 19.

Oviduct pores on segment 14.

Spermathecal pores, five pairs.

Accessory copulatory structures. Three pairs of well marked elliptical tumid patches, each with a median linear depression on the posterior portions of segments 9, 10, and 11, and extending over a space equal to that between setæ 1 and 3 on each side. A smaller patch on the anterior part of the segments 9 and 10, confluent with the larger posterior one, but not so strongly marked.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. True calciferous glands present in segments 10, 11, and 12. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. Last heart in segment 12.

Excretory system. Plectonephric.

Reproductive system. Testes in segments 10 and 11, into which the rosettes open. The same segments are filled with sperm.

Prostates small, flattened, and bilobed, but with a single duct on each side, in segment 18.

Sperm sacs attached to the anterior wall of segment 12, and the posterior wall of segment 9, with a smaller pair attached to the anterior wall of segment 14.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, 5 pairs, in segments 5, 6, 7, 8, and 9. Each consisting of a sac, with a diverticulum more than half as long as the former.

Habitat. Castlemaine. Collected by Mr. T. S. Hall, M.A.

(6) *Perichæta rubra*, sp. n. (Figs. 25, 26, 27). Length of spirit specimen $2\frac{1}{4}$ inches, breadth about $\frac{1}{8}$ inch. Number of segments 80–90.

Prostomium not completely dovetailed into the peristomium (about $\frac{1}{2}$). The peristomium with a distinct median ventral cleft.

Clitellum distinct and complete, occupying segments 14–16.

Setæ, in front of the clitellum 10 each side, behind 12.

Male pores on distinct papillæ on segment 18, at the level of the third seta of each side.

Oviduct pores on segment 14 anterior to, and ventral of, the first setæ.

Spermathecal pores, 5 pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the second seta of each side.

Accessory copulatory structures. Median ventral ridges occupying the anterior portions of segments 17, 19, 20, 21, 22 and 23. On segment 10, two strongly marked circular patches, with central depressions, placed posterior to the setæ and at the level of the interval between the second and third setæ. On segments 6, 7, 8 and 9 in the median ventral space devoid of setæ, and anterior to the level of the latter, are pairs of closely apposed circular tumid patches, each with a central pore-like depression. On segment 5, a median ventral patch.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. True calciferous glands in segments 10, 11 and 12. Large intestine commencing in segment 15.

Circulatory system. Dorsal vessel single. Last heart in segment 12.

Excretory system. Plectonephric.

Reproductive system. Testes, two pairs in segments 10 and 11, into which the rosettes open.

Prostates small, flattened, and bilobed, but with a single duct in segment 18.

Sperm sacs attached to the posterior wall of segment 9, the anterior of segment 12, and a small pair to the anterior of segment 14.

Ovaries in segment 13, with oviducts opening into the same segment.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a large sac, with a diverticulum of about the same length as the sac.

Habitat. Tallarook, Goulburn River. Collected by Mr. A. H. S. Lucas. This is locally known as the "red worm."

(7) *Perichæta frenchii*, sp. n. (Figs. 31, 32, 33, 79). Length of spirit specimen 2–4 inches, breadth about ⅛ inch. Number of segments 110.

Spirit specimens are dark purple colour in front of the clitellum, save on the mid-ventral surface; dark purple median dorsal line; the rest of the body a dirty white.

Prostomium not completely dovetailed into the peristomium (about half). The peristomium marked by a distinct median ventral cleft.

Clitellum occupying segments 13–16, together with sometimes the anterior part of 17 dorsally.

Setæ, 10 each side in front of the clitellum, behind this 12 each side.

Male pores on papillæ on segment 18, at the level of the interval between the two inner setæ of each side. A distinct depression between the two papillæ.

Oviduct pores on a small elliptical patch on segment 14, anterior to, and slightly ventral of, the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the innermost setæ on each side.

Accessory copulatory structures. Median ventral ridges, with linear depressions on the anterior parts of segments 19, 20, 21 and 22. Median ventral ridges on the posterior parts of segments 9 and 10; the anterior of the two, small.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. True calciferous glands in segments 10, 11 and 12. Large intestine commencing in segment 15.

Circulatory system. Dorsal vessel single, the last heart in segment 12.

Excretory system. Plectonephric.

Reproductive system. Testes in segments 10 and 11, rosettes in the same segments.

Prostates flattened, bilobed, one half in segment 18, the other in segment 19; each half with a short separate duct, the two uniting on each side in segment 18.

Sperm sacs attached to the posterior wall of segment 9, and the anterior of segment 12. Saccular in form.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a sac, with a diverticulum longer than the latter, and terminating in a slightly swollen part.

Habitat. Loch, S. Gippsland; Narre Warren, Waratah Bay (Mr. W. Mann).

Found abundantly under logs at Narre Warren by Mr. French and myself. I have much pleasure in associating with this the name of Mr. French, the Government Entomologist of Victoria, to whom I am much indebted for frequent and valuable assistance. This is one of those forms which make burrows, coming to the surface under logs and stones, in which position the burrow lies open, the upper surface being closed in by the log or stone.

(8) *Perichæta steelii*, sp. n. (Figs. 37, 38, 39). Length of spirit specimen $2\frac{1}{2}$ inches, breadth about $\frac{1}{8}$ inch. Number of segments about 120.

Prostomium incompletely dovetailed into the peristomium (about $\frac{3}{4}$). The peristomium marked by a distinct median ventral cleft.

Body dark purple-brown at the anterior end, with a dark median dorsal line along the body. Light brown behind the clitellum, except the dorsal portion close to the latter.

Setæ. The first 3 segments have 11 on each side, after this there are 12 setæ on each side.

Male pores on segment 12, at the level of the innermost setæ, but not on papillæ.

Oviduct pores on segment 14.

Spermathecal pores, 5 pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the second seta of each side.

Accessory copulatory structures not developed, except a slight median ventral ridge on segment 17.

Dorsal pores present, the first between segments 3 and 4.

Alimentary canal. Gizzard in segment 5. True calciferous glands in segments 10, 11 and 12. Large intestine commencing in segment 15.

Circulatory system. Dorsal vessel single. Hearts in segments 5–12, the last three large.

Excretory system. Plectonephric.

Reproductive system. Testes in segments 10 and 11, into which the rosettes open.

Prostates small, flattened, bilobed, but with a single duct in segment 18.

Sperm sacs attached to the anterior wall of segment 12, and the posterior of segment 9.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a sac, with a diverticulum about half the length of the former.

Habitat. Woodend. Collected by Mr. T. Steel.

(9) *Perichæta lateralis*, sp. n. (Figs. 55, 56, 57, 78). Length of spirit specimen 3–3½ inches, breadth less than ⅛ inch. Number of segments 126.

Prostomium not completely dovetailed into the peristomium (about ⅔). The prostomium marked by a median ventral cleft.

Clitellum complete, lighter coloured than the surrounding parts, occupying segments 14, 15 and 16.

Setæ in front of the clitellum, 10 or 11 each side; behind the clitellum, 10–12 each side.

Male pores on papillæ on segment 18, at the level of the interval between the second and third setæ of each side.

Oviduct pores on segment 14 placed on an elliptical patch, each opening almost at the same level as, and very slightly in front of, the innermost seta of each side.

Spermathecal pores, three pairs, between segments 6 and 7, 7 and 8, 8 and 9, at the level of the fifth seta of each side.

Accessory copulatory structures. A pair of small papillæ each immediately in front of, and confluent with, one of the papillæ bearing the male opening. In addition to these, which are very characteristic, two small pairs of tumid patches may be present at the level of the innermost setæ, one half on segments 18 and 19, the other half on segments

19 and 20, and another pair may be present at the level of the interval between the two inner rows of setæ on each side, half on segments 9 and 10.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present, but vascular swellings present in segments 9–12. Large intestine commencing in segment 17.

Circulatory system Dorsal vessel single. Hearts in segments 6–12.

Excretory system. Plectonephric.

Reproductive system. Testes, in pairs, in segments 10 and 11, with rosettes opening into the same segments.

Prostates flattened and elongate, with a somewhat mammillate surface. Each is leaf-shaped, the single duct running up the centre in the position of a mid-rib. Extending through segments 18–21.

Sperm sacs, three pairs, one pair on the anterior wall of segments 11 and 12; another on the posterior wall of segment 9. Sac-like in form.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, three pairs, in segments 7, 8 and 9. Each consisting of a sac, with a long coiled tubular diverticulum.

Habitat. Castlemaine (collected by Mr. T. S. Hall). Tallarook, Goulburn Valley (collected by Mr. A. H. S. Lucas.)

(10) *Perichæta dendyi*, sp. n. (Figs. 49, 50, 51, 77). Length of spirit specimen 2½ inches, breadth about ⅛ inch. Number of segments about 160. Colour yellowish when alive.

Prostomium completely dovetailed into the peristomium, the former being distinctly wedge-shaped.

Clitellum complete, occupying segments 14–16.

Setæ, as far back as segment 19, there are 6 on each side, arranged in pairs; segment 20 has 8 each side, in pairs, behind this increased to 10 each side, and at the posterior end vary from 7–10. The inner two on each side remain regular along the whole length of the body.

Male pores on slight papillæ on segment 18, at the level of the interval between the two inner setæ of each side.

Oviduct pores on segment 14.

Spermathecal pores, four pairs, between segments 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the innermost setæ.

Accessory copulatory structures. Narrow tumid ridges placed on the mid-ventral lines between segments 17 and 18, 18 and 19, 19 and 20. The single ridge may be divided into two halves, the centre of each half corresponding with the level of one of the innermost setæ. Special small tumid patches are constantly present, surrounding the openings of the two posterior pairs of spermathecæ.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present. Vascular swellings in segments 9–12. Large intestine commencing in segment 18.

Circulatory system. Dorsal vessel single. Hearts in segments 8–12. A supra-intestinal vessel present in segments 9–12.

Excretory system. Meganephric.

Reproductive system. Two pairs of testes in segments 10 and 11, into which open the rosettes.

Prostates, flattened bodies folded over the intestine on each side in segment 18.

Sperm sacs, two pairs, one attached to the anterior wall of segment 12, the other to the posterior wall of segment 9. Sac-like in form.

Ovaries in segment 13, with oviducts opening into the same segments.

Spermathecæ, four pairs, in segments 6, 7, 8 and 9. Each consisting of a long sac, with a very short diverticulum at its base.

Habitat. Healesville (collected by Dr. Dendy), living in rotten logs.

I have much pleasure in associating with this the name of Dr. Dendy.

(11) *Perichæta lochensis*, sp. n. (Figs. 1, 2, 3). Length of spirit specimen 3 inches, breadth about $\frac{1}{8}$ inch.

Prostomium not completely dovetailed into the peristomium (about $\frac{3}{4}$).

Clitellum well-marked and complete, extending over segments 14–16, and including also the posterior part of segment 13.

Setæ; the usual number on each side, as far back as the 17th segment, is 9; there may occasionally be 11; after and including the 19th segment there are 10. A small posterior part of the body, distinct from the rest by its lighter colour and flattened shape, dorso-ventrally, has 16–19 setæ on each side.

Male pores on slight papillæ on segment 18, at the level of the interval between the two inner setæ of each side.

Female pores on segment 14 anterior to, and ventral of, the level of the two innermost setæ.

Spermatheeal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, difficult to see.

Accessory copulatory structures. Segments 17 and 18 have their mid-ventral parts tumid. A special swollen part lies immediately in front of the male opening on each side, and there are tumid ridges ventrally between segments 18 and 19, 19 and 20, but these are not strongly marked.

Dorsal pores present.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but vascular swellings are present in segments 12–15. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. Hearts in segments 8–12, the first two being small.

Excretory system. Meganephric. Each nephridium has a large sac.

Reproductive system. Two pairs of testes in segments 10 and 11, into which the rosettes open.

Prostates coiled, tubular, occupying segments 18–21.

Sperm sacs, two pairs, one attached to the anterior wall of segment 12, the other to the posterior wall of segment 9.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, 5 pairs, in segments 5, 6, 7, 8, and 9, each consisting of a sac and diverticulum less than half the length of the former.

Habitat. Loch, S. Gippsland, under logs.

(12) *Perichæta dubia*, sp. n. (Figs. 46, 47, 48, 67). Length of spirit specimen $1\frac{3}{4}$ inches, breadth $\frac{1}{8}$ inch. Number of segments, about 100.

Prostomium completely dovetailed into the peristomium.

Clitellum extending over segments 13–17; lighter colour than the surrounding parts; not thick and glandular, and scarcely noticeable ventrally.

Setæ. The first setigerous segment has 6 on each side, the 15 following ones have 8; behind this the number varies from 9–12.

Male pores on papillæ on segment 18, at the level of the interval between the two inner setæ of each side.

Oviduct pores on segment 14 slightly anterior to, and very nearly on, the same level as the innermost setæ of each side.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the intervals between the two inner setæ of each side.

Accessory copulatory structures. These resemble somewhat those of *P. bakeri*, but the two forms may be distinguished by the position of the spermathecal pores and the form of the prostate. Between segments 17 and 18, 18 and 19, and 19 and 20, are three pairs of elliptical tumid patches, nearer to the median line than the male pores.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but vascular swellings in segments 9–14. Large intestine commencing in segment 18.

Circulatory system. Single dorsal blood-vessel. Hearts in segments 5–12, those in segments 5–8, small. No continuous supra-intestinal vessel, but one in each of the segments 12–8 (?), which is connected with the dorsal vessel in the posterior part of the segment, and ends blindly in the anterior part.

Excretory system. Meganephric.

Reproductive system. Two pairs of testes in segments 10 and 11, into which the rosettes open.

Prostates coiled and tubular, extending through segments 18 and 19, the blind end being in segment 18.

Sperm sacs, two pairs, one attached to the anterior wall of segment 12, the other to the posterior wall of segment 9.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a long sac with a short diverticulum, about $\frac{1}{3}$ the length of the former.

Habitat. S. Warragul (collected by Mr. W. Mann).

(13) *Perichæta walhallæ*, sp. n. (Figs. 43, 44, 45, 66). Length of spirit specimen 1 inch, width slightly less than $\frac{1}{8}$ inch. Number of segments 88.

The form of the body is bluntly tapering at both ends. There is a median broad dark purple-brown band starting immediately behind the clitellum, and running back half way to the posterior end. In the median third of the body the lateral surfaces are of the same colour, but chequered with little rectangular light areas.

The prostomium is not completely dovetailed into the peristomium (about ½).

Clitellum well marked, tumid and complete, occupying segments 14–16.

Setæ, in front of the clitellum, 10 on each side; behind, 12.

Male pores on segment 18, at the level of the interval between the two inner setæ of each side. Between the two openings a ridge runs across the mid-ventral surface, with a depression both in front of, and behind, it.

Oviduct pores on a small elliptical patch on segment 14, anterior to the level of the setæ.

Spermathecal pores difficult to see externally.

Accessory copulatory structures. None present.

Alimentary canal. Gizzard in segment 5. No true calciferous glands. Large intestine commencing in segment 15 (?)

Circulatory system. Dorsal vessel single. Last heart in segment 12.

Excretory system. Meganephric.

Reproductive system. Two pairs of testes in segments 10 and 11; rosettes opening into the same segments.

Prostates small, tubular, coiled, in segment 18.

Sperm sacs, one pair, attached to the anterior wall of segment 12. Sac-like in form.

Ovaries in segment 13, with oviducts opening into the same segment.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a long sac with a short diverticulum.

Habitat. Walhalla (collected by Dr. Dendy).

I have, unfortunately, only one specimen (a mature one) of this form. But the shape and colouration of the body, together with the absence of accessory copulatory structures, render it so distinct from other forms that I have ventured to distinguish it specifically.

(14) *Perichæta dicksonia*, sp. n. (Figs. 7, 8, 9). Length of spirit specimens 2 inches, width less than ⅛ inch.

Prostomium completely dovetailed into the peristomium, which is marked by a median ventral cleft.

Clitellum well marked, complete, occupying segments 14–16.

Setæ, 10 on each side in front of the clitellum; 11 in the middle of the body. The rows are regularly arranged along the body.

Male pores on well marked papillæ on segment 18, at the level of the second seta of each side.

Oviduct pores on segment 14 anterior to, and slightly ventral of, the level of the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9; slightly dorsal of the level of the innermost setæ of each side.

Accessory copulatory structures. Two well marked elliptical tumid patches, one immediately in front of, and the other immediately behind, the male openings. The first half on segments 17 and 18, and the second half on segments 18 and 19.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores on the anterior margin of the segments, at the level of the sixth seta of each side, commencing on the third segment.

Alimentary canal. Gizzard in segment 5. No true calciferous glands. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. Hearts in segments 6–12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11, into which the rosettes open. The testes and rosettes on each side in each segment, enclosed by a membraneous bag filled with sperm.

Prostates tubular and coiled, in segments 18 and 19.

Sperm sacs, two pairs, one on the anterior wall of segment 12, the other on the posterior wall of segment 9.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a large sac and small diverticulum, not more than one-third the length of the former.

Habitat. Fern Tree Gully, under logs.

(15) *Perichæta alsophila*, sp. n. (Figs. 10, 11, 12). Length of spirit specimen 1½–2 inches, breadth nearly ⅛ inch. Number of segments about 104.

Prostomium not completely dovetailed into the peristomium (about half). The peristomium marked by a median ventral furrow.

Clitellum well marked, complete, occupying segments 14, 15, 16.

Setæ, in front of the clitellum, 10–11 each side; behind the clitellum, 13 each side. The rows regular.

Male pores on two fairly well marked papillæ on segment 18, at the level of the interval between the second and third setæ of each side.

Oviduct pores on segment 14 slightly anterior to, and ventral of, the level of the setæ.

Spermathecal pores, four pairs, between segments 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the innermost setæ of each side.

Accessory copulatory structures. Two ridges with swollen ends, one immediately in front of, the other immediately behind, the male openings. Both have their swollen ends at the level of the interval between the two inner setæ of each side. One is placed half on each of the segments 17 and 18, the other half on each of the segments 18 and 19. A smaller ridge with two confluent swellings, half on each of segments 16 and 17, and situated in the mid-ventral space between the innermost rows of setæ. Two elliptical tumid patches in the mid-ventral space, one on the posterior half of segment 7, the other on the posterior half of segment 8.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores very prominent, at the level of the seventh seta of each side, and placed at the anterior margin of each segment, commencing with the third. On contraction in spirit, the body wall in transverse section has the form of an upper and lower half, meeting on each side at an angle which corresponds in position to the nephridiopore.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but large vascular swellings in segments 14 and 15, and smaller ones in segments 9–13. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. Last heart in segment 12.

Excretory system. Meganephric.

Reproductive system. Two pairs of testes in segments 10 and 11, into which open the rosettes.

Prostates tubular, coiled, in segment 18.

Sperm sacs, two pairs, one attached to the anterior wall of segment 12, the other to the posterior wall of segment 9. Sac-like in form.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, four pairs, in segments 6–9. Each consisting of a large sac and short somewhat thin diverticulum.

Habitat. Fern Tree Gully, under logs.

(16) *Perichæta fielderi*, sp. n. (Figs. 19, 20, 21, 64). Length in spirits nearly 6 inches, breadth $\frac{1}{4}$ inch.

Both when alive and when in spirits, the worm has not the slightest resemblance in appearance to an ordinary perichæte form. It is only provisionally referred to this genus. The body is cream coloured, with a thick bright pink coloured clitellum, and is quite smooth, there being no indication of setæ, except in the clitellar region and perhaps an odd one here and there posteriorly; to see the setæ, it is necessary to cut sections. Its general appearance is closely similar to that of a Megascolides, to which genus I took it to belong when collecting it.

Prostomium possibly completely dovetailed into the peristomium, but the latter is strongly ribbed, two grooves being continuous with the edges of the prostomium, which has also a median furrow continued on to the peristomium.

Setæ, about six on each side, irregularly arranged behind the clitellum. In segments 13–16, a pair can often be seen on either side ventrally.

Clitellum well marked and thick, extending over segments 13–18; complete, save for two small depressed patches ventrally, one in the middle of segment 16, another occupying the hinder part of segment 17 ventrally, and the anterior of 18. These depressed patches may be absent, and the clitellum complete, in some specimens.

Male pores on two prominent papillæ, which may have their inner sides confluent, on segment 18. The pores at the level of the interval between the two inner setæ of each side.

Oviduct pores in a small linear depression on the anterior half of segment 14, each pore slightly ventral of the level of the innermost setæ.

Spermathecal pores, two pairs, one on the posterior margin of segment 7, another on the posterior margin of segment 8. Each pore is placed on a small, tumid, elliptical patch.

Accessory copulatory structures. An elliptical patch ventrally, half on each of segments 19 and 20, a similar one half on each of segments 20 and 21. Only one of these may be present.

Dorsal pores present.

Alimentary canal. Gizzard in segment 15. Vascular swellings in segments 11 and 12. Calciferous glands somewhat ventrally placed in segment 13. Large intestine commencing in segment 17. Prominent glandular tufts (pepto-nephridia ?) attached to the pharynx.

Circulatory system. Dorsal vessel single. Hearts in segments 8–13. A continuous supra-intestinal vessel in segments 9–14. A lateral vessel in segments 7–13.

Excretory system. Plectonephric.

Reproductive system. Testes not visible, but a large membranous sac on each side in segment 11 filled with sperm, and enclosing a prominent rosette. Probably this encloses also the testes.

Prostates flattened, rather small; mammillated surface; in segment 18. A large whitish swelling close to each duct, containing penial setæ.

Sperm sacs, one pair, attached to the anterior wall of segment 12.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. Each consisting of a large sac and diverticulum.

Habitat. Narre Warren. Fern Tree Gully (collected by Rev. W. Fielder and Mr. Mann). Sassafras Gully (collected by Mr. Shephard). Under logs, in burrows partly exposed when the log is lifted, and partly penetrating to a depth of one or two feet beneath the surface.

The first specimens of this were found by the Rev. W. Fielder and Mr. Shephard, and subsequently Mr. French and myself found it abundantly at Narre Warren. Its area of distribution appears to be very limited, as I have never found it elsewhere, or received it from other districts.

(17) *Perichæta frosti*, sp. n. (Figs. 13, 14, 15, 71). Length of spirit specimen 6 inches, breadth about $\frac{1}{4}$ inch. Number of segments about 220.

As in the case of *P. fielderi*, the worm has not the slightest resemblance in appearance to an ordinary perichæte. It resembles closely in general appearance the group of forms at present classed together under the genus Cryptodrilus. In spirit the body is bleached, and the clitellum of a light brown colour.

Prostomium not at all dovetailed into the peristomium.

Setæ, save an odd one here and there, are invisible.

Clitellum strongly marked, saddle-shaped, incomplete ventrally, except in the middle of segments 16 and 17, extending over segments 14–17.

Male pores on very prominent papillæ on segment 18.

Oviduct pores placed on a ridge which runs across the anterior part of segment 14.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9.

Dorsal pores present, the first between segments 3 and 4.

Alimentary canal. Gizzard in segment 6. Calciferous glands in segments 8, 9 and 10. Vascular swellings in segments 11, 12 and 13. Large intestine commencing in segment 15.

Circulatory system. Dorsal vessel single, as far back as segment 13. In segment 14 and succeeding ones to the posterior end, it is double—that is, there is a loop in each segment, the two parts uniting at the septum. Hearts in segments 6–13. A lateral vessel is present on each side in segments 8, 9 and 10.

Excretory system. Plectonephric.

Reproductive system. A single pair of testes and rosettes in segment 11.

Prostates small, flattened; bi-lobed; in segment 18.

Sperm sacs. A pair attached to the anterior wall of segment 12, and a smaller pair to the anterior wall of segment 13. Sac-like in form.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, five pairs, in segments 5–9. Each consisting of a short sub-spherical sac, with a blunt rounded diverticulum about quarter the size of the sac.

Habitat. Croajingolong, E. Gippsland. Collected during an expedition of the Field Naturalists' Club of Victoria to Eastern Gippsland. I have associated with this the name of Mr. Frost, to whom I am indebted for much valuable aid.

(18) *Perichæta goonmurk*, sp. n. (Figs. 16, 17, 18). Length in spirits $4\frac{1}{2}$ inches, breadth $\frac{3}{16}$ of an inch. Number of segments about 150.

The body is dark purple colour dorsally. Laterally it is dark purple, but chequered with little rectangular cream coloured areas, in the centre of each of which is a seta.

Cream white on the ventral surface. The colour is much the same in spirit-preserved animals, as in the fresh state. This form is provisionally referred to the genus Perichæta.

Prostomium very slightly dovetailed into the peristomium.

Clitellum well marked, complete. light grey in colour, extending over segments 13–19.

Setæ. The first setigerous segment has 4 setæ on each side. The second 5, then up to the clitellum there are 6. The 20th and remaining segments have 8. The setæ are irregularly arranged, save the inner two of each side.

Male pores on papillæ on segment 18, each slightly ventral of the level of the second setæ of each side. There is a marked depression immediately in front of, and behind, a median ventral ridge on segment 18.

Oviduct pores on segment 14 anterior to, and very slightly ventral of, the level of the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9. Each slightly ventral of the level of the innermost seta.

Dorsal pores.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but vascular swellings in segments 8–14, those in segments 13 and 14 smaller than the others. Large intestine commencing in segment 16.

Circulatory system. Dorsal vessel double as far forward as the sixth segment, where the two halves do not unite anteriorly, but pass forwards on to the surface of the gizzard. In each segment the two halves unite where they pass through the septum. In addition to the dorsal, there is a *double supra-intestinal* vessel in segments 9–12. Hearts in segments 8–11. In segment 8, the hearts arise from the dorsal vessel. In segments 9–11, they arise from the supra-intestinal.

Excretory system. Plectonephric, associated with large nephridia with internal funnels at the posterior end of the body.

Reproductive system. Two pairs of testes in segments 10 and 11. Rosettes doubtful.

Prostates flattened, somewhat fan-shaped structures in segment 18.

Sperm sacs, a single small pair attached to the anterior wall of segment 12. Sac-like in form.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, five pairs, in segments 5–9, gradually increasing in size from before backwards. Each consisting of a sac, with a short blunt rounded diverticulum.

Habitat. Mt. Goonmurk, Croajingolong. Whilst collecting in Croajingolong I only found this interesting form, the colouring of which renders it at once noticeable, under logs at the head of a fern gully on Mt. Goonmurk, at an elevation of about 3500 feet. Mt. Goonmurk forms part of the Dividing Range which runs from east to west across Victoria.

(19) *Perichæta yarraensis*, sp. n. (Figs. 61, 62, 63, 74). Length of spirit specimen 5½ inches, of living form 7 or 8 inches, breadth ½ inch.

In life the body is of a dull purple colour, darker dorsally than ventrally. The setæ are placed on little lighter-coloured spots. The clitellum stands out very clearly in the living form, being thick and cream white in colour.

Prostomium completely dovetailed into the peristomium.

Clitellum thick and strongly-marked, and extending over segments 13–17. The ventral surface of segments 15, 16 and 17 is not always white and glandular, the clitellum here being then incomplete and saddle-shaped. In other specimens it is complete.

Setæ. The first two setigerous segments have four on each side, arranged in two couples. Back to the clitellum there are two couples on each side, and in addition a fifth one external to these. Occasionally, but rarely, an additional one may be developed, but the worm can be recognised by the presence of five setæ on each side, regularly arranged so far back as the clitellum and including, at any rate, the two first segments of this. Worms from four localities all show this feature. Behind the clitellum the number increases to 10–14 on each side, arranged, save the innermost one, very irregularly. There is left a broad very irregular dorsal space free from setæ.

Male pores on slight papillæ, from which penial setæ may be seen protruding, on segment 18, at the level of the interval between the two inner setæ of each side.

Oviduct pores on segment 14 anterior to, and ventral of, the level of the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the innermost setæ.

Accessory copulatory structures. Three pairs of elliptical tumid patches in front of the male openings, and three or four behind. One pair placed half on segment 17, and half on segment 18, at the level of the interval between the second and third seta on each side. The others placed at the level of the interval between the two inner setæ of each side, and placed respectively half on each of the following segments, 15 and 16, 16 and 17, 19 and 20, 20 and 21, 21 and 22, 22 and 23. Each is marked by a median linear depression.

Dorsal pores present, the first between segments 5 and 6.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present, but vascular swellings in segments 13, 14 and 15. Large intestine in segment 17.

Circulatory system. Dorsal vessel single. A supra-intestinal vessel present in segments 10–13. The last heart in segment 12.

Excretory system. Meganephric.

Reproductive system. Two pairs of testes in segments 10 and 11, into which the rosettes open. These segments are filled with masses of sperm, but these are not enclosed in sacs.

Prostates coiled, tubular, occupying segments 18, 19 and 20.

Sperm sacs, three pairs. Two large ones attached to the anterior walls of segments 12 and 13, a smaller pair attached to the posterior wall of segment 9. Sac-like in form.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, five pairs, in segments 5-9. Each consisting of a long sac, with a short diverticulum about one-fifth the length of the former.

Habitat. Tanjil Track, near Wood's Point. Warragul. Warburton.

(20) *Perichæta tanjilensis.* Length of spirit specimen $3\frac{1}{2}$ inches, breadth $\frac{3}{8}$ inch. The worm contracts very much in spirits. When alive, it has a dull grey purple colour.

Prostomium completely dovetailed into the peristomium, and marked by a median groove continuous with one which runs along the mid-dorsal line of the body.

Clitellum not strongly marked, occupying segments 14–17, and slightly darker than the surrounding parts.

Setæ. The number and arrangement varies slightly, but the following description of a particular specimen may be taken as fairly representative:—The first six setigerous segments have four on each side, arranged in couples. The seventh has four on one side and five on the other. The eighth, four on each side; and the ninth, four on one side and six on the other. The tenth, six on each side. The eleventh, four on one side and six on the other. The twelfth, four on one side and seven on the other. The thirteenth, five on each side. The fourteenth, six on each side. The fifteenth and sixteenth, five on one side and six on the other. The seventeenth, six on each side. The eighteenth, nineteenth, twentieth, twenty-first, and twenty-second segments have eight on each side, except on the right of the twentieth, where there are six. Behind this, the number varies from 6–10 on each side. The two inner rows on each side are regularly arranged, except during the posterior third of the body. The dorsal interval free from setæ is broad and irregular.

Male pores not on papillæ, at the level of the interval between the two inner setæ of each side, on segment 18.

Oviduct pores on segment 14 anterior to, and slightly ventral of, the level of the innermost setæ.

Spermathecal pores, five pairs, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of the innermost setæ.

Accessory copulatory structures. The whole of the ventral surface of segments 16–21 is deeply depressed in spirit specimens. Four pairs of small elliptical tumid patches are present, each at the level of the second seta. The first are placed half on segment 16, half on segment 17, and the remaining three respectively, half on segments 17 and 18, 19 and 20, 20 and 21.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal, Circulatory system, Excretory system and Reproductive organs similar to those of *P. yarraensis*.

This form is closely allied to the latter, but the presence in *P. yarraensis* of 5 setæ regularly arranged on each side in front of the clitellum, renders it distinct and easy to recognise.

Habitat. Gembrook (Mr. D. le Souëf), Warburton, Tanjil Track (near Wood's Point), Fern Tree Gully, and Dandenong.

(21) *Perichæta bakeri** (Fletcher). (Figs. 22, 23, 24, 75).

This form was first obtained by Mr. Fletcher from Warragul. It is very abundant there under logs, and is a characteristic Gippsland form I have since collected it in abundance at Warragul, and the surrounding district, Fern Tree Gully and Narre Warren, and have received it from Gembrook (Mr. D. le Souëf), and Healesville (Dr. Dendy).

(22) *Perichæta dorsalis*† (Fletcher). (Figs. 58, 59, 60).

This form was first obtained by Mr. Fletcher from Warragul. It is present in a much greater proportion than any other single species, and has come to me from very many parts of the colony. We did not however secure it in Croajingolong, and it does not appear to extend into the east and north-east parts of the colony.

Specimens have been secured at Warragul, Fern Tree Gully, Gembrook (Mr. D. le Souëf), Narre Warren, Dandenong, Creswick (Mr. J. Fiddian), Castlemaine (Mr. T. S. Hall), Myrniong (Mr. C. Brittlebank), Grampians (Mr. C. Frost), Gerangamete (Mr. R. L. Anderson), and Walhalla (Mr. H. R. Hogg).

DESCRIPTION OF PLATES II, III, IV, V, VI & VII.

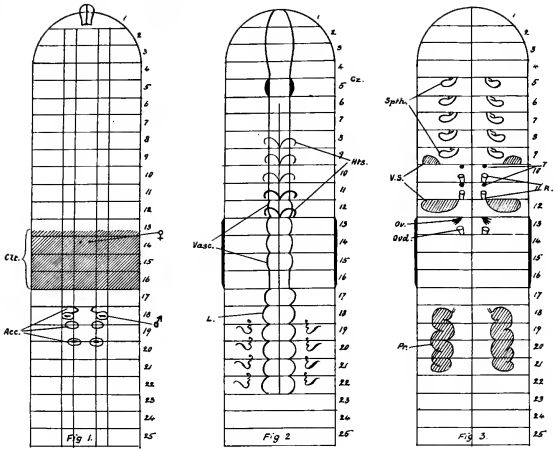
In the case of each species one drawing represents the external anatomy, a second the alimentary canal, circulatory system and disposition of nephridia, and a third the reproductive system. On Plate VII the spermathecæ are drawn in outline (under the camera lucida × 4). Lines represent the position of the two inner rows of setæ on each side.

Reference Letters.

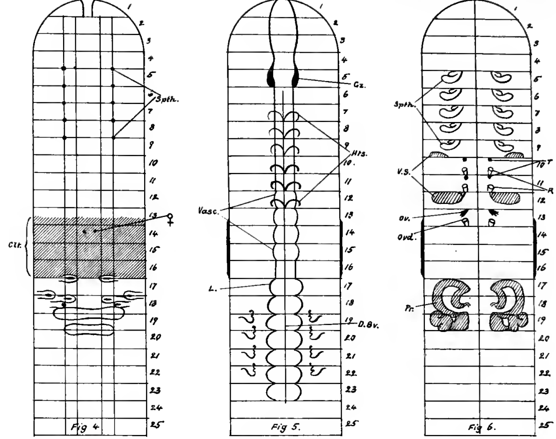
Acc.	Accessory copulatory structures.	*Ovd.*	Oviduct.
Calc.	Calciferous glands.	*Pr.*	Prostate gland.
Clt.	Clitellum.	*R.*	Sperm rosette.
D.Br.	Dorsal blood-vessel.	*Spth.*	Spermathecæ.
Gz.	Gizzard.	*T.*	Testis.
Hts.	Hearts.	*Vasc.*	Vascular swellings on œsophagus.
L.	Intestine.	*V.S.*	Sperm sacs.
Ov.	Ovary.		

* Proc. Linn. Soc., N.S.W., Vol. II (Series 2nd), September 28, 1887, p. 616.

† Proc. Linn. Soc., N.S.W., Vol. II (Series 2nd), September 28, 1887, p. 618.



PERICHÆTA LOCHENSIS.



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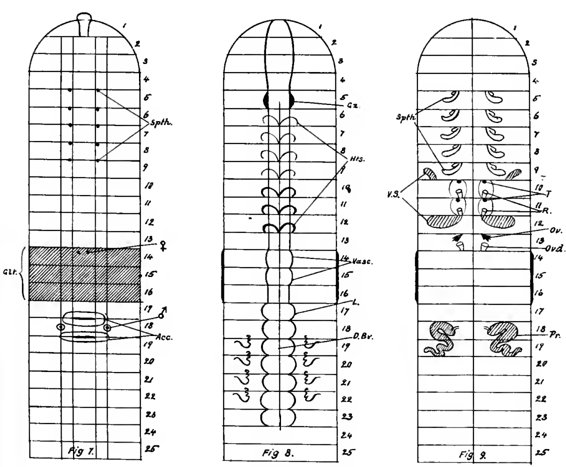

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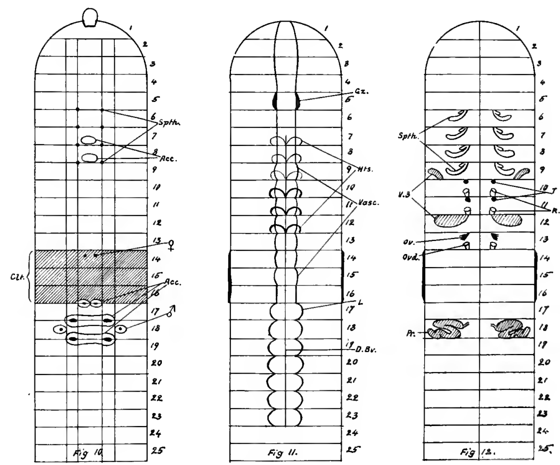
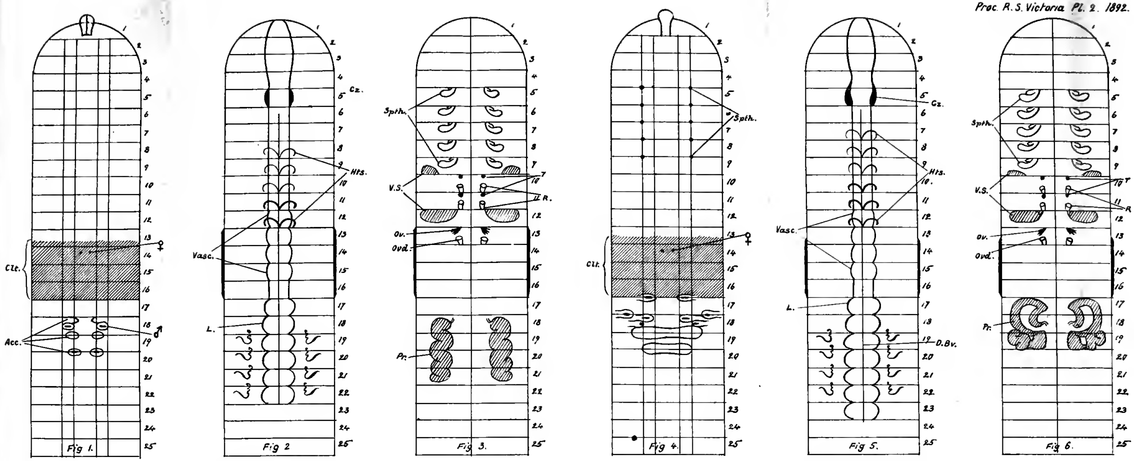


PERICHÆTA ALSOPHILA.



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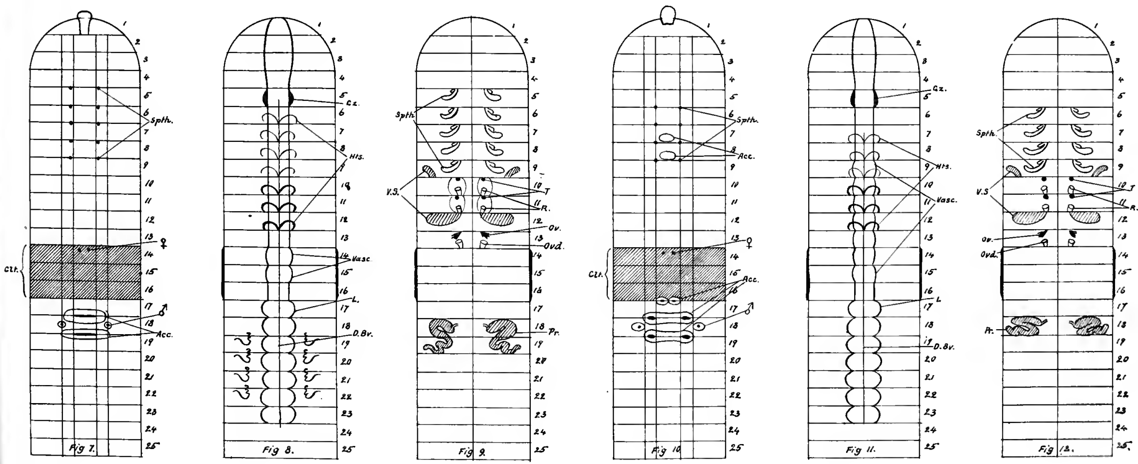

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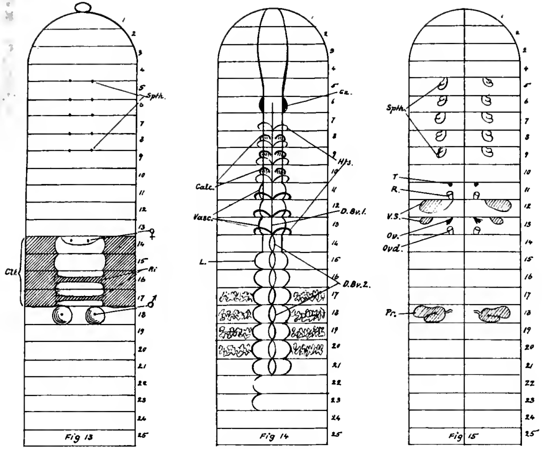
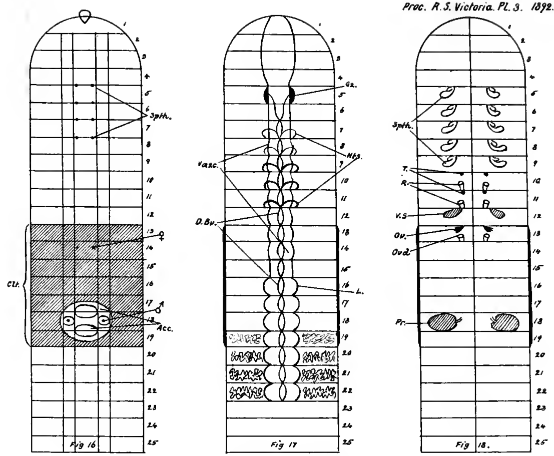


PERICHÆTA FROSTI.



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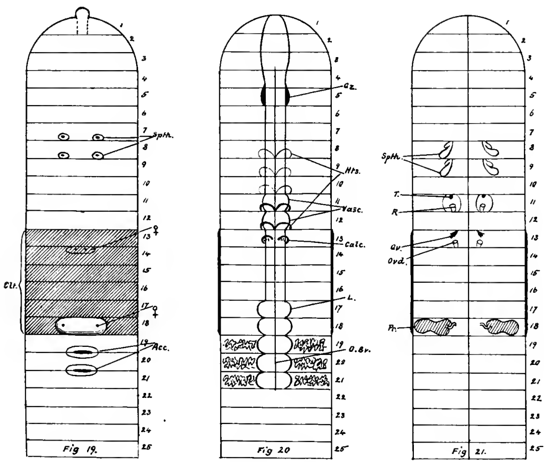
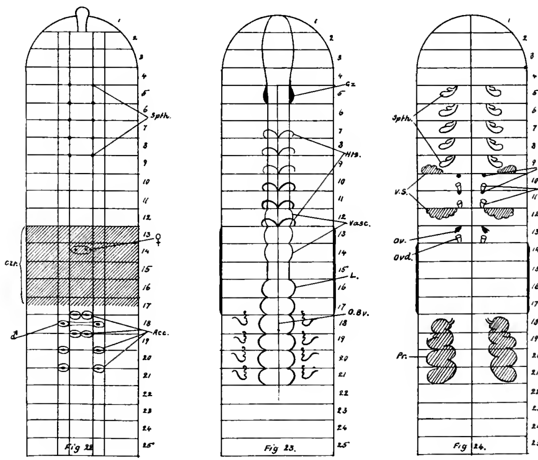
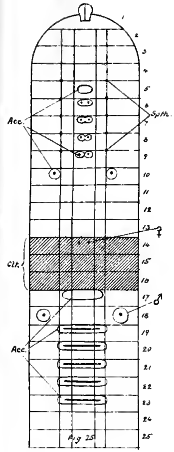
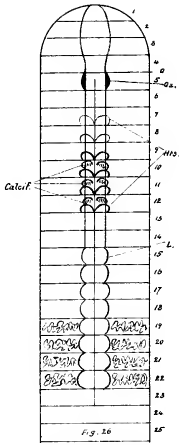


PERICHÆTA FIEDERI.



PERICHÆTA BAKERI.





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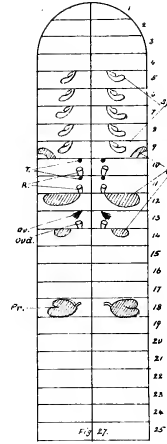

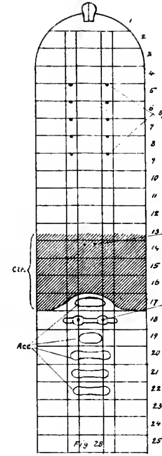

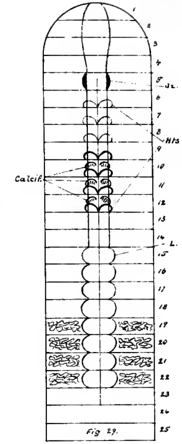

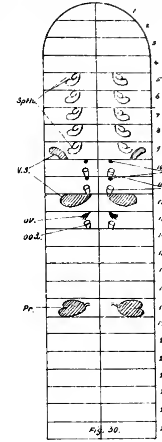

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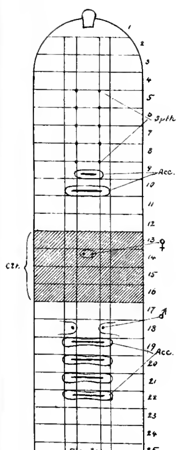
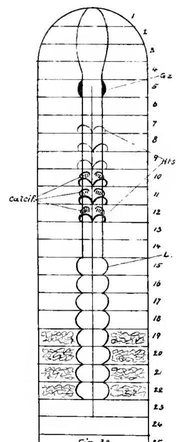
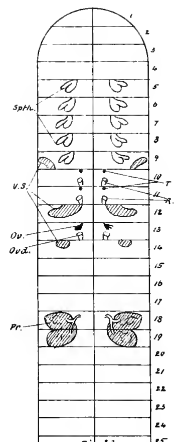
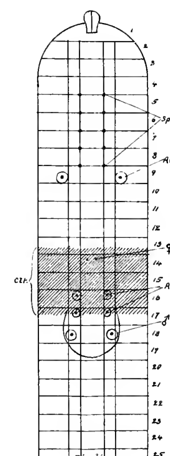
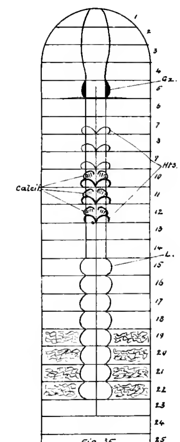


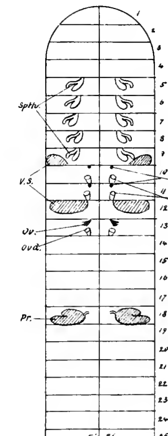


PERICHÆTA FRENCHI.

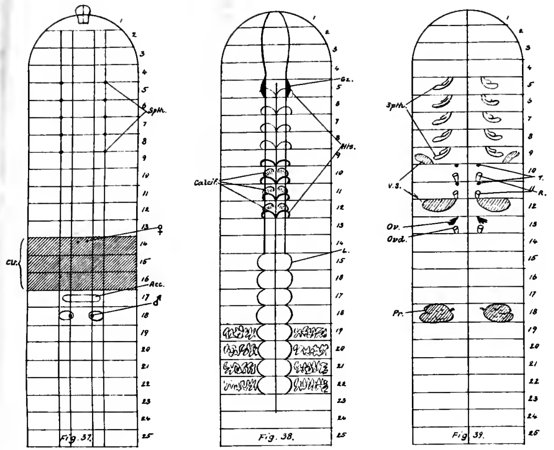




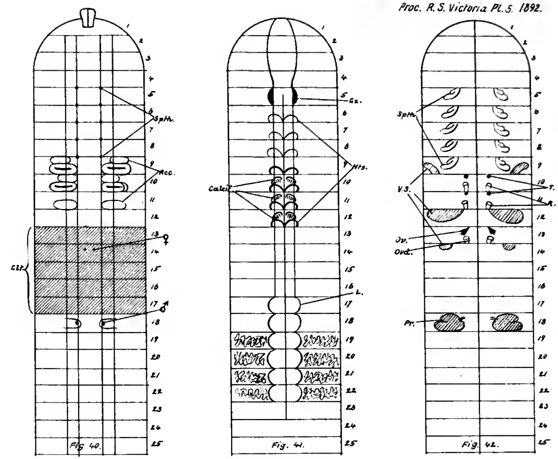




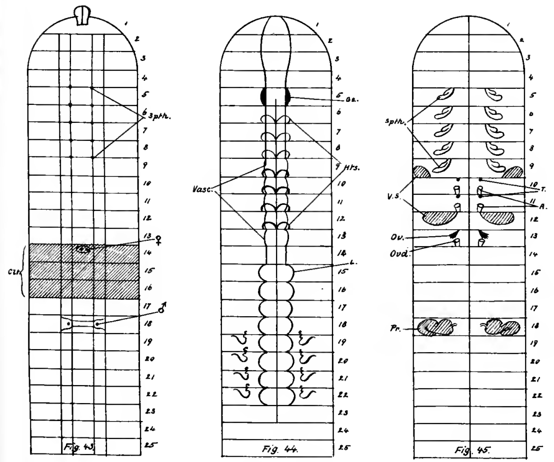
PERICHÆTA SYLVATICA.



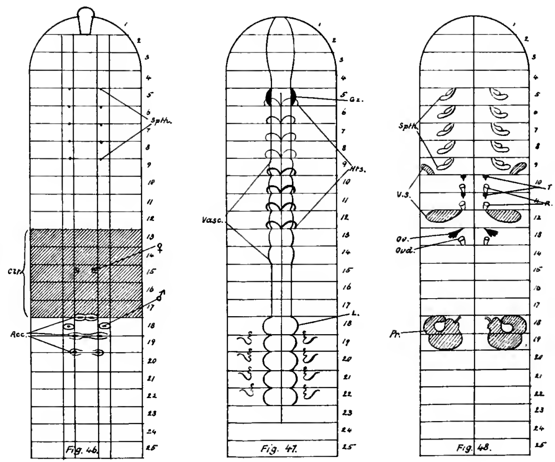
PERICHÆTA STEELI.



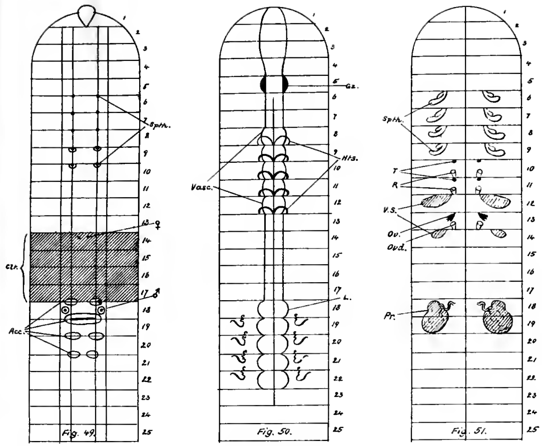
PERICHÆTA HALLI.



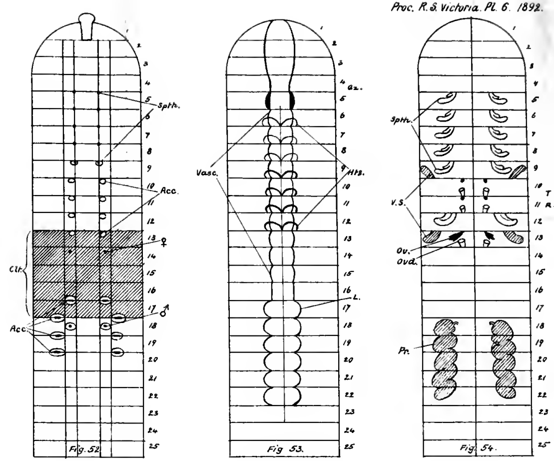
PERICHÆTA WALHALLÆ.



PERICHÆTA



PERICHÆTA DENDYI.



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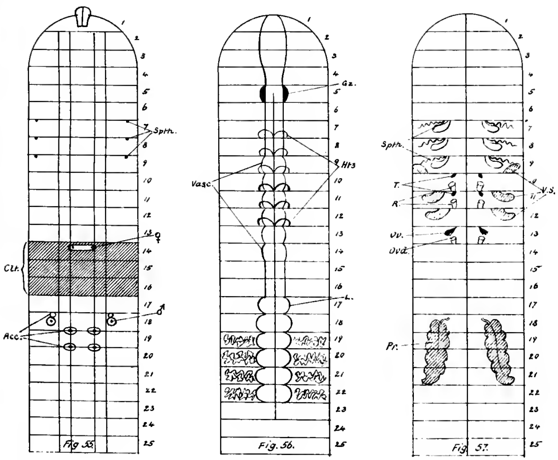
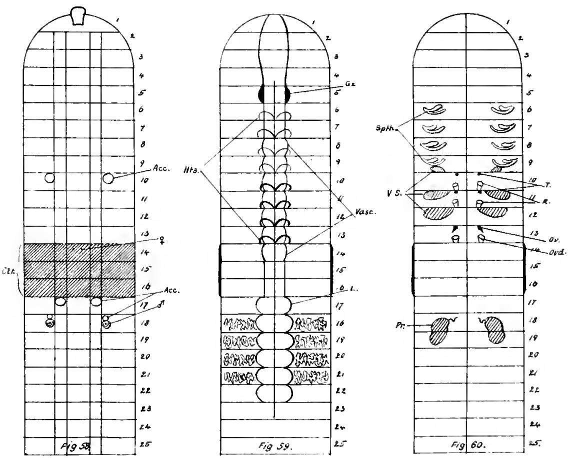


PERICHÆTA LATERALIS.



PERICHÆTA DORSALIS.

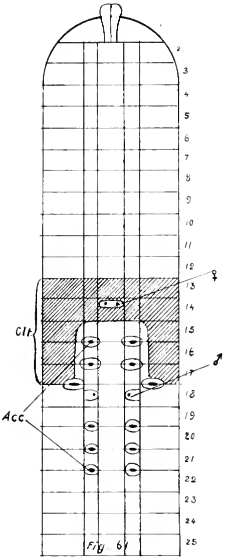


Fig 61

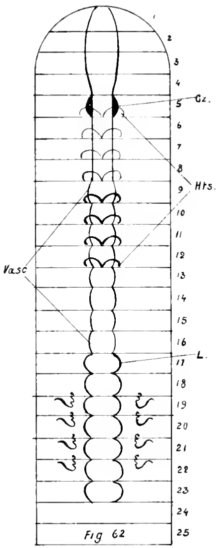


Fig 62

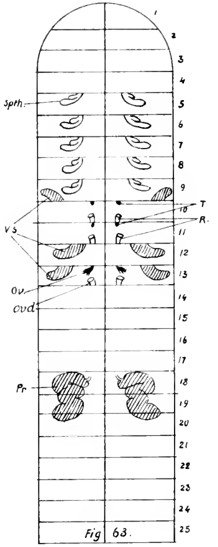


Fig 63.

PERICHÆTA YARRAENSIS.

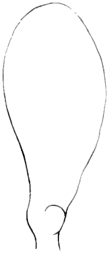


Fig 69


Fig 65


Fig. 66


Fig. 67.


Fig. 68


Fig 69.


Fig 70.


Fig. 71.


Fig. 72


Fig. 73

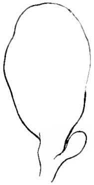


Fig. 74


Fig 75.

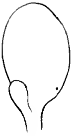


Fig 76.


Fig. 77.


Fig 78


Fig 79


Fig. 80

Art. II.—*Further Notes on the Oviparity of the larger Victorian Peripatus, generally known as P. leuckartii.*

By Arthur Dendy, D.Sc.

[Read May 12, 1892.]

My observations* on the oviparous habit of the larger Victorian *Peripatus* (hitherto generally regarded as identical with the *Peripatus leuckartii* of Sänger) have excited a good deal of hostile criticism, chiefly emanating from the pen of Mr. J. J. Fletcher. On three different occasions since the publication of my notes Mr. Fletcher has brought the question before the Linnean Society of New South Wales and his remarks have been published (I do not know whether in full or not) in the Abstracts of Proceedings of the Society.†

I have already replied to the earlier criticisms in a short paper read at the Hobart meeting of the Australasian Association for the Advancement of Science, which will, I am informed, be published shortly. Mr. Fletcher's latest observations, however, compel me to return to the question and I am the more willing to do so as I have some further information to communicate in support of my views.

The object of Mr. Fletcher's latest contribution to the literature of the subject is explained in the opening paragraph, which runs as follows:—"This paper is a reply to certain views expressed by Dr. Dendy with regard to the reproduction of the New South Wales *Peripatus*, which on the *ipse dixit* of Dr. Dendy himself is *P. leuckartii*, Säng.; the questions at issue being not whether or no the Victorian *Peripatus* is oviparous, but whether, firstly, Dr. Dendy was

* Proc. Royal Soc. Victoria for 1891, p. 31; *Nature* and *Zoologischer Anzeiger*, No. 380, 1891.

† September 30, 1891; February 24, 1892; April 27, 1892.

justified, on the evidence before him and in the absence of any personal knowledge of the reproduction of the New South Wales *Peripatus*, in contradicting statements which were quite in order; and secondly, as Dr. Dendy's views were published in September 1891, and as certain information on the subject was subsequently brought under his notice, whether it is not now nearly time that Dr. Dendy took steps to explain that his views apply wholly and solely to the Victorian *Peripatus*, and to withdraw his insinuations respecting, and his erroneous interpretation of, 'Mr. Fletcher's observations,' because already Dr. Dendy's statements are finding their way into the records of zoological literature, and confusion and misapprehension may result therefrom."

In reply to Mr. Fletcher's indictment I wish to make the following remarks:—

(1) I do not understand the meaning of the statement that the New South Wales *Peripatus* is, "on the *ipse dixit* of Dr Dendy himself," *P. leuckartii*. I certainly am not responsible for this identification, which was, I believe, first made by Mr. Olliff, who remarks,* on first recording the animal from New South Wales, that "the species is identical with that recently recorded by Mr. Fletcher from Gippsland and is probably the *Peripatus leuckartii* of Sänger." I need scarcely point out that the name *leuckartii* has since been applied by Mr. Fletcher himself to the New South Wales species.

Possibly Mr. Fletcher means to refer to the larger Victorian species, of which the first recorded specimen was identified by *himself* † as "in all probability an example of *P. leuckartii*, Sänger." If Mr. Fletcher will refer to my earliest communication on the subject‡ he will find that in recording the discovery of two specimens at Warburton (only one specimen having been previously recorded from this colony) I made the following statement, "after carefully studying Professor Sedgwick's full description of *P. leuckartii*, I am fairly certain that they do not belong to that species, but to a new one, which I for the present refrain from naming," basing my conclusion on the remarkable pattern of the skin.

* Proc. Linn. Soc. N.S.W., Vol. II, p. 981.

† Proc. Linn. Soc. N.S.W., Vol. II, p. 450.

‡ *Victorian Naturalist*, January 1889.

Professor Sedgwick, however, in reply to my observations, expressed the opinion* that the species probably was subject to a considerable range of variation in colour Having studied more specimens I myself came to the same conclusion† and have since then *followed* Mr. Fletcher in calling the larger Victorian species *P. leuckartii*. This use of the name *leuckartii* on my part seems to be Mr. Fletcher's chief grievance against me but I would ask him to remember that I have only followed his own lead in this respect.

(2) I am not aware that I have contradicted any statements for the simple reason that I cannot find that there were any definite statements as to the mode of reproduction of the New South Wales *Peripatus* for me to contradict. There was merely the assumption by Mr. Fletcher (which I quoted and characterized as very natural) that the young animals which he found in company with the parent had been born alive.

(3) I consider that I was fully justified in assuming that the mode of reproduction of the New South Wales *Peripatus* was the same as that of the Victorian one, as at the time when I wrote there were no definite observations published as to the mode of reproduction of the former, and it was almost inconceivable that different individuals which Mr. Fletcher himself, in common with all other writers on the subject, regarded as belonging to one and the same species should be oviparous in the one colony and viviparous in the other. I have no doubt now that the New South Wales *Peripatus* is viviparous, as maintained by Mr. Fletcher and Professor Haswell, but I would ask Mr. Fletcher to remember that when I wrote, the only published observations as to the mode of reproduction of the New South Wales species were—(*a*) the finding of the young in company with the mother, though there was nothing, so far as the published account goes, to show that they had not been hatched from eggs laid for some time; and (*b*) a footnote‡ to one of Mr. Fletcher's observations, stating that a female had been dissected and found to be pregnant; the term pregnant is not defined and might, in my opinion, be

* *Nature*, February 28, 1889.

† "Observations on the Australian Species of Peripatus," Proc. Royal Soc. Victoria, July 11, 1889.

‡ Proc. Linn. Soc. N.S.W., Vol. III, p. 892.

correctly applied to a female containing large but undeveloped eggs in the uterus; nothing is said by Mr. Fletcher about the embryos.

Mr. Fletcher may personally have had abundant evidence that the New South Wales *Peripatus* was viviparous, but that evidence was not published and not known to me when I wrote, and, therefore, I consider that I was quite justified in stating that the mode of reproduction of *P. leuckartii* was unknown, and in placing my own interpretation upon the only recorded facts as to the life history of the New South Wales form. Naturally I interpretated them in the light of my own observations on the Victorian species. That interpretation I now fully admit to be incorrect and I congratulate myself that if my observations have had no other good result they have at least elicited some definite information as to the mode of reproduction of the New South Wales *Peripatus.*

(4) Mr. Fletcher seems to be very greatly troubled because my statements are already "finding their way into the records of zoological literature, and confusion and misapprehension may result therefrom." There is not the slightest need for confusion now that we have at length a definite statement as to the reproduction of the New South Wales species. It must be perfectly obvious to every reader that my own observations were based entirely on Victorian specimens, as stated distinctly in the paper, and that my suggestion as to the New South Wales form was a perfectly justifiable, though, as it turns out, incorrect deduction from the only published facts. It is perhaps unfortunate that both the New South Wales and Victorian forms should have been included under the name *leuckartii*, but for this Mr. Fletcher himself is at least as much responsible as any one.

(5) Mr. Fletcher states that the question at issue is not whether or no the Victorian species is oviparous. Herein I must beg to differ from him, as this is the real question which I have been all along trying to solve and compared with which the mere question of nomenclature is, in my opinion, insignificant In concluding his observations he also indulges in certain offensive and unjustifiable personalities, which I need not quote. It is greatly to be regretted that he should have considered such a proceeding advisable

and, for my own part, I entirely fail to see the advantage to be derived therefrom and must refuse to follow his example in this respect.

Probably the solution of the whole difficulty will be found to lie in the fact that my original opinion was correct after all, and that our larger Victorian *Peripatus* is specifically distinct from *P. leuckartii*. For the present, however, I still refrain from giving it a distinctive name, as I have had very few specimens from other localities to compare it with and do not wish, if it can be helped, to create a new species merely on account of the oviparous habit. This question, however, is discussed in my communication to the Australasian Association already referred to.

As to the oviparous habit of our larger Victorian species (so called to distinguish it from the smaller *P. insignis*), I have some additional evidence to offer and I would like at the same time to recapitulate the main arguments in favour of my view. My critics have entirely ignored all that is new in my observations, such as the remarkable sculptured egg-shell, and have suggested that what I have observed is simply a case of abnormal extrusion of eggs such as takes place sometimes in *P. novæ-zealandiæ*. Professor Hutton, however, who made the observation on the New Zealand species, merely states that the eggs are often extruded before development is complete and then always die. Professor Sedgwick quotes these statements in his monograph of the genus and yet, in replying* to my letter in *Nature*, he states that "no one knows whether the eggs so extruded undergo complete development." I suppose that most animals sometimes extrude eggs which never complete their development, but this has really little to do with the question. What I have been endeavouring to prove is that the larger Victorian species of *Peripatus* is *normally* oviparous. The two principal arguments originally brought forward—both of which have been entirely overlooked by my critics—were (1) that female specimens dissected at various times of the year were never found with embryos in the uterus, as has been so frequently described for other species, but generally with large undeveloped eggs of definite oval shape and with a thick membrane; (2) that the shell or membrane of the eggs after (but not before) being laid, is very definitely and characteristically sculptured on the outer surface, in such

* *Nature*, September 24, 1891.

a manner as to recall the eggs of some insects. This sculpturing alone appears to me to indicate a truly oviparous habit, and, inasmuch as it affords another character common to *Peripatus* and the *Insecta*, to deserve special attention. I am not aware that a sculptured egg-shell has hitherto been observed in *Peripatus* and I should be glad to learn from Mr. Fletcher whether anything of the kind has ever been found around embryos of the New South Wales species which have, as he informs us,* been extruded in the process of drowning.

The additional evidence on the subject which I now wish to bring forward consists in the subsequent history of the fourteen eggs which were laid in my vivarium between the 18th May and the 31st July last year and of one which, though possibly laid about the same time, was not discovered until September 16. Before going any further, however, I may premise that the fact that the eggs are really those of *Peripatus* has been absolutely proved by their development. It may also be as well to relate the fate of the parent animals by which the eggs were laid.

It may be remembered that on the 31st July, 1891, when the eggs were first found, there were in the vivarium three females and one male, all apparently in good health. The male specimen died shortly afterwards but on August 17th the females were still all alive and apparently healthy. On August 31st, as mentioned in a postcript to my first communication on the subject, one of the female specimens was found dead. On being dissected the reproductive organs appeared very well developed; but, although the ovary and oviducts were both large (the former containing a great many ovarian eggs), there was not a single egg in either of the oviducts, all having been doubtless laid.

On September 16th the two remaining females were still alive. I killed and dissected one. The organs appeared healthy and well developed. In the lower part of each oviduct one large egg was found. The eggs presented the usual characters, having a very thick but unsculptured envelope filled with yolk. Both eggs were cut open and examined microscopically, but I did not succeed in recognising any trace of an embryo in either.

On completely turning out the vivarium and examining its contents carefully, I found one more *Peripatus* egg

* Proc. Linn. Soc. N.S.W., September 30, 1891.

amongst the rotten wood (September 16). It looked much healthier than those which had previously been transferred from the vivarium, many of the latter having already begun to shrivel up and acquire a dark colour. In the newly found egg and also in the healthier-looking of those previously obtained there now appeared to be a dark spot in the interior, but this was only dimly visible through the thick sculptured shell.

On September 25th the last remaining female was still apparently in good health but on October 1st it was found dead—how long it had been so I do not know. On dissection I found the internal organs in a bad condition. Neither eggs nor embryos were visible in the oviducts. The ducts of the slime glands were very much enlarged and swollen out, while the branching portions appeared feebly developed, in fact not distinctly recognisable. The alimentary canal was almost empty and the animal seemed to have died of starvation.

On October 3 I dissected one of the eggs from the hatching box. I could find no embryo in it but only the same semi-liquid, yolk-like contents as when *in utero,* full of little oil or yolk globules. Inside the thick, sculptured "shell" there was, as usual, a very thin and delicate, transparent membrane. Probably a young embryo was really present but was broken up in opening the egg and overlooked; even at a much later period the embryonic tissues are extremely delicate.

On November 30 I noted that several of the eggs were shewing indications of an embryo appearing coiled up within them, but the shell was so thick and opaque that it was impossible to make out any details. I dissected the egg which was found on September 16 and which had since then been kept separate from the rest. I found in it a beautiful embryo *Peripatus* in an advanced stage of development. The embryo was surrounded by a delicate, transparent membrane, which fitted closely on to it and was very difficult to remove; outside this came the sculptured shell. The embryo possessed a distinct head, with clearly recognizable brain, eyes and ringed antennæ, and there were at least seven pairs of appendages behind the antennæ. It lay tightly coiled up, with the posterior extremity resting against the side of the neck, in such a position as to make it very difficult to count the appendages. The specimen was stained and mounted in Canada balsam. This embryo, then, developed for more than ten weeks after the egg had been laid and did not show the least sign of "going to the bad."

I need hardly say that during the heat of the summer months I found it a very difficult matter to keep the eggs in a suitable condition of moisture, especially as I had no previous experience to guide me. Hence it is not to be wondered at that the majority of the eggs perished, shrivelling up and being attacked by a mould. As I was away from Melbourne for some weeks during the summer I entrusted the eggs to the care of the Rev. W. Fielder, who most kindly looked after them for me in my absence. Frequent attention was necessary in renewing the supply of moisture.

On April 14, 1892, only three eggs remained in the hatching box. the others having been removed as they showed signs of going bad. One of the remaining three had been showing dark pigment inside for some days past. This egg I removed and carefully dissected. I found the shell of a much darker (yellow) colour than when laid, a good deal crumpled on the surface, and very soft, as though beginning to decay away. The contained embryo was removed and found to be in excellent condition, although *outside* it there appeared under the microscope a great many very fine threads, which I take to be the hyphæ of a fungus. Possibly this fungus might have ultimately killed the embryo but the latter was so far advanced that it seemed to be on the verge of hatching. It was enclosed within the usual transparent delicate membrane lying within the thick shell. I could not determine whether the fungal hyphæ had penetrated within this inner membrane but I think it very doubtful. The embryo was tightly coiled up as in the previous case. When uncoiled it measured about 5 mm. in length (exclusive of the antennæ) and 1 mm. in breadth. *All* the appendages were developed, viz., antennæ, oral papillæ, two pairs of jaws and fifteen pairs of claw-bearing legs. The eyes were conspicuous at the bases of the antennæ, and the antennæ themselves showed each about twenty deeply pigmented annuli. The remainder of the body was nearly white, but very distinct, isolated pigment patches (chiefly indigo blue, with a few specks of orange) appeared scattered pretty abundantly over the legs and back. The mouth was surrounded by the very characteristic, thick, transversely furrowed lip. The dermal papillæ were very obvious and exhibited the characteristic spines, the cuticle being very strongly developed. The claws on the feet were very distinct. The alimentary canal was full of granular food yolk. The specimen was stained with borax carmine and mounted in Canada balsam.

This embryo, then, developed for at least eight months and a half after the egg was laid and at the end of that time was a perfect young *Peripatus*, differing externally from the adult only in its smaller size and less deeply pigmented skin.

There are still two eggs left in the hatching box but they do not look to me at present as if they were going to hatch. Whether they do so or not, however, I think I may fairly claim to have now definitely proved that the larger Victorian *Peripatus* at any rate sometimes lays eggs, and that these eggs are capable of undergoing development outside the body until perfect young animals are produced. The great length of time required for the development of the eggs is very remarkable, but it is only what one might expect on considering the unusual length of time required for intra-uterine development in other species.

Art. III.—*Nest and Egg of Queen Victoria's Rifle Bird (Ptilorhis Victoriæ).*

(With Plate I.)

By D. Le Souëf.

[Read March 9, 1892]

The nest and egg of the Victoria rifle bird here depicted, was taken on one of the Barnard Islands by Mr. H. Barnard and myself. We visited these islands on November 18, 1891. in quest of the egg of this bird, and built our small humpy about eight feet from a screw palm (Pandanus aquaticus), which grew just above high water mark. We saw a pair of rifle birds in some light scrub close by our camp, and they seemed very fearless, the hen bird especially so. Next morning was spent in searching over this interesting and densely timbered island, but without success. During the afternoon, however, we determined to watch the hen bird, which was seen on a tree close by, and so posted ourselves one on each side of the aforementioned patch of scrub. The bird had some moss in her bill, which she kept dropping and catching again before it reached the ground, and we naturally thought she was building, but presently she darted down into the scrub close by Mr. Barnard. In a few minutes he saw her fly into the screw palm by our camp, in which we found she had her nest. The nest itself which was built near the crown of the tree about seven feet from the ground, not being visible, and all we could see was the head of the bird. She continued sitting most of the next day, having apparently become accustomed to our presence.

We then took the nest and found it contained only one egg, which was hard set, the chick being about seven days old. The nest was built principally of vine tendrils and leaves rather loosely put together (Plate I).

Fig 1

Fig 2

R Wende

Troedel & Co

The egg has a little more gloss on than is shown in the illustration.

Another egg and nest which was said to belong to this species was previously sent to Mr. C. French, in 1886, from the Cardwell Scrub, but the egg was spotted instead of being streaked, as in the present specimen; it is also smaller, and the nest, although made of somewhat similar material, is not so large, and is much more compactly built. Eggs of the same species of bird often vary considerably in colour, markings, and size, but still the general characteristics are the same, except in a few instances, notably the egg of the *Gymnorhina tibicen*. On several occasions I have noticed that the eggs laid by one pair of birds are almost identical with those laid by the same pair in the previous year, especially in the case of sea-birds, and it would be of interest to ascertain if this fact has been noted by other oologists.

Art. IV.—*Notes on the Lilydale Limestone.*

(With Plates VIII and IX.)

By Rev. A. W. Cresswell, M.A.

[Read July 14, 1892.]

The limestone formation of Cave Hill quarry at Lilydale, the subject of this paper, is, for the most part, a hard semi-crystalline marble deposit, wedged in between hard quartzite on the one side, and soft shales and mudstones on the other; and has for many years past been recognised by Professor Sir F. M'Coy and others as of Upper Silurian age, of about the horizon of the English Wenlock, from an inspection of its contained fossils. The limestone strata dip to the east at varying angles of from 35° to 50°, the strike being nearly north and south magnetic, varying, however, on the east side of the quarry to as much as 18° east of magnetic north. The exact thickness of the limestone is not as yet known, for it does not naturally crop out on the surface, but is only artificially exposed by quarrying. As early as 1856, the late director of our Victorian Geological Survey, Mr., now Sir A. R. C. Selwyn, speaks* of the limestone as known to exist, but as only discoverable by a well-like hole on the side of the hill, leading into a cave hollowed out in the rock, and sloping down to a depth of 120 feet, with stalactites, &c. (a specimen of which is shown). But about fifteen years ago, a quarry was excavated in the limestone on the side of the hill, and the opening to the cave is now covered up with *débris*, and is inaccessible.

The progress of quarrying has now proved the limestone to be of much greater thickness than was at first reported.† The measurement across the outcrop is about 5 chains, or

* Report on Geological Structure of Colony of Victoria: Basin of Yarra, &c., 1856.

† "Victorian Naturalist," 1885, II, No. 3, p. 35.

330 feet, and allowing for the average dip of 40°, this would mean a vertical thickness of about 220 feet, but this is only so far as it is at present exposed. Its eastern limit may be considered to be about already reached, for almost immediately flanking it on that side may be seen an extensive series of quartzite and conglomerate strata, running conformably with the limestone; but on the west it is not yet defined as it

CORRIGENDA ET ADDENDA.

Page 39.—For (See Fig. 1), read (See Fig. 9, Plate IXA).

For (See Fig. 2), read (See Fig. 10, Plate IXA).

" 41.—Read "Pleurorhynchus costatus" and "Pleurorhynchus bellulus" under *Lamellibranchiata*, instead of under *Gasteropoda*.

Plate VIII.—1. Tremanotus pritchardi.

2. Eunema etheridgei.

3. Stomatia antiqua.

" IX.—4. Tryblidium nycteis.

5. Pleurorhynchus costatus.

6. Pleurorhynchus bellulus.

7. Naticopsis lilydalensis.

8. Ambonychia tatei.

appears in the quarry, when looked at as a whole, and from a distance, is cream, or almost white, especially on weathered exposures; but when freshly broken, it is of different shades of dark or light bluish grey, pinkish brown, or grey with pinkish brown patches. It is for the most part semi-crystalline, is here and there somewhat brecciated on a small scale, and is in some places roughly oolitic (a slide of an oolitic specimen on view).

ART. IV.—*Notes on the Lilydale Limestone.*

[illegible]

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330 feet, and allowing for the average dip of 40°, this would mean a vertical thickness of about 220 feet, but this is only so far as it is at present exposed. Its eastern limit may be considered to be about already reached, for almost immediately flanking it on that side may be seen an extensive series of quartzite and conglomerate strata, running conformably with the limestone; but on the west it is not yet defined, as it is still partly covered over with basaltic soil and decomposing basalt. (See Fig. 1.)

About half a mile off, or rather less, to the west, and on the other side of the valley, are a series of sandstones, shales, and mudstones exposed beneath the basalt in the Melbourne Road cutting, and seen to be dipping in the same direction as the limestone.

The lateral extension of this Lilydale limestone is a matter of much uncertainty. It is generally believed to be like most other Silurian limestones, and especially in Victoria, a mere lenticular or cake-like patch that rapidly thins out in all directions, but as the country in the neighbourhood is completely covered over with soil, trees, and verdure, it must remain more or less a matter of conjecture, until someone is enterprising enough to prospect the country, if not with a diamond drill, at least with a geological cheese-borer. Its *northern* extension has not been observed at all, but what looks somewhat like a *southern* extension of it may be seen in the shape of two bosses of the same kind of limestone in the side of the railway cutting, about three-quarters of a mile towards Melbourne, and somewhere about on the line of the strike of the limestone at Cave Hill quarry.

As it is hardly conceivable that the great thickness of the Cave Hill limestone, however lenticular it may be, can thin out so rapidly as all this, these two bosses, or boulders, in the railway cutting are probably mere outlying boulders of a southerly extension of the limestone that is mainly concealed beneath the surface. (See Fig. 2.)

The general colour of the Cave Hill limestone, as it appears in the quarry, when looked at as a whole, and from a distance, is cream, or almost white, especially on weathered exposures; but when freshly broken, it is of different shades of dark or light bluish grey, pinkish brown, or grey with pinkish brown patches. It is for the most part semi-crystalline, is here and there somewhat brecciated on a small scale, and is in some places roughly oolitic (a slide of an oolitic specimen on view).

The limestone strata are separated at intervals by five dark shaly or mudstone partings, averaging from 18 inches to 4 feet across; the thickest one, which is of a dark brown or claret colour, is upwards of 4 feet, and in this one is an almost perpendicular shaft-like cave, 91 feet deep, apparently caused by the action of running water.

I am informed by the owner, Mr. David Mitchell, of Burnley, that the limestone of his quarry has been long ago analysed, and runs to 95 or 96 per cent. of calcium carbonate. The limestone is in high esteem as the best and purest source of lime for building purposes in the colony. It has also been lately turned to profitable account in the manufacture of cement, and the owner informs me that the force required to pull it apart is 985 lbs. The stone has not been directly used for building purposes, but some slabs, which, when polished up, have an ornamental appearance, have been occasionally used for marble mantelpieces. Upon the whole, I think, therefore, we may congratulate Mr. David Mitchell upon having a more payable thing in his possession than many a gold mine. When the quarry has been in full work in prosperous times, he tells me that he has had as many as 120 men employed on it, and has been able to send away the almost incredible amount of 70 tons of lime a day. In these days of depression, however, when there is so little demand for lime, 20 men are found quite sufficient to do all the work of the quarry that is required.

The limestone of Cave Hill, like most other limestones, contains occasional patches of crystalline calcite, mostly in rhombohedrons or in modified scalenohedrons. It also contains segregated lumps and layers of chert, in which corals and other small fossils are sometimes beautifully preserved (specimens of both calcite and chert are exhibited). Associated with this same limestone, the following minerals have been found, but not in sufficient quantity to be of any commercial importance:—Galena, malachite, azurite, and copper and iron pyrites (specimens on the table). The great interest, however, of the Lilydale limestone lies in its fossils—of which, indeed, the limestone itself is largely composed—and which constantly attract scientific visitors from Melbourne and other places, and indeed from the neighbouring colonies.

In fact, one of my chief reasons in writing this paper is to take possession, in the name of Victorian geologists, of the priority in describing some of the fossils, as at present so many of them have been described by geologists outside the colony; for without a moment wishing to do away with that principle of free-trade in scientific research that we all so much rejoice in, or desiring to make any undue claim for protection to native industry in Victorian geology, I think you will agree with me that it is but right that we should try to take inventories of our own possessions for ourselves, and not leave it to outsiders to do it for us.

The following is a list of the Lilydale fossils that have been so well described by Mr. Robert Etheridge, jun., Government Palæontologist of New South Wales, in Nos. 3 and 7, Vol. I, of the "Records of the Australian Museum," there:—Favosites grandipora, Trochus (Scalætrochus) lindströmi, Niso (Vetotuba) brazieri, Cyclonema australis, Cyclonema lilydalensis, Phanerotrema australis, Oriostoma northi, Murchisonia attenuata (?), Bellerophon cresswelli, Ambonychia poststriata. In addition to these, Mr. Etheridge records, without describing, the well-known and world-wide Silurian brachiopod, "Atrypa reticularis," and mentions also that there are three species of the well-known Rhizopod "Stromatopora" yet to be described. The fossils which I myself wish to record, as also occurring in the Lilydale limestone, and as a supplementary list to that supplied by Mr. R. Etheridge, jun., are the following:—

Mollusca and Molluscoidea.

Cephalopoda.—Orthoceratites, sp.; and Discoceras? sp.

Bellerophontidæ.—Tremanotus pritchardi.

Gasteropoda.—Eunema etheridgei, Stomatia antiqua, Tryblidium (Metoptoma) nycteis, Pleurorhynchus (Conocardium) costatus, and Pleurorhynchus (Conocardium) bellulus, Naticopsis lilydalensis.

Lamellibranchiata.—Ambonychia tatei.

Brachiopoda.—Strophomena rugosa, Leptœna transversalis, Orthis elegantula.

Cœlenterata.

Actinozoa.—Heliolites, sp.; Cyathophyllum, sp.

Some of these names will at once be recognised as being those of world-wide Upper Silurian forms, but the following species are new, as far as my knowledge goes, and so I will venture to name and describe them as such, at least provisionally :—

The first and most important to be described is a shell belonging to the Bellerophontidæ, a group of extinct shells of generalised form, which had characters that are now divided between the Cephalopoda, the Heteropoda, and groups of Gasteropoda, of which Pleurotomaria and Haliotis are respectively the types. It is a *Tremanotus* which I have named T. pritchardi, in compliment to Mr. G. B. Pritchard, a well-known geological friend, who has kindly lent me the best specimen that I have with me, and which he found in the Lilydale quarry some time ago. *Sp. Char. of T. pritchardi* shell discoidal, bi-concave, trumpet-shaped, and very thick, consisting of about five rapidly increasing whorls, forming a deep umbilicus on both sides; spire elliptical in section, and back symmetrically convex. Breadth of the shell about two inches, length from three and a half to four inches. Aperture very much expanded and reflected like the mouth of a trumpet, but more so anteriorly than laterally; the inner surface of expanded outer lip quite smooth. No slit or sinus as in Bellerophon, but the middle dorsal line of the shell is pierced by a row of oval siphonal openings, resembling those of Haliotis, there are about seven of them to an inch of the periphery. The outer surface of the shell is ornamented with spiral fluctuating lines parallel to the dorsal keel, and becoming on the expanded outer lip more flattened, coarser, and more plait-like. There are also the very distinct lines of growth in a transverse and backward direction to the dorsal keel, that are so characterestic of the Bellerophontidæ. The lines in the two directions combining in this shell to give a very distinct fenestrated appearance. T. pritchardi has in general form a near resemblance to "Tremanotus maideni," described by Mr. Robert Etheridge,* from the Hawkesbury (Trias) rocks of New South Wales, and which he regards as a curious survival from Silurian times, but, besides other differences, our fossil is a very much thicker shell.

The next fossil to be briefly described as far as may be from very imperfect specimens, is *Eunema etheridgei*, a gasteropod shell that appears to belong to the Littorinidæ,

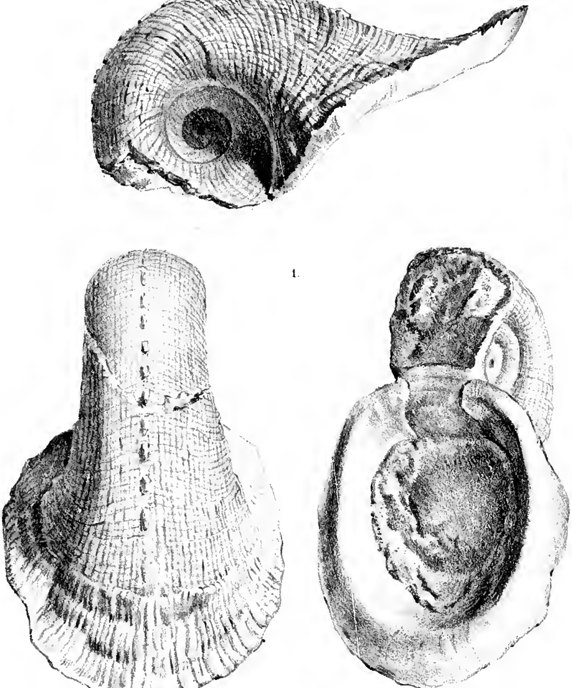
* Department of Mines.—Memoirs of Geological Survey of New South Wales. Palæontology I. Invertebrate Fauna of Hawkesbury; Wianamatta Series, by Robert Etheridge, jun.

like the Cyclonemas of this formation, which it very much resembles, only that the spire is more elevated. In typical Eunemas, according to Nicholson, "the whorls are more or less angular, and the surface is often adorned with elevated spiral ribs." In our Eunema, however, the whorls are rounded like those of Cyclonema, and are traversed with spiral keels, but more numerous and less distinct than in C. australis, and C. lilydalensis. There is also an indistinct appearance of a spiral band about the middle of the whorls. C. etheridgei is like "E. cirrhosa" of the English Wenlock, as figured in Murchison's Siluria, but has much more numerous keels. I have taken the liberty of naming this shell after the celebrated Palæontologist of New South Wales, who has taken so warm an interest in our Victorian fossils, and which I hope may be still continued, notwithstanding the fact that he is an outsider and lives across the border.

The few other shells which I take to be new, shall be passed over with but very slight notice, as time hastens, and there are three other papers to follow. One is a gasteropod shell, a Stomatia, which I have called "*Stomatia antiqua*," because, as far as I am aware, it is the oldest Stomatia upon record. The whorls are somewhat steeper in the sides, and more flattened than Stomatias usually are, and though the spire is broken off in the only specimen I have, it must have been higher than is usually found in that genus, but in all other respects the appearance of the shell is that of a "Stomatia." The whorls are diagonally crossed with very numerous lamellæ-like lines of growth. The shell is one and a half inches long, and one inch wide. Then there are *two small species of "Pleurorhynchus, or Conocardium"*— lamelli-branchiate shells belonging to the Cardiidæ, one about half-an-inch long, with nine simple ribs on the anterior part of each valve, and about seventeen on the hinder part, and which I have called "*Pleurorhynchus costatus*." And the other species is about one-third of an inch long, with the body of the shell more oblique to the hinge line, more prettily banded and ribbed than the other species, the ribs being crossed with striæ, and the valves having a distinctly fenestrated appearance at the posterior end. This I have accordingly named "*Pleurorhynchus bellulus*."

There are two other shells that I have not figured on that diagram, but have here to show you. I will pass them over with bare mention, not having yet had time to examine and compare them with other shells. One is a Gasteropod, a *Naticopsis* apparently, which I will call *N. lilydalensis*, if it should turn out to be new; and the other is a lamelli-branchiate shell, an Ambonychia, differing from A. post-striata of Etheridge, and alluded to by Professor Tate, as having a fenestrated ornament on the sides of the valves. If Professor Tate has not already named it, and will forgive my impudence, I will take possession of it in the name of Victorian geologists and call it A. tatei, for I am pretty sure we had found it long before he did.

In concluding, I desire to acknowledge my indebtedness to Mr. D. Mitchell, the owner of the quarry, and also to his foreman, Mr. J. Fuller, for statistical and other information about the quarry; to Mr. G. B. Pritchard, of the Working Men's College, for the loan of fossils; and to Mr. H. J. Stokes, organist of St. John's, Camberwell, for the photographs of the quarry that have been exhibited in illustration of this paper.



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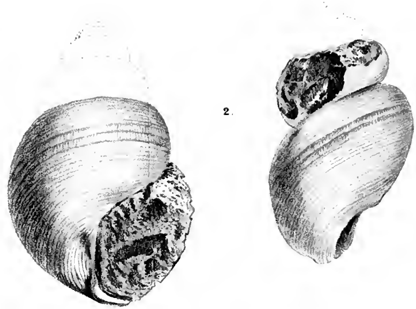

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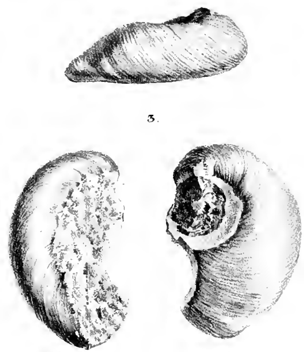

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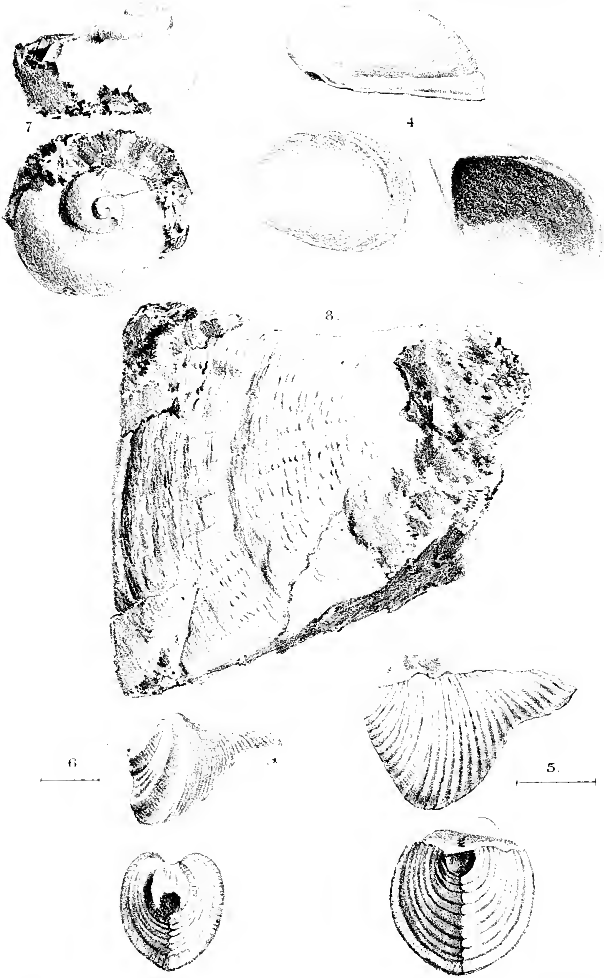

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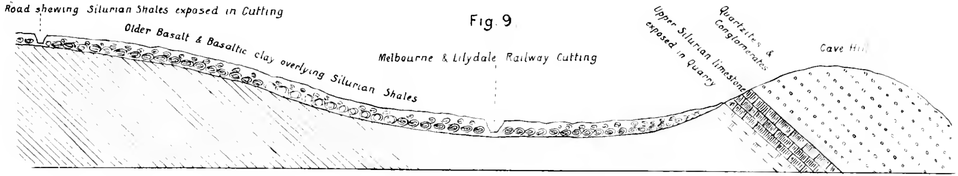
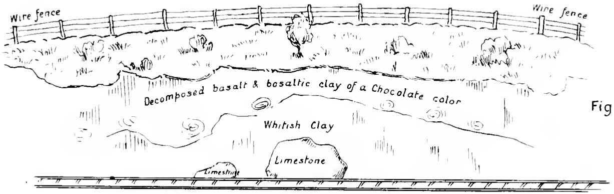
Fig 9



Enlarged Section along A B of Plan length about half a mile.

Fig 10.



View of west side of Cutting of Melbourne & Lilydale Railway about 3/4 of a mile further towards Melbourne than Cave Hill shewing the two bosses of limestone referred to in the paper

Art. V.—*Preliminary Account of the Glacial Deposits of Bacchus Marsh.*

(With Plates X, XI and XII.)

By Graham Officer, B.Sc., and Lewis Balfour,

Melbourne University.

[Read July 14, 1892.]

The subject of glaciation is one that is always of the greatest scientific interest. Its important bearings on the questions of climate, past and present, and on the problems connected with the evolution and distribution of plants and animals, render it a field where the astronomer, geologist and biologist may meet on common ground. The subject has received its fair share of attention in the Northern Hemisphere, in Europe, America, and Asia, but in the Southern Hemisphere, where the evidence of past glaciation is not so conspicuous, comparatively little has been done in this direction. Any evidence of past ice-action in Australia that may be discovered is of peculiar value, on account of its bearing on the question of the probable cause of ice-ages.

The earliest reference to glacial action in Victoria is made by Selwyn in his work on the Geology of this colony. In this, a conglomerate is mentioned as occurring near Bacchus Marsh, and which contained boulders which he and Mr. (afterwards Sir) R. Daintree considered could only have been brought there through the agency of floating ice.

Mr. James Stirling, F.G.S., and Dr. Lendenfeldt, have described evidences of former extensive glaciation in the Australian Alps. To these discoveries reference will be made later on.

Mr. E. J. Dunn, F.G.S., has contributed two papers on the Glacial Conglomerates of Victoria—one read before the Royal Society of Victoria; the other, in which the first is incorporated, before the Australasian Association for the

Advancement of Science at the 1890 meeting. This conglomerate is described as occurring, among other places, at Bacchus Marsh, and is said to consist of material, the great bulk of which is derived from schistose and other ancient rocks and to contain pebbles, boulders and masses of from 20 to 30 tons weight. Granites, gneiss, schist, quartz-rock, sandstone, lydianite, agate, shale, porphyry, and jasper, &c., are said to occur in it. Many of the included stones are striated, and often flattened on one or more sides; others are well rounded, and others again are rough angular fragments. Erratic blocks of granite occur on the surface at Wild Duck Creek, near Heathcote.

Mr. Dunn is of the opinion that "no other conclusion can be arrived at than that floating ice has been the agent by which the material has been brought into its present position." "Much of the material," he says, "is foreign, and many of the rocks are not known to occur at present in this Continent anywhere near Victoria." He also considers the conglomerate at Wild Duck Creek to be very similar to the Dwyka glacial conglomerates of South Africa. Mr. Dunn's description is very general, and the evidence on which his conclusions are based is somewhat vague and wanting in specific detail.

Mr. T. S. Hall, M.A., has also given a short account of these deposits at Heathcote in the "Victorian Naturalist," (Vol. VIII, No. 2). He also considers the beds to be of iceberg origin.

Victoria is divided into two main areas by a continuation of the Australian Cordillera, known as the Main Divide, or Great Dividing Range. This extends from Forest Hill on the east to the Grampians on the west. In the eastern part of the south division we have the South Gippsland and Westernport Ranges, of which the Southern Spur forms a leading feature. West of Port Phillip we have the isolated Otway Ranges. The Main Divide reaches its highest elevation in its eastern portions, Mount Kosciusco being over 7000 feet and several other mountains over 6000 feet above sea level. Passing westwards the elevation gradually diminishes. The average elevation is about 3000 feet, but in some places it sinks to 1000 feet above sea level. The average distance from the coast is about seventy miles. There are three main drainage systems—(1) The Murray System, north of the Divide; (2) The South Eastern or Gippsland System, south of the Main Divide and east of the southern spur; (3) The South Western System, south of the Main Divide and west of the Southern Spur. The Main Divide, according to Murray, is a "longitudinal area of Lower Palæozoic rocks, with granite and trappean intrusions." These may be overlaid by, or flanked by Upper Palæozoic, Mesozoic, and Tertiary deposits.

The Bacchus Marsh district is situated about midway between Melbourne and Ballarat, and thus belongs to the South West Drainage System. The principal streams in the locality are the Werribee and its tributaries, the Myrniong and Korkuperrimul Creeks and the Lerderderg River. The town of Bacchus Marsh is picturesquely situated in a broad extensive valley 343 feet above the sea, and which has probably formed the basin of an ancient lake. On the one side runs the Werribee, and on the other the Lerderderg, the junction of the two streams taking place about a mile below the town. From Bacchus Marsh the country gradually rises to the Dividing Range, only a few miles distant to the north. The rising ground between Bacchus Marsh and the Dividing Range is known as the Pentland Hills.

The so-called glacial conglomerates are well developed in this district and numerous sections exposed to view by the Creeks and various cuttings provide very favourable conditions for their study.

The first section we examined is situated on the Ballarat Road, about three miles on the Ballarat side of Bacchus Marsh, and is at a height of about 750 feet above the sea. The deposit exposed consists of a matrix of clay of a quite unstratified appearance, and of a somewhat variable consistency. It is tough and hard in places, while in others it is softer and less tenacious. The colour is an indefinite patchwork of white, yellow and purple. Through this matrix are scattered irregularly numerous stones of various sizes and sorts, rounded and sub-angular. These stones do not show the slightest trace of arrangement either in size or in position. Some of the stones are waterworn, but many present quite another and distinct appearance. These often show one or more flattened sides, while the edges and ends are frequently rough or sub-angular. Besides these peculiarities many show striated surfaces, the striæ generally running in the direction of the longest axis, but several sets of striæ can often be distinguished. Certain kinds of stones show striæ much better than others.

A hard fine grained argillaceous sandstone varying in colour from a very light to a darker green is the predominating rock-material, and this kind usually exhibits the most marked striations. Another common variety is a blue-black very hard quartzite. These, though commonly exhibiting flattened or facetted sides and angles, seldom show striæ, their surfaces being more often polished.

Granite often occurs though not so frequently as the other kinds of rock. The largest boulders are of this material. One taken from the cutting can be seen lying at the side of the road, which is well flattened on one side. The granite is generally considerably decomposed. At the top of the cutting a large angular fragment of sandstone occurs, while another piece can be seen at the base; whether the latter is *in situ* or not we have not yet determined.

The unstratified nature of this deposit, together with the peculiar nature and want of arrangement of the included stones, at once stamps it as of glacial origin.

A few feet back from the top of the cutting on the south side, an outcrop of white silicious sandstone occurs. We are inclined to think that the glacial deposit is banked up against this, really overlying it.

A short distance below the cutting a small lateral road joins the main one, and on this road, a hundred yards or so from the junction, another cutting exposes a good section. The material exposed is similar to that just described, but is of a more uniform purple colour. It is also somewhat harder. It is quite unstratified and contains numerous well striated stones. On the surface, on both sides of this cutting, glaciated stones are scattered about in great profusion and variety. This deposit apparently overlies sandstones and is continuous with that exposed on the main road.

Before making our next visit to the locality, we wrote to Mr. Charles Brittlebank, of Dunbar farm, near Myrniong, who, we were led to believe, could give us information in our researches. Mr. Brittlebank readily responded, and during our subsequent visits has rendered us much valuable aid. He has accompanied us on most of our expeditions and shown us much hospitality, while his intimate knowledge of the locality, as well as his keen powers of observation, have been of the greatest assistance to us. Mr. Brittlebank informs us that he found glaciated stones in this district four years ago. He thus appears to have been the first to actually prove the glacial origin of the deposits in question.

The valley of the Myrniong Creek for some little distance above its junction with the Werribee is cut through basalt and sandstones and conglomerates to a depth of over 600 feet. Good sections are exposed along this valley.

On the south side, about half a mile above the confluence of the two streams, a depth of over 100 feet of a material similar to that described on the Ballarat Road is exposed. It consists of a mass of yellowish white clay, quite unstratified, and in texture somewhat soft on the weathered surface, but much harder on being penetrated. Numerous stones of all sorts and sizes, from mere grit to boulders several feet in diameter, are scattered irregularly, and without any trace of arrangement throughout this clay. Among these stones, the principal varieties are those occurring in the cutting on the road already described. Chiastolite and other varieties of slate were found, together with quartz, bits of jasper, and a hard, red quartzitic sandstone. Most of these stones are sub-angular, often showing one or more smoothed and flattened surfaces, while the edges and ends are roughly angular; many are well striated and grooved in a characteristic manner. On some large boulders lying at the base of the cliff, the striæ and grooves are exceptionally well developed. This deposit can be traced up the valley for about a quarter of a mile above this point, when it thins out, and is seen to overlie and flank the sandstones through which the valley has been worn. It is overlaid by basalt known as the newer volcanic, and assigned to Pliocene age (Fig. 1).

On the other side (north) of the Myrniong Creek, but nearer its junction with the Werribee, the glacial deposit is again well shown to a depth of about 150 feet. It is much the same as that on the opposite side of the valley, and striated stones are numerous. This extends to within 200 yards or so from the junction of the two streams. It can be traced over the brow of the valley up to about the level of Mr. Brittlebank's house, about 350 feet above the Creek, and about 1100 feet above the sea. It then spreads out over the surface.

It would seem evident then, that the valley now occupied by the Myrniong Creek at this point at any rate is a very ancient one, and was at one time probably almost filled up by this glacial conglomerate. The sandstones and conglomerates through which the valley is worn, were set down as Upper Palæozoic by the Geological Survey; then, on the discovery of three species of Gangamopteris, Professor McCoy assigned them to Triassic times. Last year, more fossils were obtained. These were somewhat fragmentary, but Sir Frederick McCoy thinks he can identify Schizoneura and Zeugophyllites, indicating a lower Triassic age for the rocks in question.

After the glacial material had been deposited in this ancient valley, it was overflowed by basaltic lavas of Pliocene age. Whether the older basalt of Miocene times also overflowed this valley previously to the former, we cannot say with certainty. We have seen no evidence of it at any rate. Since Pliocene times the valley has been again denuded to its present condition.

From the general characters presented by the so-called glacial conglomerates, we were much inclined to the opinion that they would turn out to be, not an iceberg-drift, but in reality till, or boulder-clay—in fact the ground moraine of ancient glaciers. These characters may be summed up as follows:—(1) The unstratified nature of the clayey matrix. (2) The number and variety of the included stones. (3) The striated and glaciated aspect of many of these stones. (4) Their total want of arrangement. In fact, these deposits bear such a striking resemblance in every way to the till of Scotland and elsewhere in the Northern Hemisphere, that it can hardly be doubted that they are of similar origin. Corroboration was therefore to be sought for in the shape of roches moutonnées, or shattered rock surfaces beneath this deposit.*

In the valley of the Myrniong Creek, opposite the section described as occurring on the south side, can be seen rounded, hummocky-looking masses of sandstone, the appearance of which is very suggestive of glacier action. It is very probable that the glacial conglomerate not long since covered these rocks, and thus protected them during a long period from the effects of weathering. It must also be remembered that the glacial conglomerate itself must have been protected for a considerable time by the basalt. The sandstone is hard and massive, and is just the kind of rock on which the abrading and rounding effect of glacier ice would be well represented. Certainly, striæ and grooves are absent, but

* Having had opportunities of observing the till and other phenomena of glaciation in Scotland, Ireland, and Switzerland, I can vouch for the striking resemblance of our glacial deposits to the boulder-clay of the Northern Hemisphere.—Graham Officer.

these may have weathered away. In many parts of the Scottish Highlands, where the whole country shows the rounded and flowing contour characteristic of ice-action, it is often very difficult to find actual scorings and grooves.

Some little distance further up the Creek a section has been exposed by the stream, showing some feet of a hard unstratified material containing striated stones. This was much harder than any we had previously examined, and was traversed by joints. It was seen to be clearly overlaid by sandstones, the junction between the two being very distinct, there being apparently an unconformity. Here a fault occurs through the sandstones and the underlying material, the displacement being about seven feet, and the hade at a high angle. There would seem to be no doubt that the overlying sandstones are continuous with the surrounding ones, which, as we have seen, are probably Triassic. So now it seemed probable that we had to deal with two glacial deposits.

At the junction of the Myrniong and Werribee, the latter stream is seen to be flowing over the highly inclined and sorely denuded edges ot Lower Silurian rocks, here consisting of very hard, fine-grained, well stratified sandstones. On the weathered surface the colour of these is of a patchy yellow rusty colour, but on the fractured fresh surface they are of a light greenish white, or light slaty white colour. On proceeding up the Werribee from the junction, we found ourselves walking over another kind of material, which was seen to rest unconformably on the Silurian rocks, which it closely resembles in colour. The Creek has cut its way through this to the Silurian, so that on the floor of the river course one walks now on a few feet of Silurian, and now on this other deposit, while sections are exposed on both sides of the stream. This deposit consists of an exceedingly hard clayey material, through which are scattered stones and boulders of considerable size, of granite, quartzite, fine-grained hard sandstones (very similar to the underlying Silurian), and quartz. Nearly all these present the flattened sides, and striated and grooved surfaces characteristic of ice action. The stones and boulders at this point are very numerous, and the scorings and scratchings exceptionally well developed. This conglomerate resembles those already described, in the absence of any appearance of stratification, the character of the included stones, and the total want of arrangement of the latter. In fact, it cannot be distinguished from boulder-clay or till. However, it differed from those we had yet examined, except the last described, in being so excessively hard and tough, and in being traversed by numerous joints. Till one has actually tried, it is impossible to give an idea of the difficulty of extracting a stone from this material, which will only come away in small angular fragments, in a manner that is peculiarly exasperating. On the north side of the Creek, a short distance from the junction, a section of a similar deposit is exposed, which presents a somewhat stratified appearance; striated stones occur irregularly through this, but they are not so numerous as on the opposite side of the Creek. The appearance of stratification presented may possibly be due to pressure. It is overlaid by basalt.

On proceeding up the Werribee a few yards further on the south side we found a small cliff, where the junction of the conglomerate with the underlying Silurian could be well seen in section. Here was a place where, if the conglomerate were a true till, we might expect to find the underlying rock smoothed and striated, or else shattered. The section exposed showed the Silurian rocks rising in a hummocky way, and closely overlaid by the conglomerate. A closer inspection revealed a certain rounded and facetted appearance, that was very suggestive of ice action. Having found a place where the overlying deposit was thinner than usual, we resolved to clear away a portion, and after some difficulty and hard work succeeded in laying bare a portion of the rock below. We were amply rewarded for our trouble. The Silurian rock presented in a beautiful manner a well smoothed and striated surface, with deeper parallel grooves, all running in a north and south direction, and of the glacier origin of which there could be no doubt whatever. The Silurian strata here dip west, at angles of from 50° to 60°. So it will be seen that the strata are cut across at right angles to the dip, in fact in the direction of the strike. It is quite impossible that this can be due to the action of the Creek, or indeed to the action of water at all. The striæ and grooves point right across the Creek. The contiguous portions of the overlying deposit, when removed, were found to retain perfect mouldings of the grooves and striæ beneath.

This striated and grooved rock surface, taken in connection with the nature of the overlying deposit, leaves no room for doubt as to the glacier origin of the latter, and that it is a true till, or moraine profonde. This till can be traced down the Werribee to its junction with the Myrniong Creek, and a little way beyond on the latter Creek. It here is apparently overlaid by the Triassic rocks. With heavier tools than we had at our disposal, and a little more time, it would not be difficult to remove more of the till from the underlying Silurian, and thus lay bare more of the moutonnée surface.

A few days after this discovery, we received a letter from Mr. Brittlebank, stating that he had found a further example of roche moutonnée at the lower end of the Werribee Gorge, nearly two miles below its junction with the Myrniong. On our next visit, we accordingly proceeded to the spot, and examined the rocks in question.

The Gorge has been cut to a depth of over 600 ft. through a mass of Silurian rocks, flanked by the Triassic sandstones and conglomerates, the former having formed a ridge or island in the Triassic sea or lake (Fig. 1). The Silurian rocks here consist of slates, finely laminated shales, and hard quartzitic sandstones; quartz veins are frequent, and a dyke of porphyry also occurs. The strata are inclined at the usual high angles, being often almost vertical.

At the place indicated by Mr. Brittlebank we found the till again overlying the Silurian. Here, it presents much the same appearance as that last described, glaciated stones and pebbles being frequent. At this point, at a spot where the till was only about a foot thick, Mr. Brittlebank had laid bare a portion of the underlying rock. An example of roche montonnée was thus exposed to view, which was even better than the one first discovered. More of the overlying deposit was now removed, and a greater surface of the underlying rock uncovered, this being an operation of some difficulty. The surface exposed presented the appearance of three smooth parallel ridges, well scored and striated, with well rounded grooves six or more inches deep between. Here, as before, the striæ and grooves run north and south, in the direction of the strike, and right across the river (Pl. XI). In several places, the rock has been fractured at right angles to the groovings. Photographs of these were obtained. This was by no means the only spot in this locality where roches moutonnées were found. A short distance further up the Creek can be seen a rounded hummock of Silurian rock, which has been denuded of the overlying till. The effects of weathering have obliterated all striæ and grooves, but the rounded contour still remains. In several other places small portions of the till were removed, and a striated and grooved surface invariably exposed, the direction of the striæ being still constant. The till here is about ten or twelve feet in thickness, and is distinctly overlaid by the Triassic rocks. On the opposite side of the river (south side), a good section is exposed. The till is again seen resting on the Silurian rocks, which here also, as seen in section, appear to have been subjected to the action of ice (Pl. XII). The strata are nearly vertical. The till here is seen to thin out, forming a wedge-shaped mass. It is overlaid by the Triassic rocks which, below the lower end of the wedge, rest directly on the Silurian. The till and overlying formation extend a short distance up the Creek from this point, when they terminate against the uprising ridge of Silurian strata.

There would seem to be little doubt that the Triassic rocks overly the till unconformably. It will now be seen that there are two distinct glacial deposits. Of these, one is overlaid by the Triassic sandstones and conglomerates, and is undoubtedly an ancient till, or moraine profonde; the other overlies the Triassic rocks and is similar to the lower till, except that it is not so hard nor so traversed by joints, which is hardly a matter for surprise.

Numerous well striated stones and boulders are scattered over a great part of the surface between the Ballarat Road and the Myrniong and Werribee streams, up to an elevation of over 1100 feet above the sea. These stones can be traced flanking the ridges that overlook the Werribee. At a point opposite the Gorge, at the lower end, the stones are especially numerous and very well striated. In addition to the commoner varieties, a hard semi-crystalline sandstone, of a dark pink colour, occurs. The stones here overly the Triassic sandstones, and can be traced along a small lateral gully right down to the Werribee. The deposit from which they come is exposed at various points along this gully, and is quite similar in its unstratified nature, and in the irregular arrangement of the included stones to that described before. In places it presents a very hard texture, sometimes somewhat resembling the till below the Triassic rocks, in other places it is softer, but in several places where its junction with the underlying sandstones could be seen, it was so invariably hard and thick that we could not clear any away so as to expose the underlying rock. However in places, as seen in section, the latter presented a rounded appearance that was very suggestive of ice action.

At the intake of the Bacchus Marsh water supply on the Werribee, about a mile below the Gorge, where the valley is very broad, a splendid section of a till-like deposit is exposed; there being over 70 feet. The matrix is a yellowish-white clay, very tough and hard, and stones and boulders of the usual kind are scattered through it in a pell-mell fashion, with no trace of arrangement. There is no stratification, but irregular bands occur here and there, sometimes lenticular in form. These bands are in some cases of a fine sandy material; others consist of minute angular fragments of much the same nature as the rest of the deposit, but coarser. These bands are only about eighteen inches or two feet in thickness, and seem to have been formed by the intermittent action of running water. Similar bands and lenticular patches of sand and other material occur frequently in the till of the Northern Hemisphere, having been formed by the action of sub-glacial streams. We have not yet been able to determine definitely the relations of this deposit, but from its nature and position, as well as its great thickness, we incline to the opinion that it belongs to the upper glacial deposit. It occurs again about half a mile further down the river, where good sections of it are exposed. It here does not contain nearly so many stones, while those that do occur are generally small, otherwise it is similar to that last described. We have not found the deposit between this point and Bacchus Marsh along the Werribee.

About four miles up the Korkuperrimul from the bridge on the Ballarat Road, a glacial conglomerate is again met with containing numerous typical glaciated stones. The matrix is exceedingly hard and devoid of stratification. In places, when looked at from one point of view, an appearance of a somewhat irregular stratification can be seen. However, a more careful examination reveals the fact that what are apparently lines of stratification, are in reality curved division-planes, which are probably due to shearing stresses. At one place in this section a departure from the usual irregular disposition of the stones may be observed. The stones are arranged in a sloping fashion, along an inclined plane. This arrangement is sometimes met with in the till of the Northern Hemisphere. At this place also a boulder, about eighteen inches long and somewhat pear-shaped, can be seen resting in the matrix in a vertical position. Now, if such a boulder were dropped from an iceberg, we might expect it to remain in an upright position in the soft clay, but if so, we should certainly expect to find the clay indented beneath it. Of this, there is not the slightest indication.

A little further up the Creek another section is exposed. Here our till-like deposit rests on massive sandstone, but we were unable to remove sufficient of the former in order to expose the surface beneath. At one point, however, a somewhat remarkable feature occurs. In the sandstone is an oblique gap about four or five feet deep, as if a block had been torn out. This cavity is filled with the overlying material, and two or three flattened and striated stones rest on its lower *side* (not *bottom*). It is difficult to conceive how icebergs could have deposited stones in this manner, while on the other hand it is readily explained on the glacier theory.

The locality between this place and the large quarry, about two miles further down the Creek, we have not yet examined. Between this quarry, situated on the north side of the Korkuperrimul, and the bridge on the Ballarat Road, the valley in which the Creek flows follows approximately the axis of what has once been an anticlinal fold of the Triassic sandstones. Opposite the large quarry, the valley is a little to the right of this axis. Between this large quarry and the Creek, striated stones are numerous. A small lateral gully exposes sections. One of these shows a somewhat loamy clay, in which are irregularly imbedded large angular fragments of sandstone, in appearance very like the underlying rock. Large granite boulders, quartzite, slate, quartz, and fragments of jasper also occur, many showing flattened and striated surfaces.

On the Creek opposite the quarry, a cliff of about 60 feet of the glacial deposit is exposed. It is very similar to that described on the Ballarat Road. It rests on sandstones, the broken ends of which can be seen protruding from the base of the deposit, which towards the top, presents a somewhat stratified appearance. On the opposite side of the Creek, high cliffs of basalt (newer) occur. This has evidently filled up the valley at this place, probably covering the glacial deposit and having since been denuded away to its present state.

Several hundred yards further down the Creek, on the right hand side, a section exposed shows a few feet of an unstratified material bearing striated stones, and overlaid by very irregularly stratified tumultuous-looking sandstones. These sandstones are very probably simply beds associated with the glacial deposit. This is indicated by their tumultuous appearance, and by the fact that we found several well scored stones in them. Moreover, a small patch of a material similar to that beneath occurs intercalated with them. The basalt is banked right up against this, the line of junction being almost vertical. The whole mass probably formed a ridge in the valley at the time the basalt overflowed it. Striated stones can be traced for about a third of a mile further down this valley, on the right hand side, being overlaid by basalt (Fig. 2) The characteristic stones of the glacial deposit can be traced along the hills flanking the valley on the left. At one spot, between the big quarry and another smaller one further down the valley, a conglomerate occurs, which consists of a loamy matrix, in which are scattered angular fragments, in all positions, of soft sandstone. This rests on the denuded edges of well stratified Triassic sandstone, from which the fragments have apparently been derived.

Some distance further on, a small quarry occurs in the Triassic sandstones, which here dip E.S.E. about 35°. The glacial conglomerate can be traced to about 200 feet above the Creek, and in the quarry can be seen in section resting on the sandstones to a depth of about five feet. On the left hand side of this section, the junction is very marked, while tracing it to the right, it becomes very indefinite by the disintegration of the sandstone. This section is at right angles to the dip. At the same quarry, another section is exposed at right angles to the former. This exhibits remarkable and important features. Beginning at the lower end of the section, a pell-mell accumulation of rough angular and rounded blocks, up to eighteen inches and two feet in diameter, embedded in a loamy matrix, is seen overlying soft purplish stratified clays or shales. The latter are much broken up and disintegrated at their junction with the overlying deposit. Angular blocks of sandstone in every conceivable position are mixed up in the ruin, and in fact a definite junction it is almost impossible to distinguish. Further along the section, this mixed material merges into a purplish mass of clay, overlying broken and shattered sandstones. (The shales and sandstones are of the same formation.) This purplish clay, which is evidently derived from the shales, presents the appearance of having been pushed over the sandstones, angular blocks of which are scattered through it. A little further along, a large irregular fracture in the sandstone occurs, being seven or eight feet deep. This is literally stuffed with stones and boulders of the various kinds met with in the glacial conglomerate. Many of these show flattened and striated surfaces. A granite boulder, over a yard in diameter, is jammed into the bottom of this fracture, while broken and angular fragments of the sandstone are also scattered through it, the whole being imbedded in a loamy clay-like material, which seems to have been squeezed into the fracture (Fig. 3). At several other sections exposed in this quarry, similar appearances can be noted. The sandstone has been fractured, and the glacial material literally injected into the cracks and fissures. Several striated stones were picked out from one of these fissures.

It will be seen that, as in the case of the Myrniong Creek, the glacial deposit lies in an ancient valley of denudation. It was probably overflowed by Pliocene basalt, which would thus be the means of protecting the underlying formations during a considerable period. We could not find any more traces of the glacial material between this place and the Werribee.

This concludes the evidence we have so far collected, and it all points irresistibly to the conclusion, that glacier-ice has been the agent by which the effects described have been accomplished. No iceberg theory will account for the facts presented at the quarry. How will such a theory account for the fracturing of the underlying rocks, and the ramming of the fractures with large erratic boulders and the material in which these boulders are imbedded? On the other hand, these are facts which are readily explained on the glacier hypothesis. In the Northern Hemisphere shattered surfaces are frequently met with below till. In his "Great Ice Age," p. 16, Prof. James Geikie says:—"Soft sandstones and highly jointed rocks . . . often show a broken and shattered surface below till; sometimes, indeed, thick sandstones appear 'broken up' to a depth of many feet below boulder-clay, the coarse angular débris shading gradually into till of the normal type." This corresponds exactly with the features presented at the quarry, where the sandstones are soft and easily disintegrated. Cases in Scotland and elsewhere in the Northern Hemisphere are not uncommon, where the shattered surface of the underlying rock is "stuffed" with erratic stones and boulders.

The conclusion, then, to which we are led is, that the deposits we have been considering constitute a true till, or moraine profonde. This is borne out by further considerations. It is worthy of note, that the stones occurring in this till, at the quarry we have been speaking about, are not nearly so well striated as those occurring in the region of the Werribee Gorge. In the former case, we have seen that the underlying sandstone is very soft, and would not striate stones well; on the other hand, the underlying rocks in the region of the Gorge are much harder, consisting to a great extent of conglomerates, just the kind of rocks that would produce marked scorings on the stones of the till.

These are specific evidence against the iceberg theory. There are also more general arguments. These arguments have been used before to refute the iceberg hypothesis of the origin of the boulder-clay in the Northern Hemisphere, and they apply equally well here.

Mr. Dunn describes the so-called glacial conglomerate, besides being found at Bacchus Marsh, as occurring on both sides of the Dividing Range, at Wahgunyah, Rutherglen, The Springs, El Dorado, Wooragee, Tarrawingee, Baddaginnie, at various points on the road between Wangaratta and Kilmore, north east of Costerfield, Wild Duck Creek (west of Heathcote), underlying the auriferous deposits at Carisbrook and Creswick. South of the Dividing Range, it is met with about four miles east of Gordons, Barrabool Hills, and near Foster in South Gippsland. Thus it will be seen that the deposit is widely distributed, and it appears to be of considerable thickness, being over 100 ft. in several known instances.

It has been shown (Croll, "Climate and Time;" Geikie, "Great Ice Age," &c.), that the amount of material carried by icebergs is quite inconsiderable, and what is carried generally consists of rubbish and angular blocks that have fallen on the surface of the parent glacier. In the case of the ice-sheet that is at present desolating Greenland, the surface of the ice is very free from débris of any kind, and so it is quite a rare thing to find an iceberg shed from one of the vast glaciers of that country bearing any material at all. Yet a tremendous amount of erosion must be going on, and the eroded material is being accumulated beneath the ice as a moraine profonde, although prodigious quantities must be carried away by sub-glacial streams. Dr. Wright ("Ice Age in North America") calculates that from the great Muir glacier in Alaska over $33\frac{1}{4}$ million cubic yards of sediment is annually carried away by sub-glacial streams. Little, if any, of the sub-glacial material can be carried away by icebergs—a few stones, perhaps, frozen into the bottom of the bergs. The finer material carried away by streams from beneath these great glaciers must inevitably be stratified, and well stratified, as the quantity of material brought down must vary considerably from time to time. Even if much fine matter were carried by icebergs, it would inevitably be re-assorted by the water; the stones, too, would assuredly show some trace of arrangement.

In the deposits we have been considering, the absence of stratification and the total want of arrangement of the included stones, are their chief and most striking characteristics. Then again, in the great mass of the sections we have examined angular fragments are comparatively rare, except as we have seen, where the till rests on the underlying rock. So here again, we have a strong argument in favour of the glacier theory.

Further, these deposits are found up to a height of 1400 ft. at Ballan; so, to account for them on the iceberg theory, we would require a submergence of at least 2000 ft. to allow icebergs to float, and as icebergs can only transport material from higher to lower levels, it is quite impossible to account for the mingling of fragments of the underlying rock in the overlying till, at an elevation not exceeding 800 ft. above the sea. Besides, such a submergence would considerably diminish the area from which the deposits could be derived, and their extent indicates a large surface. Again, such a submergence would tend to produce climatic conditions which would be quite opposed to the production of glaciers, even were the astronomical conditions favourable. It must also be observed that, so far as we have seen, these deposits are quite unfossiliferous.

Mr. Dunn states that much of the rock material occurring in the till is not known at present to occur *in situ* on this Continent anywhere near Victoria. Daintree remarks that a granite occurs in the formation at Bacchus Marsh, which he had not observed south of Queensland. However, as he has not described this granite, it would be difficult now to identify it. We would reply to this that further search will probably reveal the sources of this material. The geology of Victoria has not been so fully worked out as to warrant us asserting that a certain kind of rock does not occur *in situ*. Then again, it must be remembered that these deposits are anterior—as we shall show—to the Miocene and Pliocene lava flows, and probably to the Miocene leaf-beds, so that, not to speak of the effects of denudation, a a great deal of the then rock surface is now concealed.

Of the various kinds of rock met with in the till in the Bacchus Marsh district, the great majority are derived from Silurian rocks, which form the main part of the Dividing Range. In the Werribee Gorge several kinds of slate occur, which are identical with slates found in the till. Quartz veins are also numerous in the Silurian rocks. We also noted a quartzitic sandstone in the Gorge, which is very similar to fragments found in the till. Several varieties of quartzite occur in the till which we have not yet seen *in situ*, but we have not yet examined the Ranges to the north, and it is very probable they will be found there as quartzites frequently occur in the Silurian. Fragments of schistose rocks have also been observed in the till, and these occur *in situ* to the north.

Several kinds of granite occur in the till. Granite is found *in situ* in the locality, and among the granite boulders some occur that seem identical with this granite. A very coarsely crystalline variety is also met with, the crystals of felspar being sometimes over an inch in length. Though we ourselves have not seen this in place, yet the Geological Survey report a granite with very large crystals of felspar as occurring in this locality. Pegmatite and aplite also are found in the till. As both of these may occur as veins in other granite, it would not be surprising if they have been overlooked. It is not unlikely even that they may be now concealed beneath the basalt that is well developed in this district.

Summing up, then, the results of our investigations, it would appear that two main points are clearly brought out. The first of these is, that there are two distinct glacial deposits; and the second, that both of these deposits are due to glacier ice, and not to icebergs—in fact, both being moraines profondes. Both are of similar character, except that the lower one is more indurated and jointed. Of these, the latter has been seen to closely enwrap the smoothed, grooved, and furrowed surfaces of Silurian rocks, of the glacier origin of which there can be no doubt. It is useless at this stage of geological inquiry to maintain that icebergs can produce roches moutonnées. A full discussion of this point may be read in Dr. Croll's "Climate and Time," Geikie's "Great Ice Age," and in "The Labrador Coast," by Dr. Packard. In connection with the upper till, though no undoubted roches moutonnées have yet been met with, yet, as we have seen, shattered rock surfaces below the till are found, which may be said to be quite as characteristic of the action of glacier-ice as a smoothed and moutonnée surface.

It now becomes a most important and interesting question to determine the respective ages of the two tills. It seems certain that we must look to astronomy for the explanation of ice ages. Dr. Croll's celebrated theory has, until now, notwithstanding considerable adverse criticism, been the most satisfactory explanation offered. Recently, however, Sir Robert Ball in his little work "The Cause of an Ice Age," has re-stated the astronomical theory, pointing out an error made by Croll. It would be beyond the scope of this present paper to enter into a discussion on the cause of ice ages, it will suffice to say that Sir Robert Ball has stated the case with great force and clearness. The theory as it now stands shows that when the astronomical conditions for the production of extensive glaciation arise, then we have a period during which several glacial epochs alternate with genial epochs between the two hemispheres, the length of each epoch being 10,500 years. The conditions for this state of things then gradually disappear, and do not occur again till after the lapse of long ages. Sir Robert Ball says he makes no attempt to state the date of the last glacial period, nor to say when the next is to take place. So, according to this theory, using the term "period" to embrace several glacial and genial "epochs," we should expect to find evidence of glaciation in both hemispheres during the same period, though not necessarily to the same extent, for of course the astronomical conditions for glaciation are liable to considerable modification by the existing distribution of land and sea, and the elevation of mountain chains.

Now, taking the case of our lower till first, we have seen that it is overlaid (apparently unconformably) by rocks which have been assigned to Lower Triassic age. In the Permian Period in the Northern Hemisphere, there are clear indications of a glacial epoch or epochs. In England, Dr.

Ramsay describes "brecciated conglomerates," consisting of "pebbles and large blocks of stone, generally angular, imbedded in a marly paste." Many of these stones are as well scratched as those found in modern moraines, or in boulder-clay. Similar boulder-beds occur in Scotland, Ireland, and Germany. Mr. Wallace ("Island Life") states that these physical indications are corroborated by a consideration of the life of the period, which is characterised by its poverty. In India, similar Permian boulder-beds occur, in which large striated stones and boulders are found. In one instance, the rock surface beneath this deposit was glacially scored and striated. These beds have been correlated with similar ones in South Africa, also of Permian age. Mr. G. W. Stow has, according to Dr. Ramsay, given elaborate accounts of these South African boulder-beds. He says that in Natal the great masses of "moraine matter" not only contain ice-scratched stones, but the underlying rocks are well rounded and mammilated, and covered by "deeply incised glacier grooves" in a direction that at last leads one to the pre-Permian mountains, whence the stones forming the moraines have been derived. In Natal, the striated rocky floor is only 30° south, and in India, only 20° north of the equator.

That evidence of severe glaciation should be found in the same period in both hemispheres, and so near the equator—being actually within the tropics in one case—is a strong argument in favour of the astronomical theory, betokening a much wider cause than mere local elevation. This being the case, we might expect to find traces of a glacial period during Permian times here in the more southern parts of Australia. The position of our lower glacial conglomerate, or till, is quite compatible with its being of Permian age, and when to this we add the considerations just noted, this conclusion is much strengthened. There is a strong break in the flora at the close of the Permo-carboniferous series in New South Wales (Prof. David, Address A.A.A.S., 1890). It is possible that this break may correspond with a Permian glacial period.

Now, as regards our upper till. We have not as yet been able to arrive at any very definite conclusion as to the age of this deposit. As we have seen, it lies on the denuded surface of the Triassic rocks, and is certainly overlaid by the Pliocene basalt. That it is also overlaid by the older basalt admits of little doubt, for although this basalt occurs in the locality, yet we have never found a trace of any volcanic material in the till. The same reasoning applies as to its relation to the Miocene leaf-beds that are well developed in the district. These beds consist for the most part of hard clay-ironstone, in which leaf and plant impressions are very numerous, and as a rule exceedingly well preserved. As we have not found any fragments in the till that in any way resemble the material of these beds, it seems highly probable that the upper till is pre-Miocene.

In Europe, we have evidence of glaciation in Eocene times. In the "Flysch" of Switzerland, huge erratics occur. One of these measured 105 ft. in length, 90 ft. in breadth, and 45 ft. in height (Croll, "Climate and Time," p. 305). Although the Eocene fossils, both in Europe and Australia, indicate a mild climate, yet, as has been pointed out by Croll and other eminent authorities, the life of a glacial epoch would be characterised by negative conditions. As it is of the very essence of the astronomical theory of ice-ages that glacial alternate with genial epochs, it is only to be expected that the life of the genial epochs would be the more likely to be preserved. So it is possible that out upper till is Eocene; this, however, we merely throw our as a suggestion, in the absence of any further evidence at present. Considering the great amount of erosion that took place in Upper Mesozoic and early Tertiary times, it seems improbable that this deposit is earlier than Eocene.

Mr. Stirling and Dr. Lendenfeldt have described undoubted evidences of glaciation in the Australian Alps. These gentlemen found glaciated surfaces on Mt. Cobberas at elevations between 6000 ft. and 4000 ft. above the sea, on Mt. Pilot, and on Mt. Kosciusco. Erratics of huge basaltic boulders occur in "linear extension for miles" in the Reewa River and Snowy Creek valleys, the nearest basaltic outliers being twenty miles away. Perched blocks of hornblende porphyrite occur on "crests of spurs and sidelings" in a regular descending series from near the summit of Mt. Bogong towards the Reewa valley, many of them resting on smoothed surfaces of pegmatite. Moraines occur at the base of Mt. Bogong, at 1000 ft. above sea level. Similar evidences of former glaciation have also been described by Mr. Stirling as occurring in the Livingstone valley, Parslow's Plains, and elsewhere in our Alpine regions.

There would seem to be no doubt that the glaciation indicated by these evidences in the Australian Alps is of much more recent age than that represented by the upper till at Bacchus Marsh. The presence of erractics of basalt, in "linear extension" along the valleys and on the slopes of the Alps is sufficient to show this. Dr Lendenfeldt considered that this period of glaciation only terminated between 2000 and 3000 years ago, but, as Professor Hutton has shown, there is no evidence to sustain this. Professor Hutton has expressed the opinion that there was no evidence to indicate that the Southern Hemisphere had ever had a glacial period. That glaciers had formerly existed in the Australian Alps, he has explained on the hypothesis of a local elevation of the Alps, to about 3000 feet above their present level. Now this glaciation took place since Miocene times, as is shown by the basaltic erratics. Mr. Stirling has assigned it to the Pleistocene Period. It is impossible that it can be earlier, for if it were, the erractics would have long ago disappeared from their positions on mountain sides and spurs.

During the Pliocene Period we have evidence, in the distribution of marine gravels, of a submergence of nearly 1000 feet below the present level, and since then the land has gradually risen to its present condition (Murray). In his address to the Biological Section of the A.A.A.S., at Hobart, Professor Spencer says:—"We must conclude from the mammalian fauna, that there has been no absolute land connection between South-east Australia and Tasmania since practically the end of the Tertiary Period or early in Pleistocene times, as otherwise it would be impossible to account for the absence, not only of the dingo, but of the large and specialised diprotodont fauna, of which the Pleistocene Period saw the rise and fall upon the mainland." From the evidence supplied by raised beaches, and by the great depth to which many of our river channels have been cut, it is apparent that the land has been gradually rising for a considerable period. It is thus pretty certain that, since the beginning of Pleistocene times, the land surface has never stood higher, relatively to the sea, than it does now, and in Pliocene times, as we have seen, there was a submergence of nearly 1000 feet below the present level.

If denudation has been the means of reducing the height of our Alpine regions by about 3000 feet since the last glaciation took place, then it would be quite impossible for lines of erratic boulders and perched blocks on mountain spurs to be preserved. Many of these, according to Mr.

Stirling, even yet show striated and grooved surfaces. If the mountains had suffered much denudation, the striæ and grooves would certainly have been removed and roches moutonnées would have vanished—except where protected by overlying deposits—long ago.

So then, seeing that the theory of greater elevation cannot be sustained, we must look in another direction for the explanation, and we have the astronomical theory at hand. According to this theory, we should expect to find evidence of a Pleistocene glacial period here, corresponding with that of the Northern Hemisphere. As we have seen, this is the period to which Mr. Stirling has referred this latest glaciation of the Australian Alps. As eminent authorities have already observed, in trying to realize the probable effect of astronomical conditions favourable to glaciation in the Northern and Southern Hemispheres respectively, the great proportion of sea to land that now obtains in the south must always be borne in mind. The effect of this, in the present distribution of land and sea, would undoubtedly be to mitigate these conditions. In Pleistocene times, there is no evidence to show that our mountains were appreciably higher than now; it seems more probable that our land surface stood actually lower. So that the astronomical conditions which, during this period, resulted in producing such a severe glaciation in the Northern Hemisphere, were probably so mitigated in the Southern Hemisphere that glaciers only appeared in the higher mountains.

Mr. G. S. Griffiths, in a paper on the "Evidences for a post-Miocene Glacial Period in Victoria," describes heavy boulder washes, distributed in many parts of the Colony. These "washes" are ascribed to glacial action. Though the evidence for this is not conclusive, yet it is by no means improbable that these heavy deposits of boulders—many of them basaltic—were formed at the period of the last glaciation of the Alps, when the precipitation was much greater than now. The Dividing Range, except in its eastern parts, not being high enough for the production of glaciers, in the short hot summers of the epoch vast floods from melting snow swept down from the mountains, swelling the rivers and depositing these boulder beds.

At the two earlier periods of glaciation we have indicated, it is not improbable that there was a greater southward extension of land by way of Tasmania than now obtains. In Upper Palæozoic times, the Main Divide must have stood many thousand feet higher than it does now. In Eocene times, though enormous denudation had then taken place, this mountain chain must have been very much higher than now. Under these conditions, the glaciation during an ice age might be of considerable severity.

We would thus appear to have evidence of three periods of glaciation in Australia, which may be provisionally assigned as follows:—(1) One in Permian times, of considerable severity; (2) one in Eocene times, also severe; (3) one in Pleistocene times, mild, being represented only by glaciers in the higher mountains. At these periods then, it would appear that the Dividing Range nourished great glaciers which radiated outwards, and, in the two earlier periods at least, spread to some distance over the lower ground. Beneath these glaciers the till, or glacial conglomerate, was accumulated as a ground moraine.

Undoubted evidence of glaciation has been adduced by Professor Tate and Mr. G. B. Pritchard from South Australia, and traces have also been noted in Tasmania, although Mr. Johnston remarks ("Geology of Tasmania") that there is no evidence there to show that a glacial period has ever taken place. However, it will seem strange if further evidence from Tasmania be not forthcoming.

In concluding this paper, we would urge the careful examination and mapping of our glacial deposits, and the collection of all evidence bearing upon them. In the words of Sir Robert Ball—"A strict search for glacial indications among all deposits, primary, secondary, and tertiary, would be one of the most valuable pieces of scientific work possible at the present time."—("Cause of an Ice Age," p. 149).

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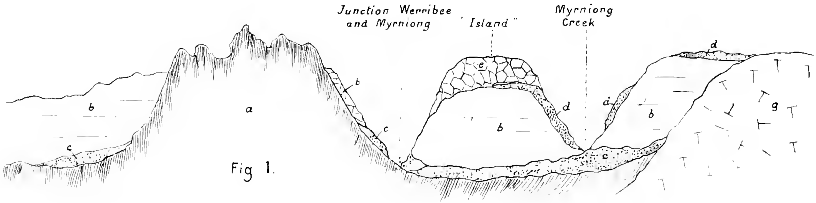

Fig 1.

Ideal Section through Werribee Gorge to junction with Myrniong thence across "Island"
(Island = local name for area included between Werribee and Myrniong)

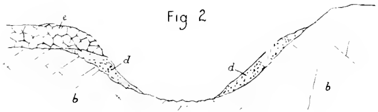

Fig 2

Section accross Korkuperrimul Creek
opposite Small Quarry

Fig 3.

Fracture in Triassic Sandstone with
granite boulder at bottom.

a Lower Silurian b Triassic (sandstone & conglomerate) c Lower Till. d Upper Till e Basalt g Granite

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Art. VI.—*Synopsis of the Australian Calcarea Heterocœla; with a proposed Classification of the Group and Descriptions of some New Genera and Species.*

By Arthur Dendy, D.Sc., F.L.S.

Demonstrator and Assistant Lecturer in Biology in the University of Melbourne.

[Read September 8, 1892.]

1. Introductory Remarks.

Owing to the reduction of the Government grant to the Royal Society, it has been found impossible at present to continue the publication of the volume of the Transactions which the Council of the Society generously set apart for "A Monograph of the Victorian Sponges." Under these circumstances the Council has kindly agreed to my proposal to divide the work by publishing in the Proceedings of the Society only the necessary systematic portion, without illustrations, and publishing the anatomical portions, for which numerous illustrations are indispensable, elsewhere. It is hoped, however, that the continuation of the Monograph in its original form may be carried out at some future date.

I have in my possession, in addition to the very fine series of Victorian Heterocœla collected by Mr. Bracebridge Wilson, a number of very valuable specimens, including several remarkable new species, from other parts of Australia, and it seemed desirable to incorporate descriptions of these in the present communication. I have also a number of fragments of type specimens, generously forwarded to me by the authorities of the British Museum, which brings the total number of species of Australian Calcarea Heterocœla in my collection up to forty-seven.

Up to the present time sixty-two species of this group of sponges have been described from Australian seas, chiefly by Hæckel, von Lendenfeld, Poléjaeff and Carter. Sixteen new species are described in the present paper, which brings the total number of Australian species of Calcarea Heterocœla up to seventy-eight. In order to make the work as complete as possible, I have decided to include, not only descriptions or notes of the forty-seven species which I have been able to study for myself, but also references to those species which I have not seen, and thus to provide a complete Synopsis of the Australian Calcarea Heterocœla.

In order to arrange the species satisfactorily, I have been obliged to adopt a classification which has many new features. This classification has not been arrived at hastily, nor without careful consideration of the work of previous writers. It is impossible to justify it fully in this place, because it is based upon a minute study of anatomical details and a careful consideration of historical questions of priority in nomenclature into which I have not space to enter. I intend, however, to publish a paper on the minute anatomy and classification of the group in another place, in which these questions will be fully discussed; and, in the meantime, I may perhaps point out that the classification proposed is based upon the careful anatomical examination of a very large number of species.

It will be seen that more stress is laid upon the arrangement of the skeleton than is usual at the present day, and less upon the form and arrangement of the flagellated chambers, which I find to vary considerably, even within the limits of a single species. This change certainly facilitates the identification of specimens, and will probably be welcomed by those workers who have not at their disposal the elaborate appliances required for the preparation of stained microscopical sections.

Poléjaeff* clearly showed that no hard and fast line could be drawn between the Sycons and Leucons of Hæckel. This idea was followed up by von Lendenfeld, who has created a special group, the *Sylleibidæ*,† to include the intermediate forms. This group, however, seems to me to be very artificial, as, judging from my own observations, it appears that

* Report on the Calcarea of the Challenger Expedition.

† See especially "Die Spongien der Adria. I. Die Kalkschwämme." Zeitschrift für Wissenschaftliche Zoologie, Vol. 53, 1891.

the transition from the Sycon to the Leucon type of canal-system has not taken place along a single line of descent, but along several. Here, as in other cases, we must classify by an assemblage of characters. The canal-system alone is by no means sufficient, though, when taken in conjunction with the skeleton, it is often of great value.

In enumerating the various genera and species I have not attempted to give a complete list of synonyms and references, as this would have taken up a large amount of space. In the case of the species, however, I have given those synonyms and references which are most important.

My warmest thanks are due to Mr. J. Bracebridge Wilson for the bulk of the specimens here described, to Mr. Thos. Whitelegge for a very valuable collection from Port Jackson, to the Adelaide Museum for some very interesting specimens from St. Vincent's Gulf, to Professor Spencer for a number of specimens from Port Jackson, to Sir Frederick M'Coy for permission to examine the collection in the Melbourne National Museum, and to Dr. Günther for fragments of type specimens in the British Museum.

2. Proposed Classification of the Calcarea Heterocœla.

Order HETEROCŒLA, Poléjaeff.

Calcareous sponges in which the collared cells are confined to more or less well-defined flagellated chambers.

Family 1.—Leucascidæ.

Flagellated chambers very long and narrow, copiously branched; communicating at their proximal ends with exhalant canals which converge towards the oscula; their blind distal ends covered over by a dermal membrane pierced by true dermal pores which lead into the irregular spaces between the chambers. Skeleton consisting principally of small radiates irregularly scattered in the walls of the chambers and exhalant canals and in the dermal membrane.

GENUS I.—*Leucascus*, nov. gen.

Diagnosis.—The same as that of the family.

(For species see Part 3 of the present paper.)

FAMILY 2.—SYCETTIDÆ.

Flagellated chambers elongated, arranged radially around a central gastral cavity, their distal ends projecting more or less on the dermal surface and not covered over by a continuous cortex. Skeleton radially symmetrical.

GENUS II.—*Sycetta* (Hæckel, *emend.*)

Diagnosis.—Radial chambers not inter-communicating. Articulate tubar skeleton. No tufts of oxea on the distal ends of the chambers.

(For example see Part 3 of the present paper.)

GENUS III.—*Sycon* (Risso, *emend.*)

Diagnosis.—Radial chambers not inter-communicating. Articulate tubar skeleton. The distal ends of the chambers provided each with a tuft of oxeote spicules.

(For examples see Part 3 of the present paper.)

GENUS IV.—*Sycantha*, von Lendenfeld.

Radial chambers long, united in groups; those of each group inter-communicating by openings in their walls and each group with a single common opening into the gastral cavity. The radial chambers have freely projecting distal cones surmounted by oxeote spicules. Tubar skeleton articulate.

No Australian species of this genus has yet been found. The type is von Lendenfeld's *Sycantha tenella*.*

FAMILY 3.—GRANTIDÆ.

There is a distinct and continuous dermal cortex covering over the chamber layer and pierced by inhalant pores.

* "Die Spongien der Adria. I. Die Kalkschwämme," p. 51.

There are no subdermal sagittal triradiates or quadriradiates.* The flagellated chambers vary from elongated and radially arranged to spherical and irregularly scattered, while the skeleton of the chamber layer varies from regularly articulate to irregularly scattered.

GENUS V.—*Grantia* (Fleming, *emend.*)

Diagnosis.—The elongated flagellated chambers are arranged radially around the central gastral cavity; they are not provided with tufts of oxea at their distal ends, but are covered over by a dermal cortex composed principally of triradiate spicules and without longitudinally disposed oxea. An articulate tubar skeleton is present.

(For examples see Part 3 of the present paper.)

SUB-GENUS.—*Grantiopsis*, nov.

Diagnosis.—The sponge has the form of a greatly elongated, hollow tube, whose wall is composed of two distinct layers of about equal thickness. The outer (cortical) layer is provided with a very strongly developed skeleton of radiate spicules and contains the narrow, ramifying inhalant canals. The inner (chamber) layer is formed by elongated radial chambers arranged very regularly side by side. The skeleton of the chamber layer is very feebly developed; the normal subgastral triradiates are replaced by quadriradiates; the tubar skeleton is articulate, and composed of very abnormal sagittal triradiates whose paired rays are greatly reduced.

(For species see Part 3 of the present paper.)

GENUS VI.—*Ute* (Schmidt, *emend.*)

Diagnosis.—The ends of the elongated radial chambers are covered over by a well developed cortex, consisting in great part of large oxeote spicules arranged parallel to the long axis of the sponge. The tubar skeleton is articulate or else composed entirely of the basal rays of subgastral triradiates.

(For examples see Part 3 of the present paper.)

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* I propose these names for spicules lying beneath the dermal surface and with inwardly directed basal or apical rays as the case may be. Such spicules are of great importance for purposes of classification.

Sub-Genus.—*Synute*, Dendy.

Diagnosis. — Sponge compound, consisting of many *Ute*-like individuals completely fused together and invested in a common cortex composed largely of huge oxeote spicules.

(For species see Part 3 of the present paper.)

Genus VII.—*Utella*, nov. gen.

Diagnosis.—Flagellated chambers elongated, arranged radially around the central gastral cavity. There are no longitudinally arranged oxea in the dermal cortex, but a layer of oxeote spicules lies beneath and parallel to the gastral surface. The tubar skeleton is articulate.

I propose this genus for Hæckel's *Sycandra hystrix*.* Schmidt's *Ute utriculus* (the *Sycandra utriculus* of Hæckel†) may perhaps also be included therein.

No Australian species are as yet known.

Genus VIII.—*Anamixilla* (Poléjaeff, *emend.*)

Diagnosis.—Flagellated chambers elongated and radially arranged. There is no special tubar skeleton, the skeleton of the chamber layer consisting of large radiate spicules, arranged without regard to the direction of the chambers, and of the outwardly directed basal rays of subgastral triradiates.

(For species see Part 3 of the present paper.)

Genus IX.—*Sycyssa*, Hæckel.

Diagnosis.—The flagellated chambers are elongated and arranged radially around the central gastral cavity. The skeleton consists exclusively of oxeote spicules.

The only known species of this genus is Hæckel's *Sycyssa huxleyi*,‡ from the Adriatic.

Genus X.—*Leucandra* (Hæckel, *emend.*)

Diagnosis.—The flagellated chambers are spherical or sac-shaped, irregularly arranged and communicating with the

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* Die Kalkschwämme. Vol. II, p. 375. † *Loc. cit.*, p. 370.

‡ Loc. cit., p. 260.

gastral cavity, or main exhalant canals, by a more or less complicated canal-system. The skeleton of the chamber layer is irregular.

(For examples see Part 3 of the present paper.)

GENUS XI.—*Lelapia* (Gray, *emend.*)

Diagnosis.—Canal system unknown. Skeleton of gastral surface composed of ordinary radiates. Skeleton of dermal surface composed of triradiates, quadriradiates and minute oxea. Skeleton of the chamber layer composed of large, longitudinally arranged oxea, crossed at right angles by bundles of tuning-fork-shaped triradiates whose oral rays are directed towards the gastral cavity, while the basals point towards the dermal surface.

(For species see Part 3 of the present paper).

GENUS XII.—*Leucyssa*, Hæckel.

Diagnosis.—Flagellated chambers (presumably) spherical or ovoid, irregularly arranged. Skeleton composed solely of oxeote spicules.

No species of this remarkable genus are as yet recorded from Australian seas, the only examples being Hæckel's *Leucyssa spongilla*, *L. cretacea* and *L. incrustans*.*

FAMILY 4.—HETEROPIDÆ.

There is a distinct and continuous dermal cortex covering over the chamber layer and pierced by inhalant pores. Subdermal sagittal triradiates are present. The flagellated chambers vary from elongated and radially arranged to spherical and irregularly scattered. An articulate tubar skeleton may or may not be present.

GENUS XIII.—*Grantessa* (von Lendenfeld, *emend.*)

Diagnosis.—The flagellated chambers are elongated and arranged radially around the central gastral cavity. The dermal cortex consists principally of triradiates and does not contain longitudinally disposed oxea.

(For examples see Part 3 of the present paper.)

* Loc. cit., pp. 137, 138, 139.

GENUS XIV.—*Heteropia* (Carter, *emend.*)

Diagnosis.—The distal ends of the elongated radial chambers are covered over by a well-developed dermal cortex, consisting principally of large oxea arranged parallel to the long axis of the sponge.

I propose to retain this generic name for Carter's *Aphroceras ramosa*,* which he observes belongs to his genus *Heteropia*. No species are yet known from Australia.

GENUS XV.—*Vosmaeropsis*, nov. gen.

Diagnosis.—Flagellated chambers spherical or sac-shaped, never truly radial. Dermal cortex composed principally of triradiates, without longitudinally disposed oxea.

(For species see Part 3 of the present paper.)

FAMILY 5.—AMPHORISCIDÆ.

There is a distinct and continuous dermal cortex covering over the chamber layer. Subdermal quadriradiates are present. The flagellated chambers vary from elongated and radially arranged to spherical and irregularly scattered.

GENUS XVI.—*Heteropegma* (Poléjaeff, *emend.*)

Diagnosis.—The flagellated chambers are elongated and arranged radially around the central gastral cavity. There is a vestigial tubar skeleton of minute radiates. The dermal cortex is very thick, composed principally of large triradiate spicules.

(For species see Part 3 of the present paper.)

GENUS XVII.—*Amphoriscus* (Hæckel, *emend.*)

Diagnosis.—The flagellated chambers are elongated and arranged radially around the central gastral cavity. The skeleton of the chamber layer is composed exclusively of the apical rays of subdermal and subgastral quadriradiates.

(For examples see Part 3 of the present paper.)

GENUS XVIII.—*Syculmis* (Hæckel, *emend.*)

Diagnosis.—The flagellated chambers are elongated and arranged radially around the central gastral cavity. The

* Proc. Lit. Phil. Soc. Liverpool, Vol. XL, Appendix, 1886, p. 92.

skeleton of the chamber layer is composed of the apical rays of subdermal and subgastral quadriradiates. There is a root-tuft of oxea and anchoring quadriradiates.

The only known species of this remarkable genus is Hæckel's *Syculmis synapta*,* from Bahia.

GENUS XIX.—*Leucilla* (Hæckel, *emend.*)

Diagnosis.—Flagellated chambers spherical or sac-shaped, never truly radial.

(For examples see Part 3 of the present paper.)

GENUS XX.—*Paraleucilla*, nov. gen.

Diagnosis.—Chambers spherical or sac-shaped (?). Beneath the dermal cortex a series of subdermal cavities supported by an outer and inner layer of quadriradiates whose apical rays cross each other in opposite directions. Beneath these comes the chamber layer, whose skeleton consists of irregularly arranged quadriradiates. Large, longitudinally arranged oxea occur between the triradiates of the dermal cortex.

(For species see Part 3 of the present paper.)

3. SYNOPSIS OF THE AUSTRALIAN SPECIES OF CALCAREA HETEROCŒLA.

1. *Leucascus simplex*, n. sp.

Sponge usually more or less flattened, cushion-shaped, spreading, with convex upper surface; sometimes becoming almost globular. Oscula irregularly scattered on the upper surface, one or several, varying in size, naked. Surface smooth. The largest specimen is a rather thin, ovoid, flattened crust, which, from its shape, appears to have grown on a crab's back; it is about 35 mm. long, 20 mm. broad, and only about 2 mm. thick in most parts; the other specimens, though smaller, are much thicker, one being nearly spherical. The surface is covered by a thin, pore-bearing dermal membrane.

* Die Kalkschwämme, Vol. II, p. 288.

The flagellated chambers (if one may use the term) are greatly elongated, tubular and copiously branched; their terminal branches end blindly beneath the dermal membrane. Their walls are thin and pierced by numerous prosopyles. There is no central gastral cavity but the chambers open into exhalant canals, devoid of collared cells, which converge towards the oscula. The scattered dermal pores lead into wide, irregular spaces between the tubular chambers.

The skeleton is extremely simple, consisting of small, regular triradiates, irregularly scattered in the walls of the chambers and exhalant canals, and in the dermal membrane. All the spicules are alike, except that some exhibit an incipient apical ray. The rays are straight, conical, fairly sharply pointed; measuring about 0·1 by 0·01 mm.

Localities.—Near Port Phillip Heads (Stations 1 and 5, coll. J. B. Wilson); Watson's Bay, Port Jackson (coll. T. Whitelegge).

2. *Leucascus clavatus*, n. sp.

The type specimen of this species is a sub-globular sponge about 14 mm. in maximum diameter, with a single rather wide osculum. It very closely resembles *L. simplex* in general appearance, canal system and skeleton, and the only point of distinction of any importance which I have been able to find consists in the presence in *L. clavatus* of large club-shaped oxea lying at right angles to and with the club-shaped extremity projecting slightly beyond the dermal surface. These spicules attain a length of about 0·7, and a diameter, in the thickest part, of about 0·1 mm. The outer end of the spicule is usually more or less rounded off and slightly curved, while the inner portion is straight and tapers gradually to a sharp point. The triradiates are like those of *L. simplex*, and of nearly the same size, perhaps a little larger on an average.

A second specimen is irregularly lobate, and differs from the type in its much denser texture, which is due to the stronger development of the mesoderm. It contains very numerous embryos, which fact may be associated with the strong development of the mesoderm.

Locality.—Near Port Phillip Heads (coll. J. B. Wilson).

3. *Sycetta primitiva,* Hæckel.

Sycetta primitiva, Hæckel. Die Kalkschwämme, Vol. II, p. 237.

Locality.—Bass Straits, Gulf of St. Vincent (Hæckel).

4. *Sycon coronatum,* Ellis and Solander, sp.

Spongia coronata, Ellis and Solander. Zoophytes, p. 190.
Grantia ciliata, auctorum.

Sycandra coronata, Hæckel. Die Kalkschwämme, Vol. II, p. 304.

Locality.—East coast of Australia (Hæckel. Also recorded from the Mediterranean, Atlantic and Pacific).

5. *Sycon carteri,* n. sp.

Colonial; consisting of very many small Sycon individuals united in a copiously branching, bushy mass; branching irregular. Sycon individuals about 5 mm. in length by 1·5 mm. in diameter; cylindrical; with minutely conulose surface and naked, terminal oscula.

Canal-system typical; chambers thimble-shaped, rather short, with freely projecting distal cones.

Skeleton arranged in typical manner. Spicules as follows:—(1) Gastral quadriradiates; sagittal; oral rays shorter and stouter than basal, slightly recurved, gradually sharp-pointed, measuring 0·11 × 0·007 mm.; basal ray rather more slender, straight, very gradually sharp-pointed, about 0·2 mm. long; apical ray variable, stout, more or less curved, often angulate, gradually sharp-pointed, about 0·077 mm. long. (2) Gastral triradiates; like the quadriradiates but without the apical ray. (3) Subgastral sagittal triradiates; oral rays extended almost in a line, gradually sharp-pointed, measuring about 0·06 × 0·007 mm.; basal ray very long (0·175 mm.), straight, gradually sharp-pointed, extending for more than half the length of the chamber and forming by itself about half of the articulate tubar skeleton. (4) Ordinary tubar triradiates; like the last but with shorter basal ray and oral angle diminishing towards the distal cone. (5) Oxea of the distal cones; rather short and stout, angulate, with shorter and stouter outer, and longer and slenderer inner segments; fairly sharp-pointed at both ends; measuring about 0·15 × 0·01 mm.

Locality.—St. Vincent's Gulf, S. Australia, (coll. Adelaide Museum).

6. *Sycon minutum*, n. sp.

Solitary; sessile, or with very short stalk; sub-cylindrical or sausage-shaped, with naked terminal osculum surrounded by a membranous extension of the wall of the gastral cavity. Texture characteristically soft and spongy; surface minutely conulose. Usually only about 5 or 6 mm. in height by 2 mm. in breadth.

Canal system typical; chambers rather short, thimble-shaped, often octagonal in transverse section, with low rounded distal cones; inhalant canals usually square in transverse section.

Skeleton arranged as usual. Spicules as follows:—(1) Gastral quadriradiates; facial rays straight, subequal in length, very long, slender and gradually sharp-pointed, measuring about 0·12 by 0·0035 mm.; oral angle somewhat smaller than the paired angles; apical ray short, relatively stout, slightly curved, sharp-pointed, about 0·03 mm. long. Towards the osculum these spicules become much more markedly sagittal. (2) Gastral triradiates; like the foregoing, but without apical ray. (3) Subgastral triradiates, not distinguishable in form from the ordinary tubar spicules. (4) Tubar triradiates; varying from sagittal, with very widely extended, slightly curved, oral rays, to sub-regular; rays long and slender, gradually sharp-pointed, the basal not much longer than the orals, measuring about 0·1 by 0·006 mm.; these spicules are rather irregularly arranged. (5) Oxea of the distal cones; not very numerous; long, slender, straight or very slightly curved; fusiform and gradually sharp-pointed at each end; measuring about 0·28 by 0·007 mm.; arranged in loose tufts which project obliquely upwards from the distal cones towards the osculum.

Locality.—Watson's Bay, Pt. Jackson (coll. T. Whitelegge).

7. *Sycon raphanus*, O. Schmidt.

Sycon raphanus, O. Schmidt. Spong. Adriat. Meer., p. 14.

Abundant in the collection. Solitary, usually about half an inch in height, with well developed stalk, markedly conulose surface and small oscular fringe. In spiculation I can find no tangible distinction between this common Victorian species and the European *S. raphanus* as described by Hæckel in "Die Kalkschwämme."

Localities.—Near Port Phillip Heads (Stations 1, 8, 14, and outside the Heads, coll. J. B. Wilson); King Island (coll. Professor Spencer). Hæckel also records the species from Bass Straits and the Gulf of St. Vincent.

8. *Sycon setosum*, O. Schmidt.

Sycon setosum, O. Schmidt. Spong. Adriat. Meer., p. 15.

I identify two specimens in the collection with this species. They differ from the typical *S. raphanus* in the more hairy surface, due to the greater length of the dermal oxea, and also in the elongation of the apical rays of the gastral quadriradiates. Probably it is merely a slight variety of *S. raphanus*. The species has hitherto only been recorded from the Mediterranean.

Locality.—Near Port Phillip Heads (Stations 6, 9, coll. J. B. Wilson).

9. *Sycon ensiferum*, n. sp.

Solitary, stipitate, closely resembling *S. raphanus*; with very markedly conulose surface and little or no oscular fringe. The two specimens are rather larger and especially stouter than most Australian specimens of *S. raphanus* which I have seen.

Canal-system typical; chambers of good length, terminating in low, rounded distal cones.

Skeleton arranged in typical manner. The species is distinguished by the following characters in its spiculation, which in general characters resembles that of *S. raphanus* closely:—(1) The apical rays of the gastral quadriradiates are very strongly developed, swelling out into long club-shaped form (sword-shaped in longitudinal section), but fairly sharply pointed and only very slightly curved, very much broader in the distal than in the proximal half. (2) The ordinary tubar radiates very frequently have a small apical ray developed. (3) The basal rays of many of the most distally situated tubar triradiates are very strongly bent outwards from the wall of the chamber, so as to curve over and protect the entrances to the inhalant canals. (4) The oxea at the distal ends of the chambers are of moderate length and thickness, straight or nearly so, symmetrical and fairly gradually sharp-pointed at each end.

Locality.—Near Port Phillip Heads (Station 9, coll. J. B. Wilson.)

10. *Sycon subhispidum*, Carter, sp.

Grantia subhispida, Carter. Annals and Magazine of National History, July 1886, p. 36.

This species, described by Mr. Carter from Mr. Wilson's collection, evidently belongs to the genus *Sycon*, but I have not been able to identify any of my specimens therewith.

Locality.—Near Port Phillip Heads (Carter).

11. *Sycon ramsayi*, von Lendenfeld, sp.

Sycandra ramsayi, von Lendenfeld. Proc. Linn. Soc., N.S.W., Vol. IX, p. 1097.

I have only seen specimens of this species from Port Jackson. Mr. Carter, however, records it amongst Mr. Wilson's sponges from Port Phillip. The gastral cavity is, according to my experience, widely dilated, and not comparatively small, as stated in the original description.

Localities.—Port Jackson (von Lendenfeld, &c.); near Port Phillip Heads (Carter).

12. *Sycon boomerang*,* n. sp.

Solitary, stipitate; of slightly compressed, ovoid shape, tapering gradually below to form the narrow stalk, which is about equal in length to the main body of the sponge; with a rather small, terminal, naked osculum. Total height of the specimen about 37 mm., greatest breadth 12·5 mm. The dermal surface is smooth and even, but with a characteristic porous appearance. The wall of the sponge is very thick and the gastral cavity correspondingly narrow.

The radial chambers are very long and narrow and branch repeatedly, the branches running parallel and becoming much narrower as they approach the dermal surface. The inhalant canals are correspondingly long and narrow, and their outer ends are covered over by a delicate pore-bearing membrane which stretches between the rounded distal ends of the chambers. The gastral cortex is thin. The skeleton is arranged in typical manner, the spiculation being as follows:—(1) Gastral quadriradiates; sagittal; with very long, slender, hastate basal ray, measuring about 0·2 × 0·007 mm., sometimes longer; paired rays about one-third to one-half the length of the basal ray and somewhat stouter, straight, conical, gradually sharp-

* So called from the shape of the apical rays of the gastral quadriradiates.

pointed; apical ray very strongly developed, gradually thickening for about two-thirds of its length, where it is extraordinarily stout, then bending sharply and tapering more suddenly to a sharp point, length about 0·155 mm., greatest thickness up to 0·028 mm. though generally less. (2) Gastral triradiates; sagittal or sub-regular, with long, slender, gradually sharp-pointed rays, the oral rays often somewhat curved. (3) Subgastral sagittal triradiates, not clearly differentiated from the ordinary tubar spicules. (4) Tubar triradiates; with very long, straight, slender, conical basal ray and shorter, widely extended, often slightly curved oral rays. In spicules taken from about the middle of the length of the chamber the basal ray measures about 0·17 by 0·07 mm., and the orals about 0·1 by 0·07 mm.; but there is a good deal of variation. In some of the tubar spicules a fairly well developed apical ray is found. In some of the most distal triradiates the basal ray, now much shortened, is curved outwards so as to lie in the pore-bearing membrane, which is also supported by small, scattered triradiates and oxeotes like those found at the distal ends of the chambers. (5) Oxea of the distal cones; short but fairly stout, more or less club-shaped, usually with the thick distal portion bent at an angle to the remainder; measuring about 0·08 by 0·008 mm.; these characteristic little spicules are arranged in dense tufts at the distal ends of the chambers.

Locality.—Near Port Phillip Heads (coll. J. B. Wilson).

13. *Sycon gelatinosum*, Blainville, sp.

Alcyoncellum gelatinosum, Blainville. Actinologie, p. 529.

Sycandra alcyoncellum, Hæckel. Die Kalkschwämme. Vol. 2, p. 333.

Sycandra arborea, Hæckel. Die Kalkschwämme, Vol. 2. p. 331.

This common Australian species is very variable in form, being either colonial (generally richly branched) or solitary, with the oscula sometimes naked and sometimes provided with a fringe of spicules. The shape of the dermal oxea also varies greatly, from club- or nail-shaped to sharply-pointed at each end. The extensive series of specimens in my collection, from various parts of Australia, shows that it is quite impossible to separate Hæckel's two species, *arborea* and *alcyoncellum*, from one another, and I revert to Blainville's original name, *gelatinosum*, for both.

Localities.—Port Jackson; Port Phillip; Bass Straits; St. Vincent's Gulf; west coast of Australia (various authors and collections; Hæckel also records the species from Java).

13A. *Sycon gelatinosum* var. *whiteleggii*, nov.

I propose to distinguish by the above name a very beautiful variety of the foregoing species found by Mr. T. Whitelegge at Watson's Bay, Port Jackson. There are nine specimens, all solitary and with a well-developed oscular fringe of long silky spicules. In addition to this oscular fringe, however, all have a beautiful frill or collar of long, silky spicules, projecting like a halo from the base of the oscular fringe and at right angles to the long axis of the sponge. In external form this variety closely resembles Hæckel's beautiful figure of *S. (Sycarium) elegans.* The dermal oxea are long and slender, and gradually sharp-pointed at each end, and the more distal tubar triradiates are greatly enlarged, with long and stout, but still straight basal rays. These peculiarities in spiculation are, however, found in some specimens of *S. gelatinosum*, from which the present variety cannot be sharply distinguished.

Locality.—Watson's Bay, Port Jackson (coll. T. Whitelegge).

14. *Sycon giganteum*, n. sp.

Solitary, with very short stalk or none at all. Tubular, greatly elongated, in parts more or less compressed, but not varying greatly in diameter throughout; with a single, wide, naked osculum. Both specimens are curved or bent. The largest is nearly 100 mm. in length by 14 mm. in breadth; the other is only a little shorter. The wall of the sponge is about 3 mm. in thickness. The dermal surface is in part quite smooth and in part tessellated.

The radial chambers are narrow and greatly elongated, they branch repeatedly and the branches run parallel with one another to the dermal surface. They communicate with the gastral cavity by long exhalant canals, from which they are separated by diaphragms. These exhalant canals appear like continuations of the chambers only without collared cells, they may unite together before opening on the gastral surface. The chambers are approximately circular in transverse section. The inhalant canals are irregular and very narrow, opening on the dermal surface through narrow, irregular chinks between the tufts of oxea.

The skeleton is arranged as usual, the spiculation being as follows:—(1) Gastral quadriradiates; small, very irregularly and confusedly arranged, so as to form a dense though not very thick cortex; usually more or less strongly sagittal, but very variable in the proportions of the rays. The basal ray varies from two or three times the length of the orals to about the same length or even shorter; it is straight and conical. The oral rays are usually slightly curved towards one another, conical and sharp-pointed, averaging about 0·04 by 0·005 mm. at the base; apical ray conical, very slightly curved, sharply pointed, about 0·05 mm. long. (2) Subgastral sagittal spicules, indistinguishable. (3) Tubar triradiates, with rather short and stout, conical, sharp-pointed rays; the oral rays very widely extended, often nearly at right angles to the basal, nearly straight, averaging about 0·084 mm. by 0·009 mm. at the base; basal ray varying from about the same length to considerably longer than the orals, the disproportion being greatest at the distal ends of the chambers. (4) Tubar quadriradiates, differing from the foregoing in the development of a short, stout, curved and sharply pointed apical ray; abundant, especially towards the gastral surface, where the tubar skeleton becomes very irregular. (5) Oxea, short, straight or rather crooked, slender, tapering to a sharp point at the proximal end and with the distal end swollen out into an ovoid head, like that of a spermatozoon, length about 0·17, thickness below the head 0·007 mm., head nearly twice as thick. These spicules are arranged in very dense tufts at the distal ends of the chambers and their thickened ends form an almost continuous crust over the dermal surface of the sponge. The whole skeleton is very dense and compact, so that the texture of the sponge is very firm, as in *S. gelatinosum*, which it closely approaches in spiculation.

Locality.—St. Vincent's Gulf (coll. Adelaide Museum).

15. *Sycon compressum*, auctorum.

Grantia compressa, various authors (*e.g.*, Bowerbank).

Sycandra compressa, Hæckel. Die Kalkschwämme. Vol. II, p. 360.

This common European species is recorded from Australia both by von Lendenfeld and Carter, but I have never myself seen specimens from Australian seas. Von Lendenfeld* states that all the specimens in Australian waters are cylindrical and must be referred to Hæckel's variety *lobata*, which he proposes to erect into a species under the name *Grantia lobata*. Carter† simply records *Grantia compressa* amongst Mr. Wilson's sponges, and *also* a tubular variety which he terms *fistulata*, and which is probably identical with von Lendenfeld's *lobata*.

I include the species in the genus *Sycon* on account of the tufts of oxea which crown the radial tubes. The dermal cortex is very thin.

Localities.—Port Jackson (von Lendenfeld); near Port Phillip Heads (Carter).

16. *Grantia labyrinthica*, Carter.

Teichonella labyrinthica, Carter. Annals and Magazine of Natural History, July 1878, p. 37.

Grantia labyrinthica, Carter. Annals and Magazine of Natural History, July 1886, p. 38.

I have already given a detailed account of the history and anatomy of this remarkable species in my memoir "On the Anatomy of *Grantia labyrinthica*, Carter, and the so-called Family Teichonidæ," published in Vol. XXXII, N.S., of the Quarterly Journal of Microscopical Science. The species appears to be fairly common near Port Phillip Heads, the largest specimens which I have seen measure no less than five inches across the top, a truly gigantic size for a single Sycon individual.

Localities.—Fremantle, W.A. (Carter); near Port Phillip Heads (Station 5 and outside the Heads, Carter and coll. J. B. Wilson).

17. *Grantia extusarticulata*, Carter, sp.

Hypograntia extusarticulata, Carter. Annals and Magazine of Natural History, July 1886, p. 43.

Solitary, sessile, sac-shaped, broadest below and tapering gradually to the terminal osculum, which is naked. The single specimen is markedly compressed, and measures 25 mm. in height and 11 mm. in greatest width. The wall of the sac is not much more than 1 mm. in thickness and the gastral cavity is correspondingly spacious. The dermal

* Proc. Linn. Soc., N.S.W. Vol. IX, p. 1106.

† Ann. and Mag. Nat. Hist. July 1886, p. 37.

surface is very smooth. The anatomy is very typical. The radial chambers are straight, cylindrical and only slightly branched, and extend from gastral to dermal cortex. The inhalant pores are irregularly scattered through the dermal cortex, which is well developed and about 0·07 mm. thick. The gastral cortex is of about the same thickness and is perforated by the short, wide exhalant canals, one coming from each chamber and separated from it by a constricted diaphragm.

The skeleton is arranged in typical manner, the spiculation being as follows:—(1) Gastral quadriradiates; sagittal, oral angle a little wider than the laterals; facial rays straight, conical, gradually sharp-pointed; basal ray about 0·2 by 0·01 mm.; oral rays 0·12 by 0·01 mm.; apical ray short, fairly stout, only moderately sharply-pointed, slightly curved, about 0·06 mm. long. (2) Gastral triradiates; similar to the foregoing, but with no apical ray. (3) Subgastral sagittal triradiates; strongly developed, with widely extended, slightly recurved, gradually sharp-pointed oral rays and very long, straight basal ray gradually tapering to a sharp point; oral rays about 0·15 by 0·014 mm.; basal ray about 0·35 by 0·014 mm. (4) Tubar triradiates; somewhat smaller than the foregoing but well developed, with straight or nearly straight rays, gradually sharp-pointed, the basal considerably longer than the other two. (5) Dermal triradiates; sagittal, very similar to the tubar triradiates but perhaps a little longer and placed horizontally in the dermal cortex. (6) Oxea of the dermal cortex; very small, straight, gradually sharp-pointed at the inner end and beautifully hastate or lance-pointed at the outer; about 0·045 by 0·005 mm.; arranged at right angles to the dermal surface. Occasionally a large oxeote spicule is found around the margin of the osculum, but these are extremely rare.

Mr. Carter's specimen, described from Mr. Wilson's collection, was "agglomerated." I have little doubt as to the specific identity of the two, but there are sufficient points of distinction between my specimen and Mr. Carter's original description to render a fresh description desirable.

Locality.—Near Pt. Phillip Heads (Carter; and Station 9, coll. J. B. Wilson).

18. *Grantia gracilis*, von Lendenfeld, sp.

Vosmaeria gracilis, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1111.

In canal system, so far as we can judge from the author's description, this species appears to resemble my *Grantia rosmaeri*, the radial chambers communicating with the gastral cavity by elongated exhalant canals.

Locality.—Port Jackson (von Lendenfeld).

19. *Grantia rosmaeri*, n. sp.

Specimen solitary, sessile (?), sac-shaped, tapering gradually above to the naked, terminal osculum; 15 mm. high and 7 mm. in greatest transverse diameter. Texture hard, dermal surface echinated by the large, projecting oxea. Wall of sac only about 1 mm. thick.

The dermal cortex is very strongly developed, about 0·08 mm. thick; the gastral cortex is two or three times as thick, but less dense and not so well-defined. The radial chambers are rather short and more or less branched. Their distal ends abut against the dermal cortex, while proximally they communicate with the gastral cavity by means of long, wide, exhalant canals, which penetrate the gastral cortex and may unite together before opening onto the gastral surface. The chambers are separated from the exhalant canals by constricted diaphragms. The inhalant pores take the form of irregular canals penetrating the dermal cortex.

Except for the unusual thickness of the cortex and the great size of the oxeote spicules the skeleton is arranged in the ordinary manner. The spiculation is as follows:—(1) Gastral quadriradiates; usually more or less sagittal, but very variable; rays straight or paired rays slightly curved, stout, conical and gradually sharp-pointed; size very variable; paired rays averaging, say, about 0·2 by 0·025 mm.; basal ray about the same thickness and usually somewhat longer; apical ray thorn-like, short, stout, conical, usually slightly curved, finely pointed, about 0·07 mm. long, projecting into the gastral cavity and exhalant canals. (2) Gastral triradiates; usually like the foregoing but without the apical ray; towards the osculum, however, they become much more strongly and regularly sagittal, the widespread, slightly recurved oral rays being much longer and stouter than the basal ray; amongst these suboscular spicules quadriradiates are very rare. (3) Subgastral sagittal triradiates; indistinguishable from the remainder of the tubar skeleton, which merges somewhat gradually into the gastral cortex. (4) Tubar triradiates;

strongly sagittal; with widely extended, short, straight, conical and gradually sharp-pointed oral rays, and much longer, straight, gradually sharp-pointed basal ray; oral rays about 0·1 by 0·015 mm.; basal ray about 0·28 by 0·015 mm. (5) Triradiates of the dermal cortex; usually slightly sagittal but nearly regular; rays stout, straight or slightly curved, conical, gradually sharp-pointed; about 0·24 by 0·028 mm.; arranged in several layers parallel with the dermal surface. (6) Oxea; very large, stout, fusiform, usually gently curved, gradually sharp-pointed at each end; varying in size up to about 1·8 by 0·07 mm. The outer ends of these spicules project far beyond the dermal surface, while their inner ends extend through the chamber layer into the gastral cortex.

Locality.—Watson's Bay, Port Jackson (coll. T. Whitelegge).

20. *Grantia (?) infrequens*, Carter, sp.

Hypograntia infrequens, Carter. Annals and Magazine of Natural History, July 1886, p. 39.

The chief peculiarities of this species appear to be the presence of a very strong dermal cortex and the fact that the tubar skeleton is made up entirely of the basal rays of subgastral sagittal triradiates. I have not seen the species myself, and Mr. Carter apparently had only a single small specimen, collected by Mr. Wilson. I include it provisionally in the genus *Grantia*.

Locality.—Near Port Phillip Heads (Carter).

21. *Grantia (?) lævigata*, Hæckel, sp.

Sycortis lævigata, Hæckel. Die Kalkschwämme, Vol. II, p. 285.

In his description Hæckel distinctly states that in the case of the tubar triradiates the basal ray is always directed centrifugally outwards, while in the dermal triradiates it lies parallel to the long axis of the sponge and points to the aboral pole. No mention is made in the text of any subdermal sagittal triradiates with inwardly directed basal ray, but in the figure (Plate 49, Fig. 3) such appear to be present. Hence if the figure be correct we should have to place the species in the genus *Grantessa*, but the evidence is hardly strong enough to justify us in so doing at present.

Locality.—Gulf of St. Vincent (Hæckel).

22. *Grantiopsis cylindrica*, n. sp.

Sponge forming long, cylindrical tubes, which may branch, with single, terminal, slightly constricted, almost naked oscula. Surface not hispid but slightly roughened by the large triradiate spicules of the cortex. The largest tube in the collection is unbranched and slightly crooked, 57 mm. long and with a nearly uniform diameter of 5 mm.

The wall of the tube is about 1 mm. in thickness, and is divided into two sharply defined concentric layers of about equal thickness. The outer of these layers forms a firm cortex with a very strongly developed skeleton. The inner layer is soft and spongy, consisting almost entirely of the radial chambers, which have but a feebly developed tubar skeleton.

The inhalant pores, scattered in groups over the dermal surface, lead into very sharply defined, wide inhalant canals, which penetrate the cortex, uniting into larger trunks which conduct the water to the ordinary "intercanals" between the radial chambers.

The radial chambers are arranged side by side with great regularity. Each is a straight, wide, unbranched (or very slightly branched) tube, extending completely through the chamber layer. In cross section they vary from nearly square to nearly circular. Each opens directly and separately into the gastral cavity, the gastral cortex being so thin that no special exhalant canals are required. Each is provided at its proximal end with a membranous diaphragm, which, in the spirit specimen, almost closes the opening.

The arrangement of the skeleton is a slight modification of the *Grantia* type, but the spiculation is very peculiar, as follows:—(1) Gastral quadriradiates, slightly sagittal, with small facial and enormous apical rays; the oral angle is rather wider than the lateral angles, but there is not much difference in the length of the facial rays, which are nearly straight (the orals may be slightly curved), fairly stout, conical and gradually sharp-pointed, about 0·056 by 0·007 mm. The apical ray is slightly curved, very stout, sword-shaped in optical section, thickest in about the middle, gradually sharp-pointed, about 0·14 by 0·014 mm. These apical rays thickly echinate the gastral surface. (2) Subgastral quadriradiates; strongly sagittal; the oral rays very widely extended and parallel to the gastral surface; the basal ray extending centrifugally towards the dermal surface through about half the thickness of the chamber layer; the apical ray projecting into the gastral cavity, almost in a line with the basal ray. The basal ray is long, straight, and gradually sharp-pointed, about 0·28 by 0·01 mm.; the oral rays are short, straight, conical and gradually sharp-pointed, about 0·056 by 0·008 mm.; the apical ray is slender, conical, elongated, slightly curved and finely pointed, about 0·09 by 0·007 mm. (3) Tubar triradiates; consisting almost entirely of the strongly developed, centrifugally directed basal ray, which is straight, fusiform, gradually sharp-pointed at the distal end, and at the proximal end provided with a pair of minute, widely divergent, conical teeth, which represent the extremely reduced oral rays. The basal ray measures about 0·3 by 0·008 mm., while the teeth representing the oral rays are only about 0·003 mm. in length. The entire tubar skeleton is made up of these spicules and the basal rays of the subgastral quadriradiates, arranged usually in single series but with overlapping ends, each series comprising only about three spicules. (4) Triradiates of the dermal cortex; very large and stout and regularly sagittal, the oral angle being very considerably wider than the paired angles; all the rays are straight, conical and gradually sharp-pointed, the oral rays measuring about 0·54 by 0·07 mm., and the basal ray somewhat shorter and slenderer. These spicules are arranged in many layers, parallel to the dermal surface and extending through the entire thickness of the cortex. (5) Dermal oxea; short, slender, slightly crooked, sharply pointed at each end, about 0·1 by 0·006 mm. These spicules occur in large numbers on the dermal surface, projecting at right angles from the outermost portion of the cortex. (6) Oxea of the oscular fringe; long, straight and slender, gradually sharp-pointed at each end though hastate at the outer end. These spicules form a kind of vertical palisade inside the margin of the osculum, their outer ends projecting to form a feebly developed oscular fringe. (7) Oscular triradiates: closely resembling the remarkable tubar triradiates, but with the oral rays not quite so much reduced. These spicules occur mixed with the inserted portions of the oscular oxea, and assist the latter in forming a dense palisade; the paired rays are directed towards the osculum, and no part of the spicule projects freely like the oxea do.

This sponge is decidedly the gem of Mr. Wilson's collection. The exquisite symmetry of the skeleton and canal-system, combined with the remarkable spiculation, render it one of the most beautiful and interesting sponges which I have ever seen, although the external form is not particularly attractive.

Locality.—Near Port Phillip Heads (coll. J. B. Wilson).

23. *Ute syconoides*, Carter, sp.

Aphroceras syconoides, Carter. Annals and Magazine of Natural History, August 1886, p. 135.

I identify with this species a single specimen collected by Mr. Wilson and a number of very beautiful examples sent to me from Port Jackson by Mr. T. Whitelegge. As pointed out by Mr. Carter, the species closely resembles Schmidt's *Ute glabra*, having the same characteristic silvery sheen on the surface, due to the presence of the huge, longitudinally disposed oxea. The Port Jackson specimens are shortly stipitate and one of them consists of two individuals united below for about half their length, or one might regard it as a branched individual.

Localities.—Near Port Phillip Heads (Carter, and Station 14, coll. J. B. Wilson); Watson's Bay, Port Jackson (coll. T. Whitelegge).

24. *Ute argentea*, Poléjaeff.

Ute argentea, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 43.

This species is also very similar to Schmidt's *Ute glabra*. Although the skeleton is, as Poléjaeff points out, "inarticulate," there are no subdermal sagittal triradiates with inwardly directed basal ray. From personal examination of Poléjaeff's type I believe this species to be quite distinct from *Ute syconoides*, the latter differing, amongst other things, in its much longer radial chambers, with many-jointed tubar skeleton, and in the much slenderer and less densely packed longitudinal oxea.

Locality.—Off Twofold Bay (Poléjaeff).

25. *Ute spiculosa*, n. sp.

Sponge colonial, consisting of a number of individuals (about twenty in the specimen under examination) united together by their bases so as to form a spreading colony. The individuals composing the colony are sessile, ovoid, narrowing above to the small terminal osculum, which has a very inconspicuous fringe; they attain a height of about 15 mm. and a maximum diameter of about 5 mm. The texture is dense and firm, and the surface is roughened by the projecting ends of some of the large oxea.

The gastral cavity is narrow and cylindrical, occupying only about one-third of the total diameter of the sponge. The flagellated chambers are long and narrow and more or less radially arranged with regard to the central gastral cavity; they do not extend nearly through the entire thickness of the sponge wall, and they communicate with the gastral cavity through long, sometimes branched exhalant canals. The inhalant canal system consists of scattered pores on the dermal surface leading into elongated canals which lead down between the chambers, but the typical syconoid arrangement of the canal system is greatly obscured by the strong development of the mesoderm and the dense, irregular skeleton. There is a very thick, dense cortex on both dermal and gastral surfaces.

The skeleton of the gastral cortex consists of a densely felted mass of irregularly arranged triradiates, mostly lying parallel to the gastral surface. These spicules are sagittal, with fairly stout, straight, conical and gradually sharp-pointed rays; the oral rays are longer than the basal and the oral angle wider than the other two; oral rays about 0·18 mm. by 0·02 mm., basal about 0·12 mm. by 0·016 mm. The skeleton of the chamber layer is dense and irregular, but shows traces of the articulate tubar arrangement in the usually centrifugal direction of the basal rays of the triradiates. These spicules are smaller than those of the gastral cortex, and of different shape; there is not much difference in the length of the rays, though the basal may be slightly longer or shorter than the others; all the rays are fairly stout, conical and gradually sharp-pointed; the basal is straight but the orals are more or less curved towards one another; dimensions of rays about 0·12 by 0·016 mm.

The skeleton of the dermal cortex consists of a dense, confused mass of triradiates, resembling those of the chamber layer but becoming markedly smaller towards the outside, where they lie parallel to the surface; amongst which are found oxea of two kinds:—(1) Very large, stout, fusiform, slightly curved and sharply pointed at each end; measuring about 1·8 mm. by 0·1 mm., and arranged parallel to the long axis of the sponge, with the upper end often slightly projecting. (2) Small, long and slender, nearly straight, gradually sharp-pointed at the inner end and usually more or less hastate or lance-pointed at the outer; measuring about 0·24 by 0·008 mm. These spicules occur in the outermost portion of the cortex, and their outer ends project well beyond and more or less at right angles to the dermal surface. A number of similar but longer spicules inserted around the inside of the osculum form a dense but not prominent oscular fringe.

Locality.—Watson's Bay, Pt. Jackson (coll. T. Whitelegge).

26. *Ute spenceri*, n. sp.

Sponge solitary, sessile, globular or sub-spherical, with correspondingly dilated gastral cavity and narrow, naked osculum. The texture is firm and harsh to the touch, the dermal surface being rather uneven and slightly roughened by the projecting apices of some of the large oxea, but not hispid. Diameter of entire sponge about 11 mm.; thickness of wall about 2·5 mm. The dermal cortex is very thick, occupying more than one-third of the entire thickness of the wall.

The inhalant pores, scattered over the surface of the sponge, lead into wide, irregular, sub-dermal cavities, lying in the cortex, from which narrow inhalant canals lead down between the radial chambers. The radial chambers are arranged with considerable regularity parallel to one another. They are long and narrow (about 1·0 mm. by 0·14 mm.), and at their distal ends they branch in a curiously irregular manner, the branches sometimes penetrating for some little distance into the dermal cortex. The proximal ends of the chambers are all situate about at the same level, which is some little distance from the gastral cavity and even from the gastral cortex, which latter, though dense, is very thin as compared with the dermal cortex. Hence we find a number of rather short, cylindrical, radially-arranged exhalant canals, which look like continuations of the radial chambers without the collared cells, and which may unite together in groups before opening on the gastral surface. The radial chambers are separated from the exhalant canals by well-marked diaphragms.

The skeleton is very dense and very complicated and consists of the following parts:—(1) Quadriradiates of the gastral cortex; sagittal, with straight, conical, gradually sharp-pointed facial rays; the oral angle is wider than the paired angles and the basal ray may be either longer or shorter than the other two, which measure, say, about 0·09 by 0·008 mm.; the apical ray is well developed, conical, gradually sharp-pointed, slightly curved, and nearly as long and thick as the oral rays. These spicules form such a dense feltwork that it is difficult to make out the details of individual form *in situ*, while the projecting apical rays thickly echinate the gastral cavity. (2) Quadriradiates of the exhalant canals; these are extremely characteristic and peculiar spicules; the basal ray is reduced to a mere rounded tubercle, while the oral and apical rays are long, straight and very slender, and finely pointed; the oral rays diverge at an angle of about 120° and the apical comes off between them and appears to lie nearly in the same plane; the oral rays measure about 0·08 by 0·0027 mm., though occasionally stouter, and the apical ray is about one-third as long; these spicules are found around the exhalant canals, with the apical ray projecting into the cavity. A few larger and stouter quadrradiates, with normal basal ray, also occur around the exhalant canals. (3) Inner sagittal triradiates; under this term we may perhaps, in this species, include all those triradiates which lie in the zone between the gastral cortex and the commencement of the flagellated chambers, although they lie at varying depths beneath the gastral cortex. The oral rays are straight or nearly so, conical and gradually sharp-pointed, about 0·09 by 0·0085 mm.; the basal ray is long, straight, conical and gradually sharp-pointed, measuring about 0·16 by 0·0085 mm.; the oral angle is wider than the paired angles. (4) Tubar triradiates; very similar to the foregoing but the basal ray gradually diminishes in length towards the dermal cortex. These spicules form an articulate tubar skeleton of many joints, which is continued, as already indicated, within the inner limits of the chamber layer to the gastral cortex, while towards the outside it becomes irregular and gradually passes into the skeleton of the dermal cortex. (5) Triradiates of the dermal cortex; slightly sagittal or sub-regular, mostly larger and stouter than the tubar triradiates, with conical, sharp-pointed rays measuring about 0·16 by 0·02 mm., but very variable; towards the outside they lie parallel to the dermal surface, but otherwise they are very irregularly arranged. (6) Large oxea of the dermal cortex; fusiform, slightly curved, gradually sharp-pointed at each end; measuring about 1·4 by 0·1 mm., but sometimes more or less. These spicules are imbedded in large numbers in the dermal cortex at various levels; they mostly lie more or less parallel to the long axis of the sponge, but there is a good deal of irregularity in their arrangement and not infrequently one end of the spicule projects slightly beyond the dermal surface. (7) Minute oxea of the dermal surface; short and slender, usually slightly curved; the inner end gradually tapering to a fine point, the outer end thicker, more or less hastate, minutely toothed or roughened. These spicules measure only about 0·04 by 0·003 mm.; they occur in large numbers on the dermal surface. (8) Minute oxea of the gastral surface; similar to the foregoing but not so numerous.

One of the two specimens in the collection was attached to a crab's back, which it completely covered like a thick crust; it resembled a specimen cut in half longitudinally, with the concave gastral surface turned towards the crab's back. Hence, as the gastral cavity was no longer an enclosed space, there was no osculum in the ordinary sense of the word. The crab, of course, occupied the gastral cavity, and the exhalant canals of the flagellated chambers must have discharged their contents on to the crab's back. One often finds sponges growing on crab's backs, but I never before saw a case in which the essential form of the sponge was so strangely modified in accordance with this habit. Had it not been for the presence of the other and normal specimen in the collection I should have been inclined to regard this strange modification in form as of at least specific value. The species, is, however, so well characterised by spiculation, &c., that there can be no doubt as to the identity of the two specimens.

I have much pleasure in dedicating this remarkable species to Professor W. Baldwin Spencer.

Locality.—Watson's Bay, Port Jackson (coll. T. Whitelegge).

27. *Synute pulchella*, Dendy.

Synute pulchella, Dendy. Proceedings of the Royal Society of Victoria, Vol. IV (New Series), p. 1.

I have nothing to add to my description of this remarkable sponge until such time as I may be able to publish illustrations of its anatomy.

Locality.—Near Port Phillip Heads (Dendy).

28. *Anamixilla torresi*, Poléjaeff.

Anamixilla torresi, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 50.

I have seen no specimen of this sponge except a portion of the type from the British Museum.

Locality.—Torres Straits (Poléjaeff).

29. *Leucandra australiensis*, Carter, sp.

Leuconia fistulosa, var. *australiensis*, Carter. Annals and Magazine of Natural History, August 1886, p. 127.

There is one specimen in the collection, belonging to the National Museum, which closely resembles in external characters and spiculation that described by Mr. Carter. The slenderness of the radiate spicules gives to the sponge a soft and yielding texture, while the dermal surface is densely hispid from the long, slender, projecting oxea. At first sight the specimen looks like a large example of *Grantessa hirsuta*, but it differs markedly in the arrangement of the canal system and in the absence of the subdermal sagittal triradiates. The chambers are large and irregularly sac-shaped, averaging say about 0·3 by 0·1 mm. (but very variable); not arranged radially around the central gastral cavity of the sponge, but around wide exhalant canals which penetrate the thickness of the wall of the sponge and are, like the gastral cavity itself, echinated by the apical rays of quadriradiate spicules.

Locality.—Near Port Phillip Heads (Carter, and Station 14, coll. J. B. Wilson).

30. *Leucandra alcicornis*, Gray, sp.

Aphroceras alcicornis, Gray. Proceedings of the Zoological Society of London, 1858, p. 114.

Leucandra alcicornis, Hæckel. Die Kalkschwämme, Vol. II, p. 184.

I have not yet had an opportunity of examining this widely distributed and very remarkable species.

Locality.—Bass Straits (Hæckel). Also recorded from various localities in the Pacific and Indian Oceans and from the Cape (*vide* Hæckel).

31. *Leucandra cataphracta*, Hæckel.

Leucandra cataphracta, Hæckel. Die Kalkschwämme, Vol. II, p. 203.

Leucandra cataphracta, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1129.

I am indebted to Mr. T. Whitelegge for a considerable number of fine specimens of this sponge from Watson's Bay, Port Jackson. Neither Hæckel nor von Lendenfeld have described the flagellated chambers, which are small, approximately spherical and scattered abundantly in the thick wall; measuring about 0·09 mm. in diameter.

Localities.—Port Jackson (Hæckel, von Lendenfeld, &c.); Port Denison (von Lendenfeld).

32. *Leucandra typica*, Poléjaeff, sp.

Leuconia typica, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 56.

Leucandra typica, von Lendenfeld. Proceeding of the Linnean Society of New South Wales, Vol. IX, p. 1130.

Locality.—Port Jackson (von Lendenfeld. Recorded by Poléjaeff from the Bermuda Islands).

33. *Leucandra meandrina*, von Lendenfeld.

Leucandra meandrina, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1128.

I identify with this species a somewhat massive but not large specimen collected by Mr. Wilson, which seems to agree closely with a fragment of the type from the British Museum, but the species is by no means an easy one to characterise.

The chambers are approximately spherical and about 0·09 mm. in diameter.

Localities.—Port Jackson (von Lendenfeld); near Port Phillip Heads (coll. J. B. Wilson).

34. *Leucandra vaginata*, von Lendenfeld.

Leucandra vaginata, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1133.

Locality.—Port Jackson (von Lendenfeld).

35. *Leucandra conica*, von Lendenfeld.

Leucandra conica, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1126.

Locality.—Port Jackson (von Lendenfeld).

36. *Leucandra hispida*, Carter, sp.

Leuconia hispida, Carter. Annals and Magazine of Natural History, August 1886, p. 128.

This species is abundant in the collection. It is distinguished by its elongated cylindrical form, hispid surface, and the long-rayed, slender triradiates of the main skeleton. All the specimens are solitary and sessile, of moderate size and with a well-developed oscular fringe. The large oxea of the dermal surface are long and comparatively slender, slightly curved. The flagellated chambers are approximately spherical and average about 0·09 mm. in diameter.

Mr. Carter appears to have had only a single specimen (collected by Mr. Wilson), which was exceptionally short and "conoglobular;" I judge from his description and manuscript illustrations of the spiculation that it is specifically identical with the specimens described above.

Localities.—Near Port Phillip Heads (Carter, and Stations 6, 10, 14, coll. J. B. Wilson); Port Jackson (coll. Professor Spencer).

37. *Leucandra echinata*, Carter, sp.

Leuconia echinata, Carter. Annals and Magazine of Natural History, August 1886, p. 129.

This species is abundant in the collection. The sponge usually has the form of a rather small, ovoid, sessile, thick-walled individual, with terminal fringed osculum and coarsely echinated dermal surface. The species exhibits a good deal of variation in spiculation, especially in the size of the irregularly arranged triradiates of the main skeleton, which are often very much larger than those of the dermal cortex. The other forms of spicule present are gastral quadriradiates, large dermal oxea (echinating the surface), and long, slender, hair-like oxea of the oscular fringe. The flagellated chambers are approximately spherical and densely scattered throughout the thickness of the wall; they measure about 0·09 mm in diameter.

Locality.—Near Port Phillip Heads (Carter, and Stations 1, 9, 10 and outside the Heads, coll. J. B. Wilson); Watson's Bay, Port Jackson (coll. T. Whitelegge).

38. *Leucandra multifida*, Carter, sp.

Leuconia multifida, Carter. Annals and Magazine of Natural History, August 1886, p. 141.

Locality.—Near Port Phillip Heads (Carter).

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39. *Leucandra lobata*, Carter, sp.

Leuconia lobata, Carter. Annals and Magazine of Natural History, August 1886, p. 143.

Locality.—Near Port Phillip Heads (Carter).

40. *Leucandra compacta*, Carter, sp.

Leuconia compacta, Carter. Annals and Magazine of Natural History, August 1886, p. 144.

Locality.—Near Port Phillip Heads (Carter).

41. *Leucandra phillipensis* n. sp.

The single specimen in the collection is a solitary, sessile, irregularly sac-shaped sponge, with a constricted terminal osculum provided with a feebly developed oscular fringe. The outer surface of the sponge is slightly hispid and the wall of the sponge is rather thin, enclosing a wide gastral cavity. The height of the sponge is about 40 mm., the greatest width 20 mm., and the thickness of the wall nearly 3 mm. There is a very thin dermal and gastral cortex. The canal-system is very typical; thickly scattered groups of dermal pores lead into wide, more or less lacunar inhalant canals, which penetrate deep into the substance of the wall. The exhalant canals are also wide and deep and unite together in groups before opening into the gastral cavity. Between these wide inhalant and exhalant canals the flagellated chambers are thickly scattered; these are generally more or less ovoid in shape but only about 0·14 mm. in longer diameter.

The skeleton is rather weak owing to the prevailing slenderness of the spicule-rays, the spiculation being as follows:—(1) Gastral quadriradiates; usually more or less sagittal; with very long, slender, straight or nearly straight, sharp-pointed facial rays; the oral angle wider than the paired angles and the oral rays somewhat longer than the basal; oral rays about 0·4 by 0·01 mm.; basal ray about 0·3 by 0·01 mm. The apical ray is straight or slightly curved, conical and finely pointed, measuring about 0·16 by 0·01 mm. These spicules are very abundant and form a thin gastral cortex, the apical rays projecting into the gastral cavity in large numbers. The walls of the larger exhalant canals are also provided with very similar spicules. Near the osculum the gastral spicules become much more strongly sagittal and the apical ray is often absent. (2) Triradiates of the main skeleton; varying from nearly regular to slightly sagittal; with very long, slender, straight or slightly curved rays, sharply pointed and measuring about 0·33 by 0·016 mm. These spicules are very irregularly arranged but many of them have one ray pointing centrifugally towards the dermal surface. In many of them a small apical ray is developed. (3) Triradiates of the dermal surface; similar to the foregoing but decidedly smaller; arranged parallel to the surface to form a thin dermal cortex. (4) Large dermal oxea; rather slender, fusiform, symmetrical, very slightly curved, gradually sharp-pointed at each end; measuring about 1·4 by 0·03 mm.; occasionally however they are much larger and they may then have a hastately pointed inner end. These spicules are scattered singly and irregularly at right angles to the dermal surface, with the outer end projecting for a short distance. (5) Long, fine, hair-like oxea; these are arranged in loose, irregular, scattered bundles between the large oxea and they also form the feebly developed oscular fringe.

Locality.—Near Port Phillip Heads (coll. J. B. Wilson).

42. *Leucandra gladiator*, n. sp.

The single specimen in the collection forms an extremely irregular, contorted crust, with a number of deeply convex surfaces, bordered by prominent margins, as if it had grown over some irregularly cylindrical body. A few small oscula are irregularly scattered over the convex upper surface. The surface is slightly hispid, the hispid character becoming much more strongly developed at the margins of the crust. The specimen has been broken, but it must have been about 50 mm. in greatest diameter. The growth has been extremely irregular, and it has enclosed various foreign objects. The texture is coarse and fragile. The dermal cortex is strong, but not very thick.

The canal-system is difficult to work out in detail, owing to the strong development of the skeleton, which renders section-cutting very difficult. There is no large, central, gastral cavity, but a number of tolerably wide exhalant canals converge towards each osculum. The flagellated chambers are irregularly scattered, approximately spherical, and about 0·09 mm. in diameter.

The skeleton is composed of the following spicules:—(1) Gastral quadriradiates; minute, cruciform or dagger-shaped;

the apical ray long, slender, straight and gradually sharp-pointed, nearly in a line with the basal ray; the facial rays short, stout, conical and sharp-pointed, the basal rather longer than the other two and often slightly crooked, the orals being straight; basal ray about 0·03 by 0·007 mm.; orals 0·02 by 0·007 mm.; apical 0·08 (or less) by 0·006 mm. These spicules are found in the walls of the larger exhalant canals, but they are not very abundant. (2) Enormous sub-regular or irregular triradiates, with conical, gradually sharp-pointed rays which measure, when fully developed, about 1·8 by 0·16 mm. These spicules form the bulk of the skeleton and are irregularly and abundantly scattered throughout the thickness of the sponge; they vary considerably in size. (3) Small, straight oxea, of hair-like fineness and up to about 0·1 mm. in length; scattered through the interior of the sponge, either separately or in dense sheaves (trichodragmata). (4) Triradiates of the dermal cortex; strongly sagittal, with long, nearly straight, very widely extended, gradually sharp-pointed oral rays, and much shorter, straight, gradually sharp-pointed basal ray; these spicules form a dense feltwork, they are quite irregularly arranged, except that they all lie parallel to the dermal surface. They vary greatly in size, the oral rays, which are extended almost in a line, measuring up to about 0·65 by 0·036 mm., with the basal about 0·3 by 0·036 mm. (5) Dermal oxea; straight, slender, gradually sharp-pointed at each end. In most parts of the surface these spicules are comparatively few in number, projecting at right angles from the dermal cortex and measuring only about 0·4 by 0·01 mm. They vary greatly in size, however, and around the margins of the sponge they become very greatly elongated, forming a thick, dense fringe.

This very remarkable species is obviously very closely related to the European *Leucandra nivea*, as described by Haeckel in "Die Kalkschwämme"; in both we find colossal triradiates, smaller dermal triradiates, dagger-shaped quadriradiates and trichodragmata (which are extremely rare in calcareous sponges), and in both we meet with the characteristic encrusting habit. There are, however, certain marked differences in spiculation, as in the shape of the dermal triradiates and of the dagger-shaped quadradiates, and especially in the presence in *L. gladiator* of the projecting dermal oxea, which seem to be entirely wanting in *L. nivea.*

It is important to notice that Mr. Carter's *Leuconia nivea* var. *australiensis* appears to be totally distinct both from the true *Leucandra nivea* and from *L. gladiator*. It is curious that Mr. Carter should have chosen this name for one of Mr. Wilson's sponges and that later on Mr. Wilson should have obtained from the same locality another species which really is very closely related to the remarkable *Leucandra nivea*.

Locality.—Outside Port Phillip Heads (coll. J. B. Wilson).

43. *Leucandra carteri*, n. sp.

Leucaltis floridana, var. *australiensis*, Carter. Annals and Magazine of Natural History, August 1886. p. 145.

This species appears, from Mr. Carter's description, to be a large, massive *Leucandra*, resembling *L. microraphis* in form but distinguished by the presence of minute oxea on the surface. As the name *australiensis* is already occupied in the genus I propose to call the species *Leucandra carteri*.

Locality.—Near Port Phillip Heads (Carter).

44. *Leucandra schulzei*, Poléjaeff, sp.

Eilhardia schulzei, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 70.

Localities.—Off Pt. Jackson and Twofold Bay (Poléjaeff).

45. *Leucandra loricata*, Poléjaeff, sp.

Leuconia loricata, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 63.

Leucortis loricata, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1123.

Locality.—Off Port Jackson (Poléjaeff).

46. *Leucandra pulvinar*, Hæckel, sp.

Leucortis pulvinar, Hæckel. Die Kalkschwämme, Vol. II, p. 162.

This species ranges, according to Hæckel, from the Red Sea to the west coast of Australia. I have not yet met with it.

Locality.—West coast of Australia (Hæckel. Also recorded from the Red Sea and various parts of the Indian Ocean).

47. *Leucandra helena*, von Lendenfeld, sp.

Leucaltis helena, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1119.

Locality.—Port Jackson (von Lendenfeld).

48. *Leucandra pumila*, Bowerbank, sp.

Leuconia pumila, Bowerbank. Monograph of British Sponges, Vol. 2, p. 41.

Leucaltis pumila, Hæckel. Die Kalkschwämme, Vol. 2, p. 148.

Locality.—Bass Straits (Hæckel. Also recorded from various localities in the Atlantic Ocean, *vide* Bowerbank and Hæckel).

49. *Leucandra bathybia*, Hæckel, sp.

Leucaltis bathybia, Hæckel. Die Kalkschwämme, Vol. 2, p. 156.

Leucaltis bathybia var. *australiensis*, Ridley. Zool. Coll. H.M.S. "Alert," British Museum, p. 482.

Leucaltis bathybia, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1121.

Locality.—Port Jackson (Ridley. Recorded by Hæckel from the Red Sea).

50. *Leucandra pandora*, Hæckel, sp.

Leucetta pandora, Hæckel. Die Kalkschwämme, Vol. 2, p. 127.

Localities.—Bass Straits and Gulf of St. Vincent (Hæckel).

51. *Leucandra microraphis*, Hæckel, sp.

Leucetta microraphis, Hæckel. Die Kalkschwämme, Vol. 2, p. 119 (=*Leucetta primigenia* var. *microraphis*).

Leucetta microraphis, von Lendenfeld, Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1117.

Leuconia dura, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 65.

I identify with this species a number of large specimens of very irregular external form. They are sometimes compressed, sometimes massive and sometimes sac-shaped, with thick walls; usually with wide naked oscula and large exhalant canals. The texture is very coarse, hard and dense; the surface is irregular, and often characteristically ridged; frequently the huge triradiate spicules can be seen with the naked eye on the dermal surface. Some specimens have a few quadriradiate spicules, while in others I cannot find any.

Some of the specimens measure four or five inches in their longest diameter, and one was remarkable from having been of a green colour in life, probably due to symbiotic algæ.

The flagellated chambers are approximately spherical; thickly scattered through the sponge, and about 0·12 mm. in diameter. In some specimens the mesoderm around the chambers is very strongly developed, giving to the sponge a very dense texture. The inhalant pores are scattered thickly over the dermal surface, at any rate in parts.

The skeleton is dense and very irregular, consisting of scattered triradiates of two very different sizes, rather small and enormously large, the former being most abundant.

I consider Poléjaeff's *Leuconia dura* to be identical with this species, because I do not think the presence of sagittal spicules in the neighbourhood of the osculum is a specific character, as it is of such extremely general occurrence.

Localities.—Near Port Phillip Heads (Stations 1 and 9 and outside the Heads, coll. J. B. Wilson); Torres Straits (Ridley, Poléjaeff); Port Jackson (von Lendenfeld).

52. *Leucandra haeckeliana*, Poléjaeff, sp.

Leucetta haeckeliana, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 69.

Vosmaeria haeckeliana, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p 1114.

Locality.—Off Port Jackson (Poléjaeff).

53. *Lelapia australis*, Carter.

(?) *Lelapia australis*, Gray. Proceedings of the Zoological Society of London, 1867, p. 557.

Lelapia australis, Carter. Annals and Magazine of Natural History, August 1886, pp. 138 and 148.

This sponge appears to be of exceptional interest, and I greatly regret that I have never had an opportunity of examining it.

Locality.—Near Port Phillip Heads (Carter).

54. *Grantessa sacca*, von Lendenfeld.

Grantessa sacca, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1098.

Hypograntia sacca, Carter. Annals and Magazine of Natural History, July 1886, p. 42.

This very beautiful sponge is well represented in the collection. All the specimens which I have seen, six in number, are more or less compressed, in the case of large specimens very much so. The finest specimen is 60 mm. in height by 50 mm. in greatest breadth. Von Lendenfeld represents the radial chambers as being perfectly straight and unbranched, whereas, in the Victorian specimens, they branch repeatedly, the branches running parallel with one another to the dermal surface. This may possibly constitute a specific difference, but I am more inclined to think that the figure referred to is incorrect.

Localities.—Port Jackson (von Lendenfeld); near Port Phillip Heads (Carter, and outside the Heads, coll. J. B. Wilson).

55. *Grantessa hirsuta*, Carter, sp.

Hypograntia hirsuta, Carter. Annals and Magazine of Natural History, July 1886, p. 41.

In anatomical characters this species closely resembles *G. sacca*, but differs markedly in external appearance and in the less regularly arranged tubar skeleton, which, though composed of slender spicules, is very dense and confused. The subdermal sagittal triradiates, with inwardly directed basal ray, are not mentioned by Mr. Carter; they are clearly present in my specimens though less obvious than in *G. sacca* on account of the somewhat confused character of the tubar skeleton. The oxea of the dermal tufts are straight, or only very slightly curved. The manuscript illustration which Mr. Carter has kindly sent me shows only a very slight curvature, though he describes them as "curved." The species is abundant in the collection.

Localities.—Near Port Phillip Heads (Carter; and Station 1 and outside the Heads, coll. J. B. Wilson); King Island (coll. Prof. Spencer); Hobart, Tasmania (coll. A. Dendy).

56. *Grantessa hispida*, n. sp.

Small, cylindrical or slightly compressed, solitary persons, with more or less distinct fringe around the terminal osculum and strongly hispid surface. The largest specimen in the collection is about 40 mm. high by 4 mm. in greatest diameter, the wall of the sponge being only about 0·56 mm. thick. The canal system closely resembles that of *G. sacca*, but the chambers are shorter and less branched. The skeleton is arranged as in *G. sacca*, but the dermal tufts of oxea are less definite and less regularly arranged, and the tubar skeleton is composed of much fewer joints. The spiculation is as follows:—(1) Gastral quadriradiates; very rare, with short apical ray. (2) Gastral triradiates; strongly sagittal, with very long and slender rays; gradually sharp-pointed; basal ray straight, about 0·3 by 0·0083 mm.; oral rays straight or slightly crooked, often unequal in length, about 0·2 by 0·008 mm. (3) Subgastral sagittal triradiates; oral rays widely extended, slightly recurved, sharply-pointed, about 0·12 by 0·0082 mm.; basal ray long, straight, sharp-pointed, varying in length up to about 0·3 mm., and about as thick as the orals, extended in a centrifugal direction through the chamber layer. (4) Tubar triradiates, resembling the foregoing, with similar very long basal rays. (5) Subdermal sagittal triradiates; with very widely extended oral rays lying in the dermal cortex, and long straight basal ray extending inwards through the chamber layer; oral rays up to about 0·2 by 0·01 mm.; basal ray up to about 0·32 by 0·01 mm.; all sharply-pointed. (6) Dermal triradiates; sagittal, resembling the foregoing, but often very irregular and with shorter basal ray. (7) Dermal oxea; long, straight or slightly curved, spindle-shaped, gradually sharp-pointed at each end, length variable, up to about 0·7 by 0·016 mm. in the largest specimen, but much longer and slenderer in one of the smaller ones. The spicules of the oscular fringe do not differ markedly from these.

Locality.—Near Port Phillip Heads (Station 9, coll. J. B. Wilson).

57. *Grantessa poculum*, Poléjaeff, sp.

Amphoriscus poculum, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 46.

Heteropia patulosculifera, Carter. Annals and Magazine of Natural History, July 1886, p. 49.

A careful examination of portions of Carter's and Poléjaeff's type specimens from the British Museum has convinced me that the two are specifically identical, and

I therefore revert to the earlier specific name. I have also two other specimens collected by Mr. Wilson, one of which exhibits very beautifully the "agglomerated" character mentioned by Carter, while the other is only a fragment. The quadriradiates mentioned by Carter are scarce and inconspicuous, and I have not noticed them in the other specimens.

Localities.—Off Port Jackson (Poléjaeff); near Port Phillip Heads (Carter and coll. J. B. Wilson).

58. *Grantessa erinaceus*, Carter, sp.

Leuconia erinaceus, Carter. Annals and Magazine of Natural History, August 1886, p. 130.

This species is readily recognised by its external appearance and the peculiar arrangement of the dermal oxea. The flagellated chambers are elongated and radial, but very irregular and branching, and they communicate with the gastral cavity by unusually long exhalant canals, which unite together in groups. The tubar skeleton is very irregular, but still presents clear traces of the typical "articulate" arrangement. Subgastral sagittal triradiates are present, and the subdermal sagittal triradiates, with inwardly directed basal rays, are very conspicuous. There is a dense dermal cortex of much smaller triradiates, and a less well-developed gastral cortex. Endogastric septa, without spicules, are present in both my specimens, and, as Mr. Carter also mentions them in his, they would seem to be characteristic of the species.

Locality.—Near Port Phillip Heads (Carter, and Station 7, coll. J. B. Wilson).

59. *Grantessa intusarticulata*, Carter, sp.

Hypograntia intusarticulata, Carter. Annals and Magazine of Natural History, July 1886, p. 45.

Hypograntia medioarticulata, Carter, *loc. cit.* p. 46.

I have eleven specimens which I believe to be all referable to this species, and I am strongly of opinion that Mr. Carter's *Hypograntia medioarticulata* is specifically identical with his *intusarticulata*. The minute details of spiculation vary considerable in different specimens, the most characteristic features being the dermal crust of minute oxea or "mortar spicules," and the subdermal sagittal triradiates. The radial chambers are much branched, which I believe is what Mr. Carter means when he says that they intercommunicate by large holes. The branches run parallel with one another to the dermal cortex; the exhalant canals are short.

Localities.—Near Port Phillip Heads (Carter, and Stations 3, 5, 8, 9 and outside the Heads, coll. J. B. Wilson); Watson's Bay, Port Jackson (coll. T. Whitelegge).

60. *Grantessa* (?) *polyperistomia*, Carter, sp.

Heteropia polyperistomia, Carter. Annals and Magazine of Natural History, July 1886, p. 47.

Locality.—Near Port Phillip Heads (Carter).

61. *Grantessa* (?) *compressa*, Carter, sp.

Heteropia compressa, Carter. Annals and Magazine of Natural History, July 1886, p. 51.

Locality.—Near Port Phillip Heads (Carter).

62. *Grantessa* (?) *pluriosculifera*, Carter, sp.

Heteropia pluriosculifera, Carter. Annals and Magazine of Natural History, July 1886, p. 52.

Locality.—Near Port Phillip Heads (Carter).

63. *Grantessa* (?) *erecta*, Carter, sp.

Heteropia erecta, Carter. Annals and Magazine of Natural History, July 1886, p. 53.

Locality.—Near Port Phillip Heads (Carter).

64. *Grantessa* (?) *spissa*, Carter, sp.

Heteropia spissa, Carter. Annals and Magazine of Natural History, July 1886, p. 54.

Locality.—Near Port Phillip Heads (Carter.)

The last five species are described by Mr. Carter apparently from single specimens, all collected by Mr. Wilson. It appears to me very doubtful whether they are all specifically distinct, and also whether some of them at any rate are not mere varieties of *G. poculum* or *Vosmaeropsis macera*, which they resemble in spiculation. Unfortunately, I have not seen any of the types.

65. *Vosmacropsis macera*, Carter, sp.

Heteropia macera, Carter. Annals and Magazine of Natural History, July 1886, p. 50.

This species is well represented in the collection I have been able to convince myself of the correctness o. the identification by a minute comparison of a piece of Mr. Carter's type from the British Museum. It is remarkable for its densely agglomerated or colonial habit. Specimens may attain a large size, consisting of very numerous individuals almost completely fused together, usually in linear series, which are inter-connected by cross-bars. The oscula are raised on conical prominences, and each indicates a separate gastral cavity. The canal system is remarkable. The chambers are thimble-shaped and mostly widely separated from the gastral cavity, with which they communicate by a strongly developed system of exhalant canals, each being separated from its exhalant canal by a well developed diaphragm. Those chambers which lie next to the dermal surface still exhibit a radial arrangement with regard to the long axis of the individual. Both subdermal and subgastral sagittal triradiates are strongly developed.

Locality.—Near Port Phillip Heads (Carter, and coll. J. B. Wilson).

66. *Vosmacropsis depressa*, n. sp.

Specimen flattened, cushion-shaped, with flat under and convex upper surface. About 12 mm. in horizontal diameter, and only 4 mm. thick in the middle. Margin rounded, roughly circular in outline. There is no wide gastral cavity, but several large, branching exhalant canals converge to a single small osculum situate near the middle of the upper surface. Surface smooth; no distinct oscular fringe.

The inhalant canal-system is quite irregular, commencing in wide lacunar spaces situated beneath the thin, pore-bearing dermal cortex. The flagellated chambers are irregularly but thickly scattered throughout the thickness of the sponge, with no trace of radial arrangement around a central gastral cavity. They are irregularly sac-shaped or thimble-shaped, measuring about 0·2 by 0·09 mm.

The bulk of the skeleton is made up of fairly large, subregular or slightly sagittal triradiates, scattered without definite order throughout the thickness of the sponge, but many with one slightly longer ray pointing towards the dermal surface. Beneath the dermal surface, but apparent only on the upper surface of the sponge, is a distinct layer of subdermal sagittal triradiates with inwardly-directed basal ray. The dermal skeleton is made up principally of subregular triradiates of various sizes, placed horizontally, but with no definite arrangement; amongst these very minute, slender oxea are scattered, rare on the upper surface of the sponge but abundant on the lower; around the osculum these oxea are numerous and a few are much larger than the rest. Around the main exhalant canals there is a layer of small sagittal triradiates. The forms and dimensions of the different spicules are as follows:—(1) Triradiates of the exhalant canals; sagittal, rays conical, fairly sharply-pointed; basal straight, orals usually slightly incurved or recurved; basal commonly somewhat shorter than orals, which measure about 0·16 by 0·012 mm. Just below the osculum I have seen short apical rays in a few of the sagittal radiates. (2) Triradiates of the main skeleton; subregular or slightly sagittal; rays usually straight, conical, gradually sharp-pointed, rather slender, up to about 0·36 by 0·024 mm. (3) Subdermal sagittal triradiates; similar to the foregoing but a good deal smaller, and with the basal ray much longer than the others. (4) Dermal triradiates; subregular, with long, conical, gradually sharp-pointed rays varying greatly in size, up to about 0·54 by 0·045 mm. (5) Oxea; mostly very minute and slender, sharply-pointed at each end, with one end rather thicker than the other; straight; often slightly roughened; usually short, but varying greatly in length; around the osculum a few much stouter ones occur, but still very small.

Locality.—Near Port Phillip Heads (Sorrento Reef, coll. J. B. Wilson).

67. *Vosmaeropsis wilsoni*, n. sp.

Sponge colonial, consisting of short, thick, sub-cylindrical or truncatedly conical individuals united together by their bases into smaller or larger agglomerations, which may attain a diameter of nearly five inches. Each fully grown individual has a circular osculum at its summit, which may or may not have an oscular fringe, adjacent individuals of the same colony sometimes differing in this respect. The osculum is often provided with a very distinct, membranous diaphragm, situated a short distance within its margin. The individuals vary in size, and, owing to their peculiar colonial and branching habit, it is difficult to give exact measurements, but we may put down the average adult size as about 20 mm. long and 5 mm. in diameter. A large colony contains dozens of such individuals united together in a complicated and irregular manner. The outer surface is smooth, except for a slight unevenness due to the presence of large triradiates, visible to the naked eye. The colour of spirit specimens varies from pure white to pale brown, but one specimen which I observed as it came out of the dredge was then of a violet purple colour.

The gastral cavity is wide and cylindrical and the wall is about 2·5 mm. thick. There is a dense, thick cortex on both gastral and dermal surfaces.

The inhalant pores are thickly scattered over the surface of the sponge; each leads separately into a short, narrow, cylindrical canal, situate in the outer portion of the dense dermal cortex; these canals soon unite to form larger, but still very well-defined, cylindrical canals, which anastomose with one another by cross-branches and finally lead down to the chamber layer between the dermal and gastral cortex, where the canal system becomes more or less lacunar. The flagellated chambers are thickly scattered through the mesoderm of the chamber layer; they vary much in shape and size, from approximately spherical and only about 0·072 mm. in diameter to elongatedly sac-shaped and as much as 0·37 by 0·13 mm.* The exhalant canals unite together into tolerably large trunks, which penetrate the gastral cortex and open into the gastral cavity.

The skeleton is divisible into four portions, that of the gastral cortex, that of the chamber layer, that of the dermal cortex and that of the osculum. The gastral cortex is about 0·3 mm. thick and its skeleton consists entirely of a dense feltwork of medium-sized triradiate spicules, arranged irregularly but parallel to the gastral surface. These spicules are sagittal, the oral angle being rather wider than the paired angles and the oral rays rather longer than the basal; oral rays straight or very slightly curved towards one another, conical and gradually sharp-pointed, measuring about 0·3 by 0·024 mm.; basal ray straight, conical, gradually sharp-pointed, a little shorter than the orals. The

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* These measurements were taken from different specimens, but it would be difficult to make a mistake as to the species in this particular case, and we also find considerable variation in the chambers even in the same section.

skeleton of the chamber layer is made up of large subdermal and subgastral sagittal triradiates, whose basal rays penetrate the chamber layer in opposite directions. These spicules vary greatly in size, the basal rays often extend completely through the chamber layer and are very thick; the oral rays are shorter, more or less curved and widely extended. Frequently many of those which have centrifugal basal rays are not strictly subgastral but have the oral rays situate at various levels in the chamber layer. The rays are conical and gradually sharp-pointed. The dermal cortex is about 0·4 mm. thick and its skeleton is made up almost entirely of triradiate spicules of various shapes and sizes. Towards the inside we find large, regular or subregular triradiates, arranged parallel to the dermal surface, with conical, gradually sharp-pointed rays which measure up to about 1·0 by 0·17 mm.; many, however, being much smaller. On the outside is a much thinner layer of very different, small triradiates. These spicules are irregular in shape and irregularly arranged; their rays are conical and gradually sharp-pointed, but crooked; one of them commonly projects inwards at right angles to the dermal surface; the rays measure about 0·083 by 0·0052 mm. We also find in the outermost part of the dermal cortex a few very minute, straight, slender oxea, whose exact size and shape are very difficult to determine. The oscular skeleton consists of a fringe (not always visible to the naked eye but sometimes strongly developed) of very long and very slender oxea.

I have much pleasure in dedicating this very remarkable and abundant species to Mr. J. Bracebridge Wilson, who has collected all the specimens at present known.

Locality.—Outside Port Phillip Heads (coll. J. B. Wilson).

68. *Heteropegma nodus gordii*, Poléjaeff.

Heteropegma nodus gordii, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 45.

The only specimen which I have seen of this species, unless indeed *H. latitubulata* be considered specifically identical, is a portion of Poléjaeff's type specimen in the British Museum. I have nothing to add to Poléjaeff's excellent description.

Locality.—Torres Straits (Poléjaeff. Poléjaeff also records the species from the Bermudas).

69. *Heteropegma latitubulata*, Carter, sp.

Clathrina latitubulata (provisional, incertæ sedis), Carter. Annals and Magazine of Natural History, June 1886, p. 515.

After describing the external form and spiculation of this remarkable sponge, Mr. Carter remarks that in general form it is very much like Poléjaeff's *Heteropegma nodus gordii*, but totally different anatomically. I have fortunately been able, owing to the kindness of the authorities of the British Museum, to make a minute anatomical examination both of Poléjaeff's type of *Heteropegma nodus gordii*, and also of Carter's type of *Clathrina latitubulata*, and I have also received the latter species direct from Mr. Wilson. I find that in external form, canal-system, and also in the arrangement of the skeleton, the two species are identical, agreeing with the admirable figures given by Poléjaeff in his Challenger Report. The only difference which I have been able to detect concerns the size and shape of the minute quadriradiate spicules of the chamber layer, which are even further reduced in *H. latitubulata* than they are in *H. nodus gordii*.

Locality.—Near Port Phillip Heads (Carter, and Station 1, coll. J. B. Wilson).

70. *Amphoriscus cyathiscus*, Hæckel.

Amphoriscus cyathiscus, Hæckel. Prodromus eines Systems der Kalkschwämme. Jenaische Zeitschrift, Vol. 5, part 2, p. 238.

Sycilla cyathiscus, Hæckel. Die Kalkschwämme, Vol. 2, p. 250.

Locality.—South Australia (Hæckel).

71. *Amphoriscus cylindrus*, Hæckel, sp.

Sycilla cylindrus, Hæckel. Die Kalkschwämme, Vol. 2, p. 254.

Amphoriscus cylindrus, von Lendenfeld. Proc. Linn. Soc. N.S.W., Vol. IX, p. 1103.

Locality.—Port Jackson (von Lendenfeld. Recorded by Hæckel from the Adriatic).

72. *Leucilla uter*, Poléjaeff.

Leucilla uter, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 53.

Polejna uter, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1115.

Localities.—Torres Straits (von Lendenfeld. Recorded by Poléjaeff from the Phillipine Islands and the Bermudas).

73. *Leucilla imperfecta*, Poléjaeff, sp.

Leucetta imperfecta, Poléjaeff. Report on the Calcarea of the Challenger Expedition, p. 67.

Vosmaeria imperfecta, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1113.

Locality.—Off Port Jackson (Poléjaeff).

74. *Leucilla australiensis*, Carter, sp.

Leuconia johnstonii, var *australiensis*, Carter. Annals and Magazine of Natural History, August 1886, p. 133.

This beautiful little species nearly always presents itself under the form of a small, ovoid, sessile, solitary person, with single, circular, naked, terminal osculum. The sponge-wall is comparatively thick, and the dermal surface smooth and hard owing to the large quadriradiates. One very large specimen in the collection, however, is conical in shape, and has a very irregular surface, but this is very exceptional. The species is sometimes social, and rarely consists of two or more individuals united together, or of a single branched individual; but the small egg-like form is highly characteristic. There are numerous specimens in the collection.

The flagellated chambers, thickly scattered through the thickness of the wall, are usually approximately spherical, and about 0·1 mm. in diameter; immediately beneath the dermal cortex, however, they are commonly rather larger and more or less sac-shaped.

Locality.—Near Port Phillip Heads (Carter, and Stations 1, 5, 6, 9, coll. J. B. Wilson, and off Geelong, coll. H. Grayson).

75. *Leucilla prolifera*, Carter, sp.

Teichonella prolifera, Carter. Annals and Magazine of Natural History, July 1878, p. 35, and August 1886, p. 146.

This beautiful species is represented in the collection by a number of fine examples, one of which I have already figured in my paper "On the Anatomy of *Grantia labyrinthica*, Carter, and the so-called Family Teichonidæ" (*Quarterly Journal of Microscopical Science*, Vol. 32, N.S.) The flagellated chambers are approximately spherical and about 0·09 mm. in diameter, thickly scattered through the substance of the sponge. With the exception of the small quadriradiates in the walls of the oscular tubes, and the very large quadriradiates of the dermal surface, the skeleton is quite irregularly arranged, consisting of scattered triradiate spicules. On account of the large subdermal quadriradiates, though the inwardly-directed apical ray is but short, I propose to include the species in the genus *Leucilla.*

Localities.—Near Port Phillip Heads (Carter, and outside the Heads, coll. J. B. Wilson); Freemantle, W.A. (Carter).

76. *Leucilla saccharata*, Hæckel, sp.

Leucandra saccharata, Hæckel. Die Kalkschwämme, Vol. 2, p. 228.

Leucandra saccharata, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1137.

This remarkable species exhibits a singular irregularity in external form, varying from compressed, irregularly-folded plates to elongated cylindrical tubes, and often attaining a large size. It is common in Port Jackson, whence I have received specimens from Professor Spencer, but I have only seen a single specimen from Port Phillip, collected by Mr. Wilson.

The flagellated chambers are approximately spherical, scattered irregularly, about 0·09 mm. in diameter.*

Localities.—Bass Straits (Hæckel); Port Jackson (von Lendenfeld, and coll. Prof. Spencer); Port Denison (von Lendenfeld); Port Phillip (Station 14, coll. J. B. Wilson).

77. *Leucilla villosa*, von Lendenfeld, sp.

Leucandra villosa, von Lendenfeld. Proceedings of the Linnean Society of New South Wales, Vol. IX, p. 1131.

The only specimen of this sponge which I have seen is a piece of the type from the British Museum, in which subdermal quadriradiates, with long, inwardly-directed apical ray, are abundant. I therefore include the species in the genus *Leucilla.*

Locality.—Port Jackson (von Lendenfeld).

78. *Paraleucilla cucumis*, Hæckel, sp.

Leucandra cucumis, Hæckel. Die Kalkschwämme, Vol. 2, p. 295.

Localities.—Bass Straits and Gulf of St. Vincent (Hæckel. Also recorded by Hækel from Ceylon).

* Von Lendenfeld gives the diameter as 0·04 mm., but this is probably an error, for he also says that in *Leucandra typica* the chambers "are smaller than in any other case, their diameter rarely exceeding 0·04 mm." (*loc. cit.*, p. 1130).

Art. VII.—*On Two New Tertiary Stylasterids.*

(With Plate XIII.)

By T. S. Hall, M.A.

[Read October 13, 1892.]

No members of the family *Stylasteridæ* have, I believe, been recorded as fossils in Australia, their small size having caused them to be overlooked by collectors. The specimens I have found, were obtained by washing the clays which are so characteristic of our Eocene deposits.

The arrangement of the pores in the cyclosystems of both species seems to warrant the formation of new genera for their reception; at any rate, they will not fit into any of the genera defined by Moseley.

Genus, *Deontopora* (gen. nov.)

Dactylopores arranged in an arc of about three-quarters of a circle round a gastropore at the centre, and absent on the inner or attached edge of the cyclosystem. There are no styles visible on a superficial examination in the dactylopores, and the presence of matrix in the gastropores prevented the search for them there without mutilation of what is at present, the only specimen I have.

D. mooraboolensis (sp. nov.)

The cœnosteum is branched, but its general form is as yet unknown. The portion found is about 1 cm. long and 2 mm. in diameter. The surface is composed of dense calcareous tissue, and, as in *Astylus subviridis* (Moseley),* is marked by conspicuous longitudinal rounded ridges,

* "On the Structure of the Stylasteridæ." Phil. Trans., 1878, p. 457.

separated by grooves. The ridges are parallel and can be traced separately for some distance. In some places, branching and anastomosing of the ridges takes place. Over the surfaces of the ampullæ the ridges are contorted very much, and their individuality is preserved for a very short distance. In the grooves between the ridges, under a strong light, narrow slit-like pits can be seen with a hand lens. Pourtales, as quoted by Moseley,* mentions small linear pores arranged in rows and scattered over the whole cœnenchyma in *Pliobothrus symmetricus* (Pourtales). These pores, Moseley states, are occupied by canals of the cœnosarcal meshwork in the recent condition. The pits in *Deontopora* are probably the mouths of pores with the same function, as the microscope shows they have considerable depth. In two places, where smaller branches had been broken off, the cœnosteum had a cellular appearance, but this was not visible on the ends of the specimen.

The cyclosystems are arranged alternately on opposite sides of the branch, and are a little over 1 mm. in diameter. The axis of the system and that of the branch, form an angle of about 45°. The inner wall of the gastropore is confluent with the side of the branch, and the cord-like ridges mentioned above, run right down into the mouth of the pore. The dactylopores are placed on an elevated flattened, horse-shoe-shaped ridge overlooking the gastropore. Each dactylopore is situated in a broad, deep groove, at about one-third of its length from the outer end of the groove. This groove cuts the outer wall of the cyclosystem, while its inner end runs out on to the level floor pierced by the gastropore. As in *Astylus subviridis*,† the upper edge of the system slightly overhangs the outer wall, and shows marginal indentations corresponding with the centres of the outer ends of the pseudosepta, or walls between neighbouring dactylopores. The broken edges of the pseudosepta are cellular in appearance. The number of dactylopores in each system is variable, twelve or thirteen usually occurring. In one place, where a small branch is given off, a gastropore is in the axil, and four dactylopores are placed on each of the opposite sides, none being found on the sides of either the main or the secondary branch. In another case, the cyclosystem is at one side of the base of a small branch, slightly below the level of the axil, so that the position of a

* *Id.*, p. 440. † Moseley, *op. cit.*, p. 457.

branch, in reference to a cyclosystem, is not quite constant. In the latter case, six dactylopores are present. In both these cases the dactylopores are rather indistinct, and the systems are possibly in process of obliteration, such obliteration being recorded by Moseley, as occurring in older portions of colonies of *Errina*.*

The gastropore is approximately circular in outline, slightly funnel-shaped above, and cylindrical below. The presence of the matrix prevented a closer examination of its deeper parts.

The ampullæ form comparatively large hemispherical projections above the surface of the cœnosteum. Their position is not constant, though they lie near the base of a cyclosystem. Some systems have no ampulla near them, while one has two, placed one on each side of the base, though one seems the usual number. In some cases, a small aperture at the base leads through the outer wall of the ampulla, which, as a fractured portion shows, is thin. In one instance, this aperture is surrounded by a slightly projecting neck, with a thick, definite wall. The only external openings leading into ampullæ mentioned by Moseley,† occur in male colonies of *Sporadopora*, where they are small and slit-like, and are placed at the bottom of irregular depressions, which are seen with difficulty.

In *Cryptohelia* the female colony has but one ampulla associated with each cyclosystem, but in what are, perhaps, male colonies, several ampullæ occur with each.‡ In the female colonies of most of the stylasteridæ described by Moseley, there is only one planula developed in each ampulla, and the only means of escape seems to be by absorption and breaking down of the outer wall of the ampulla.§

In *Cryptohelia*, however, there are several gonophores present in each gonangium in all stages of development.‖ In the latter case, a definite constant means of escape for the planulæ would seem to be necessary, though I can find no mention of this. The large size of the ampullæ in the present example of *Deontopora*, would be a strong argument in favour of the colony being a female one, and the presence of such a definite opening into the ampullæ would, I think,

* *Op. cit.*, p. 444. † *Op. cit.*, p. 431.

‡ *Op. cit.*, p. 463. § *Id.*, p. 441.

‖ *Op. cit.*, p. 477.

show that it would be required frequently. Possibly then, we have in this instance a near approach to the conditions found in the gonangia of *Cryptohelia.*

When other specimens of this stylasterid are available for examination, the exact position of the genus in the group will, probably, be determinable. The suppression of some of the dactylozoids of a cyclosystem on one side of a gastrozoid, occurs at times in *Stylaster*, and is constant in *Cryptohelia.* In the latter case, however, the suppression is accompanied by the production of a calcareous lamina overhanging and protecting the cyclosystem; but it must be noted that the abortion occurs on opposite faces of the system in *Cryptohelia* and *Deontopora.* In the former, it occurs on the side of the system towards the proximal end of a branch, while in the latter, it is towards the distal end.

In *Astylus*, which is probably the nearest ally of *Cryptohelia*, the homologue of the external lid of the latter is a small tongue-like projection placed somewhat deeply in the gastropore, and dividing it into an inner and an outer chamber.* Sections would, of course, require to be rubbed down to settle whether or not such a process is found in *Deontopora*, or whether, on the other hand, a style is developed. In the former case its nearest ally would be *Astylus*, and in the latter *Stylaster.* If neither style nor process occur, its affinities would be with *Conopora.*† The external characters point, I think, to an alliance with *Astylus* and *Cryptohelia.*

Locality.—Grey clays, Orphanage Reserve, Fyansford, Geelong. Only one specimen found.

Genus *Leptobothrus* (gen. nov.)

The pores are grouped in cyclosystems; dactylopores not in radial grooves.

The absence of grooves containing the dactylopores is a feature not apparently occurring in any genera in which cyclosystems are found, though it occurs in *Sporadopora* and *Distichopora.*

L. spenceri (sp. nov.)

The specimen figured consists of a portion of a branch which is circular in section. Length 5 mm., diameter 1 mm.

* Moseley, *op. cit.*, p. 458.

† *Id.*, p. 503.

The regularity of its form is disturbed by cyclosystems, which are scattered irregularly over its surface. The surface is marked by minute pores, which are slit-like, oval, or circular. They are larger and more distinct than the corresponding pores of *Deontopora*, and are irregularly scattered.

The cyclosystems appear as cylindrical elevations at right angles to the axis of the branch, and irregular in position. The gastropores have well defined walls of similar texture to the surface of the branch. They are cylindrical in shape, and maintain the same diameter right to the top of the cyclosystem, not as in most other genera, opening into a basin-shaped depression. The dactylopores are about eight or nine in number, and open directly on the surface of the ring which forms the boundary of the gastropore, not being placed in radial grooves. The apertures are about midway between the inner and the outer walls. No styles were seen in either kind of pore.

The ampullæ are not noticeable externally, but a large distinct pore, with a slightly expanded external opening, is present at a small distance below the cyclosystem in nearly every instance. In *Cryptohelia*,* the ampullæ are always developed in connection with the cyclosystems, and the invariable presence of a pore in this position in the present specimen, renders it probable that it leads into an ampulla. One or two pores which, though somewhat smaller, have a similar appearance, are placed without relation to any cyclosystem. Named as a compliment to Professor W. Baldwin Spencer.

Localities.—A well-sinking in the Eocene beds at Belmont, near Geelong, and at Schnapper Point.

My thanks are due to Professor Spencer for suggestions, and for the loan of works, without which this paper could not have been prepared.

* Moseley, *op. cit.*, p. 477.

DESCRIPTION OF PLATE.

FIG. 1.—*Deontopora mooraboolensis*, enlarged.

FIG. 2.—Two ampullæ seen somewhat from below.

a.—Broken end of a small branch showing cellular appearance, due to the cut ends of the cœnosarcal tubes.

b. b.—Ampullæ, the one on the left being broken.

c.—Pore of ampulla, with definite ring-like wall.

d. d.—Slit-like pores in grooves on surface of cœnosteum.

e.—Pore of ampulla, its wall being broken.

The part shown in this Figure is seen from above in the lower left-hand corner of Fig. 1.

FIG. 3.—Diagram of cyclosystem of *Deontopora*.

Gp.—Gastropore.

Dp.—Dactylopore in groove.

Ps. Ps.—Pseudosepta.

FIG. 4.—*Leptobothrus spenceri*, enlarged.

FIG. 5.—Diagram of cyclosystem of the same.

Gp.—Gastropore.

Dp.—Dactylopore.

Fig 1.

Fig 2

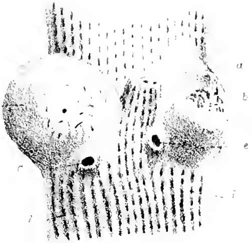


Fig 3.

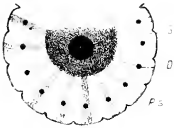
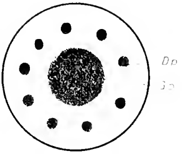


Fig 4.

Fig. 5.



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Art. VIII.—*Three rare Species of Eggs hitherto only described from the Oviduct of the Bird.*

By A. J. Campbell, F.L.S.

(Communicated by Professor W. Baldwin Spencer, M.A.)

[Read September 8, 1892.]

1. Sericulus melinus, Latham (Regent-bird).

Locality.—Somewhat restricted, being chiefly confined to the sub-tropical coastal scrubs of the Northern portion of New South Wales and Southern Queensland; but its extreme limit appears to be Port Jackson in the South, where the bird has been occasionally observed, and the Fitzroy River in the North. I have recorded having received a skin of a young male from Duaringa, near that River.

Observations.—The Regent-bird, especially the adult male with glorious black and yellow plumage, Gould has well said is one of the finest of Australian Fauna. Last November I undertook an excursion to the Richmond River District, New South Wales, with a view of obtaining, amongst other items, the eggs of the Regent-bird. I found the luxuriant scrubs abounding with Regent-birds, in fact, they were as plentiful there as the Wattle-birds about the Banksia groves of our Southern coast. We experienced no difficulty in procuring our few specimen skins. All that was necessary was to select a balmy day and recline under a Canthium tree, where the birds (males in various stages of plumage and females) came to regale themselves on the bunches of hard yellow berries. Nevertheless, although well aided with a hardy companion, I prosecuted a vigorous and toilsome search through dense labyrinths of hot scrub and thorny brakes of prodigal growth, where the thick foliage of the trees caused a perpetual twilight underneath, but returned without the eggs. It was an experience akin to seeking for the proverbial needle in a haystack. From evidence gained by dissection and otherwise, it appears that November was too early for the majority of the birds. However, just prior to leaving (19th November) we detected a female carrying a stick, and after much laborious work we succeeded in tracing her through an entanglement of wild raspberries and stinging trees, and were satisfied that she was building in a certain bushy Buoyong (*Tarrietia*) tree, after seeing her return several times, each time with a twig in her bill. Marking the tree, we pointed it out to two young farmers, directing them to send the eggs after us. Some weeks afterwards, I received a doleful letter stating they were unable to climb the tree. However, the next month another farmer, whose scrub paddock I had scoured, following up my instructions, found therein a Regent's nest containing a pair of fresh eggs, which I now have pleasure in describing.

The Eggs.—(*a*) A beautiful, well-shaped specimen, with a fine texture of shell of a light yellowish-stone colour, with a faint greenish tinge, and marked with blotches and spots of sienna, but principally with hair-like markings of the same colour in fanciful shapes and figures, as if a person had painted them on with a fine brush. Intermingled are a few greyish streaks, dull, as if under the shell's surface. All the markings are fairly distributed, but are more abundant around the upper quarter of the egg. The dimensions are 4 cm. long by a breadth of 2·8 cm., somewhat large compared with the size of the parent. The character of the markings resemble much the egg of its close ally, the Spotted Bower-bird (*Chlamydodera maculata*), which I found near Wentworth, River Darling, October 1887, with the difference that the ground colour of the Regent is more yellowish and not of the greenish shade of the Bower-bird. (*b*) Similar to the other specimen, but markings less pronounced and finer in character, with a greater proportion of the dull greyish hair-like streaks, also a little smaller; length 3·95 cm. by a breadth of 2·75 cm.

The Nest.—It was discovered during the last week in December, was placed about 15 feet from the ground, and was observed by the bird sitting thereon. The structure was of such a loose nature—merely a few twigs forming a flat shelf about five inches across—that it fell to pieces on removal from the tree. It was accounted remarkable how the eggs could retain their position in it. The description of the nest verifies the statement found in Gould, that "it is rudely constructed of sticks; no other material being employed, not even a few roots as a lining," but is at variance with Mr. North's statement, which precedes his description of the egg taken from the oviduct of a bird by Mr. Cockerell, the collector, the only other egg at present known.

Incidentally, the streaky markings of the eggs open up a speculation in reference to coloration. A clever paper read before this Society some time ago, suggested the bowers or play houses of the birds as attributive to the cause. Perhaps Mr. Lucas had in his mind Jacob and the flocks that conceived before the rods and brought forth cattle, "ringstreaked, speckled, and spotted." But all bower-building birds do not lay streaky-coloured eggs, to wit, the Satin Bower-bird (*Ptilonorhynchus*). I succeeded in taking a good photograph of the Regent-bird's bower.

2. Scythrops Novæ-Hollandiæ, Latham (Channel-bill)

Locality.—This bird is a wanderer over the whole of Australia, but has not yet been received from the South West portion, and sometimes reaches Tasmania. Is recorded from New Guinea.

Observations.—The Channel-bill is manifestly interesting, because it is the largest of Australian Cuckoos. It is sometimes known inland as the "flood" bird, arriving with such occurrences. Gould described an egg from the oviduct. Mr. North described a similar immature egg from a bird shot on the Macleay River during the first week in November 1884. An egg collected for me (taken from a crow's nest, if I recollect rightly) at Cooper's Creek, was unfortunately broken in transit.

The Egg.—A mature example, in the possession of Mr. D. Le Souëf, Zoological Gardens, Melbourne, may be described as light buff or pinkish-brown in colour, mediumly spotted with pinkish-red and chestnut, with a number of light purplish markings under the shell's surface. In shape and in general coloration, it is not unlike a Strepera's (Crow-shrike) small egg. Texture of shell a little coarse; surface almost lustreless; length 4·2 cm. by a breadth of 2·84 cm. The egg was taken in October 1880, near Inglewood, Queensland, where the Channel-bills were fairly numerous, by Mr. Herman Lau, an observing naturalist, and, as remarkable as it may appear, from the nest of the Sparrow-hawk (*Accipiter*), together with an egg of the bird of prey.

On another occasion, Mr. Lau took a pair of Channel-bill's eggs, together with a pair of the common magpie's *Gymnorhina tibicen*), all fresh from the nest of the latter; while the previous season he took a pair of young Channel-bills from a Strepera's nest, and forwarded them to the Queensland Museum. It would be interesting indeed to learn if the same Channel-bill deposit two eggs in the foster bird's nest, or were they laid by separate birds.

3. Lopholaimus Antarticus, Shaw (Topknot Pigeon).

Locality.—The coastal scrub generally from Cape York to Gippsland Lakes. Occasional stragglers reach Tasmania. This handsome bird is persistently omitted from the Victorian list, notwithstanding it has been recorded from Eastern Gippsland, and I possess a note of a flock having appeared at Tyrell Creek, near Charlton, November 1889.

Observations.—I enjoyed ample opportunity of observing these pigeons at home in the Richmond River scrub last November, but was much too early for their breeding season. It was delightful as the rising sun was gilding the tops of the taller trees of the scrub to steal along the leafy avenues to some favoured native Tamarind tree (*Diploglottis*), there to watch the Topknot Pigeons, in company with the gorgeously dressed Magnificent and Swainson's Fruit Pigeons, ravishing the agreeable acrid bunches of fruit. The flight of the Topknot Pigeon is rapid and powerful. At times they congregate in large numbers, hence they are sometimes called "flock" pigeons by the dwellers of the scrub. The egg I am permitted to describe is in the collection of Mr. Le Souëf. It was taken from the nest at the end of January 1887, by Mr. Herman Lau, Vandilla, Queensland. Incubation was about a week old, therefore it is probable that this species lays one egg only.

The Egg.—Is dull white, somewhat granulated. In shape, inclined to oval, with peculiarly pointed extremities, especially the smaller end which nips off suddenly. Length 4·5 cm. by a breadth of 3·09 cm.

The Nest.—The bird was shot, not knowing it flew from the nest, which was immediately discovered about forty feet from the ground on a thick branch of a Eucalypt, near the outskirts of the Bunya Mountain scrub. Like those of the majority of pigeons, the nest was of the usual scanty nature of coarse sticks, a few finer inside.

Art. IX.—*Notes on the Mode of Reproduction of Geonemertes australiensis.*

By Arthur Dendy, D.Sc., University of Melbourne.

[Read October 13, 1892.]

In the paper on *Geonemertes australiensis** which I had the honour of reading before this Society last year, I shewed, by anatomical examination, that in this worm the sexes are not united in the same individual, but that distinct males and females exist. The males, however, appeared to be much less common than the females and the single one which I obtained was considerably below the average size, though, from the insufficiency of the data, it was impossible to found any generalization upon this fact. At the time when I wrote I had made no observations either as to the mode of copulation of male and female or as to the manner in which the eggs are deposited. Relying upon my anatomical investigations, however, I ventured to indulge in certain speculations on these points, which are contained in the following paragraph:—

"The ova, as already stated, grow to a very large size, measuring up to about 0·6 mm. in diameter. It seems to me almost impossible that they should be discharged through the narrow, preformed genital ducts. I believe that they escape by rupture of the body wall and that the ducts merely serve to convey spermatozoa to them. That these ducts do so convey the spermatozoa I conclude from the fact that I have found spermatozoa in them. Probably the process of fertilization is effected by the male crawling over the female and passing out the sperm as he crawls."†

Since this was printed my friends Messrs. C. C. Brittlebank and H. Giles have collected specimens of *Geonemertes australiensis* and also made some extremely interesting observations upon the method of copulation and egg-laying. I have to thank these gentlemen, not only for an account of their observations, but also for sending me the specimens

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* "On an Australian Land Nemertine (*Geonemertes australiensis*, n. sp.)" Proc. Royal Soc. Victoria, Vol. IV, N.S., p. 85.

† *Loc. cit.*, p. 115.

upon which these observations were based, so that, in the case of the egg-laying habits, I was able to continue the observations on my own account. It will be seen in the sequel that my suggestion as to the manner in which the eggs are discharged from the body was incorrect, while, on the other hand, my views as to the method of copulation receive support. The new observations referred to above are as follows:—

On the 22nd of May last Mr. Brittlebank found, near Myrniong, two specimens of *Geonemertes*, apparently male and female in copulation. The supposed male was very much smaller than the female, and was riding on the back of the latter. The female was about three-quarters of an inch and and the male only about one-quarter of an inch in length when crawling. Mr. Brittlebank observed the specimens for an hour and then posted them to me, but unfortunately they were lost in the post, so that I was unable to determine the sexes by microscopical examination. The notes and sketches made by this careful observer, however, point strongly to the conclusion that the specimens were really male and female. Again, on August 5, Mr. Brittlebank wrote to me that he had found another pair coupled and he adds "the male only crawled over the dorsal surface of the female." Unfortunately these specimens also are not forthcoming for microscopical examination, but Mr. Brittlebank informs me that he watched them for a long time.

The above evidence, though not absolutely conclusive, points strongly to the conclusion that my suggestion as to the manner in which the eggs are fertilized is correct. We have next to deal with the manner in which the eggs are deposited.

On July 4th Mr. H. Giles, of Creekside, Nar-Nar-Goon, found a very fine specimen of *Geonemertes*, which he kept, intending to send it to me alive. He forgot it, however, for some days, and meantime, on July 7th, it deposited a mass of eggs, and on the 13th it was found coiled around a second mass of eggs. On the 15th July I received from Mr. Giles the parent worm and the two masses of eggs which it had laid, the worm apparently in good health, and without any signs of rupture of the body wall, and still containing a number of eggs visible through the integument. I kept this specimen under observation for a long time, and on August 1st found it lying by the side of yet a third mass of eggs which it had evidently just deposited underneath some moss in the vivarium. The parent animal survived, apparently in perfect health and condition, until September 19th, when I killed and preserved it for future reference.

It will be observed that all these three lots of eggs (which I shall describe presently) were laid by an animal in captivity, and if this were all the evidence forthcoming some critic might perhaps suggest that the laying of the eggs was due to the abnormal conditions of life, as has been suggested in the case of *Peripatus.* Fortunately, however, about the same time two other observers, Mr. Hennel and Mr. Fiddian, found similar masses of eggs in a state of nature, which they kindly brought to me, and which subsequently proved to be undoubtedly eggs of *Geonemertes.* Mr. Hennel obtained his specimen on July 18th, in the damp bark of a gum tree on the Dandenong Creek, and Mr. Fiddian's specimen was found beneath a stone, at Creswick, at the end of July.

The newly deposited eggs of *Geonemertes australiensis* are opaque spherical bodies about 0·6 mm. in diameter and of a white or nearly white colour. Some thirty of these eggs are enclosed together in a sausage-shaped mass of colourless transparent jelly, about half an inch in length, the individual eggs being scattered through the jelly. The surface of the gelatinous matrix is smooth, and the jelly appears to be common to all the eggs, instead of forming a special envelope around each, as in the case of frog-spawn. One such mass of eggs is deposited at a time, and, as is evident from the observations recorded above, at least three can be deposited in succession by the same animal, at intervals of several days, the animal itself remaining perfectly uninjured. Hence it appears almost certain, although the actual deposition of the eggs has not been observed, that they leave the body separately, each by the narrow duct which leads from the sac or capsule containing it to the exterior. This duct, then, appears to serve both for the admission of the spermatozoa and for the extrusion of the fertilized eggs. The source of the gelatinous material in which the eggs are deposited, and also the manner in which the whole mass is moulded into shape, have yet to be discovered. Probably the animal discharges the eggs and pours out the jelly as a secretion from the surface of the body simultaneously. If this were done while the animal was slowly crawling along the result would certainly be one of the curious egg-masses described above. We may compare this hypothetical process with the formation of the slimy track which under ordinary circumstances the animal leaves behind it when it crawls, only in the latter case the secretion of slime, and consequently the slimy track, are continuous. I do not mean to suggest by this comparison that the gelatinous matrix is identical with the ordinary slime, for that I think highly improbable.

With regard to the development of the eggs my observations have been attended with very little success. The opacity of the embryos, due to the presence of a large quantity of food yolk, renders investigation of them in the living state extremely difficult, and the cutting of sections, which I also attempted, has not so far yielded satisfactory results either. As might have been expected, I have not found any trace of the Pilidium stage so characteristic of some marine nemertines. So far as I can judge at present the development appears to be direct.

On August 26th I examined some of the embryos from the mass of eggs which was found freshly deposited in the vivarium on August 1st. It was easy to distinguish two stages of development. In the first the embryos were spherical and each enclosed in a very delicate transparent membrane. Each was about 0·6 mm. in diameter, opaque and solid-looking, and clothed with short cilia. They revolved slowly inside their delicate envelopes and sometimes slightly changed their shape. In the second stage the embryos had emerged from their delicate envelopes and under the microscope they slowly crawled about, constantly changing their shape in an amœboid fashion, elongating as they crawled. They were clothed with short cilia and were still perfectly opaque. No eye spots were yet visible.

The next stage observed was in the mass of eggs collected by Mr. Fiddian at Creswick, some of which I examined on August 26th, about a month after they had been found. When removed from the soft, investing jelly these embryos elongated themselves greatly and crawled about pretty freely, much after the fashion of the adult worm. A single pair of eye spots was visible at the anterior end. Microscopic examination, by means of sections and otherwise, showed that the proboscis, alimentary canal and nervous system were all well developed, even the characteristic stylets of the proboscis being present. Hence, although these animals had not yet left the investing jelly, the development was nearly complete. The alimentary canal still contained, however, a very large quantity of unabsorbed yolk-granules.

ART. X.—*The Bluff at Barwon Heads.*

(With Plate XIV.)

By G. S. GRIFFITHS, F.G.S.

[Read November 6, 1891.]

This bold headland, at the mouth of the River Barwon, presents some features of geological interest. A crag of grey sandstone, it owes its preservation to the circumstance that its seaward extremity stands upon a basement of hard lava, which rises just above the level of high-water. The result of such an arrangement of the rocks is illustrated by the profiles of two of the cliffs, one of which consists wholly of calcareous sandstone, the lava foundation being wanting.

Where the base is of lava, as it is in the cliff at *B* in Section *A B*, the profile has an inclination of about 45°, and can easily be scaled. This shows that the rate of recession of the face of the cliff is much faster than that of the foot. Now, the foot of such cliffs is cut back by both the sea and the weather, while the face is cut back by the weather alone. As the waves and weather together work into the cliff much more quickly than the unaided atmospheric agencies can, we seek for some special condition in the cliff itself, to explain the slanting profile, and we find it in the toughness of the lava base, which here retards the encroachments of the waves.

If we now turn to the cliffs near *D*, we see that one is vertical, and another, which I have not drawn, is deeply undercut at the sea level, so that it continually falls in great slabs, which encumber the beach. Here the entire face of the cliff is of homogeneous material, and the greater wasting power of the sea over the atmosphere shows itself in the profile, which is vertical where it does not overhang its foot. The aerial destruction is not less here, but the sea scour is much greater. Hence the difference between the profiles of the two cliffs.

The next circumstance illustrated by the local features is the effect of a lava flow upon the distribution of shallow water deposits.

The tongue of rock projected in a molten state across a submarine plain of shifting sands, forms a permanent ridge against which the swift currents at once heap up bars of sand. When these become very thick, so that the lower portions are not disturbed for long periods, the base of the mass may become cemented into hard rock by the percolation of lime in solution, or from the moment sand is heaped over the uncooled lava, the gases and acidulated waters may slake the mass into compact strata. This has occurred here, and thus a spit seems to have been formed, over which is spread a bed of clay which may be volcanic ash decomposed *in situ*, or an ordinary littoral deposit. Upon the top of this clay bed is a very horizontal soil bed; just such a sandy loam as is now seen to be capping the cliffs, very fine, and darkened with abundant carbonaceous matter. The next stage is that this land surface—which may have been no more than the muddy fore-shore of the Barwon, or Lake Connewarre—gets covered with sand, which is false bedded, and as far as I can see, unfossiliferous. Whether then this is a sedimentary or an eölian deposit it is hard to say, as false bedding occurs in rocks originating in either way. There are, however, thin beds of water-worn conglomerates intercalated between these false bedded sandstones, which lead me to believe that the coast was sinking and that the sands were spread over this spit by the sea currents. The old land surface humus, although it has been compressed by the overlying sandstone, is still about two feet thick, and its upper margin is very sharply marked off from the deposit above it. This latter rises as a cliff face to a height of from seventy to ninety feet. It is divided into at least three greater divisions, and these again are resolvable into lesser beds, all current bedded. There are differences to be observed which distinguish the larger masses from each other. The middle bed at one part of the cliff especially, contains so much lime that every projection of the rock wall carries its group of stalactites. At a considerable height up the cliff face there is a bed of conglomerate, or breccia, marked *E* in the sections. The stones are small sized, some are basaltic pebbles water-worn, the rest are of sandstone, some rolled and some not, many having a black burnt look. The whole mass is very strongly cemented together by carbonate of lime. It is worthy of

Fig I

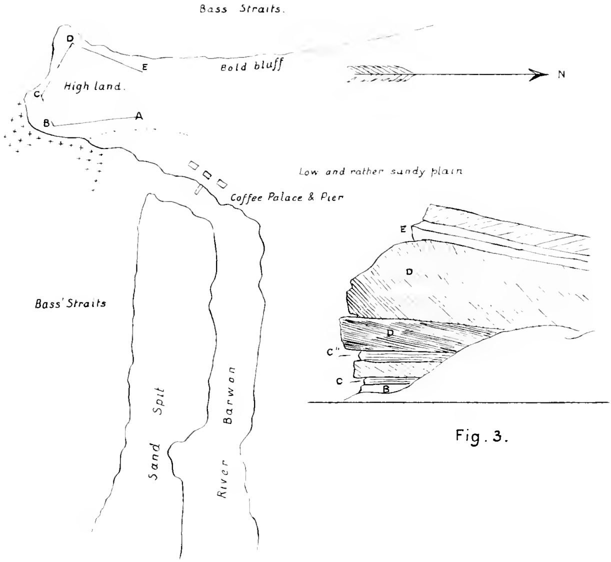
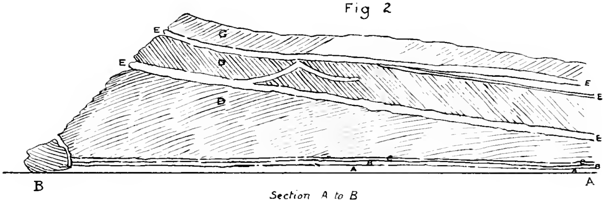


Fig. 3.

Fig 2



Section A to B

notice, that while the old land surface at the base is quite level, the conglomerate bed rises from *A* to *B* in that section. Other similar beds lie above this one, none lying horizontally.

The lava flow is not seen to the west of the Barwon Headland *(B)*, but some beds of clay, of volcanic origin probably, though destitute of basalt boulders, are to be seen at two levels.

On the beach at *E*, which is about three hundred yards distant west of the last cliff, a bed of rough conglomerate is being broken up by the waves. This is beneath the horizon of the lava flow at *B*, but it nevertheless contains plenty of basalt boulders. Amongst other rocks there are quartz pebbles, and broken shells are plentiful. The stratum is about three feet thick, and it lies between beds of sandstone. Where the scour of the sea has worn down the conglomerate to a smooth flat floor, its varied materials set in a hard matrix give to it the appearance of a gigantic brawn.

The Barwon Head beds must be either late Tertiary or Pleistocene. When they were forming, Bass's Strait extended northwards of the present coastline. Subsequently the area rose again, and when the present cliff tops were probably seventy to ninety feet lower than they are now, one extension of Lake Connewarre southward covered them, and the silt from its floods spread their soil over the barren sand rock. More tilting up of the strata drove back the lake waters to the north; or it may be that the Barwon cut through the sandstone ridge that lay between the lake and the sea, and thus let out and lowered the waters of Connewarre, until they approximated their surface levels to that of the ocean into which they were discharged.

ART. XI.—*On the Conductivity of a Solution of Copper Sulphate.*

(With Plates XV and XVI.)

By W. HUEY STEELE, M.A.

[Read August 11, 1892.]

The following observations were made with the intention of examining, under various conditions, the conductivity of a salt solution, which is of some importance at present, owing to the attention being paid to solutions now by Ostwald, van't Hoff, and others. I chose copper sulphate ($Cu\,SO_4 + 5\,H_2O$) to work with, as that was the most convenient. It is plentiful and easily purified, and copper is a convenient metal to use for making the electrodes.

All the methods of measuring electrolyte resistance by the ordinary Wheatstone bridge and galvanometer are more or less unsatisfactory, the only satisfactory method being that suggested by Kohlrausch, namely, of using rapidly alternating currents and a telephone, instead of steady currents and a galvanometer. The alternate current may be produced by a small dynamo, but much more conveniently by an induction coil maintained by a few cells. A small coil is preferable to a large one, as the statical charge on the electrodes, especially if they be small, is liable to introduce a serious error, besides which is the annoyance of receiving shocks on touching exposed parts of the circuit, if one works with such high E.M.F.'s as are produced in a large coil. The coil I used, when maintained by four freshly charged Grove cells, gave a spark of rather more than a centimetre, but I generally used a much weaker primary current. A slide wire bridge is generally recommended, but I found a resistance box more sensitive and more convenient. The greatest sensitiveness I ever obtained was about 1 in 1500, that being with a resistance of 1500 ohms. The distribution of resistances which is most advantageous in the arms of the ordinary Wheatstone bridge is by no means the best in Kohlrausch's arrangement. In the former, it is necessary to arrange the arms so that when the resistances are balanced, the maximum current shall pass through the galvanometer, and generally the variable arm can be so arranged that there is no perceptible deflection of the needle. But in Kohlrausch's method, one cannot get complete silence in the telephones, and a variation of say 1 per cent. is more noticeable in a feeble sound than in a loud one, and so (unless the currents be very weak) the arms have to be arranged to send the minimum current through the telephones. This method also differs from the ordinary in its inability to measure with accuracy low resistances, less than 10 ohms, neither can it measure very high resistances more than 50,000 ohms, although, with the box I had, I could otherwise have measured 1,000,000 ohms. Where one tries to measure these high or low resistances, it is found that when the resistances are approximately balanced, it takes a considerable alteration, say 5 per cent. in the variable arm, to produce any perceptible change in the sound in the telephone, and when the change is produced, it is not so much a change in intensity as in quality—it almost seems like an alteration in pitch, though that could not be. Besides overcoming the difficulty introduced by polarisation, there is an enormous advantage in Kohlrausch's method in the way of rapidity. Making an observation is the matter of seconds, instead of minutes.

The cell I used to examine the effect of change of temperature on conductivity was a glass tube (see Fig. 1), about 20 cm. in length, and 1 cm. in diameter, slightly bent. The ends of this fitted into two flat copper cups, with holes in the sides, fitted with slightly conical necks. These cups were about 7 cm. × 5 cm. × 2 cm. The space between the glass and the copper necks was tightly packed with loose hemp, and formed a perfectly water-tight joint. Wires soldered to the cups gave a means of connection, the cups, or rather their interior being the electrodes, the surfaces exposed to the solution being about 80 square cm. The cups were closed at the tops by blocks of indiarubber cut to fit. I had some difficulty, however, in making these quite water-tight, and tried several methods of stopping up the cracks. It was easy enough to stop them at ordinary temperatures, but the difficulty was to find some cement that did not soften at 100° C. Sealing-wax and putty were among the things I tried, but neither remained water-tight at 100° C. A solution of indiarubber in naptha was finally tried, and with complete success, and I found the whole cell now water-tight even under considerable hydrostatic pressure. Glass tubes were passed through the indiarubber blocks, and Liebig condensers were attached to these by pieces of indiarubber tubing. The inner tubes of the condensers were closed at the top by corks. The condensers were held vertically by clamps, and the cell was thus suspended. It was immersed in oil to a depth of about 6 cm. (dotted line in figure). I had to keep it hung, as my bath was copper. I tested the insulation of the oil, and could get no current through a very slight thickness of it. When heating a solution, air bubbles began to form at about 75° C. The bending of the tube was to allow the escape of these when they became large enough, as well as to allow the steam to escape more readily when the temperature rose to boiling point. The condensers were, of course, intended to keep the solution at a constant strength. Observations of the resistance above 70° were made after the solution had been well boiled, so that there were no air bubbles to increase the resistance of the system.

To observe the temperature, I took a glass tube of the same section and thickness as that of the cell, and corking one end, I partially filled it with the same solution as that with which I was working, and putting the thermometer into this, I put the tube in a slanting position in the bath. Under these conditions, I considered that the temperature of the solution in the second tube ought not to differ much from the temperature of the solution in the cell. For extra security, however, I always kept the temperature within a degree or two for several minutes, and within $\frac{1}{5}$ degree for about half a minute before taking a reading of the resistance. The salt I used was ordinary commercial copper sulphate which I purified by making strong super-saturated solutions in distilled water, and taking the crystals which were deposited before the solution became cold. I obtained the strength of each solution by weighing the amounts of salt and water in it, and checked the results by taking the density with hydrostatic balance, using a glass sinker, and then comparing these values with a series previously obtained and plotted.

I made a very great number of observations altogether, but finally have drawn my conclusions from eight sets, which were the last made, and on which I spent more time and pains than on the others. In the results which follow,

T is the temperature centigrade, R the observed resistance of the system in legal ohms, and k is the conductivity, *i.e.*, the reciprocal of the specific resistance. Taking s as the specific resistance $r = \frac{l\,s}{\pi r^2}$, where r is the mean radius, and l is the length increased by ·8 r at each end, $\frac{l}{\pi r^2}$ is a constant for the instrument determined by measurement once for all. Thus $k = \frac{l}{\pi r^2} \cdot \frac{1}{R}$ and $\log k = \log \frac{l}{R} - \log R = 1{\cdot}2540 -$ $\log R$, so that the calculation of k from the observed resistances is very simple. The following tables show all the observations used from which I calculated my results :—

5·93 %			25·70 %			9·24 %		
T	R	k	T	R	k	T	R	k
17	1155	·01554	18	409	·0439	17	852	·0211
31	887	2025	30	320	·0561	30	669	268
41	769	2335	42	260	·0690	42	558	322
50	679	2645	54·6	220	·0816	55	482	372
60	629	2855	70	195	·0920	70	435	413
70	589	305	81	181	·0992	32	639	281
99	537	3343	88	174·5	·1022	70	433	414
97	537·5	334	98	165·0	·1088	95	409	439
94	540	332	96	167·0	·1075	99	404	444
89	548	328	92	170·0	·1056	91	407	441
80	556	323	88	173·0	·1038	88	413	435
70	581	309	81	179·2	·1002	80	420	427
						85	414	434

3·34 %			2·51 %			1·258 %		
T	R	k	T	R	k	T	R	k
18·9	1800	·00997	18·3	2290	·00784	15·8	4030	·00445
31	1459	·01230	30	1837	·00977	35·2	2800	641
45	1225	1465	40	1598	·01123	52	2350	764
60	1066	1684	50	1440	·01246	65	2120	847
70	999	1796	60	1335	1344	80	1990	902
80	962	1866	70	1266	1418	.....	....	....
100	928	1934	80	1218	1474	80	1957	917
99·7	929	1932	97	1174	1529	90	1915	937
98·5	930	1930	94	1175	1528	94	1925	932
95	932	1926	90	1182	1519	97	1915	937
92	933	1924	85	1192	1506	100	1901	944
90	935	1920	80	1212	1481	97	1903	943
87	940	1909				94	1901	944
85	943	1903						
80	957	1875						

·597 %			·262 %		
T	R	k	T	R	k
99	3270	·00549	99	6270	·00286
97	3250	552	96·5	6260	287
95	3235	555	94	6260	287
93	3230	556	91	6280	286
89	3230	556	86·5	6330	283
87	3235	555	80·5	6430	279
84	3250	552	70·3	6740	266
82	3260	550	18	13850	1296
80	3280	547	30·5	10870	1651
70	3400	528	45	8900	2017
16·3	6650	270	60	7550	2377
30·2	5060	355	70	7060	2564
46	4130	435	80	6550	2740
69	3650	492	70	6900	2601
70	3380	531			

I had now to find, first, the law of variation of conductivity with temperature, and second, its variation with strength of solution. In working out the former, I took 20° C. as my standard, and in what follows, t is the excess of temperature over 20°. I found that each set of observations was given within the limits of errors of observation by the formula $k_t = k_{20}\ (1 + \alpha\ t - \beta\ t^2)$ k_t and k_{20} being the conductivities at 20° + t° C. and 20° C. respectively. To determine α and β as accurately as possible, I worked it out in each case by the "method of least squares," working from the conductivities at 20, 30, 40, 50, 60, 70, 80, 90, and 100° C. found by interpolation from the results given above.

The values I found are shown in the following table :—

n (Solution Concentration).	k_{20}	α	β
25·7 %	·0458	·0254	·000100
9·24	·0224	·0237	140
5·98	·0165	243	144
3·34	·0102	211	125
2·51	·00808	221	136
1·26	·00482	231	138
·597	·00293	215	115
·262	·00135	220	69

From this table it will be seen that α and β are fairly constant for all solutions, though perhaps α increases slightly with the concentration. The errors in β are too great and too irregular to indicate any law of variation. Assuming then that α and β are constant, we find the mean values are, $\alpha = \cdot 0229$; $\beta = \cdot 000121$. In α the probable error of the result is ·00054, or a little less than $2\frac{1}{2}$ per cent. of the whole. Although the values of α and β thus found give the conductivity with fair accuracy, yet they fail in one particular. It will be seen on examining the results in the case of the last two solutions, that there is a temperature of maximum conductivity somewhere between 90 and 100° C. In previous experiments, however, I got maxima between 90 and 100°, with solutions of 3 and 6 per cent., it being very marked in the latter case. It is possible that there may be a maximum in every case, but generally above 100° C., and that its position may vary considerably with very small impurities in the solution, though I do not know what impurity I could have introduced in the one case and not in the other, as in each case I used water distilled in the same way, and salt from the same vessel.

I should remark that, in calculating α and β in the case of the solutions that have a maximum under 100°, I only used the results between 20° and 80°.

It now remained to determine the law connecting conductivity and concentration (k and n). After trying various formulæ and plotting several functions of k and n, I at last suspected that k varied as some power of n, and on taking logarithms and plotting them, I found the resulting curve very nearly a straight line, the deviations from it being such as might arise from errors of observation. Putting $k = a\, n^b$, we have $\log k = \log a + b \log n$. This is a very simple form to work out by "least squares," and I found the constants were $a = \cdot 00403$, $b = \cdot 766$, the average error being 3·4 per cent. The general expression for the conductivity thus becomes $k = \cdot 00403 \times n^{\cdot 766} (1 + \cdot 0229\, t - \cdot 000121\, t^2)$. The curves I, II, and III show the relations between the conductivity and temperature for three different solutions, and may be taken as typical. The curves themselves are plotted from the mean values of the temperature coefficients, and the crosses show the actual observations. As I remarked previously, the coefficients are probably some function of the concentration, but my results are not accurate enough to determine it. Curve IV shows the logarithms of the different values of the conductivity and concentration; as before, the curve showing the mean calculated values, and the crosses the observed values.

The following table gives the conductivities for several concentrations and temperatures, and may be useful for reference :—

TEMP.	CONCENTRATION.						
	·1 %	·5 %	1	5 %	10 %	20 %	30 %
20	·000690	·00237	·00403	·0138	·0235	·0398	·0543
30	·000840	403	490	168	286	484	661
40	·000975	335	569	195	332	562	767
50	·001090	374	635	218	371	628	857
60	·00119	468	693	238	405	685	936
70	·00127	436	744	254	433	733	1000
80	·00133	459	780	267	455	771	1050
90					472	800	1090
100					483	819	1120

DESCRIPTION OF PLATES XV AND XVI.

FIG. 1.—*a*, glass tube; *b b*, copper cups; *c c*, indiarubber blocks; *d*, hemp packing; *e e*, Liebig condensers; *f*, level of solution in cell; *g*, level of bath in which cell is immersed.

FIG. 2.—Curves I, II, III, showing agreement between mean value of temperature coefficients, and values in typical cases. Abscissæ represent temperature centigrade; ordinates, conductivity.

FIG. 3.—Curve IV, showing that the connection between the logarithms of the concentration and conductivity is linear, and consequently, that the conductivity varies as a power of the concentration. Abscissæ, logarithms of conductivity; ordinates, logarithms of concentration.

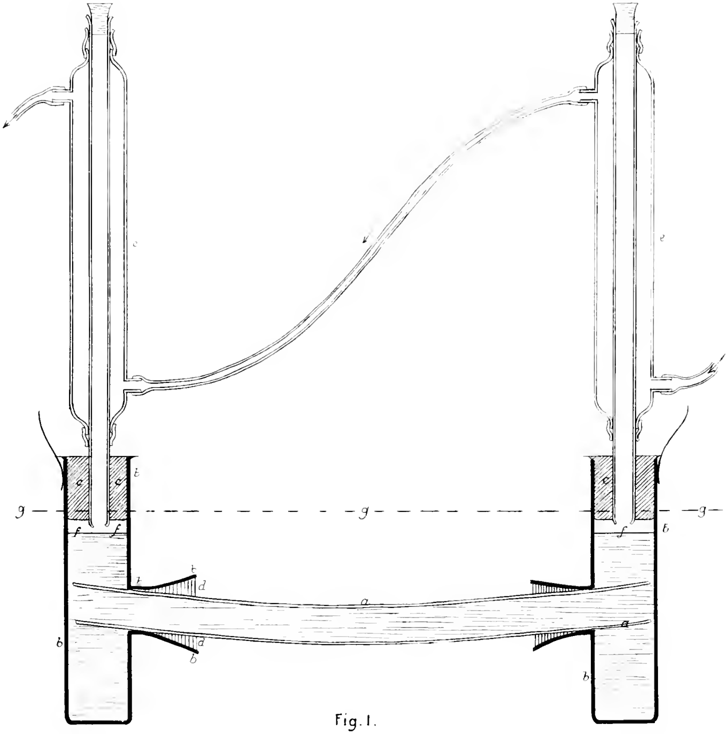
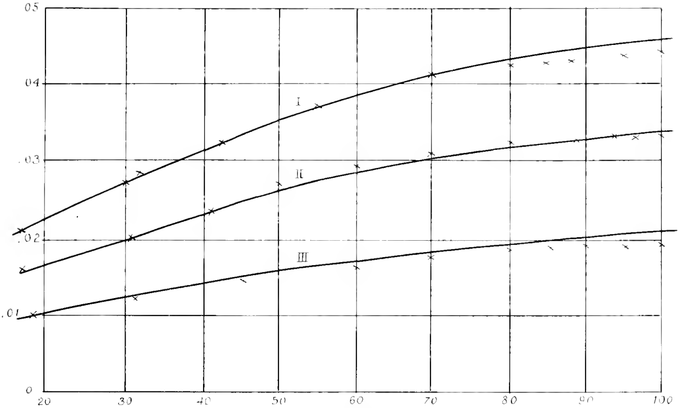
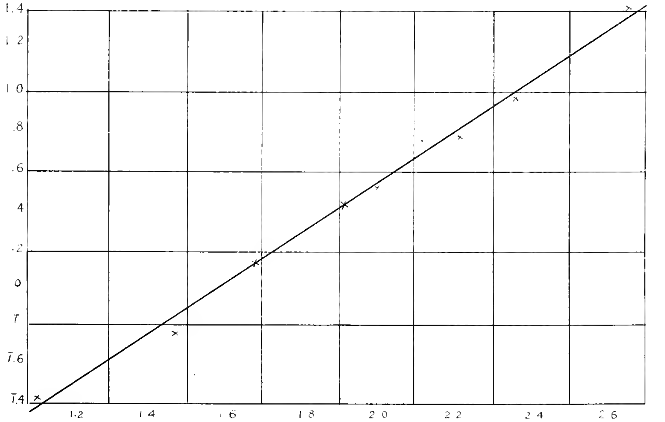


Fig. 1.



05
04
.03
.02
.01
0
20
30
40
50
60
70
80
90
100
I
II
III

Fig. 2



1.4
1.2
1.0
.8
.6
4
.2
0
1.6
1.4
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6

Fig. 3.

ART. XII.—*The Lichens of Victoria. Part I.*

By REV. F. R. M. WILSON.

[Read November 10, 1892.]

INTRODUCTION.

1.—THE STRUCTURE OF LICHENS.

Lichens are cellular plants, and consist generally of *thallus*, *apothecia*, and *spermagones*.

1. The thallus is usually composed of layers (*a*) *cortical*, (*b*) *gonidial*, (*c*) *medullary*, and (*d*) *hypothalline*.

(*a*) The cortical layer, which occurs on the upper surface of most, and also on the under surface of many lichens, varies in composition, but is generally formed of closely compacted cellules. It varies also in colour, in thickness, in degree of tenacity, and in smoothness of surface. The inferior cortex of many lichens is furnished with *rhizinæ*, or root-like filaments, by which the plants are attached to their substratum.

(*b*) The gonidial system, which generally occurs immediately under the cortex, is specially characteristic of this class of plants. When the gonidial cells are completely filled with bluish or olive-green matter, they are called *granula gonima*; but when the yellowish-green contents are surrounded by a hyaline space within the cell, they are called *gonidia*. Both kinds are usually sphæroidal. In some genera the gonidia are flat and irregular in outline, *chroolepoid*. Some lichens are *chrysogonimic*, with golden yellow gonidia.

(*c*) The medulla, which is found beneath the gonidial system of many lichens, consists of colourless, tubular, and articulate filaments, more or less closely compacted or interlaced.

(*d*) The hypothallus, which is spread under the thallus of some lichens, is usually of a dark colour, and is formed of the filamentous growth arising from the germinated spores, on which the other parts of the thallus are deposited.

2. The apothecium, or reproductive organ, consists of (1) an *excipulum*, either pale or dark, on which lies (2) the *hypothecium*, also either dark or colourless. From the surface of the latter rises (3) the *thecium* or *hymenium*, which contains *thecæ*, generally surrounded by *paraphyses* or club-shaped filaments, all which are usually glued together by the *gelatina hymenia*. The surface formed by the conglutinated apices of the paraphyses is termed the *epithecium* or disk. The hypothecium of nucleated apothecia is styled a *perithecium*.

The various forms of apothecia are (*a*) *lecanorine*, *i.e.*, orbicular and bordered by a thalline margin; (*b*) *lecideine*, *i.e.*, orbicular with no thalline margin, but often bordered by the edge of the excipulum or hypothecium, which is called a *proper* margin, *i.e.*, a margin proper to the apothecium; (*c*) *graphidine*, *i.e.*, like writing, irregular in form, but typically narrow and horizontally lengthened; and (*d*) *pyrenodine*, *i.e.*, globular and nucleated.

The thecæ contain spores, usually 8, but sometimes 1, or 2, or 4, or 6, or sometimes innumerable. The spores vary much in size and form and colour and contents. Some are divided into two or many cells, and some are simple. The outer and inner walls are called the *epispore* and *endospore*.

3. The spermagones are small thalline tubercles, containing a colourless receptacle, within which there arise minute filaments, either simple, when they are termed *sterigmata*, or articulate, when they are termed *arthrosterigmata*. These filaments carry upon their apices very minute bodies, called *spermatia*, which are of various shapes, but generally cylindrical, and which are readily separable and pressed forth in great numbers through a pore in the apex of the spermagone. The spermatia are supposed to fertilise the apothecia, but their function is not known.

There are also other bodies occasionally found on the thallus. *Pycnides* are small organs of a dark colour, containing filaments called *basidia*, which bear, singly at their summits, minute, generally oblong, bodies, called *stylospores*. These are by many authors supposed to be a sort of secondary fructification, and by others affirmed to be minute fungi. *Cyphellæ* are minute excavations in the under surface of certain lichens. Their function is unknown. When they are apparently filled with white or yellow powder, they are called *pseudocyphellæ*. *Cephalodia* are tubercles of various shapes, which are found on many species, and contain cells or granula gonima. Their functions are unknown. *Soredia* are powdery protrusions of gonidia and of portions of the interior through the surface of the thallus. In some species, the apothecia are often converted into soredia and are sterile. This formerly constituted a genus *Variolaria*, from which this formation is styled *variolarioid*. The surface of the thallus is often roughened by minute thalline excrescences, which formerly gave rise to a genus *Isidium*, by which name this formation is still distinguished. The obsolete genus *Lepraria* was formed of lichens whose thallus is sterile and pulverulent. The obsolete genus *Spiloma* has been found to consist of certain small fungi parasitic on lichens. Various other foreign growths are occasionally detected on tneir thallus and apothecia. Sometimes minute algæ, or fungi, or portions of mosses will come into view under the microscope; but their structure is evidently very different from that of the lichen with which they are found.

2.—The Uses of Lichens.

Their chief design in nature seems to be to form a vegetable soil for the growth of higher plants. It is remarkable that no poisonous principle has ever been found in any species of lichen; yet, with the exception of a few kinds, they are seldom eaten by animals. Snails devour them, and there are microlepidopterous larvæ which feed upon them. On a coral island in the Indian Ocean, I found lichens with the traces of the claws of crabs, which had evidently sought nourishment from them, especially from their apothecia. The omnivorous *Acarus destructor* seems to infest lichens, both in the field and in the herbarium. Some species afford nourishment to the higher animals. What is called the reindeer moss is a lichen, and is well-known as the chief food of the reindeer in Lapland. There are also species in other lands, which are useful as fodder for domestic animals. Even human beings occasionally use some kinds for food, others are employed for medicine, and others again have proved valuable for the dyeing of cloth.

3.—The Geographical Distribution of Lichens.

The growth of lichens in Victoria depends chiefly on the moisture of the various districts of the colony. On the plains, and even on the hills, north of the Dividing Range. they are much fewer than on the southern slopes of the Range, and on the hills and in the forests towards the coast. Sub-Alpine species are found on the lofty mountains of the Victorian Alps, and sub-tropical species in east Gippsland. This latter district, indeed, from its position near the warm currents of the Pacific Ocean, and sheltered from the Southern Ocean by Tasmania, is physically, rather a part of New South Wales, than a province of Victoria.

The annual firing of the forests has destroyed, and is destroying, many spots which used to be good collecting grounds. As lichens live only by the influence of air and moisture, their growth is intermittent; and many of them increase very slowly, probably continuing in life for centuries, and their reproductive organs are supposed to remain fertile for ages. The destruction of such plants is a loss which cannot be readily made good. Many of them are of more rapid growth, and some of them are annual.

In favourable localities they are found on the earth, on stones, on rocks, on the bark and leaves of trees, and on other plants, even on other lichens, on dead wood, on decayed moss, on fallen leaves, &c., on dry bones, on leather, on glass. Some prefer one substratum and some another. and some grow indifferently on any. Some saxicole lichens grow only on calcareous rocks, some on siliceous rocks, and some on any. Certain kinds love the mountain, and some grow only on Alpine or sub Alpine heights; others love the plain. Some grow only in wet places, others in the dense sunless shade, either on trees or in caves, or under overhanging rocks. Some like the neighbourhood of the sea. others of rivers or lakes. Some live in the water, either constantly or occasionally submerged, in the channels of streams, or on the seashore; and some flourish on the slate roofs of houses.

4.—The Collecting of Lichens.

The collecting of lichens is best done in fine, but not too dry, weather. Those which grow closely attached to the bark of plants, may be secured by cutting off the bark with a strong sharp knife. If a piece of wood is taken along with the bark, so much the better, as it will prevent the bark curling up when dried. The tough timber of our fences and decorticated hardwood trees, on which some grow, will need the use of cold chisel and hammer. Rocks, especially granitic and basaltic, require a light well-tempered steel chisel, by which tolerably thin pieces can be detached from almost any rock by the exercise of a little skill.

All that is necessary to preserve the specimens is, to fold them up at once in soft paper (newspaper will do), to prevent them rubbing against one another in the bag in which they are carried home. Those which grow on earth require more careful management. They need to be collected with a sufficient piece of earth, and tenderly wrapped up. When brought home, the earth needs to be pared off under the specimen to a level surface, and then solidified by the application of a solution of isinglass in spirits of wine. The solution, when liquefied in a bottle under a heat of 25° to 30° C., or 77° to 86° Fahr., is dropped with a camel hair pencil on to the earth till saturation, taking care not to let it touch the thallus, which it would discolour. It should be applied underneath. When, after a day or so, the earth, thus saturated, has become dry on the surface by exposure to the air, the specimen should be placed for a few days under sufficient pressure to keep it in shape; it will thus harden into a form suitable for glueing on to paper, as described below.

5.—The Herbarium.

The mounting and arrangement of lichens will be most conveniently carried out by glueing each specimen (with Russian glue) on to the centre of a piece of writing-paper, with a space below to record the name of the plant, the substratum on which it was found, the place and date of finding, and the name of the collector, and with a space above to record notes of examination. These pieces of writing-paper may be then pinned at each end on to quarto single sheets of white cartridge paper with "lill" pins, six specimens of the same species to the sheet, if small, or two if larger. They can thus be easily detached for special examination. The largest specimens may be glued on to the cartridge paper itself. These sheets of specimens should be enclosed in a quarto cover of cartridge paper, one species, or even one variety to each cover, and the covers, put loose, with the open side inwards, into a quarto book cover of pasteboard (three ply), joined together by a strip of strong white binder's cloth, of such width that each cover, when filled, is two inches thick.

For convenience of moving them to fumigate, &c., the books should be arranged in open boxes in an upright row. The most convenient size of box is that of J.D.K.Z. Geneva cases. The boxes being arranged like shelves, the names of the family, series, genus and sub-genus are written in large characters on the backs of the book covers, and thus at a glance down the herbarium, the needed book can be readily seen and easily taken out. The names of the species enclosed in the books should be written on the left hand lower corner of each doubled cover, and thus any specimen can be conveniently found and replaced without delay.

To preserve the specimens from the ravages of insects, they need to be occasionally exposed to the fumes of bi-sulphide of carbon in a covered water-tight case. The quantity of fluid required depends on the completeness with which the case is filled by the boxes. A few ounces in a small cup will serve for a case measuring inside 3 ft. x 2 ft. x 1 ft. 3 in., which will contain three boxes.

6.—The Examination of Lichens.

The examination of lichens for ordinary purposes is most simply and expeditiously carried out by detaching a small portion of thallus or apothecium, or a spermagone, and putting it with a drop or two of water on a glass slide for a short while to soak, then bruizing it down gently with a pen-knife, till it is apparently dissolved. A dry cover is applied, and gently pressed down with a dry knife. The slide is then put under a microscope having a good $\frac{1}{4}$ inch object glass, and an eye piece magnifying from 250 to 300 diameters. When more careful examination is needed for drawings of structure, a fine section will need to be made of the moistened apothecium, &c., with a section cutter, or with a sharp surgeon's knife, under a watchmaker's lens. It will require great nicety to make a good section, neither too thick and opaque, nor too thin and deprived of large spores. Drawings and measurements may be made with a camera lucida and a micrometer. A home made camera lucida can be easily constructed by cementing a half of a glass cover on to the end of a thin plate of brass, having at the other end an aperture to correspond with that of the eye piece, and bent in the middle at *an angle of* 45 *degrees.*

The chemical re-agents used in examining specimens are decried by some lichenologists as being unreliable. They are, however, valuable assistants in determining species, although they may not be absolutely conclusive taken by themselves. The usual formula by which the solution of iodine (signified by the letter I), is prepared is—iodine, 1 gr., iod. potass., 3 grs., distilled water, ½ oz. For all practical purposes, however, a strong enough solution is made by putting a few grains of iodine into a small phial of water and allowing it to stand a day or so. The solution needs to be kept in a glass-stoppered bottle of dark colour, or covered with tin foil to exclude light. Hypochlorite of lime (signified by the letter C), is prepared by putting a small portion of chloride of lime into a phial of water, and shaking it. When the fluid clarifies, it is ready for use. Hydrate of potash (signified by the letter K), is composed of equal weights of water and caustic potash. It may be well to inform the beginner that when the water is added to the caustic potash, a good deal of heat is evolved. It is well, therefore, to previously warm the bottle, lest the sudden heat should break it. The supply of caustic potash needs to be kept from the air by beeswax round the stopper of the bottle in which it is preserved. The hydrate should also be kept in a stoppered phial, and must be used carefully, as it corrodes clothing, &c. These re-agents may be applied, a drop at a time, by means of thin rods of glass; keeping each rod for its own solution, and wiping them dry on an old rag after using them.

The application of C and K is either to the surface of the plant or to the medulla. The younger part of the thallus is the best for examination. In cold weather, a little heat needs to be applied to hasten the action. This may be done either by placing the phial with the solution in a cup of warm water, or by putting the part under examination close to the mouth and breathing heavily and repeatedly on it after touching it with the solution. First apply C to a portion of the thallus, and note the result. Then to another portion apply K, and, after watching the effect a short while, add C and note the results. To examine the action on the medulla, scrape off a portion of the cortex from another part of the thallus, and apply K and C in the same manner. The more freshly made the solutions are, and the more carefully they are kept from the air, the more reliable are the results.

7.—The Classification of Lichens.

The classification of lichens adopted in the following pages, is that of Nylander, as the most natural, being based upon the consideration of all the parts and organs of the plants, and exhibiting their place in reference to the neighbouring classes of Algæ on the one side, and Fungi on the other.

8.—The History of Victorian Lichenology

Begins with this century. The first lichens collected in Victoria are recorded in an appendix to Flinders' Voyage to Terra Australis, published in 1814. The collection was made in various parts of Australia and Tasmania by Mr. Robert Brown, who accompanied Captain Flinders in his investigation of the coasts of New Holland in 1802. Brown's specimens were afterwards re-examined by Rev. J. M. Crombie, and the result recorded in the Journal Lin. Soc., 1880.

In 1848 and 1849, Dr. Ferdinand Mueller, now Baron von Mueller, collected a number of lichens in Victoria, and sent them to Dr. Hampe, who determined the species. The list appeared in the Report of the Government Botanist to the Victorian Council, 1854. A second parcel of specimens collected in Gippsland and the Australian Alps, was sent to Dr. Hampe, and enumerated by him in Schlechtendals Linnæa, 1856. This list was transcribed into the Government Botanist's Report to the Victorian Legislative Assembly, 1858. These namings by Hampe need revisal, in view of the more minute examination of later lichenology.

A few lichens collected by a visitor from Glasgow, Mr. Hugh Paton, were named by Dr. Stirton, and published by him in the Proceedings of the Royal Society of Victoria, September 1880. They are five in number, and all new to science.

Collections have been made by Messrs. R. Wilhelmi. D. Sullivan, C. Walther, Merrall, C. French, and Mrs. McCann, and forwarded by Baron von Mueller to Europe. The earlier collections were sent to Dr. Krempelhuber, of Blankenberg, on the Hartz Mountains, by whom their names and the descriptions of new species were published in *Den Verhandl. des Kais. Kœn. Zool. Bot. Gesel,* in Wien.,

1880. A list of the names was printed in the Supplement to the eleventh volume of the "Fragmenta Phyt. Austral." Authentic named specimens of most of these are preserved in the Melbourne Botanic Museum. These determinations of Krempelhuber have been revised by Professor Jean Mueller, of Geneva, in the *Ratisbon Flora or Bot. Zeit.* 1887. The later collections received by Baron von Mueller were sent to Professor Mueller, by whom their names and the descriptions of new species are recorded in the *Ratisbon Flora* from time to time. Authentic named specimens of most of them are preserved in the Melbourne Botanic Museum, and a list of those named from 1881 to 1887 is given by Baron von Mueller in the *Victorian Naturalist,* October 1887.

Collections made by Miss F. M. Campbell (now Mrs. Martin), by Mr. F. Reader, and by Rev. F. R. M. Wilson were sent for determination to Dr. C. Knight, of New Zealand. Subsequently, some have been named and described by Rev. F. R. M. Wilson, and lists of them have appeared from time to time in the *Victorian Naturalist,* October 1887, June 1888, August and September 1889, and April 1890; and latterly many, especially of the crustaceous kinds, have been submitted to Professor Mueller, whose determinations have not yet been published.

In 1891, a paper entitled "Lichens Collected in the Colony of Victoria, by Rev. F. R. M. Wilson," was published by the Linnæan Society of London. Many of the names and descriptions there given are reproduced in the present paper, but some are altered. The alterations of names are noted in each case.

Those localities to which no name is appended have been ascertained by the author.

CLASS LICHENES. Micheli.

Thallus containing gonidia or granula gonima variously disposed, and very often also crystals of oxalate of lime. Fructification consisting of spores in thecæ; gelatina hymenia in most species becoming blue, in others reddish, and seldom unaffected by the application of an aqueous solution of iodine. Spermagonia in minute thalline tubercles distinct from the apothecia.

FAMILY I.—COLLEMACEI.

Thallus usually dark in colour, black, brown or olive, sometimes ashy or bluish, various in form, gelatinous in substance, enclosing granula gonima, which are variously arranged, moniliform or enclosed in sacs or dispersed. Apothecia usually rufescent or pale, seldom black, generally lecanorine or biatorine, rarely endocarpoid.

TRIBE I.—LICHINEI.

Thallus blackish or brown, small, filiform, cæspitoso-fruticulose or depresso-radiate. Saxicole.

GENUS 1.—EPHEBE, Fr. Born.

Thallus fruticulose, filiform, branched and entangled; granula gonima large, arranged chiefly under the cellulose cortex sub-transversely, two or four or more together. Apothecia endocarpoid in thickened portions of the thallus. Spermatia cylindrical.

1. *E. pubescens*, Fr.

Thallus blackish brown, small (about 3 millimetres high, ·1 mm. thick), much branched, somewhat decumbent, slightly rugulose, containing brownish green granula gonima. Diœcious. Spores 8, colourless, oblong, simple or 1 septate, ·011 to ·016 × ·003 to ·004 mm. (Nyl.) Paraphyses indistinct.

Hab. on sub-Alpine rocks, Mount Macedon. Sterile.

Previously named by me (Trans. Lin. Soc. 1890) *Stigonema ephebioides*, Wilson, from a few small imperfectly developed specimens. The lenticular con-colorous bodies then noted by me as apparently connected with the plant, were possibly foreign to it.

GENUS 2.—LICHINA, Ag.

Thallus brownish black, fruticulose, firm; granula gonima bluish; apothecia terminal in sub-globose open thalline receptacles. Spermatia oblong. Spores 8, colourless, ellipsoid, simple.

1. *L. pygmæa*, Lightfoot.

Thallus small (½ inch or a little more), branches flattened towards the apices. Spores ·022 to ·029 × ·011 to ·016 mm. Nyl. Gelatina hymenia unaffected by iodine.

Hab. on maritime rocks washed by the sea. Rep. Gov. Bot. 1854. Doubtful; probably the next species.

2. *L. confinis*, Ach.

Similar to the preceding, but smaller, in more compact tufts, and with terete branches. Spores ·0195 × ·011 mm. (Nyl.)

Hab. on maritime rocks between high and low water, Sandringham, Barwon Heads, Lorne, Warrnambool.

Tribe 2.—Collemei.

Thallus various in form, membranaceous, lobate or laciniate or microphylline, sometimes fruticulose, sometimes granulose; rigid when dry, turgid and gelatinous when moist. Apothecia lecanorine, in a few cases biatorine, in still fewer endocarpoid.

Genus 1.—Synalissa, D.R. Nyl.

Thallus small, of various forms, incrusting, submembranaceous, granulose or fruticulose. Granula gonima in globular cells. Apothecia innate, lecanorine, or rarely endocarpoid. Spermatia oblong.

1. *S. cancellata*, Wilson.

Thallus black or obscurely olivaceous, submembranaceous, cancellate, minutely atro-granulose, effuse at circumference and encrusting the substratum. Granula gonima light green, contained in gelatinous sacs (inky with I), 1–5 in each; also moniliform among fine elementary filaments. Apothecia minute (to ·25 mm.), prominent in the thalline granules, one in each, at first endocarpoid, at length rufescent, lecanorine, elevated, disk concave or plane, with thalline margin withdrawn. Spores colourless, ellipsoid or ovoid, simple, with narrow epispore, ·01 to ·012 × ·004 to ·006 mm. Paraphyses slender; thecæ cylindrical; gelatina hymenia I. vinous, then yellow.

Hab. on sub-Alpine rocks and moss, Mt. Macedon.

Previously named by me (Trans. Lin. Soc. 1890) *S. micrococca*, Born. et Nyl.

Genus 2.—Collema, Ach. Nyl.

Thallus very various, granula gonima moniliform, no distinct cortical layer. Apothecia rufescent, usually lecanorine; hypothecium distinctly cellulose; spores eight, colourless, commonly multilocular, rarely simple.

Sub-Genus 1.—Collema, *Spores ellipsoid.*

1. *C. læve*, Taylor.

Thallus olivaceous, under surface paler or cinerascent, smooth, rotundo lobate, undulate. Apothecia rufous or fusco-rufous, plane, at length convex, with a thin entire thalline margin. Spores fusiformi ellipsoid, ·013 × ·004 mm., 3 to 5 septate, and also longitudinally divided. Granula gonima moniliform. Gel. hym. blue with iodine.

Hab. among mosses on granitic rocks, M'Crae's Island. Rep. Gov. Bot. 1854. Traawool, Beaconsfield.

Previously named by me (Trans. Lin. Soc. 1890) *Leptogium olivaceum*, Wilson.

Form *granulatum*, Wilson.—Thallus olivaceous or fusco-olivaceous, here and there plumbeous; beneath paler, firm, moderate (one inch wide), smooth, very often near centre or wholly obscurely granulate.

Hab. on bark of trees, Warrnambool, Gippsland, Kew.

Form *fimbriatum*, Wilson.—Thallus crisped at circumference, and isidioso fringed. Sterile.

Hab. on bark of trees, Warrnambool.

Form *isidiosum*, Wilson.—Thallus plumbeo cœrulescent, here and there olivaceous, membranaceous, thin, plicato undulate, more or less covered with cœsious or obscurely plumbeous isidia.

Hab. on bark of trees, Warrnambool, Gippsland.

2. *C. plumbeum*, Wilson.

Thallus plumbeous, small, complicate, membranaceous, rotundo-lobate, lobes undulate. Apothecia minute, often crowded, rufous brown, sessile, plane, thalline margin entire.

Spores ellipsoideo-fusiform, ·02 × ·004 mm., 5 septate, and also longitudinally divided. Gran. gon. oblongo globose, ·003 to ·005 mm., moniliform: yellow with iodine. Gel. hym. blue with iodine.

Hab. on mosses on trees, Warburton.

3. *C. furvum*, Ach.

Thallus dark fuscous green or nigro-olivaceous, membranaceous, granulate, lobate, lobes complicate, often undulate; blood-red with iodine. Apothecia fuscous, plane, thalline margin entire. Spores ovoid or ellipsoid, ·018 to ·024 × ·009 to ·011 mm., 3 septate, irregularly murali-locular.—B. v. M., *Vic. Nat.*, Oct. 1887, p. 88.

4. *C. atrum*, Wilson.

Thallus black, moderate (to 1½ inch), circumference lobate, complicato squamose, thick, cartilaginous, granulato-corrugate. Apothecia black or dark rufous or sometimes pale, with entire thalline margin, attaining 1 mm. diam. Spores ovate or fusiformi ellipsoid, acuminate at one or both apices, ·018 to ·026 × ·005 to ·006 mm., 3 to 4 loculate. Thecæ clavate, intensely blue with iodine. Paraphyses slender, crowded.

Hab. on calcareous maritime rocks, Warrnambool.

Sub-Genus 2.—Synechoblastus, *spores elongate.*

1. *S. congestus*, Wilson.

Thallus black or atro-fuscous, small (to 1 inch) cartilaginous, difformi-lobate, lobes rotundate, undulate, circumference elevated, incrassate, arcuate. Apothecia black or pallid or dark red, moderate (2 mm. diam.), plane, with thickened margin, at length convex, immarginate. Spores cylindrical or ellipsoideo cylindrical, sometimes curved, often acuminate at the apices, simple or 1 septate, containing two to five locules, ·017 × ·0035 mm. Paraphyses thick, inarticulate. Gel. hym. blue with iodine, thecæ intensely blue. Gran. gon. conglomerated into sacs, two or three or more in each, not moniliform.

Hab. on mosses, &c., on calcareous maritime rocks, Warrnambool.

2. *S. quadrilocularis*, Wilson.

Thallus fusco olivaceous or nigricant, membranaceous, adhering, lobate, thicker at circumference, crisped. Apothecia moderate, crowded, black or rufous black, plane or somewhat concave, thalline margin entire. Spores cylindrical, rounded at each apex, somewhat curved, ·02 to ·03 × ·003 to ·005 mm., 3 septate. Paraphyses slender, inarticulate. Gran. gon. moniliform, or sometimes conglomerated in fours into gelatinous sacs.

Hab. on mosses on sub-Alpine granitic rocks, Mt. Macedon.

3. *S. senecionis*, Wilson.

Thallus green or fuscous green or olivaceous, under surface cærulean green, thin, membranaceous, smooth, shining or somewhat shining, or sometimes granulato rugulose, moderate (2 to 3 inches), rotundo lobate, lobes imbricate, undulato crispate, circumference ascending. Apothecia rufous or testaceo rufous, about 1 mm. diam., often crowded, plane or rather convex, thalline margin entire. Spores elongato fusiform, straight or curved or spirally contorted, ·03 to ·05 × ·004 to ·008 mm., 3 to 9 septate. Gel. hym. blue with iodine. Gran. gon. oblong or reniform (1 to 2 mm. long), or subglobose (1 mm. diam.)

Hab. on bark of Senecio bedfordii, rarely and smaller on bark of Prostanthera lasianthus, Mt. Macedon; Lakes Entrance, Gippsland. When young, the thallus is tense and vivid in colour, like a thin, glistening film of green paint.

4. *S. leucocarpus*, Taylor.

Thallus 1 to 3 inches diam., foliaceo membranaceous, smooth, olivaceous, lobes rotundate, undulate and plicate, margin flexuose. Apothecia often crowded, albocarneous; disk convex, pruinose; margin entire, at length concealed. Spores elongato fusiform, often acuminate at apices, 3 to 5 septate, ·03 to ·05 × ·008 to ·01 mm.

Hab. on trees, Cromb., Journ. Lin. Soc., XVII; Wilson's Promontory, Gov. Bot. Rep., 1854; Krplhbr., *Verhandl. Zool. Bot. Gesells.*, in Wien, 1880; by Curdie's Creek, Mt. Macedon, Warburton, Lorne, Glenmaggie, Beaconsfield, Mt. William, Dandenong Hills.

Var. 1 *petræus*, Wilson.—Obscurely olivaceous or nigricant; lobes smaller, somewhat complicate. Apothecia small, nigricant, seldom carneous, albo pruinose, disk plane. Spores pluri- (about 7) septate, ·03 to ·04 × ·004 to ·005 mm.

Hab. on granitic rocks in mountain streams in Tallarook Ranges.

Var. 2 *minor*, Wilson.—Much less and darker than the type; submonophyllous, rotundate, often obscurely furfuraceo granulose. Apothecia minute and much crowded. Spores as in type.

Hab. on trees near Lake Wat Wat, Gippsland.

5. *S. glaucophthalmus*, Nyl.

Thallus olivaceo-fuscous, ½ inch or more diam., here and there fenestrato dissected, scrobiculate and often granuliferous. Apothecia glaucous lilac, plane or somewhat concave, thalline receptacle prominent, margin very thin. Spores as in *S. nigrescens*, to which this species is allied.

Hab. on bark of trees and bushes; *Leptogium glaucophthalmum*, B. v. M., *Vic. Nat.*, Oct. 1887, p. 89; Warrnambool, Mordialloc, Cunninghame, Buninyong, Lake Wat Wat.

6. *S. nigrescens*, Huds.

Thallus black green, thinly membranaceous, submonophyllous, orbicular, depressed, rotundato lobate, radiately rugoso plicate. Apothecia obscurely rufous, plane, crowded, thalline margin entire. Spores fusiformi cylindrical, often pluriseptate, ·034 to ·042 × ·005 mm.

Hab. on trunks of trees, Warrnambool, Mordialloc, Cunninghame, Buninyong, Metung.

Genus 3.—Leptogium, Fries.

1. *L. biloculare*, Wilson.

Thallus plumbeous, membranaceous, small (½ inch) laciniato lobate, lobes sinuate and undulate. Apothecia pale rufous, minute (2–7 mm. diam.); thalline margin prominent. Spores fusiformi ellipsoid, bilocular, ·015 × ·006 mm. Gel. hym. blue with iodine.

Hab. on the bark of a tree, Mt. Macedon.

2. *L. sinuatum*, Huds.

Thallus plumbeo-fuscescent, rotundato lobate, reticulato rugulose, lobes crowded, imbricated, margin entire or crenate.

sub-erect. Apothecia brown, scattered, small, sessile, concave, margin smooth, entire, elevated. Spores oblongo ellipsoid, attenuated at apices, irregularly murali locular, ·02 × ·008 mm.

Hab. on mossy rocks, Mt. Macedon, Kilmore, Lorne.

3. *L. lacerum*, Ach. var. *intermedium*, Arn.

Thallus plumbeous, or pallido plumbeous, or fuscescenti plumbeous, very thin, smooth or slightly rugulose, undulate and plicate, laciniato lobate, lobes rotundate or lacerate; margin crisped, irregularly crenate or spatulato fimbriate, fimbria often repeatedly branched. Apothecia pallido rufous, not frequent, small or moderate, margin elevated. Spores oblongo ovoid, narrow at one or both apices, murali locular in typically 3 series, ·025 × ·008 mm.

Hab. on mossy rocks and bushes in bed of stream, Cobden, Mt. Macedon, Beaconsfield, Lorne.

Aspect intermediate, between *lacerum* and *tremelloides*.

Var. 2. *pulvinatum*, Hffm.—Thallus dark brown, smaller, pulvinate, lobes minute, much crowded, denticulato laciniate; sterile.

Hab. on earth, Kew; rare.

4. *L. tremelloides*, L. var. *azureum*, Sw. = *Collema azureum*. Report Gov. Bot. 1854.

Thallus plumbeo glaucescent, here and there fuscescent, smooth, lobate, imbricate and crispate. Apothecia rufous, elevated, margin entire, plumbeous or pallid. Spores ellipsoid, acuminate at apices, 5 septate and also longitudinally divided, ·016 × ·006 mm.

Hab. on trees (*Collema azureum*), McCrae's Island, Rep. Gov. Bot. 1854; Cobden, Lake Elingamite, Black Spur, Mt. Macedon, Warburton, Lorne, Beaconsfield, Lakes Entrance.

Var. 2. *musciteyens*, Wilson.—Darker and firmer than the type, less undulate, ascending.

Hab. on stems of mosses on trees, Warburton, Korumburra.

Var. 3. *isidiosum*, Wilson.—Much smaller than the type, partially covered with a granulose isidium. Apothecia small, occasionally isidiose on margin.

Hab. on mossy bush, Cunninghame.

5. *L. philorheuma*, Wilson.

Thallus more or less obscurely plumbeo cinereous or brown, very thin, to ½ inch wide, sub-ascending, lobate, plicato undulate; margin crenate, sinuate and crisped. Apothecia small (1 to 1·5 mm.), disk more or less obscurely rufous, sometimes black, concave or plane; thalline margin entire, thick, rounded, elevated, at length thin, equal. Spores ovate, 3 septate, and also longitudinally divided, ·015 × ·007 mm.

Hab. on mosses and rocks in the channels of streams, Curdie's Creek, Lorne, Tallarook.

Named by Dr. Knight as *L. dactylinum*, and so reported by me (Trans. Lin. Soc. 1890).

6. *L. victorianum*, Wilson.

Thallus obscurely plumbeous, here and there rufo-fuscous, under surface nearly concolorous or sub-cinerascent, large (3 inches or more diam.), more or less confusedly rugulose, rotundo lobate, lobes undulate, firm, but in old lobes thick and occasionally fusco-furfuraceous, as if deprived of cortex, sometimes clothed with squamules. Apothecia moderate, sometimes rather large rufous or fusco-rufous, thalline margin sometimes excluded, more generally plicate or granulate or briefly laciniate. Spores ovoideo fusiform, often acuminate at the apices, typically three septate, often with the central locules longitudinally or obliquely divided, ·013 to ·017 × ·005 to ·006 mm. Granula gonima moniliform.

Hab. among mosses, on trees and rocks abundantly, Mt. Macedon, Black Spur, Cobden, Sandringham (one specimen), Warburton, Korumburra.

Allied to *L. chloromelum*, Sw., and perhaps a variety of it.

7. *L. phyllocarpum*, Pers. var. *dædaleum*, Flot.

Thallus fusco plumbeous, here and there pallido plumbeous, firm, lobate, large (three or four in. diameter), longitudinally and very closely undulato rugose, or finely and acutely corrugate, under surface paler. Apothecia dark rufous, often large, thalline margin thick, densely corrugato rugulose, spores ellipsoid, attenuate at each apex, five septate, and also longitudinally divided, ·03 to ·034 × ·012 to ·015 mm. (Nyl.)

Hab. on trees and bushes, Warrnambool, Lake Victoria, Cunninghame, Lake Wat Wat; abundant, but rather rare in fruit.

8. *L. pecten*, Wilson.

Thallus minute, very thin, squamuliform, plumbeous or brown, margin digitato crenate, often pulvinato crowded. Apothecia large for the size of the plant (1·5 mm. diameter), rufescent, concave, with a thin, pallid margin, often immarginate. Spores ellipsoid, three septate with central locules often longitudinally divided, ·016 to ·024 × ·008 mm.

Hab. on dead or old bark of trees, not common, Mordialloc, Mt. Macedon, Glenmaggie.

9. *L. Burgessii*, Lightfoot.

Thallus plumbeous or brown, laciniato lobate, complicate, lobes variously margined, undulate and curled, under surface cinerascent and albido tomentellose. Apothecia dark rufous, somewhat large, plane or concave, margin thin, entire, or sub-foliaceo-crenulate. Spores ellipsoid, attenuate at each apex, three septate, and also longitudinally divided, ·03 to ·04 × ·012 to ·015 mm.

Hab. on bushes and trees and mossy rocks, Curdie's Creek, Warrnambool, Buninyong, Lake Wat Wat, Mount William; not common.

10. *L. inflexum*, Nyl.

Thallus plumbeous or plumbeo cærulescent, membranaceous, dilated, two to three inches diameter, smooth, laciniato incised, margin inflexo convolute, broadly sinuate and crenulate; under surface pallescent, very thinly tomentellose, but wide at margin. Apothecia rufous, plane or somewhat concave, rather large, appressed, foliaceo crenulate. Spores ellipsoid, attenuate at each apex, plurilocular, ·03 to ·036 × ·013 to ·017 mm. (Nyl.)

Hab. on rock at Waterfall, Upper Maffra.

Var. *limbatum*, Wilson.—Thallus orbicular and rosulate, margin for the most part densely and minutely fimbriate.

Hab. on trees and mossy logs in sub-Alpine localities, Black Spur, Warburton, Mt. Macedon.

11. *L. denticulatum*, *Vic. Nat.*, Oct. 1887, B. v. M.

12. *L. hypotrachynum*, Mull. Arg.

Thallus about 4 centim. wide, laciniæ horizontal or ascending, obovate, obtusely lobate, margin entire, thinly coriaceous, fusco olivaceous, both surfaces concolorous, smooth above or slightly rugulose, crowded beneath with polymorphous prominences, obovoid, obtuse, entire or obtusely lobate, exasperate or verruculose tomentellose. Apothecia 2 mm. diam., spores fusiformi ellipsoid, 5 septate, multilocular, ·025 × ·01 mm. Mull. Lich. Beit. XII, 12, Ratisb. Flora.

13. *L. australe*, Hook and Tayl.

Thallus foliaceo membranaceous, thin, blackish olive, smooth, lobes ascending, sub-imbricate, somewhat concave, rotundate, undulate, entire, under surface paler, sub-tomentose. Apothecia elevated, black, at length convex, margin thin, entire. McCrae's Island, Rep. Gov. Bot. 1854.

14. *L. rugatum*, Hook and Tayl.

Thallus gelatinous membranaceous, 3 inches diam., fuscous green, covered with close longitudinal plaits; lobes crowded, ascending, oblongo rotundate, crenate, somewhat concave, with minute granulate stipitate isidia expanding into thalline lobes, sterile.

Hab. on trees, McCrae's Island, Rep. Gov. Bot. 1854.

FAMILY II.—MYRIANGIACEI.

Genus 1.—Myriangium, Mnt. and Berk.

Thallus black, noduloso pulvinate, cellulose, unstratified. Apothecia sublecanorine, sphæroideo cellulose. Spores 8, colourless, irregularly septate.

1. *M. duriæi*, M. and B. = *M. durieui*, of De Bary.

Thallus black, opaque, small, tuberculato glomerate or nodoso confluent, often depresso pulvinate. Apothecia minute, black, slightly impressed. Spores oblong or oblongo ovoid, variously septate, ·017 to ·024 × ·007 to ·008 mm.

Hab. on bark of trees, Mount Macedon, Sandringham, Korumburra, Kilmore.

2. *M. dolichosporum*, Wilson.

Thallus black, opaque or slightly shining, small (2 to 5 mm. wide and 2 mm. high), unequal. Apothecia numerous, nearly covering the thallus and concolorous with it, stipitate; epithecia subrufescent, plane or concave, to 1 mm. broad, with rotundo obtuse thalline margin; stipe sometimes 1 mm. long, tapering downwards. Thecæ sphæroidal, dispersed in the cellular substance of the epithecium. Spores cylindrical, simple or obsoletely septate, arcuate, somewhat acuminate at apices, with minute guttæ arranged in the longitudinal axis, ·04 × ·006 mm. Gran. gonim. ·002 to ·007 mm. diam., often conglomerate. Texture of thallus fuscous, cellular, cells angular, ·003 to ·005 mm. diam. Cells in epithecium spherical.

Hab. on twigs of Hymenanthera banksii, Maffra.

The whole plant is often covered with the scyphophoroid apothecia standing out in all directions, and of various sizes and stages of development. The epithecium is almost identical in texture with the epithallus, but is generally concave and slightly rufescent. In old apothecia it is worn into cavities, which give it a granulato rugulose appearance. Both thallus and apothecia contain granula gonima, usually conglomerate. When a dried specimen is submerged in water, there arise from it on all sides streams of minute air bubbles for a considerable time, showing the porous nature of the plant. It does not, however, appreciably increase in size when moistened as the Collemacei do.

FAMILY III.—LICHENACEI.

Thallus various in colour, white, whitish, cinerascent, flavicant, rufous, fuscous, very rarely nigricant, and various in form, filamentous, foliaceous, squamose, crustaceous, pulverulent or evanescent. The gonidial stratum very generally of true gonidia. Apothecia various in form, stipitate, lecanorine, peltate, patellulate, lirellate or pyrenocarpous.

Series I.—Epiconiodei.

Apothecia with the spores naked, collected into a sporal mass on the surface.

Tribe 1.—Caliciei.

Thallus crustaceous, granulose or obsolete, yellow or flavo-virescent, or cinerascent, or whitish, or none. Apothecia cupuliform, sessile or stipitate.

Genus 1.—Sphinctrina, Fr. pr. p. D. N.

Thallus none. Apothecia parasitic on *Pertusariæ*, globoso turbinate, shining, black, sessile or shortly stipitate. Spores 8, nigrescent, simple.

1. *S. microcephala*, Nyl.

Apothecia black, globoso turbinate, briefly stipitate, nearly sessile, capitula small (about ·1 mm. broad), spores nigricant, fusiformi ellipsoid, nearly globose, but acuminate at apices, epispore thick, reddish, ·01 to ·012 × ·004 to ·008 mm.

Hab. on some pertussaria, on bark of Hymenanthera banksii, Maffra.

Form *tenella*, Wilson.—Like the type, but with a smaller capitulum and longer stipe (to ·5 mm.)

Hab. along with type, Maffra.

Genus 2.—Calicium, Ach. Nyl.

Thallus granulose, powdery, crustaceous, squamulose, or altogether evanescent. Apothecia generally black, stipitate or subsessile, capitula globose, or turbinate, or cupular. Spores fuscous or nigricant. Spermatia short, oblong.

1. *C. chrysocephalum*, Ach.

Thallus citrine or obsolete. Apothecia small (·6 mm. high), black, stipe slender (·06 mm. thick). Capitulum small (·12 mm. broad), turbinate ; beneath citrino suffused. Sporal mass umber brown ; spores fuscous, globose, ·003 to ·006 mm. diam.

Hab. on decorticated decaying eucalyptus, near river, at Maffra, Kilmore.

Var. *filare*, Ach.—Stipe longer and more slender (to ·8 × ·4 mm.) ; capitulum smaller ; sporal mass protruding upwards to a great height.

Hab. along with type, Maffra.

2. *C. phæocephalum*, Borr. var. *phædrosporum*, Wilson.

Thallus white, or whitish, with pale glaucescent verrucose congested granules, which are sometimes dissolved into citrine soredia. Apothecia atro-fuscous, with slender stipe (about ·2 mm. high, ·1 mm. thick), the upper part citrino suffused; capitulum hemispherico-turbinate or sub-globose; margin citrino suffused; sporal mass from fulvous to umbrine. Spores dilutely nigrescent, very nearly colourless, delimitated by a dark line; form variable, globose or ellipsoid, simple, nucleated, diameter ·002 to ·004 mm.

Hab. on decaying decorticated eucalyptus, near Kilmore.

I am doubtful whether the granules of the thallus belong to this lichen, or are an undeveloped form of some other. Perhaps the plant is of a new species, which may be called *C. phædrosporum.*

3. *C. niveum*, Wilson.

Thallus snowy white, thick, or cinerascenti albid, thinner, effuse, rimulose with convex areolæ. Apothecia minute (·5 to ·8 mm. high), stipe slender (·07 mm. thick), either all whitish or partly hyaline and partly fuscous, or all fuscous, or all black, sometimes furcate. Capitulum hemispherico lenticular, black, about ·25 mm. broad, sometimes divided into two or three or more lobes. Spores dilutely nigrescent, fusiformi ellipsoid, or oblong, compressed, simple, ·004 to ·006 × ·002 to 0025 mm., paries thick. Gel. hym. with iodine vinous yellow.

Hab. on dead bark of living eucalyptus, Cunninghame, Maffra, Beechworth.

Perhaps a variety of *C. pusiolum*, Ach.

4. *C. Victoriæ*, C. Knight.

Thallus white or whitish, or cinerascent, more or less marked, effuse. Apothecia all black, ·5 to 1 mm. high, stipe slender (·1 mm. thick) and a little thicker at the base. Capitulum turbinato lenticular or hemispherico lenticular, ·25 to ·5 mm. broad. Spores fuscous or fuscescent, fusiformi ellipsoid, compressed, simple, ·005 to ·008 × ·002 to ·003 mm., when viewed from the side bacillar, ·0015 mm. wide; paries thick, defined by a dark line on the outside.

Hab. on decaying decorticated eucalyptus, Croydon, Kew, Warrnambool, Warragul, Black Spur, Lakes Entrance, Mt. William, Tallarook, Mt. Macedon, Beechworth; frequent.

Allied to *C. parietinum*. Somewhat variable. *C. jejunum* reported by me (Trans. Lin. Soc. 1890), is now judged by me to be a not clearly marked form of *C. Victoriæ*.

5. *C. parvulum*, Wilson.

Thallus white or whitish, sub-determinate. Apothecia all black, ·4 mm. high, stipe slender (·05 mm. thick). Capitulum lenticular, ·16 mm. broad. Spores dilutely nigrescent, ellipsoid, simple, ·003 to ·006 × ·0015 to ·0025 mm., paries thin, black.

Hab. on decorticate eucalyptus, Maffra, Mt. Macedon, Beechworth.

The thallus looks like a thin coat of whitewash, on which the densely black apothecia, though very minute, are clearly visible. The outline of the spores is remarkable for its blackness, being in this respect like *C. Victoriæ*.

6. *C. contortum*, Wilson.

Thallus whitish, very thin. Apothecia all black, 1 mm. high, stipe ·1 mm. thick, contorted. Capitulum hemispherico lenticular. Spores dilutely nigrescent, fusiformi ellipsoid, simple, ·004 × ·0014 to ·002 mm.

Hab. on decorticate decaying eucalyptus, Lakes Entrance.

Allied to *C. Victoriæ*, which it resembles in its apothecia, but the capitula are smaller, the spores also are smaller and narrower, and different in colour.

7. *C. gracillimum*, Wilson.

Thallus indicated by a whitish spot. Apothecia all black, small (·8 mm. high); stipe very slender (·06 mm. thick); capitulum minute (·1 mm. broad); turbinato lenticular. Spores more or less dilutely nigrescent, ellipsoid or fusiformi ellipsoid, uniseptate, ·002 to ·004 × ·001 to ·002 mm., with a locule in each cell.

Hab. on decaying decorticated *Aster argyrophyllus*, Mt. Macedon.

The apothecia are extremely minute, being visible only under a powerful lens.

8. *C. deforme*, Wilson.

Thallus cinerascent, thin, granulose. Apothecia black, deformed by thalline and other granules, 1 mm. high, or a little more; stipe ·2 mm. thick; capitulum turbinato lenticular, to ·5 mm. broad. Sporal mass black, protruding, sometimes extending far on one side. Spores nigrescent, fusiformi ellipsoid, uniseptate, septum often indistinct, ·006 to ·008 × ·0025 to ·004 mm.

Hab. on decaying decorticated eucalyptus, Lakes Entrance. The apothecia have a deformed appearance, unlike the ordinary neatness of the genus. Its surface seems to be glutinous, readily retaining any granules or other particles that fall on it.

9. *C. rosco-albidum*, Wilson.

Thallus rosy-whitish, thick, minutely cancellate, chrysogonimic. Apothecia minute (·7 mm. high), all black; stipe slender (·06 mm. thick); capitulum lenticular (·2 mm. broad). Spores nigrescent, oblong or oblongo ellipsoid, apices rotundte, uniseptate, ·005 or more × ·002 to ·003 mm.

Hab. on decayed decorticated eucalyptus, Maffra, Kilmore. The thallus covers a good part of the tree, and when bruised, it becomes a deep yellow.

10. *C. capillare*, Wilson.

Thallus white, thin, or very thin. Apothecia all black, ·1 mm. high; stipe slender (·1 mm. thick); capitulum turbinato lenticular, ·3 to ·4 mm. broad. Spores nigrescent, oblong or ellipsoid, uniseptate, ·005 × ·0025 mm.

Hab. on decaying decorticated eucalyptus, Mt. Macedon, Warburton, Maffra.

Perhaps a variety of *C. subtile*, Pers., of which I reported it a variety (Trans. Lin. Soc., 1890).

11. *C. biloculare*, Wilson.

Thallus whitish or cinerascent, thin. Apothecia, all black, ·8 to ·1 mm. high; stipe, ·1 mm. thick; capitulum lenticular or sub-turbinato lenticular, ·3 to ·4 mm. broad. Spores fuscescent or fusco nigrescent, ellipsoid, or sub-fusiformi ellipsoid, bilocular or obsoletely bilocular or simple, with septum not visible, epispore thickish, ·005 to ·008 × ·002 to ·0035 mm.

Hab. on decaying decorticated eucalyptus, Warrnambool, Maffra, Bright.

Perhaps a variety of *C. subtile*, Pers., of which I reported it a variety (Trans. Lin. Soc., 1890).

12. *C. obovatum*, Wilson.

Thallus cinerascent, thin. Apothecia black, to ·8 or 1 mm. high; stipe to ·08 or ·1 mm. thick; capitulum obovate or turbinate, ·2 to ·3 mm. broad. Spores nigrescent, ellipsoid, uniseptate, each cell containing a globular locule, septum not always visible, ·005 to ·012 × ·003 to ·004 mm.

Hab. on eucalyptus wood in mountain regions, Mt. Macedon.

Distinct by the obovate capitulum.

13. *C. piperatum*, Wilson.

Thallus albido cinerascent or cinereous, thin. Apothecia black, sub-sessile, ·2 mm. high; stipe thick (·1 mm.); capitulum lenticular, disk plane, ·25 mm. broad. Spores fusco nigrescent, oblong, uniseptate, each cell containing a globular locule, ·004 to ·008 × ·0025 to ·005 mm.

Hab. on eucalyptus wood, both trees and fences, common, Mt. Macedon, Kilmore, Beechworth.

14. *C. nigrum*, Schær var. *minutum*, Knight.

Thallus obscurely cinerascent, granulose. Apothecia all black, small (·5 mm. high); stipe thick (·1 to ·12 mm.); capitulum turbinato cylindrical, disk pruinose, ·3 to ·7 mm. broad. Spores nigrescent, ellipsoid, uniseptate, constricted in the middle, each cell containing a globular locule, ·004 to ·012 × ·002 to ·006 mm.

Hab. on the horizontal surface of decaying eucalyptus fences, Kew, Maffra, Oakleigh.

15. *C. quercinum*, Pers. var. *bulbosum*, Wilson.

Thallus albido cinerascent. Apothecia to ·1 mm. high; stipe to ·2 mm. thick, capitulum globose, ·5 mm. diam., cinereo pruinose beneath. Spores fusco nigrescent, subfusiformi ellipsoid, ·006 to ·012 × ·003 to ·005 mm., uniseptate, septum often indistinct, cells containing each a nigrescent locule, epispore distinct, rubescent.

Hab. on decaying decorticated eucalyptus, Mt. Macedon.

Reported by me (Trans. Lin. Soc.) as *C. bulbosum*, and perhaps a variety of *C. quercinum*.

Var. 2. *microcarpum*, Wilson.—Thallus cinereous. Apothecia small, ·3 to ·4 mm. high; stipe black, ·1 to ·2 mm. high, ·05 to ·1 mm. thick; capitulum turbinate, disk flat, ·1 to ·2 mm. broad, margin cinerascent or albido cinerascent. Spores fuscescent, 1 septate, paries thick, constricted in middle; apices rather acuminate, ·008 × ·003 mm.

Hab. on decaying eucalyptus stump, near Tallarook.

Var. 3. *Clarensis*, Wilson.—Thallus whitish or cinerascent, of medium thickness. Apothecia black, ·8 mm. high, stipe ·1 mm. thick, capitulum ·3 mm. broad, turbinato lenticular, margin whitish. Spores fuscous or fuscescent, ellipsoid, narrow at apices, often constricted in middle, uniseptate or bilocular, ·005 to ·008 × ·002 to ·0035 mm.

Hab. on decaying decorticated eucalyptus, Bright, Beechworth.

16. *C. curtum*, Borr.

Thallus whitish, thin or evanescent. Apothecia to 1·8 mm. high, but often much less, stipe to ·2 mm. thick, capitulum turbinate, to ·6 mm. broad, albo suffused beneath. Sporal mass black, protruded upwards. Spores nigricant, ellipsoid, uniseptate, ·005 to ·01 × ·002 to ·003 mm.

Hab. on decaying decorticated eucalyptus and old hardwood fences, frequent and abundant, Lorne, Mt. Macedon, Oakleigh, Black Spur, Maffra, Bright, Mordialloc.

17. *C. trachelinum*, Ach. var. *elattosporum*, Wilson.

Thallus obscurely cinerascent or albescent. Apothecia very various in size, to 2 mm. high; stipe at the base ·25 mm. thick; capitulum globose or turbinate, to ·5 mm. broad, rufous at margin and upper part of stipe and even the disk. Spores ·003 to ·008 × ·002 to ·004 mm.

Hab. on decaying decorticated eucalyptus and fences, Cobden, Warburton, Warragul, Maffra, Lorne, Cunninghame.

The dimensions of the spores are half of those described by Nylander. This is in Victoria the commonest species of this genus, and often grows in large patches on the trees, covering many square feet with abundant apothecia, sometimes making the tree seem as though clothed with short hair.

Var. 2. *meiocarpum*, Wilson.—Thallus whitish, thin. Apothecia small, about ·8 mm. high; stipe about ·1 mm. thick; capitulum turbinato lenticular ·3 mm. broad; margin and upper part of stipe rufous. Spores fuscescent, ellipsoid, constricted in middle, uniseptate, with minute loculi in each cell, ·006 to ·007 × ·003 mm.

Hab. on decorticated lightwood tree, Kilmore.

18. *C. aurigerum*, Wilson.

Thallus white or whitish, somewhat thick. Apothecia small, stipe black ·2 to ·8 mm. high, ·05 to ·1 mm. thick; capitulum wholly covered with flavescent powder, lenticular, ·4 mm. broad. Spores nigrescent or fuscous, ellipsoid, uniseptate, rather constricted in middle, containing a locule in each cell, ·005 to ·007 × ·002 to ·004 mm.

Hab. on decaying eucalyptus wood, Mt. Macedon.

Possibly only a variety of *C. roscidum.*

19. *C. roscidum*, Flk. var. *eucalypti*, Wilson.

Thallus cinerascent, here and there flavo sorediose and then sterile. Apothecia to 1·3 mm. high, stipe black, ·1 mm. thick; capitulum turbinate, beneath more or less flavo virescent, to ·3 mm. broad. Spores fuscescent or more or less dilutely nigrescent, defined by a black line, ellipsoid, narrow at each apex, often constricted at middle, uniseptate, containing a paler locule in each cell, ·005 to ·009 × ·003 to ·005 mm.

Hab. on dead bark and decaying wood of eucalypti, Beechworth, Mt. Macedon.

20. *C. roscidulum*, Nyl.

Thallus white, thick, here and there rufescent (query alien ?). Apothecia ·9 mm. high, stipe ·1 mm. thick; capitulum turbinato lenticular, ·4 mm. broad; margin and upper part of stipe golden green. Spores fuscescent, ellipsoid, constricted at middle, uniseptate, ·003 to ·006 × ·002 to ·003 mm.

Hab. on decayed eucalyptus stump, Kilmore.

Probably a mere variety of *C. roscidum.*

21. *C. hyperellum*, Ach.

Thallus flavo virescent, granulose or sub-leprose. Apothecia black; capitulum globoso-lentiform; stipe black, elongate; sporal mass black or umber black. Spores nigrescent, ellipsoid, uniseptate, ·009 to ·016 × ·004 to ·006 mm. (Nyl.)

Hab. on bark of trees. B. v. M., *Vic. Nat.*, Oct. 1877, p. 89.

Var. *calidius*, C. Knight.—Thallus yellow or sulphureo cinerascent, thickish, verrucoso unequal. Apothecia all black; stipe short and thick (to ·5 mm. high, ·3 mm. thick); capitulum turbinato lenticular, disk lecideine, to ·5 mm. broad. Spores fuscous, ellipsoid, sub-acuminate at each apex, somewhat constricted in the middle, uniseptate, ·007 to ·013 × ·003 to ·006 mm.

Hab. on wood and decorticated decaying trunks of eucalyptus, Maffra, Lakes Entrance, Bright, Beechworth.

Var. 2. *perbreve*, Wilson.—Thallus flavo virescent, crustaceous, rugose. Apothecia very short, nearly sessile. Sporal mass black, protruded horizontally until the apothecia are often conjoined. Spores fusco nigrescent, ellipsoid, often narrower at each apex, somewhat constricted in the middle, uniseptate, ·007 to ·015 × ·003 to ·0075 mm.

Hab. on decaying eucalyptus wood, Maffra.

22. *C. tricolor*, Wilson.

Thallus sulphureous, leproso granulose. Apothecia black, small (to ·75 mm. high); stipe 1 mm. thick; capitulum turbinato globose, ·2 to ·5 mm. broad, margin white. Spores fuscous, fusiformi ellipsoid, sub-acuminate at each apex, somewhat constricted in the middle, uniseptate, with a fusco nigrescent locule in each cell, ·008 to ·012 × ·003 to ·005 mm.

Hab. on decaying decorticated eucalyptus, Warrnambool, Lakes Entrance.

23. *C. flavidum*, Wilson.

Thallus yellow or sulphureous, crustaceous, smooth, nearly shining. Apothecia black, but with margin, and often the stipe tinged with the thalline colour, 1 mm. high; stipe ·5 mm. thick, tapering downwards; capitulum globoso turbinate. Sporal mass black, protruded. Spores fusco nigrescent, ovoid or sub-fusiformi ellipsoid, uniseptate, epispore rubescent, cells fuscescent, containing each one or two nigrescent locules, ·008 to ·01 × ·003 to ·004.

Hab. on decorticated eucalyptus, Lakes Entrance.

Genus 3.—Coniocybe, Ach. Nyl.

Thallus leprose or powdery, effuse or evanescent. Apothecia yellow or pale, not black, stipitate, excipulum very open. Spores usually spherical, colourless or flavescent, forming the globoso pulverulent capitulum.

1. *C. citriocephala*, Wilson.

Thallus white, thin. Apothecia minute; stipe black, slender, 1 mm. high, ·06 thick, often less. Capitulum flavo virescent, turbinate, at length globose, to ·2 mm. diameter, becoming fuscous and turbinate when stripped of the sporal mass. Spores colourless or dilutely flavid, briefly oblongo ellipsoid or spheroidal, ·02 to ·04 × ·02 to ·03 mm.

Hab. on dead wood and dead bark of trees, Lakes Entrance.

2. *C. ochrocephala*, Wilson.

Thallus whitish, often with green leprose granules. Apothecia with slender fuscous stipe, ·6 to 1·2 mm. high, ·06 to ·08 mm. thick, often bifurcate; capitulum globose, pale ochre, ·25 mm. diameter. Spores colourless or dilutely fuscescent, globose, ·002 to ·003 mm. diameter, containing a central locule.

Hab. on decaying decorticated Aster argyrophyllus, Senecio bedfordii, and eucalyptus, Mt. Macedon and Korumburra.

3. *C. rhodocephala*, Wilson.

Thallus white or whitish or cinerascent or cinereous or evanescent. Apothecia often caspitoso congested; stipe scarlet or hyaline, at length fuscous or black and pruinose, contorted and compressed, to 2 mm. high, ·2 mm. thick, sometimes furcate or two partly coalescent. Capitulum globose, obscurely rufous or fuscous, at length rose or flesh colour, pruinose, rarely albid, ·4 to ·8 mm. diameter. Spores very numerous, colourless, ellipsoid or ovate ·003 to ·006 × ·0015 to ·004 mm., bilocular or placodine or uniseptate, with a locule in each cell, epispore thick. Paraphyses numerous, distinct.

Hab. on dead wood or bark of tree, Lakes Entrance.

This species is remarkable for the form of its spores. All the genus hitherto described have spherical simple spores.

The var. *rubens* reported by me (Trans. Lin. Soc.), having been since found in larger quantity, proves to be scarcely more than a juvenile form.

4. *C. gracilenta*, Ach. var. *leucocephala*, Wilson.

Thallus green, conglomerato leprose. Apothecia with stipe long and tender (1·5 to 2·5 × ·1 mm.), fusco nigricant, opaque, and capitulum small, sporal mass white, irregularly clothing the capitulum and the upper part of the stipe. Spores colourless, minute, sphæroidal, ·002 to ·003 mm. diameter.

Hab. on earth, Fernshawe, Mrs. Martin, March 1891.

GENUS 4.—TRACHYLIA, Fr. pr. p. Nyl.

Thallus thin, granulose or subleprose, or foreign. Apothecia black, sessile, cupuliform, open, sporal mass black. Spores nigricant or fuscous black, ellipsoid or oblong, uniseptate, rarely pluriseptate.

1. *T. lecanorina*, Wilson.

Thallus cinerascent, verruculoso leprose, passim verrucoso sorediate, gonidia moderate and abundant. Apothecia small (to ·5 mm. broad), crowded, elevated in thalline receptacles. Sporal mass black, abundant, often much protruded and connecting the apothecia Spores fusco nigricant or nigrescent, or nearly colourless, ellipsoid, uniseptate, ·01 to ·02 × ·006 to ·01 mm.

Hab. on old eucalyptus fences, Cheltenham, Yalla-y-poora, near Streatham.

This plant bears at first sight a great resemblance to *Lecanora atra.*

2. *T. viridilocularis,* Wilson.

Thallus obscurely cinerascent. Apothecia black, somewhat elevated, ·3 mm. high, ·3 mm. broad. Sporal mass abundant. Spores nigricant or virescenti nigricant, irregularly ellipsoid, uniseptate, ·01 to ·02 × ·008 to ·01 mm., with one or rarely two locules in each cell.

Hab. on sawn eucalyptus rails, Kew.

This lichen is associated with *Calicium nigarum*, var. *minutum*, the *Calicium* on the more decayed horizontal face of the squared rail, and the *Trachylia* on the perpendicular face. The speres are tinged bottle green.

3. *T. emergens*, Wilson.

Thallus white or whitish, thin, smooth, somewhat shining. Apothecia seem to emerge from among the fibres of the wood, and at length barely stand out above the thallus, to ·5 mm. broad. Spores fusco nigricant, adhering closely together, ellipsoid, about ·005 × ·003 mm., but very various in size, uniseptate, with a locule in each cell.

Hab. on eucalyptus rails in sub-Alpine regions, Mount Macedon. Found also on Mount Lofty, in South Australia, and Mount Wellington, in Tasmania.

4. *T. Victoriana*, Wilson.

Thallus cinerascent, thin, effuse. Apothecia typically sessile, but often very briefly stipitate, to ·4 mm., high, disk generally sulphureo pruinose, to ·4 mm. broad. Spores fuscous, oblongo ellipsoid, ·005 to ·006 × ·003 to ·004 mm., uniseptate, with a nigrescent locule in each cell.

Hab. on old eucalyptus rails. The fuscous epispore readily rubs off, leaving the spore nigrescent, ellipsoid, narrow at each apex, and smaller, ·004 to ·005 × ·002 to ·003 mm.

5. *T. exigua*, Wilson.

T. exigua, Wilson (Trans. Lin. Soc., 1890) on further examination proves not to be a *Trachylia*.

Tribe 2.—Sphærophorei.

Thallus fruticulose, ramose and ramulose, the apices subgloboso-incrassate, enclosing the apothecia, which are nucleiform, enclosed, ultimately exposed by the bursting of the thalline covering.

Genus 1.—Sphærophoron, Pers.

Thallus cæspitoso fruticulose, smooth, polished, fragile. Apothecia in the apices of the thallus, receptacle irregularly dehiscent. Spores nigricant or violaceo nigricant, spherical or sub-globose, covered with a black powder.

1. *S. australe*, Laur. = *S. ceranoides*, Hampe.

Thallus to 2 inches long, pallid, ramose, branches compressed, explanate, often distichously ramulose, beneath albicant, rugose. Receptacle ·6 to ·12 mm. broad, lenticulari compressed, external margin above cristato crenate. Spores ·011 to ·015 mm. diam.

Hab. Sealer's Cove, by Dr. F. Mueller; Moe; *S. ceranoides*, Hampe, in Linnæa (1856), XXVIII, p. 217; *S. australe*, Müll. Lich. Beitr., XVII, p. 1; B. v. M., *Vic. Nat.*, 1887, p. 89.

Var. *proliferum*, Wilson.—Thallus cæruleo pallid on upper surface, convex, smooth, nearly shining, under surface white, fossulato canaliculate or scrobiculato unequal, to 3 inches long, sub-pinnatifid, branches linear, 2 to 7 mm., broad, variously divided. Apothecia on the under surface of the thallus, the margin branching and proliferous once or twice.

Hab. on the trunks of large trees in shady woods, Black Spur, Warburton.

The plant grows horizontally from the tree, then droops downwards, and then bends gracefully upwards, displaying the apothecia on the under side of the thallus. The proliferous branches grow, one or more, from the margin of the apothecium.

2. *S. compressum*, Ach.

Thallus pallido albicant, ramose, plano compressed. Apothecia obliquely minute on the apices; receptacle lacero dehiscent, or discoid and open. Spores nigricant, spherical, ·007 to ·011 mm. diam. (Nyl.)

B. v. M., *Vic. Nat.*, Oct. 1887, p. 89.

3. *S. coralloides*, Pers.

Kremp., in *Verhand. Zool. Botan. Gesellsch.*, in Wien, 1880, p. 329. A mistake for *Stereocaulon ramulosum*, according to Prof. J. Mueller, in *Ratisbon Flora*, 1887, No. 8.

4. *S. tenerum*, Laur.

Thallus pale or whitish, terete, slender, very much branched, branches fine and intricate. Apothecia small (·1 to ·2 mm.) on the primary branches: thalline receptacle persistent, only slightly dilated. Spores nigricant, or smeared with a friable nigricant pigment. Diam. ·007 to ·008 mm. (Nyl.)

Kremp., in *Verhandl. Zool. Bot. Gesells.*, in Wien, 1880, p. 329. According to Prof. J. Mueller (in *Ratisbon Flora*, 1887, No. 8), a specimen from Mt. Ellery is rightly determined, but specimens from Black Spur and Yarra Yarra are *Cladina aggregata*.

Series 2.—Cladodei.

Thallus generally erect. Apothecia terminal on podetia, rarely sessile; biatorine, rarely lecanorine. Spores 8, colourless, usually oblong and simple, sometimes elongate and septate. Paraphyses distinct.

Tribe 3.—Bæomycei.

Thallus horizontally expanded, crustaceous. Apothecia pale or rufescent, sessile or podetiiformi stipitate. Spores simple or septate.

Genus 1.—Gomphillus, Nyl.

Thallus very thin, consisting of gonidia and filaments irregularly conglutinated. Apothecia stipitate, small, corneous. Spores filiform, multiseptate. Paraphyses indistinct.

1. *G. bæomyceoides*, Wilson = *Patellaria Wilsoni*, Mull. Arg.*

Thallus cinereous or virescent, effuse, either very thin and somewhat shining, or rather thicker and eroso isidioso granulate. Gonidia various in size and form, conglomerated into gelatinous globules. Apothecia of a tenacious horny texture, biatorine, sometimes margined by the white hypothecium, scattered or conglomerated, depresso globose, to 1·5 mm. diam., smooth, rufo fulvescent, pale when young,

* Lich. Beitr., in Flora 1888, No. 1435.

and dark in age, sub-sessile or stipitate, stipe to ·5 mm. high and ·5 mm. thick, with sometimes two or three capitula on one stipe. Spores, eight in cylindrical thecæ, aciculari filiform, about ·14 mm. long, pluriseptate.

Hab. on roots and trunks of trees, upon mosses and bark, and jungermannias and lichens; also on the earth upon dead leaves, &c., in shady mountain forests, Black Spur, Mt. Macedon, Warragul.

GENUS 2.—BÆOMYCES, Pers.

Thallus crustaceous, powdery, granulose or squamulose. Apothecia biatorine, sessile or stipitate.

1. *B. rufus*, D. C.

Thallus albo virescent or albido glaucescent, thin, effuse, minutely granulose or squamulose or leprose, granules depressed (K yellow). Apothecia carneo rufescent or carneo fuscescent, somewhat convex, immarginate, stipe moderate or very short, whitish. Spores, 6 or 8, oblongo ellipsoid, simple.

B. v. M., *Vic. Nat.*, Oct. 1887, p. 89.

2. *B. fusco carnea*, Wilson.

Thallus pallid, granuloso verrucose, granules sometimes depressed. Apothecia rufo fuscescent, quasi pruinose, 1 to 2 mm. broad, convex, margined by the hypothecium. Stipe white, nude, short (less than 1 mm. high). K. thal. and apoth. yellow, then blood red. Spores ellipsoid, simple. ·008 to ·01 × ·003 to ·005 mm.

Hab. on clay ground, Kilmore.

3. *B. roseus*, Pers.

Thallus whitish, granulose, effuse or determinate. Apothecia roseo carneous, or albo carneous, nearly globose, about 2 mm. broad, stipe whiter or nearly white, subterete. Spores six or eight, fusiformi oblong or fusiform, simple, ·011 to ·026 × ·0025 to ·003 (Nyl.) Paraphyses slender.

Hab. on bare earth, chiefly clay. B. v. M., *Vic. Nat.*, Oct. 1887, p. 89.

(See note on next species.)

4. *B. fungoides*, Ach.

Thallus whitish, granulose, margin of granules spreading, thin, continuous. Apothecia roseo carneous or albo carneous, sub-globose, or globoso clavate, or difformi clavate, moderate or large (2 to 4 mm. broad); stipe long (4 to 8 mm.), whiter or nearly white, subterete. Spores oblong or fusiform, simple, ·011 to ·023 × ·0035 mm. Paraphyses slender.

Hab. on earth, chiefly clay, in mountain regions, Otway Ranges, Black Spur, Warburton, Mt. Lookout, (A. F. Wilson).

Probably a variety of *B. roseus*, growing in a warmer climate, as Tuckerman suggests. When not well developed it approaches the previous species.

5. *B. heteromorphus*, Nyl.

Thallus pallido glaucescent or pallido cinerascent, verrucoso unequal, forming large patches. Apothecia pale carneous, or carneo fuscescent, ·5 to 1 mm. broad, margin thick, undulate, obtuse, stipe 1 to 2·5 mm. high, variously compressed or plicate, often two to six or more apothecia on one stipe. Spores very transparent, nearly indistinct, ellipsoid, simple, ·01 × ·006 mm. Thall. and Apoth. K.+C—.

Hab. on clay ground, mosses, dead leaves, &c., in mountain regions, Black Spur, Mt. Macedon, Warburton, Otway Ranges, Lilydale, Mt. Buffalo (A. F. Wilson).

6. *B. squamarioides*, Nyl. = *Knightiella leucocarpa* = *K. squamarioides*, Mull. Arg.

Thallus albo or albido glaucescent, subopaque, squamose, squamæ difformed, about ·5 mm. broad, affixed (forming small patches about an inch wide), lobate or lobato incised, plane or somewhat depressed in the centre, concolorous beneath or whiter. Apothecia lurid or pale lurid or lurido carneus, ·2 to ·3 mm. broad, biatorine, plane, margin thickish, evanescent. Spores oblong or fusiformi oblong, uniseptate.

Hab. on earth, Mt. William (D. Sullivan). Mull. Lich. Beitr., 1888, No. 13, p. 8.

7. *B. Frenchianus*, Mull. Arg.

Thallus squamose; squamæ cæspitose, crowded, broad, inciso lobate; lobes ascending, crenulate or entire, olivaceous above, white beneath, bearing podetia here and there upon their margins. Podetia about 2 mm. high, ·66 mm. thick, olivaceous, thallino-corticate and sub-granuloso asperulate, or often towards the apex decorticate and somewhat rose-coloured, monocephalous. Apothecia about equally broad with the podetia; the whole of the apothecium at first rosello fuscescent and very widely truncato obconical and plane, but soon fuscous and convex. Spores not fully evolved. Prof. J. Mueller in Ratisbon Flora.

Genus 3.—Thysanothecium, Berk. and Mont.

Thallus partly horizontal, granulose or squamose, and partly podetiiform, often expanding at the apex, variously divided. Apothecia thin, pale or rufous, darker or lighter, terminating the terete podetium or covering the upper surface of the frond-like podetium. Spores small, ellipsoid, simple.

1. *T. hyalinum*, Taylor.

Thallus pale yellow or pale lurid, lobato granulose or squamose; podetia various in size (1 to 12 mm. high, ·5 to 2 mm. thick), sulcato rugose, sometimes squamulose below; apex dilated on one side (1 to 10 mm. broad). Apothecia pallid or carneo-rufescent, or fusco rufus, forming a thin stratum on the upper surface of the apex. Spores 8 in the thecæ, ellipsoid, simple, ·006 to ·008 × ·0035 (Nyl.)

Hab. on earth or decayed and generally burnt wood, common; Kew, Box Hill, Youyangs, Cobden, Mordialloc, Cheltenham, Oakleigh, Ringwood, Lilydale, Maffra.

Form *squamulosum*, Wilson.—Thallus yellow, more or less sordid or lurid, squamulose, squamules thick, either depressed and lobate, or somewhat ascending podetiiform, swollen upwards and briefly ramose. Apothecia cephaloid, sessile on the squamules and podetia, minute, crowded, not fully evolved.

Hab. on poor soil, Trentham (coll. by Mrs. Martin), Kew, Sandringham. Possibly a new species.

Form *intortum*, Wilson.—Thallus yellow, squamulose, podetia compressed and dilated, lobulate, apices crispate and intorted. Apothecia as in the typical form. Spores not fully evolved.

Hab. on decaying wood, Oakleigh. Coll. by Mrs. Martin.

2. *T. Hookeri*, Berk. et Mnt.

Thallus lurido flavescent, innato graniform, effuse. Podetia cinereo flavescent, about ½ inch high, frondose, stipitate, firm, striato nervose, stipe subterete, about 6 mm. high, dilated above into a simple or lobed frond. Apothecia thinly but equally covering the one side of the frond, rufus or carneo-rufus or testaceo carneous, immarginate. Spores 8, ellipsoid, ·006 to ·007 × ·0025 to ·003 mm.

Hab. on earth, near sea, Cheltenham.

Art. XIII.—*On a New Species of Leucosolenia from the neighbourhood of Port Phillip Heads.*

By Arthur Dendy, D. Sc.

[Read December 8, 1892.]

The species here described was collected by Mr. J. Bracebridge Wilson, M.A., in the neighbourhood of Port Phillip Heads, but unfortunately too late for it to be included in Part I of the Monograph of the Victorian Sponges, which deals with the group (Homoecœla) to which it belongs.

Leucosolenia uteoides, n. sp.

In external form and canal system the sponge very closely resembles *Leucosolenia stolonifer*, Dendy,* belonging, like the latter, to the section of the genus *Leucosolenia* to which I have proposed to apply the name *Simplicia*. The single specimen is colonial, consisting of about one hundred individuals united together by their bases only and rising vertically upwards side by side so as to form a compact colony. The spongorhiza is not conspicuous, being represented by the union of the various individuals at their bases. From the basal portions of the individuals, thus united, arise numerous short, slender, downward-growing, tubular processes, which apparently serve, as in *L. stolonifer*, to attach the colony to the substratum. The fully developed Ascon individuals attain a height of about 35 mm. and a diameter of about 2·5 mm. Each is a nearly straight, slender, cylindrical, thin-walled tube, narrowing slightly towards the naked, terminal osculum. The tubes may branch, especially near their bases. Under a lens the outer surface of each tube appears very slightly hispid and also exhibits that longitudinal striation, due to the presence of large oxeote spicules, which is so characteristic of the genus

* "Monograph of the Victorian Sponges," Part I, p. 46, Plate I, Fig. 2.

Ute, whence the specific name *uteoides*. The wall of the tube is about 0·13 mm. thick, the mesoderm being, as in *L. stolonifer*, very strongly developed for a Homocœl sponge.

The skeleton consists of quadriradiate and two kinds of oxeote spicules. The quadriradiates are arranged as usual in the thickness of the mesoderm towards the inside of the sponge-wall, the facial rays lying parallel to the gastral surface, the basal ray directed away from the osculum, and the apical ray projecting into the gastral cavity. These spicules are markedly sagittal, the oral rays being widely extended and distinctly recurved towards the basal. All three facial rays are long and slender, but the basal is much more so than the orals and is slightly hastate; all three are fairly sharply pointed. In an average-sized spicule the oral rays measure about 0·186 by 0·0082 mm. (near the base) and the basal about 0·31 by 0·006 mm. (near the base), but of course there is a good deal of variation, and I have measured the basal ray up to 0·42 mm. in length. The apical rays are very strongly developed; long, slender and sharply pointed; usually more or less crooked and varying greatly in length; the average length is perhaps about 0·15 mm., but this is often greatly exceeded.

The oxeote spicules may be divided into two classes according to their shape, size and position in the sponge. (1) Very large spindle-shaped oxea, completely imbedded in the outer portion of the sponge wall and arranged parallel to the long axis of the sponge. These spicules are usually straight and symmetrically fusiform, very thick in the centre and tapering gradually to a fine point at each end. Fully grown examples measure a little over 1 mm. in length and about 0·065 mm. in greatest thickness (in the centre). They are placed pretty close together side by side in a single layer. (2) Much smaller oxea projecting from between the large ones and abundantly echinating the outer surface of the sponge. These spicules are rather slender, often slightly curved or even crooked, fairly gradually sharp-pointed at each end, but with the outer end often bent slightly though sharply to one side, like a bayonet; size about 0·22 mm. by 0·008 mm. The colour of the sponge in spirit is yellowish-white.

As already pointed out this species is nearly related to my *Leucosolenia stolonifer*, but it appears to be even more nearly related to Carter's *L. asconoides*,* with which it agrees not only in general form but also in the *Ute*-like armour of huge spindle-shaped oxea. In *L. asconoides*, however, there appear to be none of the smaller oxea which so abundantly echinate the dermal surface of our species, while the large oxea are nearly twice the size of those of *L. uteoides*. It is a curious fact that in *L. asconoides*, "more or less of the arms" of the quadriradiates are "exserted between the long acerates, so as to give this part a minutely hispid appearance. At first sight the latter look like mortar-spicules or small acerates, but although they appear to serve the same purpose, they are *not* so, but what I have stated."† In view of this very definite statement it appears tolerably certain that *L. uteoides* is specifically distinct from *L. asconoides*.

* *Vide*, "Monograph of Victorian Sponges," Part I, p. 48.

† Carter, "Annals and Magazine of Natural History," August 1886, p. 135.

Art. XIV.—*The Present Position of the Snake-bite Controversy.*

By James W. Barrett, M.D., M.S., F.R.C.S. Eng.

Demonstrator and Examiner in Physiology in the University of Melbourne.

[Read November 10, 1892.]

The public and the technical press have of late been occupied with discussions on the merit or demerit of the so-called strychnine cure for snake-bite, but as usual, very little definite evidence has been adduced. I have, therefore, thought it advisable to bring the facts of the case under the notice of the members of this Society, so that the position occupied by the rival disputants may be rendered perfectly clear. Dr. Mueller of Yackandandah, it seems, has satisfied himself that a theory respecting the action of snake poison has been proved. He believes that strychnia is consequently indicated as a remedy. When, however, he is asked to substantiate both these propositions, by showing that the treatment is successful, he has no further evidence to adduce than the report of cases of snake-bite, real or supposed, in which medical men assert that patients were saved from death by the injection of strychnine. Now, it is obvious that before reports of such cases can be of much value, it is necessary to ascertain the percentage of individuals who died from snake-bite when other modes of treatment were adopted. In other words, snake-bite is or is not a very fatal affection.

The object of this communication is to endeavour to make answer to that question. In investigating it, I have had extensive recourse to tables, furnished to me by the ever obliging Government Statist, Mr. Hayter.

Table I, which follows, shows the deaths which have taken place from snake and insect bite (for the two are bracketed in returns together) in the Australian colonies during the decade 1881–1890. In accordance with the foot-note appended to this table, I have rejected from further consideration any deaths occurring in other colonies than Victoria, New South Wales, and Queensland. You will further note that of the total 125 deaths which occurred in these three colonies in the period mentioned, at least 5 or 6 are obviously due to bites of other animals than snakes. There is the further probability that some of the deaths have been caused by the enthusiastic administration of alcohol to persons bitten or supposed to be bitten. However, to be well within the mark, I assume that 125 deaths represent fatal cases of snake-bite, and proceed to deal with them accordingly.

Table I.

Deaths from Snake and Insect-bite in the Australian Colonies, 1881 to 1890.

Years.	Victoria.*	N. S. Wales.	Queensland.	South Australia†	West Australia†	Tasmania†	Total.
1881	5	5	5	..	..	1	16
1882	5	..	3	..	1	1	10
1883	2	4	..	..	..	1	7
1884	3	8	..	..	..	..	11
1885	3	3	3	..	1	..	10
1886	4	5	..	..	..	..	9
1887	9‡	3	8	..	..	1	21
1888	3	5	4	..	..	..	12
1889	2	4	11	1	..	..	18
1890	2	10	6	1	..	..	19
Total	38	47	40	2	2	4	133

Note.—There are no deaths from snake-bite in New Zealand.

In Victoria, in 1891, there were 5 deaths from snake-bite, and 1 from iguana-bite.

* In other years than 1881 and 1882, no distinction was regularly made in Victoria between snake and insect-bites. Two of the deaths in the former year, and 1 in the latter, were from insect-bite.

† In the case of these colonies, it is not certain whether there were any deaths in several of the years, as the cause was not specifically mentioned in the list of causes of death.

‡ One of these is distinguished as "vermin-bite" and 1 "insect-bite."

It will be seen that in this period, in the three colonies, snakes were unable to kill more than 125 persons.

In order to determine the relative frequency of death from snake-bite, I next append a table showing the population (actual and average) of the colonies during the same period.

TABLE II.

Mean Populations of the Australasian Colonies, 1881 *to* 1890.

YEAR.	Victoria.	N. S. Wales.	Queensland.	South Australia.	West Australia.	Tasmania.	New Zealand.*	Total Australasia.
1881	868,942	765,015	226,522	276,948	29,516	116,437	492,887	2,776,262
1882	889,720	798,540	237,611	289,916	30,389	119,473	509,308	2,874,957
1883	910,130	838,155	267,865	299,012	31,233	122,242	529,292	2,997,929
1884	932,630	883,145	294,782	308,648	32,329	125,352	548,993	3,125,879
1885	956,880	927,275	308,789	313,102	34,072	128,160	566,168	3,234,446
1886	984,860	969,455	327,034	311,254	37,184	130,441	582,306	3,342,735
1887	1,016,750	1,004,835	346,545	311,050	41,699	133,802	596,373	3,450,391
1888	1,054,980	1,035,705	361,230	312,253	42,312	137,167	605,370	3,549,017
1889	1,090,350	1,066,450	374,240	313,751	43,053	140,261	611,716	3,639,685
1890	1,118,500	1,101,840	385,805	316,425	47,950	143,733	620,780	3,734,685
Average	982,374	939,041	313,042	305,235	36,973	129,706	566,319	3,272,599

* Exclusive of Maoris.

Therefore, the proportion of fatal cases of snake-bite to the average number of persons alive during the period is shown by the following table, which gives:—

TABLE III.

The Ratio of Deaths from Snake-bite in each Colony during the Decade to the average Population.

Victoria - - - - -	1	to	25,852
New South Wales - - -	1	to	19,980
Queensland - - - -	1	to	7,826
Average - - - -	1	to	17,886

The death-rate from snake-bite in Queensland seems very much higher than in the other two colonies. The following table will, however, show the danger of drawing rash conclusions from figures :—

Table IV.

Deaths from Violence in the Australian Colonies, 1881 *to* 1890.

Years.	Victoria.	N. S. Wales.	Queensland.	South Australia.	West Australia.	Tasmania.	New Zealand.	Total.
1881	849	906	317	233	36	105	459	2,905
1882	841	904	439	210	53	88	505	3,040
1883	908	850	396	202	59	106	494	3,015
1884	799	990	509	239	51	90	548	3,226
1885	846	1,106	492	212	45	92	517	3,310
1886	942	1,083	496	272	67	94	571	3,525
1887	1,023	1,148	599	229	57	112	555	3,723
1888	1,119	1,140	593	234	90	118	513	3,807
1889	1,186	1,110	622	208	44	144	508	3,822
1890	1,165	1,163	737	238	43	138	521	4,005
Total	9,678	10,400	5,200	2,277	545	1,087	5,191	34,378

Table V.

The Ratio of the Total Deaths from Snake-bite during the Decade to the Total Deaths from Violence.

Victoria	1	to	254·7
New South Wales	1	to	221·3
Queensland	1	to	130
Average	1	to	202

The following table shows the ratio of the total deaths from violence during the decade to the average population:—

Table VI.

Victoria	1	to	101·5
New South Wales	1	to	90·3
Queensland	1	to	61·2
Average	1	to	84·3

It will thus be seen that although the ratio of deaths from snake-bite to the average population, and also to the total deaths from violence, is higher in Queensland than in the other two colonies, the ratio of deaths from violence to the average population is also higher. Consequently it is unsafe to infer, from the evidence furnished, that snake-bite is necessarily a more fatal affection in Queensland than in the other colonies.

From this mass of figures we arrive at a general conclusion that snake-bite is one of the most insignificant causes of death in our midst. For example, in the three years 1887–88–89 more persons died in Victoria from hydatid disease than were killed by snakes in Australia during the decade. Anyone who cares to look through Mr. Hayter's tables will find that the snake-bite contribution is a very small one.

In 1876, a Committee was appointed by the Medical Society of Victoria which experimented in a methodical way. The Committee consisted of Drs. M'Crea (Chairman), T. M. Girdlestone, E. Barker, J. E. Neild, A. Bowen, P. Smith, J. T. Dempster, and Professor J. D. Kirkland. The particular value of the work done by this Committee lay in the fact that it found, with antidotes then in use, the recovery of a dog from snake virus injected hypodermically was chiefly a matter of dosage. None of the dogs used recovered when half a grain of fresh liquid poison was injected. They further found that tiger snakes 3 ft. to 4 ft. long injected on an average from 1 to 1½ grains of liquid poison, a quantity believed by analogy to be barely sufficient to kill a man. One grain of tiger snake venom, if injected fairly into the skin, would be approximately a dangerous dose. It is, however, quite possible that a snake driving its fangs through the skin finds it difficult to administer the full dose. If the snake bites through clothing, the chances of a fatal issue are diminished. On the other hand, in the case of some of the Indian snakes, allied in character to the Australian black and tiger snake, the dose of poison injected amounts to from 10 to 13 grains. Comment is needless.

Furthermore, Dr. M'Crea, in 1876, forwarded a circular to a number of medical practitioners asking them for information on the subject of snake-bite. In answer, he found that 253 cases of snake-bite had occurred in the practice of a number of medical practitioners, and that of these only 25, or 10 per cent., terminated fatally. Various methods of treatment had been adopted.

It seems, therefore, that fatal results from snake-bite are not common, and can scarcely take place unless the conditions are favourable to the snake. Nevertheless, if snake-bite were responsible for only one death in the decade, one would hail with pleasure the remedy which would obviate the repetition of such an accident; and my object in referring to these figures is not to under-rate the value of any remedy.

but to show the difficulty of being accurate in forming conclusions respecting its value.

These facts are so well-known that I must apologise for restating them. I have mentioned them in outline simply as part of the argument. In fact, if the name of other remedies used in the past be excised from old reports in the Journal, and the word strychnia be substituted, the description would parallel the present accounts of the efficacy of strychnia.

If, then, a discoverer of a snake-bite antidote has to refer to mortality tables as a proof of its success, he has a small margin to work on. He is dealing with a disease which is not usually intractable.

The public reports of cases may be referred to as evidence of its value, but apart from preceding facts altogether, I would ask anyone who is inclined to attach any value to such statements to think for a moment what they mean. Men, women, or children of different physiological resistance and vigour bitten, or supposed to be bitten, by snakes of different age, biological characters, and virus-producing capacity, the punctures made into skins of different thickness and in different parts of the body—treatment of various kinds adopted. Are there here not enough variables to cause grave doubt as to the value of a new variable introduced in the form of strychnia? Again, public reports of cases have been held to prove such extraordinary theories in medical history that one may be pardoned for receiving them with great caution. As stated, other remedies for snake-bite have been similarly commended at the hands of their demonstrators in the columns of the *Australian Medical Journal.*

There is one method by which the value of strychnia as a remedy may be settled, viz., by resort to experiments on animals on which the action of snake poison does not to all appearances differ materially from that in the case of man. From this, however, Dr. Mueller dissents, though he refers to experiments made on animals in support of his theory.

The evidence adduced serves to show that there is no warrant for believing strychnia to be of any value as an antidote for snake-bite; but there is no warrant for asserting that it is valueless. By the experimental method alone, can the vexed question be settled.

ART. XV.—*Sneezing: Fallacious Observations.*

By JAMES W. BARRETT, M.D., M.S., F.R.C.S. Eng.

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[Read December 8, 1892.]

In the last edition of "Foster's Physiology," there occur the following passages:—"Coughing consists in the first place of a deep and long-drawn inspiration, by which the lungs are well filled with air. This is followed by a complete closure of the glottis, and then comes the sudden forcible expiration, in the midst of which the glottis suddenly opens, and thus a blast of air is driven through the upper respiratory passages. The afferent impulses of this reflex act are in most cases, as when a foreign body is lodged in the larynx or by the side of the epiglottis, conveyed by the superior laryngeal nerve. But the movement may arise from stimuli applied to other branches of the vagus."

"In sneezing, the general movement is essentially the same (as in coughing), except that the opening from the pharynx into the mouth is closed by the contraction of the anterior pillars of the fauces, and the descent of the soft palate, so that the force of the blast is driven entirely through the nose. The afferent impulse is usually given from the nasal branches of the fifth." When sneezing, however, is produced by bright light, the optic nerve would seem to be the afferent nerve.

In Landois and Stirling, sneezing is described as consisting "of a sudden violent expiratory blast through the nose for the removal of mucus or foreign bodies (the mouth being rarely open), after a simple or repeated spasm-like inspiration (the glottis remaining open)."

In "McKendrick's Physiology," coughing and sneezing are described as powerful expirations, in which the air is driven through the oral cavity in the first, and through the nasal passages in the second.

"Hermann's Physiology" contains the following:—"The expulsion of foreign particles. Such explosive expiration is called sneezing when the nasal cavities are concerned, and coughing when the irritant is in the larynx."

Each is accompanied by a noise produced by the sudden bursting open of a closed aperture, which in sneezing is found by the opposition of the velum palati to the pharyngeal wall, and in coughing by the opposed vocal cords.

In "Carpenter's Physiology" it is stated "the difference between coughing and sneezing is this, that in the latter the communication between the larynx and the mouth is partly or entirely closed, by the drawing together of the sides of the velum palati over the back of the tongue, so that the blast of air is directed more or less completely through the nose in such a way as to carry off any source of irritation there. Of the purely automatic character of the movement of sneezing there can be no question, since it cannot be imitated voluntarily."

In "Kirk's Handbook of Physiology" we find "the same remarks that apply to coughing are exactly applicable to the act of sneezing, but in this instance the blast of air escaping from the lungs is directed by an instinctive contraction of the pillars of the fauces, and descent of the soft palate, chiefly through the nose, and any offending matter is expelled."

In "Huxley's Elementary Physiology" it is stated "in sneezing, the cavity of the mouth is described as being shut off from the pharynx by the approximation of the soft palate and the base of the tongue, the air being forced through the nasal passages."

All these writers, then, are agreed in describing sneezing as a modified respiratory act, in which air is blown through the nose, and most of them assume that it consequently serves the purpose of driving irritating substances from the nose.

On the other hand, in one of the most recent works on the diseases of the nose (Greville MacDonald, published 1892), one finds the following reference to sneezing:—"Again, it may be doubted whether the physiological reflexes can be considered in any way beneficial. Sneezing, it may be argued, is not of any use in driving irritating particles from the nose, seeing that it consists essentially in a closing of the palate during spasmodic expiration, and thus prevents the current of air from passing through the nose. But we probably find the most accurate explanation of the phenomenon in the following considerations:—On the entrance of an irritating particle into the nose, the primary object of the reflex phenemonon is to increase the flow of mucus, not only for the sake of interposing some non-irritating substance between the sensitive membrane and the foreign particle, but even more for the purpose of washing it away. This increased flow is produced by a double mechanism. In the first place there is a supply of more blood, and the stimulation of the secreting cells, through nerve influence; and in the second, there is an increase of vascular pressure from over-filling of the venous sinuses, as described in Chapter I. Now, this pressure on the venous sinuses must be enormously increased by the convulsive respiratory act comprised in sneezing. This latter consists in a violent contraction of the diaphragm, &c., together with the closing of the glottis and the post-nasal space, by contraction of the velum and the superior strictors and of the buccal orifice by the approximation of the tongue firmly to the teeth and hard palate; in fact, every possible movement is thrown into action to prevent the exit of air from the larynx, mouth, and nose. What is the immediate consequence of this? Increase of the intra-thoracic pressure, which necessarily increases the intra-vascular tension, especially in the veins, and hence in the venous sinuses of the nose. The act of forcible expiration, with all the outlets from the thorax closed, if voluntarily induced, *i.e.*, without the preliminary irritation in the nose, is scarcely operative in producing the effect described, and it is probably only when the nerve stimulation is excited at the same time, and the gland cells are set working, that this increase in the venous pressure is of some additional assistance."

Reviewing these conflicting statements, we find difference in matters of fact, and necessarily in the inferences drawn from them. Of the inaccuracy of the description of sneezing given in "Foster's Physiology" and the other works referred to, there can be no question. The process seems to be similar to that followed in coughing, with the following amongst other distinctions:—(1) That it is entirely involuntarily. (2) That it is caused mainly through stimulation of the anterior portion of the nose. Stimulation of the posterior portion of the nose generally results in coughing. (3) That the forced expiration is, if anything, more marked than in coughing. (4) That the air in persons with normal palate (and apart from voluntary efforts modifying the act) is driven entirely through the mouth; that is to say, that the palate is probably pressed firmly back against the pharynx so as to completely cut off communication with the nose. The peculiar noise made in sneezing is probably produced by the impact of the imprisoned air on the back of the hard palate, combined with certain modification of the shape of the mouth produced by movements of the tongue and lips. In coughing, on the other hand, it would seem that the communication between the nose and throat is not necessarily cut off, and that the air sometimes passes through the nose as well as the mouth, and that special movements of the lips and tongue are certainly different, if not absent altogether. The mouth is generally opened more widely in coughing, and the noise produced by a cough is very different from that produced in sneezing. The one is laryngeal in the main, the other is chiefly buccal.

It is possible that the glottis has nothing to do with sneezing, and that the obstruction is entirely pharyngeal. If, however, there is a closed glottis, it is probable that the mode in which it is opened in the two cases is somewhat different. Coughing has, at all events, sometimes a definite object to serve. It serves for the removal of irritating particles from the air passages, and it is quite likely that the glottis may be differently disposed in sneezing. Hence the absence of glottic noise in sneezing. The statement that the blast of air in sneezing is driven through the nose has originated, I think, in the following manner:—The observations have been necessarily almost entirely personal, and as usual the introspective method, if the term can be used in this sense, has again proved fallacious. When people sneeze, they feel first a profound irritation in the anterior part of the nose. If this persists, there follow some long and deep inspirations, then a violent expiratory effort with possible closure of the glottis or some part of the pharynx; the obstruction is suddenly overcome, and the air expelled through the mouth with the characteristic noise. Usually there follows almost immediately a gush of watery fluid from the nose, which is evidence of increased secretion.

Now, putting these facts together, those who first described the process of sneezing, confused as usual inference and fact. They knew that coughing, at all events, served the one purpose of removing foreign bodies from the air passages. They inferred justly or unjustly that sneezing was adapted to remove foreign bodies from the anterior portion of the nose by means of the blast of air. They felt the irritation of the nose, and found that sneezing was usually followed by relief. Without examining carefully the act of sneezing, to see whether the air did or did not go through the nose, they assumed that it did, hence the description. It is of course possible that, in some cases where observation was made, abnormal conditions of the palate may have permitted portions of the air to get to the nose. As the act of sneezing is involuntary, while that of coughing is not, it is impossible to study the phenomena of the former, except in an impromptu and largely subjective manner. The vocal cords can be examined with the laryngoscope in coughing, but not in sneezing. Objective examination in sneezing is very limited, by reason of the nature of the act. It seems to me, however, perfectly clear that we have another example of the manner in which hypothesis has biassed observers. They have unconsciously endeavoured to make the facts fit the theory. An observation once made and stated by a competent authority has probably been copied from one work into another, until of late years the great importance given to physiological respiratory reflexes by physicians has caused the matter to be more closely investigated.

Greville MacDonald's ingenious theory of the value of sneezing, physiologically, may or may not be accurate. The fact, however, that patients suffering from eye disease frequently sneeze when exposed to a strong light, indicates the necessity for caution before assuming that sneezing has any value whatever. It may have as little to do with normal physiological function in the human being as apparently has the patellar reflex, the cremasteric reflex, or some other of the general reflexes. If sneezing is essential to the removal of a foreign body from the anterior portion of the nose, it is very difficult to understand why coughing or blowing through the nose would not be equally serviceable. As Greville MacDonald justly observes, "it is quite certain that sneezing alone cannot produce the rush of fluid from the nose. It requires a local determining agent. At present, it seems to me the only conclusion that can be safely arrived at, is the Agnostic one." Greville MacDonald's explanation is plausible, and has the merit, as far as I know, of standing alone.

How much more fallacious observation of a similar character exists in all departments of science, it is impossible to conjecture, but I think it fairly certain that, if the treatment of diseases of the nose had not become organised into a special department of medicine, it would have been assumed that the significance of the respiratory reflex was fully understood. My object in drawing attention to the matter is—(1) To put the facts, as far as possible, before members. (2) To stimulate observation, which from the necessity of the case must be largely personal. (3) To give another example of the manner in which good observers are biassed by the teleological assumption. (4) Of the manner in which such fallacious observations lead men to accept explanations which wrongly colour the work of those who have to apply them in practical life. An accurate statement of facts with regard to sneezing, would probably have stimulated inquiry into the relation between nasal disease and asthma, at a much earlier date than 1871, when attention was first drawn to the matter by Voltolini.

Art. XVI.—*Physical Constants of Thallium.*

(With Plate XVII.)

By W. Huey Steele, M.A.

[Read November 10, 1892.]

Being in possession of a piece of thallium, and being unable to find its constants in the ordinary books of reference, I determined a few of them as follows. The investigation was conducted in the Physical Laboratory of the University of Melbourne.

(1) Coefficient of Expansion.

A piece of the thallium was drawn into a wire about fourteen inches long, the ends cut off square, and a nick made near each end. It was put into a glass tube through which steam could be passed at will from a small boiler. The ends of the tube being firmly clamped, micrometer microscopes were focussed on the ends of the wire. These instruments, supplied by the Cambridge Scientific Instrument Co., read to $\frac{1}{10000}$ inch. The positions of the ends of the wire and of the outer and inner edges of each nick were observed, the observations being repeated several times. The temperature of the thallium was assumed to be that indicated by a thermometer left lying beside the glass tube all night, 16·8° C. Steam was then passed along the tube till it was fairly dry, and after about fifteen minutes, the observations of the positions of the nicks and ends of the wire were repeated, the temperature being assumed to be 100° C. The gain in length of the whole wire was observed to be ·0261 inch, between the outer edges of the nicks ·0255 inch, and between inner edges ·0255 inch. On replacing the glass tube by a scale, the length of the wire was found to be 13·83 inch, and the distance between the nicks 13·69 inch. Dividing the increase in length by the rise in temperature (83·2°), and by the length measured, the coefficients come out ·0000227, ·0000224, ·0000224, giving as mean result ·0000225.

(2) Specific Resistance.

I at first made several determinations of the resistance of the thallium, in the form of short thick wires, and compared its resistance with silver, and afterwards with lead, and separately determined the resistances of the specimens used in comparison. I found it much more accurate however to draw the thallium into a finer wire, and determine its resistance directly. This was done with a resistance box, with a shunt on the variable arm. It was measured several times at slightly different temperatures, as shown in the following table :—

t	r	s	R^1	R
21	·16	5·80	·1557	·1551
21·8	·16	6·55	·1562	·1551
22·1	·16	6·87	·1564	·1551
22·1	·17	1·95	·1564	·1551

t is the temperature centigrade, r and s are the two resistances in parallel which balance the resistance of the thallium. R^1 is $\frac{r s}{r+s}$, the observed resistance of the thallium, and R is the resistance at 20° C., reduced by the coefficient ·0039 (*vid. inf.*) The length of the thallium was 46·14 cm., and the mean value of diameter measured at different parts along it was ·0874 cm., the mean error in measuring it being ·0005 cm. The specific resistance at 20° C. is therefore

$$\frac{\pi \times {\cdot}0437^2 \times {\cdot}1551 \times 10^9}{46{\cdot}14} = 20170.$$

(3) Variation of Resistance with Temperature.

To determine this, the thallium was made into a small coil, and immersed in a large beaker of water, with a thermometer about the middle of the coil. The thallium was connected with the terminals of a slide metre bridge by means of two stout pieces of copper, to which it was firmly bound, and whose resistance was found to be about $\frac{1}{100}$ of that of the thallium. The resistance of the thallium was balanced with an approximately equal resistance of German silver, which was taken as an arbitrary unit to measure the resistance of the thallium at different temperatures. By means of a very sensitive galvanometer, the slider could be adjusted to ·1 mm., while the whole change in position for a rise of 80° C. was about 70 mm. In reducing the bridge readings to resistances, correction was made for the fact that the middle point of the wire was not the electrical centre, which was 3·3 mm. to one side, and the resistances were diminished by 1 per cent. of the cold resistance of the thallium on account of the copper connections. Two independent sets of observations were made, and from each the coefficient at 20° C. was calculated by the method of least squares. The figures from which the calculations were made are given in the annexed table :—

Set 1.		Set 2.	
t	*R*	*t*	*R*
17·8	·987	16·2	1·017
30·5	1·035	32·1	1·079
41·4	1·074	48·2	1·143
51·7	1·102	61·4	1·196
62·1	1·154	79·8	1·274
80·3	1·227	99	1·357
98·8	1·312	85·1	1·298
		72·2	1·246
		67·5	1·226

The values of the coefficient from the above tables are ·00394 and ·00400.

Having determined these values by means of the slide bridge, I proceeded to verify the result by measuring the resistances with a resistance box, and shunt as described above. Two independent sets of observations were made as before. The observed values are given in the following table :—

Set 3.		Set 4.	
t	*R*	*t*	*R*
18·1	·2054	17·3	·2134
32	·2162	59·3	·2490
40·6	·2228	80·9	·2679
53	·2329	99·3	·2842
60·7	·2381	51	·2456
72·1	·2488	24·9	·2232

The values of the coefficients from sets 3 and 4 are ·00384 and ·00391. The mean of these four gives, as the coefficient at 20° C., ·00392. This is larger than the value for most metals other than iron.

(4) Thermo Electric Height.

As I had a piece of pure silver, and no other metal pure, I resolved to find the thermo electric height of thallium with regard to silver, and assume Professor Tait's result for silver in order to obtain the absolute value for thallium. Having done so, it was found that the thallium line thus determined, crossed Professor Tait's copper line at about 70° C., and that copper was therefore an exceptionally favourable metal with which to compare thallium. I therefore obtained pure copper and compared thallium with it, and found that thallium was further below copper than below silver; and on finally trying copper and silver, I found the lines should be very much closer together than they are in Professor Tait's diagram, and that copper should be above silver and not below it. I therefore purified some lead, and constructed a diagram of my own for the four metals—lead, thallium, copper and silver. To obtain pure lead, I dissolved some sheet lead in nitric acid, and precipitated it as sulphate by adding dilute sulphuric acid. The sulphate thus obtained was heated with carbonate of soda and cream of tartar in a Hessian crucible in an injector furnace, and lead obtained which was assumed pure, though it contained a trace of potassium. I used an astatic low resistance galvanometer with a lamp and scale, at a distance of about four feet, the scale divisions being fortieths of an inch. The resistance of the galvanometer was somewhat less than an ohm, but with the leads and the wires of the thermo electric circuit, the resistance was a little over an ohm. So low an E.M.F. as ·000001 volt or 100 absolute units gave a deflection of one scale division. This appears to be about 30 times as sensitive as the one used by Professor Tait twenty years ago. To determine the exact value of a scale division, the galvanometer was joined in series with an ordinary Daniell cell and various high resistances, and immediately after or before its E.M.F. compared with a Latimer Clark cell, by means of a condenser and balliatic galvanometer. In examining the thermo electric power of two metals, I twisted together their ends and coiled the joint round the bulb of a thermometer, immersing the whole in a bath of olive oil. The other junction was kept in a large beaker of cold water with a thermometer in it, which was observed from time to time, and if necessary, correction made for the rise of temperature. This rise was never more than a degree, the corresponding correction being one or two scale divisions. The relation between the observed values of temperature and galvanometer reading is parabolic, and if we express the excess of the temperature of the hot junction over the cold by t, and the number of scale divisions by s, then $s = a\,t + b\,t^2$ is the connection between s and t, where a and b are constants to be determined preferably by the method of least squares, as was done with each set of observations, though the operation is rather laborious. The following table may be taken as typical of the accuracy attained :—

T	s (*observed*)	s (*calculated*)
19	0	0
76	114	119
73	107	112
70	102	108
76	115	119
131·7	206	201
130	202	199
180·3	249	249
200	259	260
184	249	250
179	246	247
161	232	232

In this case, the metals being thallium and lead. the resistance of the circuit was 1·395 ohm. The equation to the parabola, represented by the first and second columns, is $s = 2{\cdot}36\,t - {\cdot}00512\,t^2$ where $t = T - 19$. A Daniell cell, when used to charge a condenser, gave a throw of 276·3 sc. divs.; a Latimer Clark cell gave 346·4; the E.M.F. of the Daniell is thus—$1{\cdot}435 \times 276{\cdot}3 \div 346{\cdot}4 = 1{\cdot}144$.

The same Daniell, when connected in series with the galvanometer, gave a deflection g for resistance R. If the

g	R
142·5	12000
176	10000
195	9000
246	7000
287	6000
213	8000

current through the galvanometer be $k\,g$, then $\frac{1 \cdot 144}{R} = k\,g$, or $k = \frac{1 \cdot 144}{R\,g}$. Now the mean value of $R\,g$ is 1729000, therefore $k = \frac{1 \cdot 144}{1729000}$. If e be the electromotive force of the thermal circuit, and r its resistance, then $e = k\,s\,r$, or the electromotive force corresponding to one scale division is $\frac{1 \cdot 144 \times 1 \cdot 395}{1729000}$ volt, or 92·3 absolute units of electromotive force.

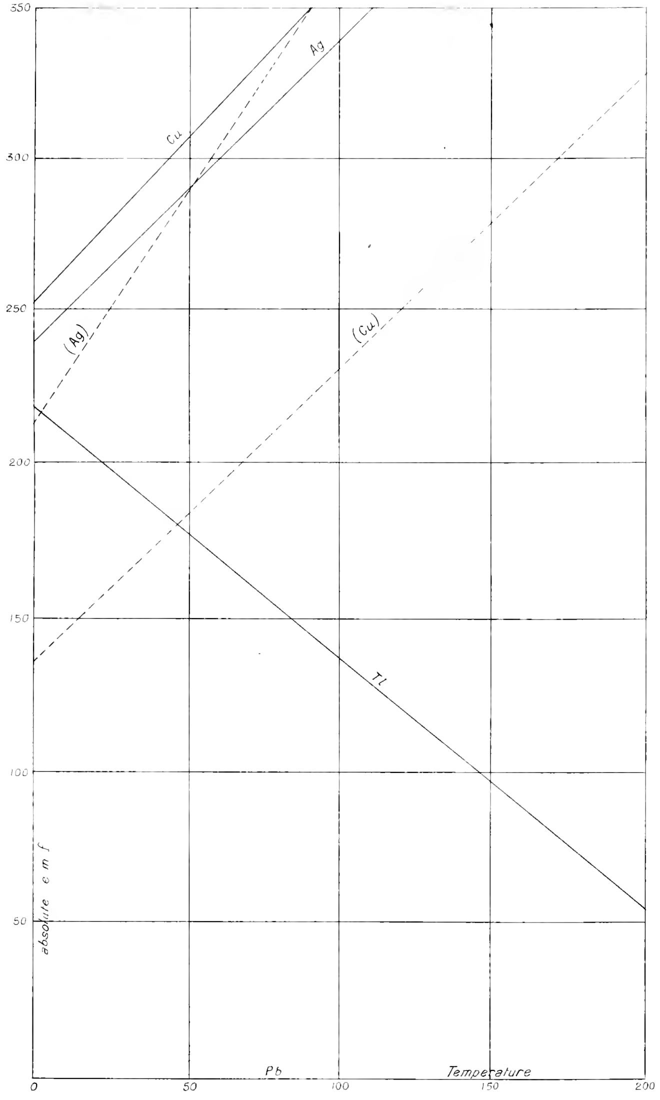
Now $s = 2 \cdot 36t - \cdot 00512t^2$, or if we measure the temperature from the neutral point of the two metals, $s = \cdot 00512t^2$. If the temperatures be the neutral point, and 100° above or below it, and if m be the relative Thomson effect, then $51 \cdot 2 \times 92 \cdot 3 = 5000\,m$, and $m = \cdot 94$.

To find the neutral point—$\frac{d\,s}{d\,t} = 0$, *i.e.*, $2 \cdot 36 - 2 \times \cdot 00512\,t = 0$, $t = 230$, *i.e.*, 249° C.; the height at 0° C. is therefore $249 \times \cdot 94 = 234$. The thermo electric height of thallium above lead is thus—$234 - \cdot 94\,t$, t here being temperature centigrade.

Another similar but independent set of observations gave as the height $198 - \cdot 65\,t$, the mean of these being $217 - \cdot 79\,t$. Of the four metals, each pair was taken together, and the following results obtained. In each case the higher metal is the first :—

1. Thallium-Lead - - $217 - \cdot 79\,t$
2. Copper–Thallium - $43 + 1 \cdot 79\,t$
3. Copper–Lead - - $252 + 1 \cdot 06\,t$
4. Copper–Silver - - $12 + \cdot 10\,t$
5. Silver–Thallium - - $40 + 1 \cdot 47\,t$
6. Silver–Lead - - $206 + 1 \cdot 35\,t$

If we add the Thallium–Lead to the Copper–Thallium, we get $260 + 1 \cdot 00\,t$, which agrees fairly well with the directly


350
300
250
200
150
100
50
0
50
100
150
200
Cu
Ag
(Ag)
(Cu)
Tl
absolute e m f
Pb
Temperature

observed value of Copper–Lead. The results with the silver are not very consistent. Various diagrams can be constructed from the above observations, but the nearest to the true one will probably be obtained from the first, third and fourth, from which the figure is drawn (see Plate XVII), the dotted lines on the figure being Professor Tait's results for silver and copper.

I have been for some months engaged on a series of observations, of which I hope to give an account to this Society shortly, from which it appears that thermo electric values cannot be absolutely constant, and which explains the above inconsistent results of the observations on these metals.

Summary.

The constants obtained are thus :—

(1)	Coefficient of expansion -	·0000225
(2)	Specific resistance - -	20200 at 20° C.
(3)	Range of resistance with temperature - -	·00392 at 20° C.
(4)	Thermo electric height -	216 — ·79 t

The thallium was obtained from Schuchardt, and Professor Masson has kindly analysed it and supplied the following statement of his results :—

"The small sample of thallium wire submitted to me, was found to contain as impurities, lead, arsenic and copper. An estimation of the lead showed it to be present to the extent of 1·50 per cent. The arsenic and copper were present in too small amount to be estimated in so small a sample. A direct estimation of the thallium itself showed the wire to contain 97·90 per cent. of that metal."

Art. XVII. — *On "Confocal Quadrics of Moments of Inertia" pertaining to all Planes in Space, and Loci and Envelopes of Straight Lines whose "Moments of Inertia" are Constant.*

By Martin Gardiner, C.E.

[Read May 12, 1892.]

Abstract.

The author commences by solving the following problem, by the Cartesian co-ordinate method :—

Problem.—Given any number of points $P_1, P_2, P_3, \ldots$ in space, and corresponding numbers $a_1, a_2, a_3, \ldots$, known in signs and magnitudes as respective multipliers; to find the Envelope of a plane $L\,L\,L$, such that, in every position it can assume, we shall have

$$a_1 \cdot p_1^2 + a_2 \cdot p_2^2 + a_3 \cdot p_3^2 + \ldots = S,$$

in which $p_1^2, p_2^2, p_3^2, \ldots$, represent the squares of the pedals from the points $P_1, P_2, P_3, \ldots$, to the plane $L\,L\,L$, and S a constant entity known in sign and magnitude.

He finds the equation of the envelope of the plane $L\,L\,L$ to be that of a Quadric whose centre is coincident with the mean-centre of the given points for the multipliers $a_1, a_2, a_3, \ldots$ And from the *form* of the equation arrived at (which is given abridged and expanded), he infers that for all possible values of the entity S, the corresponding Quadrics are Confocal Quadrics.

He then shows by a purely geometrical method (independent of co-ordinates) that for any constant value of S, the

envelope of the plane $L\,L\,L$ is a Quadric whose centre is coincident with the mean centre of the points P_1, P_2, P_3, . . . , and their respective multipliers a_1, a_2, a_3, ... And he shows that the quadrics corresponding to all possible values of the entity S, are Confocal Quadrics.

In order to amplify his Geometrical Method, he proceeds to give a full and complete solution to the particular cases in which the given points P_1, P_2, P_3, . . . , are all in one straight line. And he shows that it depends on the state of the data, as to whether the Confocal Quadrics be Ellipsoids; Hyperboloids of One Sheet; Hyperboloids of Two Sheets; Spheres; or Paraboloids.

He then directs attention to the Physical Aspect of the problem, which he enunciates as follows:—

Problem.—Given any masses M_1, M_2, M_3, . . . , in space, and corresponding units a_1, a_2, a_3, . . . , known in signs as their respective multipliers; to find the Envelope of a plane $L\,L\,L$, such that in every position it can assume, we shall have the sum of the Moments of Inertia of the masses represented by

$$a_1 \,.\, \lessgtr m_1\,(P_1\,L)^2 \;+\; a_2 \,.\, \lessgtr m_2\,(P_2\,L)^2 \;+\; a_3 \,.\, \lessgtr m_3 \,.\, (P_3\,L)^2 \;+\; \ldots \;=\; a \text{ constant } S,$$

in which m_1, m_2, m_3, . . . represent molecules of the masses M_1, M_2, M_3, . . . , at any points P_1, P_2, P_3, . . . in those masses, and in which $P_1 L$, $P_2 L$, $P_3 L$, . . . represent the pedals from the points P_1, P_2, P_3, . . . , to the plane $L\,L\,L$.

In elucidation of this aspect of the problem, he reconsiders the particular cases, in which he now replaces the given points or molecules at P_1, P_2, P_3, . . . all in one line, by Spheres whose centres are all in one straight line. He shows that the results arrived at previously, apply when masses replace mere molecules; and that, according to analogous states of the data, the Confocal Quadrics will be Ellipsoids, Hyperboloids, Spheres, or Paraboloids.

He establishes the limiting values for the constant S, and exposes the limiting forms of the Quadrics in minute and full detail. And he corroborates a remarkable theorem of

Duhamel's, as to the existence of two points, *for each of which* Poinsot's "Ellipsoid of stress" is a Sphere. He shows, moreover, these two points to belong to a "Focal Conic" of the family of Confocal Quadrics.

In the case in which the bodies are Spheres *situated in any manner in space,* he gives a simple and effective method of finding the three principal axes of inertia.

He then records the following eight Theorems, as results of his investigations:—

THEOREM 1.

Given any masses M_1, M_2, M_3, . . . in space, and corresponding numbers a_1, a_2, a_3, . . . of known signs as multipliers. If a plane $L\ L\ L$ (otherwise unrestricted) be such that in every position it can assume, the sum of the moments of inertia of the entities $a_1. M_1$, $a_2. M_2$, $a_3. M_3$, . . . , with respect to it, be of any constant magnitude S, then will the envelope of the plane be a determinable quadric Q, whose centre is coincident with the mean centre of the entities. And the whole system of quadrics Q_1, Q_2, Q_3, ... corresponding to all values S_1, S_2, S_3, ... , of S, will be concentric, coaxial, and confocal quadrics. And in all cases in which the multipliers a_1, a_2, . . . are all positive, the quadrics will be Ellipsoids and Hyperboloids of One Sheet.

THEOREM 2.

Given any masses M_1, M_2, M_3, . . . in space, and corresponding numbers a_1, a_2, a_3, . . . of known signs, as multipliers. The *envelope* of all planes $L\ L\ L$ passing through any given point V in space, and such that the sum of the moments of inertia of the entities $a_1. M_1$, $a_2. M_2$, $a_3. M_3$, ... , with respect to them severally, is of any constant magnitude S, will be a determinable quadric cone C, which envelopes a determinable quadric Q whose centre is coincident with the mean centre O of the entities. And the whole family of such cones C_1, C_2, C_3, . . . , corresponding to all values S_1, S_2, S_3, . . . , of S, will be coaxial and confocal cones enveloping coaxial and confocal quadrics, whose common centre is the mean centre O of the entities

$a_1. M_1, a_2. M_2, \ldots$ And if the point V be at infinity, and given in direction by means of a vector $O R$ passing through the mean centre O; then, corresponding to various values of S, the envelopes of $L L L$ consist of a system of confocal cylinders enveloping the quadrics, and having as common principal axis the directing vector $O R$.

Now $M_1, M_2, M_3, \ldots$ being masses, and a_1, a_2, a_3, numbers known in signs: we know that if a plane $L L L$ be such that the sum of the moments of inertia of the entities $a_1. M_1, a_2. M_2, a_3. M_3, \ldots$, with respect to it is of a constant magnitude S, then will the envelope of the plane be a determinable quadric Q. But the line of intersection $l l$ of any two mutually orthogonal planes, both tangent to the quadric Q, is obviously such that the sum of the moments of inertia of the entities with respect to it is represented by $2.s$.

We can easily form the equations of tangent planes to the quadric Q, and express their mutual orthogonism; but we need not try to evolve an equation of *a surface* which could be the envelope of all the lines $l l$ of intersection of the pairs of mutually orthogonal tangent planes to Q. This is obvious:—for if we suppose p to be any point whatever on any surface, and construct a Poinsot Ellipsoid having such point as centre, we perceive that the lines $l l$ through the point form a cone, and cannot generally *all* be tangents at one point to any other surface. However, we proceed to find the Loci and Envelopes of lines $l_1 l_1$ which fulfil the conditions as to equality of moments of inertia, and respecting which other conditions are imposed.

1°.—With respect to all the lines $l_1 l_1$ which are parallel to any fixed straight line $R R$ passing through the mean centre O, which is also the centre of the quadric Q_1.

If through O we draw a plane normal to the line $R R$, and that we put $c_1 c_1 c_1$ to represent the conic which constitutes its trace on the quadric Q_1: then, from a well-known theorem, we perceive that the pairs of mutually orthogonal tangent planes whose points of contact lie in the conic $c_1 c_1 c_1$, give us all the lines $l_1 l_1$ parallel to the fixed line $R R$, and that they constitute a Right Circular Cylinder having $R R$ as central axis.

2°.—With respect to all the lines $l_1\,l_1$ situated in tangent planes to the quadric Q_1.

We may first observe that if $P_1\,P_1\,P_1$ be any fixed plane tangent to the quadric Q_1, and that we project the quadric itself orthogonally by means of other tangent planes upon $P_1\,P_1\,P_1$, then will the projection be a conic $c_1\,c_1\,c_1$ situated in the plane $P_1\,P_1\,P_1$, which is obviously the envelope of all the lines $l_1\,l_1$ in the plane.

3°.—With respect to all the lines $l_1\,l_1$ situated in any plane $B\,B\,B$ whatever.

We first proceed and find the sum s_q of the moments of inertia of the entities $a_1.M_1$, $a_2.M_2$, $a_3.M_3$, . . . , with respect to the plane $B\,B\,B$. We then find the quadric Q_o such that the sum of the moments of inertia of the entities with respect to any of its tangent planes is $= 2.s_1, -s_q$. Then, obviously, the orthogonal projection of the quadric Q_o so found (by means of tangent planes to it) upon the plane $B\,B\,B$ will be a conic, which is the envelope of the lines $l_1\,l_1$ situated in the plane.

The following is an obvious deduction :—

THEOREM 3.

Given any masses M_1, M_2, M_3, . . . in space, and corresponding numbers a_1, a_2, a_3, . . . of known signs as multipliers; and given also the system of confocal quadrics Q_1, Q_2. Q_3, . . . , such that the sum of the moments of inertia of the entities $a_1.M_1$, $a_2.M_2$, $a_3.M_3$, . . . , with respect to tangent planes to the quadrics are equals respectively to s_1, s_2, s_3, . . . ; then the orthogonal projections of the quadrics on any given plane $B\,B\,B$ in space, constitute a family of confocal conics, which are the respective envelopes of straight lines $l_1\,l_1$, $l_2\,l_2$, $l_3\,l_3$, ... , situated in the plane, such that the sum of the moments of inertia of the entities $a_1.M_1$, $a_2.M_2$, $a_3.M_3$, . . . , with respect to them, are determinable constants. And if the plane $B_1\,B_1\,B$ be parallel to either one of the two systems of parallel circular sections of the confocal quadrics, then will the projections of the quadrics on the plane be a system of concentric circles.

NOTE.—The differences of the moments of inertia with respect to the lines $l_1 l_1$, $l_2 l_2$, $l_3 l_3$, . . . , (tangents to the respective conics) on the plane $B B B$ are obviously equals to the differences of the moments of inertia with respect to tangent planes to the quadrics Q_1, Q_2, Q_3, . . .

If we draw planes $P_1 P_1 P_1$, $P_2 P_2 P_2$, . . . , through any diameter $D D$ of any one Q of the family of Confocal quadrics, the lines $l\,l$ situated in these planes and such that the sum of the moments of inertia of the entities $a_1 . M_1$, $a_2 . M_2$, $a_3 . M_3$, . . . , with respect to them, severally, is of any constant magnitude $2.s$, have (as already observed) as envelopes, in the planes, determinable conics. And we know that those of the lines $l\,l$ which are parallel to $D D$ form a circular cylinder, having the line $D D$ as axis. But it is easy to perceive that it is only when the axis $D D$ is normal to one of the circular sections of the quadric Q that the conics cut $D D$ in the one and same point, at which the lines $l\,l$ form a tangent plane to all the conics. Hence:—

THEOREM 4.

Given any number of masses M_1, M_2, M_3, . . . , in space, and corresponding numbers a_1, a_2, a_3, . . . , of known signs as multipliers; if a straight line $l\,l$ move in space so as to be always in contact with the line $D D$ of a diameter of any quadric Q (of the confocal family) normal to either system of its circular sections, and so that in every position the sum of the moments of inertia of the entities $a_1 . M_1$, $a_2 . M_2$, . . . , with respect to it, is of any constant magnitude $2.s$; then will the envelope of the straight line $l\,l$ be a determinable quadric w of revolution, having the mean centre O as centre, and the fixed line $D D$ as axis. And all such quadrics w_1, w_2, w_3, . . . , corresponding to all possible values $2.s_1$, $2.s_2$, $2.s_3$, . . . , of the constant are determinable quadrics of revolution, having the mean centre O as common centre, and the line $D D$ as principal axis.

THEOREM 5.

The Locus of a straight line $l\,l$ through any fixed point D^1 in a line $D D$ through the mean centre O and normal to circular sections of the confocal quadrics Q_1, Q_2, Q_3, . . . , and such that the sum of the moments of inertia of the entities $a_1 . M_1$, $a_2 . M_2$, . . . , with respect to it, is of constant magnitude $2.s$, is a quadric cone of revolution having the point D^1 as vertex, and D D as axis.

We know that the *locus* of the lines l l of intersection of all pairs of mutually orthogonal tangent planes to any quadric, cone C is another quadric, cone E concyclic with the reciprocal of the cone C. (See Salmon's "Geometry of Three Dimensions," Art. 247). And if C be a cone, such that the sum of the moments of inertia of the entities $a_1 . M_1$, $a_2 . M_2$, . . . , with respect to its tangent planes, severally, be equal to a constant s, we know that the sum of the moments of inertia of the entities with respect to the lines l l, severally, must be equal to $2.s$. Hence we have:—

THEOREM 6.

Given any masses M_1, M_2, M_3, . . . , in space and corresponding numbers a_1, a_2, a_3. . . . , of known signs, as multipliers; the Locus of a straight line l l passing through any given point V in space, and such that the sum of the moments of inertia of the entities $a_1 . M_1$, $a_2 . M_2$, $a_3 . M_3$, ... with respect to it = any constant $2.s$, is a quadric cone E, having the point V as vertex, and concyclic with the reciprocal of the cone C, having V as vertex, and such that the sum of the moments of inertia of the entities with respect to its tangent planes = s, &c.

THEOREM 7.

If three planes, always mutually orthogonal, move in space so as to continue to be tangent planes respectively to any three of the confocal quadrics Q_1, Q_2, Q_3; then will the Locus of their common point of intersection be a *Sphere*, whose centre is coincident with the mean centre O of the entities $a_1 . M_1$, $a_2 . M_2$, . . . , which is also the centre of the quadrics.

NOTE.—This Theorem, which is an obvious deduction from the kinetic properties exposed, was arrived at by Salmon by means of a formula due to Chasles. (See Salmon's "Geometry of Three Dimensions," Art. 172.)

THEOREM 8.

If two planes A and B mutually orthogonal, be tangent planes respectively to any two quadrics Q_1, Q_2, of the confocal family; then will the other pair of tangent planes A^1 and B^1 through their line of intersection $l\,l$, to the same two quadrics, be mutually orthogonal.

This is an obvious deduction from the kinetic properties exposed.—The planes A and B being tangents to the quadrics Q_1 and Q_2, the moments of inertia of the entities $a_1 . M_1$, $a_2 . M_2$, . . . , with respect to them are constants s_1 and s_2; and the sum $s_1 + s_2$ of these moments of inertia is equal to the moment of inertia of the entities with respect to their line of intersection $l\,l$. And since the moment of inertia with respect to the line $l\,l$ is equal to the sum of the moments of inertia with respect to the tangent planes A^1 and B^2, it follows that A^1 and B^1 must be mutually orthogonal.

This theorem is an extension to confocal quadrics of one pertaining to confocal conics, due to Admiral De Jonquières of the French Navy, who is one of the most distinguished geometers in Europe. (See "Mélanges de Géométrie Pure," par E. De Jonquières.)

OBSERVATIONS.

The family of confocal quadrics Q_1, Q_2, Q_3, . . . , and the properties of inertia pertaining to them, are worthy of attention, not only on account of their intimate connection with "Wave Surfaces," and "Surfaces of Elasticity," but also on account of their direct applications to many important problems. (See Salmon's "Geometry of Three Dimensions," Arts. 467, 480, &c.)

2°.—Some interesting properties pertaining to confocal quadrics can be deduced by application of the numerous new theorems arrived at by the author, and published in Vol. X of the "Quarterly Journal of Pure and Applied Mathematics," under the title—"Properties of Quadrics having Common Intersection, and of Quadrics inscribed in the same Developable."

3°.—Since writing the present paper, the author has found that the question had been previously considered by the late Professor Townsend, of the Dublin University.

The results at which he arrived are given *without any investigations* on page 312 of Williamson's "Integral Calculus." From question 19, as there enunciated, it would appear that Townsend did not perceive that the envelope of the plane is an ellipsoid only when the prescribed moment of inertia is not less than a certain determinable magnitude; or that it is a Hyperboloid of One Sheet for all values less than such limiting value. Nor does it appear that he considered the case in which the envelope of the plane is a Hyperboloid of Two Sheets, or any limiting values of the moment of inertia.

Art. XVIII.—*Notes on a Poisonous Species of Homeria (H. collina, Vent.—var. miniata), found at Pascoe Vale, causing death in cattle and other animals feeding upon it.*

By D. McAlpine and P. W. Farmer, M.B., Ch. B.

[Read November 4, 1892.]

Introductory.

The sudden death of a number of cattle at Pascoe Vale, a suburb of Melbourne, about the middle of September, attracted a good deal of attention, and from various accompanying circumstances, there were grounds for believing that the herbage had something to do with it. Specimens of the supposed poisonous weed were sent to Baron von Mueller, Government Botanist, and he determined it to be a species of *Homeria*, a native of South Africa. He remarked that "in their native country occasionally pasture animals have suffered from these kinds of plants, but no poison cases have hitherto come under my own notice."

Veterinary surgeons also took the matter up, and they decided the deaths to be due to anthrax, the sudden illness of the animals and the subsequent deaths of many of them giving colour to this supposition; but it does not appear that the anthrax bacillus (*Bacillus anthracis*, Cohn) was found in the spleen of the dead animals, which is always considerably swollen and full of enormous quantities of these bacilli, when death is due to that cause. But skilled veterinary surgeons may be wrong, and the plain, common sense farmer may be right in some instances, even where the death of cattle is concerned, and here was evidently a case where further investigation was desirable. Since the *Homeria* plant, which was known to be eaten by the cows which died, was growing luxuriantly in patches extending over several acres where the cattle was feeding, and since it belonged to a genus of plants well known to have poisonous properties, it became a matter of great importance to determine whether this particular plant was poisonous or not when grown in this Colony, so we decided to submit it to the test of experiment.

History of Outbreak of Disease.

A local dairyman brought ninety-five head of cattle from paddocks a short distance to the north of Pascoe Vale, and put them on the land overgrown with *Homeria*. Next morning, about twelve head were found either sick or dying. Another dairyman brought four head from Caulfield, putting them on the same land, and next morning two were dead and two sick. Several others lost cattle in the same paddock, and it is reported that more than twenty have died altogether. It is worthy of note that the cattle reared in the locality have escaped, and are in excellent health, while only those fresh to the district have succumbed. The plant has now died down, and no more sickness is reported, but in the season, when the fresh, green, tall leaves of the *Homeria* were fully developed, it looked quite a tempting green food. The owner of one of the cows which was treated and recovered assured us that it would not now eat the plant, although it had eaten freely of it before.

As regards the presence of the *Homeria* in the locality, it may have been originally a garden escape, since these flowers are cultivated for their beauty, but although several gardens in the neighbourhood were visited, no trace of it could be found. It has also been suggested that the plant may have been introduced along with the oats formerly sown in the paddock, for it may be multiplied by means of small bulbils which it produces in great abundance, and which might easily get mixed up with other seed.

References to Homeria being Poisonous.

As to the poisonous nature of this genus of plants, there are references in various standard works, such as Le Maout and Decaisne's "System of Botany," and Redwood's "Supplement to the Pharmacopœia;" but we shall content ourselves with quoting from such a well-known work as Bentley's "Manual of Botany," 5th Ed., 1887. At page 703, he says:—"Moraea (Homeria). Some species of this genus, more especially that of *M. collina*, and of other iridaceous plants known under the name of "Tulp" at the Cape, have poisonous properties, and have been the cause of fatal results to cattle which have chanced to eat it. "Tulp" is also poisonous to human beings." Redwood refers to *Homeria collina* as Cape Tulip, and as a plant well known to almost every child in the Colony (Cape of Good Hope).

Reasons for Investigation.

Apart altogether from the practical importance of the subject, there were two main reasons which induced us to enter upon the investigation.

First, the poisonous plants introduced into Victoria have not yet been carefully recorded, and therefore any one to which suspicion attached was worthy of being enquired into, and its poisonous properties, if present, determined. In Queensland, a work has been prepared by F. M. Bailey, F.L.S., Colonial Botanist, and P. R. Gordon, Chief Inspector of Stock, entitled "Plants Reputed Poisonous and Injurious to Stock," but there is no mention in it of this one, nor even of the natural order to which it belongs. Also in New South Wales, the Botanist to the Department of Agriculture, Mr. Turner, has a paper on "The Supposed Poisonous Plants of New South Wales (both Indigenous and Exotic)." in *Ag. Gaz.* Vol. II, Part 3, 1891, but there is no reference to this plant or its order. Hence, a possible new poison plant, as far as these Colonies are concerned, deserved to be satisfactorily determined, in order to prevent its further distribution. Such a determination is a necessary preliminary step to its eradication, just as in Western Australia, where certain poisoned land, as it is called, can only be obtained on conditions of exterminating the poison plant, which is only dangerous at certain seasons of the year.

Second, as the cows which died at Pascoe Vale were said by skilled veterinary surgeons to have died from anthrax, and not from any supposed poisonous weed, this became a strong additional reason for sifting the matter to the bottom, and seeing if, after all, the reputed poisonous weed was simply an imagination of the cattle owners.

What is a Poison Plant?

A poison plant being one that poisons, the first thing to do was to settle that point, and then have the plant analysed, in order to determine the poisonous principle or alkaloid. Mr. P. Wilkinson, of the Government Analyst's Department, has made an extract from the plant, but found no alkaloid present. It is attempted to settle the former point in this paper, and in order to be clear as to what constitutes a poison, we shall take the definition as given in Guy and Ferrier's "Forensic Medicine," 6th Ed., 1888:—"A poison is any substance or matter (solid, liquid, or gaseous) which, when applied to the body outwardly or in any way introduced into it, can destroy life by its own inherent qualities without acting mechanically." And Dr. Neild's definition is:—"A poison is a substance which, taken into the body, is fitted to injure health." So if this plant can be proved to cause the death of animals feeding upon it, it will deserve the name of a poison plant, irrespective of the symptoms which it produces.

Experiments on Rabbits.

Knowing from the experiments of Professor Halford and others, that such drugs as opium and belladonna can be given in very large doses to dogs with comparatively little effect, the first difficulty was to decide upon and obtain suitable animals for experiment. After due consideration, we resolved to try the effects of the herb upon herbivorous animals such as rabbits, which Mr. Wyatt, of Woodlands Station, very kindly procured and sent to us. Three rabbits arrived on Saturday, 1st October, and were kept for a week on ordinary diet. They were all in good health and lively.

On Saturday, 8th October, at 4 p.m., two were placed in a separate cage and fed upon the *Homeria* plant, the other being reserved for future experiment. Fresh plants were brought from Pascoe Vale, and the portion growing above ground, similar to that eaten by the cattle, was moistened and given to the two rabbits. Nothing else was in the cage, and we saw them eat freely of the plant.

On Monday morning, 10th October, both were dead, and not expecting such a sudden effect, we did not watch symptoms very closely. However, the question of symptoms was a secondary one at this stage, the primary object being to determine whether feeding upon this plant would cause death. On making the post-mortem, we found the mucous membrane of the stomach and intestines congested. The rabbit kept for control was lively and well as usual.

On Saturday, 15th October, the third rabbit which had been fed during the week on green food and was quite lively, was placed upon the same diet. About 6 p.m. it was given the freshly cut *Homeria* plant, which it readily ate. On Sunday morning it was drowsy, eyes half-closed and distinctly ill. Towards evening, there were distinct traces of scouring in the cage. At 11 p.m. it was still alive, but on Monday morning, 17th October, it died at 7 o'clock.

Post-mortem.—Externally marked evidence of scouring action on tail, &c. The liver congested, kidneys slightly congested. Bladder full, which was also observed in the other two rabbits. Before opening the stomach, little spots like ulcers could be seen in the wall, and on opening it was found to contain a quantity of the herb and some mucus. The contents were moister than in the other two rabbits, and marked corrosion was visible. The mucous membrane was completely charred in places, similar in fact to what would have been expected if strong sulphuric acid had been administered. When these black spots were removed, round patches of inflammation were visible, and on holding the stomach up to the light, these patches were very conspicuous, looking like little ulcers. The entire intestinal tract was congested.

Several more rabbits were obtained from the same quarter, and on Thursday, 20th October, two were again selected for feeding on the *Homeria* plant. This was given to them about 5 p.m., along with water, and next morning, 21st October, one had died. On examination, the stomach was full and congested. The second rabbit was found dead on Saturday morning, 22nd October, and the appearance of the stomach was similar to the first, only the peeling off of the mucous membrane was more marked. More of the plant had been eaten in the latter case.

In these experiments five healthy and lively rabbits were taken, and so sure as they were fed upon the *Homeria* plant, so surely did they die, within two days at the most, while other rabbits similarly kept, but fed on ordinary food, remained alive, and as fresh as when first received. Precautions were taken to exclude all disturbing elements, so that the one point of difference was, that one set of rabbits were fed in the usual way and lived, while another set were fed on the *Homeria* plant and died.

It seems, therefore, reasonable to conclude that the eating of this plant was the cause of death, and that it is possessed of poisonous properties of an irritant nature.

Experiments on Cows.

It was considered quite satisfactory to test the effects of eating the *Homeria* plant upon rabbits, but in order to settle the matter even for cows, the Hon. the Minister of Agriculture (Mr. Graham) allowed two cows to be purchased for the purpose, one to be fed upon the plant, and the other to be fed, in the first instance, in the usual way, so as to show by way of contrast the effects of the different feeding. The two cows were placed in separate loose-boxes, and on the evening of October 14, about 6 p.m., one was given half a bag of the freshly cut *Homeria* plant and water, while the other had a good supply of hay and straw. She ate greedily of the plant (although not specially starved for the occasion) while we were present, along with Mr. W. H. Stephen, Acting Chief Inspector of Stock, and Mr. E. Rivett, M.R.C.V.S. On the following day, the cow feeding upon the *Homeria* plant was found to have eaten about half the quantity given her, and refused to have any more. On the 16th she was lying down sick, and on the 17th the same; then on the forenoon of the 18th the cow was killed, and a post-mortem made by Mr. Rivett. This cow was three days and a half under treatment, and the eating of the plant had produced a scouring action, along with general weakness, and a very perceptible trembling at the loins.

The second cow, which was also placed in a loose-box on the evening of the 14th October, was well fed on the 15th and 16th. She was made to fast on the 17th, in order to ensure active feeding, and on the 18th, about 1 p.m., was supplied with about a quarter of a bag of *Homeria*, together with drinking water. She ate very greedily of the plant, and seemed to relish it. On the 19th she was found lying down, unable to rise, and died that night. The examination of the animal was made about mid-day on Thursday, October 20, by Mr. Stephen, in the presence of both of us. The four stomachs were carefully examined, and in the rumen or paunch, there was marked congestion at the cardiac end, while the mucous membrane peeled off, and was distinctly inflamed. There was also considerable scouring of the animal before death. The stomachs of both cows were found to contain a fair amount of food.

The evidence derived from experimenting upon the cows, supplements that obtained from the feeding of the rabbits.

Conclusions.

To sum up, as far as these experiments go, there are decided indications that the *Homeria* plant has poisonous properties, capable of causing the death of cattle and other animals, and this conclusion is based upon the following grounds:—

(1) This plant is stated to be poisonous to cattle at the Cape, its native habitat, by Professor MacOwan, Government Botanist there, and the probabilities are, that it is so in Victoria.

(2) Several healthy and lively rabbits were fed upon this plant, and with abundance of material they invariably died, while rabbits fed in the usual way remained quite healthy.

(3) A cow fed upon this plant also died, and the symptoms indicated poisoning.

(4) Cows fed in the paddock where this *Homeria* grew died, while those in adjoining paddocks where the plant did not exist, were unaffected.

That the cows ate the plant was shown, not only by the undigested remains found in the stomach, but from the characteristic seed-like bulbils found there, as well as in the droppings.

Government Botanist's Description of Plant.

Baron von Mueller, Government Botanist, has kindly supplied a description of the plant, which is as follows:—

Homeria collina, Vent.—var. *miniata*.—A native of South Africa. Bulb almost spherical, covered closely by a coating of interwoven fibres, between the layers of which numerous minute readily sprouting bulbils are concealed. Whole plant to 3 feet high, but usually much less, variable also in more or less robustness or slenderness, often somewhat branched. Leaves linear to $1\frac{1}{2}$ feet long to $\frac{3}{8}$ inch broad, but frequently of much less size, always channelled and gradually much narrowed upwards; grey-green above, dark green beneath, slightly streaked, small bulbils also formed occasionally in the axils of some leaves. Inflorescence fascicularly compound when well developed. Somewhat paniculate, the supporting lowest floral leaf often much elongated, clasping at the base. Bracts comparatively long, much pointed, the outer green, the inner smaller, gradually colourless, and very tender. Flower stalks to 2 inches long, though often shorter. Some of the stalklets finally to $1\frac{1}{2}$ inches long, all enclosed in longitudinally convolute bracts. Flowers almost horizontally expanding, very tender, stem shrivelling. Tube of the calyx thinly cylindric, pale-green, darker, six streaked, generally about $\frac{3}{4}$ inch long. Lobes of the calyx three (or exceptionally two), petal-like lanceolar-ovate, about $\frac{3}{4}$ inch long, yellowish towards the base, otherwise almost brick-coloured, or nearly orange-coloured. Petals similar to the calyx-lobes, but somewhat narrower, three (or exceptionally two), along with the calyx-lobes twisted after flowering, finally deciduous. Stamens three (seldom two), much shorter than the calyx-lobes and petals. The three anthers erect, seated on the yellowish narrow staminal tube, about $\frac{1}{4}$ inch long, yellow, broad-linear, blunt, at the base minutely bi-lobed, bursting marginally. Style filiform, about as long as the stigmas. These, as well as the anthers opposite to the calyx-lobes, three (or exceptionally two) in number; hardly extending beyond the anthers, yellowish, linear-cuneate, with numerous dilated bi-lobed crenulated and ciliolated summit, and with two small tender inner appendages. Ovulary quite connate with the calyx-tube, three-celled (or seldom two-celled), cylindric and somewhat angular. Ovules very numerous, fixed along the axis. Fruit dry, trigonous cylindric, dehiscent, many seeded. The flowers are distinctly smaller than those of *Homeria collina*, their petals and calyx-lobes are more acute and of a lighter red; also less venulated, and the staminal tube is glabrous.

Conclusion.

It will be seen from the foregoing description what wonderful powers of propagation this plant possesses by means of its numerous reproductive seed-like bulbils. It can easily be understood how it has overspread the paddock by this means alone. Its showy and attractive flowers likewise rendered it an object of interest and beauty to the numerous wayfarers, particularly on Sundays, and as handfuls of the plant were taken away, it would thus be spread over a large area, and carried to different districts. It is known in other places besides Pascoe Vale, but now that its poisonous properties are unmasked, it is hoped that this brief notice of it may lead to its being promptly destroyed in any garden or cemetery where it may exist.

Art. XIX.—*Report of the Committee of the Royal Society of Victoria, consisting of* Professors Kernot, Lyle, and Masson, and Messrs. Ellery, Love, and White, *appointed to arrange for the carrying out of the Gravity Survey of Australasia.*

To the Royal Society of Victoria.

Gentlemen,—In laying before you this, the Second Annual Report, your Committee has much pleasure in informing you that the work of the Survey has now commenced. The pendulums and other apparatus lent by the Royal Society of London—of which a description is appended—have been received, and erected in a cellar at the Observatory, kindly placed at the disposal of the survey by the Government Astronomer. The observing telescope sent with the apparatus proves to be somewhat inconvenient, and it is proposed to employ a different arrangement. The stand for the air-pump was badly packed, and found to be broken on its arrival; otherwise the instruments were in very fair order. It is proposed to devote the next few months to a careful examination of the effects of temperature and pressure on the times of oscillation of the pendulums; such an investigation being rendered especially necessary by the very considerable changes of temperature to which the instruments may possibly be exposed in the course even of a single set of swings. The values of the temperature and pressure coefficients for the pendulums numbered (4) and (1821) were worked out for the purposes of the Indian Survey; but the constants of the third pendulum, numbered (11), have not yet been determined. General Walker assumed them for the purposes of the Greenwich and Kew observations (lately completed) to agree with those of the other two; but your Committee is of opinion that the matter requires further investigation.

The question as to the construction of a new pendulum has received a good deal of attention from your Committee during the past year. Fortunately the Royal Society of London has forestalled the discussion, and added pendulum (11) to the two originally asked for. The difficulty and expense attending the construction of a new pendulum has thus been avoided.

E. F. J. Love, *Secretary.*

Appendix.

Description of the apparatus to be employed in the Gravity Survey of Australasia, by E. F. J. Love, M.A.

In drawing up a description of the apparatus, we may consider separately, (*a*) the pendulums, (*b*) the clock, (*c*) the vacuum apparatus and its accessories.

(*a*) The pendulums are, undoubtedly, the most important portion of the apparatus. The three which it is proposed to employ are all constructed of the same materials, and practically identical, both in form and dimension. They are of the kind known as 'Invariable Pendulum." The form is a flat bar of plate brass 5 feet 2 inches long, 0·13 inch thick, and 1·7 inches broad, for a distance of 40 inches from the upper end. The remaining portion of the bar, termed the "tail-piece," is lenticular in section, reduced to a breadth of 0·7 inch, and terminates in a point. Just above the tail-piece is a flat circular brass bob, 6 inches in diameter and 1·3 inches thick, which is fastened to the bar by solder and rivets. The knife-edge is a prism of very hard steel, adjusted perpendicular to the plane of the bar, and attached by means of a stout T head. It is 2 inches long, 0·25 inch in height, and equilateral in section, save that the edge on which the oscillations are performed is ground to an angle of 120°. The planes on which the pendulum oscillates consist of two pieces of polished agate, ground true and set in a heavy brass frame supported on very massive levelling screws. Each pendulum has its own set of planes.

All three pendulums are about 70 years old, and have been repeatedly used for gravity survey work; in which they have given such consistent results as to warrant the belief that they have reached a condition of approximate equilibrium as regards molecular change. For a statement of their history, reference may be made to the "Report of the Great Trigonometrical Survey of India," Vol. V, Appendix p. 30.

With the pendulums is supplied a "dummy pendulum," of identical material and dimensions, into which two holes are sunk for the reception of the bulbs of a pair of thermometers. The dummy is placed in the same vacuum chamber with the pendulum when vibrating, and close to it. Their temperatures may accordingly be assumed as identical, and the temperature of the dummy, as given by the thermometers, can be employed for determining the temperature corrections to be applied to the pendulum. The corrections to be applied to the thermometers have been determined at Kew.

(*b*) The clock employed for the observation of coincidences is a siderial clock, made by Shelton, and was used by Sabine on his expedition in 1822. Its mean daily rate is very constant, but it is subject to rather considerable horary fluctuations of rate. The clock has an arrangement which allows of its being re-wound without loss of driving power during the winding.

(*c*) The vacuum apparatus consists of a cylinder of sheet copper, half closed at the top by a thick brass plate for supporting the agate planes, and closed in above this by a glass bell, ground to fit the brass plate; it is closed at the bottom by a metal hemisphere. It has one glass window about half-way up, through which the thermometers are read, and four others in the plane of the tail-piece of the pendulum. Through one pair the coincidences are observed, the other pair allowing a side view of the tail-piece, which is necessary for determining the amplitude of its vibration. To the sill of the back window is attached a brass plate bearing two scales at right angles to each other etched on ground glass, and with well blackened divisions for measuring this amplitude.

The cylinder is supported by three large levelling screws on a heavy iron girder, which is itself bolted to a very massive timber framework fastened together with iron bolts and clamps. The massiveness of the cylinder and frame render it quite impossible for the oscillations of the pendulum to be communicated to the supports.

The starting and stopping of the pendulum is performed by means of levers worked from outside the cylinder by metal rods passing through stuffing boxes, and cases filled with oil to prevent leakage of air.

A tap attached to the side of the cylinder is connected by rubber tubing to a Siphon barometer, and a second tap allows of the attachment of an air-pump in order to reduce the pressure to any desired amount, which is measured on the Siphon barometer.

As the tail-piece is only a little way above the ground, the short telescope with diagonal eye-piece sent with the apparatus is highly inconvenient. It is proposed to view the coincidences by means of a long telescope of considerable aperture, inclined at a small angle to the ground, and carrying a plane mirror in front of the object glass, so as to reflect the image of the apparatus in a nearly vertical direction. This method will result in a considerable saving of light, and a much more than considerable addition to the comfort of the observer. Anyone who has had experience in really delicate physical work will understand the importance of these considerations to the accuracy of the experiments.

In order that the images of the detached and clock pendulums may be in the same plane, a large lens is provided, by means of which an image of the clock pendulum is thrown on the ground glass scale inside the cylinder. The lens is mounted on a brass angle piece, which slides on a brass frame attached to a wooden stand. The stand rests by means of three levelling screws on a plank bolted to the framework which supports the cylinder.

Art. XX.—*Report of the Cremation Committee of the Royal Society of Victoria, appointed to enquire into and report upon "Cremation" and other methods of disposing of the dead, with particular regard to hygiene and economy.*

To the President and Members of the Royal Society of Victoria.

Your Committee has the honour to report that it has held two preliminary and three general meetings, and has considered the various methods proposed for the sanitary and economic disposal of the dead. Your Committee finds from the evidence collected, that burial now entirely fails to satisfy the demands of hygiene. There are the strongest reasons for concluding that graveyards have been in the past, and are now, prolific sources of deadly disease, not only by reason of mephitic vapours arising thence into the atmosphere, but also by percolation of putrid liquid matter in water drainage to considerable distances. Many cases have notoriously occurred, in which wells have been demonstrably poisoned in this manner at long distances from the source of infection. The risk of this is immensely aggravated as population increases. In America, Europe, and Victoria itself, the towns grow and surround the cemeteries, which soon become full. New ones are formed further away, and the land, being imperatively required by the living, the bodies are unceremoniously removed from the old graveyards, which are generally used for building blocks, public gardens, and other purposes. The removal is a dangerous process, the disturbance of the putrid, poisonous remains having been almost certainly the cause of outbreaks of malignant disease epidemics. It is practically impossible to find a site for a cemetery anywhere in the vicinity of towns, such that there would be no danger to health to the living, in which the air, the water, and the earth of the neighbourhood would be secure from the deadly contamination.

As regards Economy.—The disposal of the dead by burial is already an oppressive charge to the large majority of the population wherever it is numerous. Cemeteries are made further and further away, and the longer conveyance materially enhances the expense, and must continue to do so more and more. The unavoidable crowding of cemeteries has also had the effect of destroying, or outraging, the reverential sentiment which fondly regarded burial as finally providing for the permanent and undisturbed repose of the departed.

After being first filled with corpses to the extent of from twelve to twenty-two (seventy according to the Duke of Westminster—*Times*, December 9, 1889) in each grave, in nearly all old cemeteries, the ground is similarly used over and over again at intervals of a very few years; and the purchase of space for a grave or vault, supposed at the time to secure ownership in perpetuity, is a delusion and a snare; as a matter of fact, headstones are broken up for road metal &c.; the coffins are burned, and the bones used for manure or shot down as rubbish. No respect is shown for the remains of the dead, or for the feelings of their living representatives. All ideas of sanctity and reverence are violated. The use of vaults scarcely delays the process. Persons who have wealth and influence may, if watchful, be able to delay the sacrilege during their lives, but the next generation loses both inclination to resist, and power to postpone it.

The method pursued by the Parsees is much less objectionable hygienically considered. It consists in simple exposure on the top of a tower for vultures to dismember and devour the corpse. This does not engross an increasing quantity of land, or involve the desecration of being dug up again in a few years to make room for some one else, and perhaps of being shot as rubbish. Still less does it, like burial, poison the earth, air, and water, to the destruction of the living; but it is practised by but a small section of the population of India, outside of which it has no advocates, and is not likely to extend.

Desiccation has been recommended, and may be adapted to a very dry climate, but apparently not to others. In the Catacombs at Malta, Palermo, and some other places it has been used; but the results are such as to disgust strangers, and present such features of irreverence and desecration, as to preclude its wider adoption. It may be possible to secure hygienic results by it, but there seems to be much more risk of the contrary. A movement in favour of desiccation has occurred in America, but your Committee has no reason or wish to think that it has any chance of success.

The use of quicklime has been successfully tried in several instances, where large numbers killed in battle had to be rapidly disposed of, and in some other cases. It does not, however, appear to be adapted for general use, particularly where lime is not readily and cheaply procurable.

Another method has been suggested of disposing of the dead, by simply immersing them in a bath or tank of fused alkali, in which they entirely disappear without leaving any discoverable residue. The cost and feasibility of this method would depend upon the abundance and accessibility of the material, but it seems questionable whether it would ever commend itself to public sentiment. There appears, however, to be no hygienic objection to it.

The expedient, which seems to be in a fair way to supersede burial, is Cremation—an old one revived, and practised widely to-day. Cremation is general in Japan, and in India, where the Government has successfully introduced improved incinerators to expedite and perfect the primitive process in use by the Hindoos. Cremation is the simplest, cheapest, and most hygienic of all; it can be easily effected wherever there are combustibles, and it appears particularly adapted for use in cities, being rapid, economical, final and complete. The residue is small, innocuous, and easily preserved in urns, the cost of which is trifling. Cremation is becoming popular in Italy, where it is rapidly extending. Large numbers are now cremated in Paris, and at Gotha. In England, its progress has been even more rapid than anywhere else, except Rome. At Milan, 679 cremations have been effected in 14 years, but only 227 in the first 7 years. At Lodi, 38 in 13 years. At Rome, where the practice has grown more rapidly than at any other place in Italy, there have been 297 cremations in 7 years. At 21 towns in Italy there were in all 1463 cremations in the 14 years ending with 1890. At Woking, in Surrey, the first cremation took place in 1885, and the numbers since cremated there yearly, are, 3, 10, 13, 28, 46, 54, and 99 in 1891—253 in all; the increase being more uniformly progressive than even at Rome, which began with 15, and ended with 90 in 7 years, and had fewer in 1886 and 1887 than in 1885. The Duke of Bedford, Lord Bramwell, and Mr. Wm. Eassie, were all cremated during the current year, and Crematories are being established at Manchester, Liverpool, Ilford, Darlington, and elsewhere.

The great advantages of Cremation appear to be—Firstly. the perfect extinction, with the corpse, of the possibility of communication by it of any disease to the living. Secondly, its economy. The cost at Paris is only two francs, and it is less in Japan and India. There is every reason to believe that it could be done in Melbourne for a guinea each at most, including examinations, memorial urn, &c. Carriage must sometimes form a comparatively important item in the cost. It can, however, be much reduced, as portable iron crematories have been successfully constructed for military purposes, and will no doubt come into general use. Thirdly, its finality. Cremation will abolish at once all the shocking desecration which is now inseparable from the burial system. Fourthly, the innocuous residual ashes, less than a quart in quantity, can be preserved in an urn of æsthetic material and device, and deposited either in a public institution (or Columbarium), or confided to the care of the family ; with Fifthly, the satisfactory certainty to all concerned, that the body itself can never afterwards be subjected to disturbance, insult, or desecration, or cause incalculable harm to others.

The only apparently plausible objection that has ever been urged against Cremation is, that the body can never afterwards be available as evidence in cases of murder, particuarly by poison. A case, however, occurred at Milan, which goes far to prove that the risk is actually greater in case of burial (see Robinson, "Cremation and Urn Burial," pp. 177-8). The parents of a deceased child obtained all the certificates necessary for its burial, before resolving to have it cremated. The additional certificates however, which were required at the Crematorium, elicited the fact that the child had been poisoned accidentally by eating sweetmeats containing copper. Your Committee would strongly recommend that no system whatever be tolerated which does not provide amply strict examinations to obviate the possibility of such facts passing undetected.

An Act, legalising Cremation under conditions, has lately been passed by the South Australian Legislature at Adelaide.

Lastly, the legal aspect of the question remains to be considered.

Sir Jas. F. Stephen's judgment in the case of Dr. Price, in 1874, set at rest the question of the legality of Cremation in England, and decided that there was then no law against it there, so long as no nuisance was caused. Of course no system of disposing of the dead should be tolerated, unless all that can be called a nuisance is absolutely prevented. The objection to burial is that it produces evils far worse than nuisances. Since the judgment in question, the Cremation Society of England, though previously deterred by the discountenance of the Home Secretary, proceeded at once to cremate, and has continued to do so since. The same view appears to have been officially taken here, in the Metropolitan General Cemetery Bill, which was introduced by the Government in the Legislative Assembly in 1891, but made no further progress. The existence of this Bill implies that no legal objection to Cremation could be discovered. It provides "for the establishment and management of a Metropolitan General Cemetery" at Frankston, with nine managers; two to be appointed by the Government, and seven to be elected by the Councils of eighteen city and surburban corporations. £20,000 was to be granted from the consolidated revenue to start with, and the corporations were to contribute £2500 a year, until the fees to be charged should amount to a sufficient sum to defray expenses. The cemetery consists of 3008 acres, worth £15,000; distance from Melbourne 26 miles. It is 11½ miles round, and the cost of fencing it has been estimated at £24,000. More thousands are required for a short branch railway. The Bill provides that the managers may make regulations, to be approved by the Governor in Council, prescribing fees for burials, &c., and also for cremations. Section 71 provides that any one may direct by Will or otherwise, that his body shall be cremated, and that his executors or others may carry his direction into effect, in the cemetery, under regulations to be made under Section 77. The admission that Cremation is not illegal is something, and the attempt to legalise it is more. But cremation at a distance of 26 miles is useless. There is ample proof that its proper performance within a city admits of no reasonable objection. Persons living next door would not even know that it was in progress, and in itself it is essentially purifying as well as innocuous.

Hygiene demands the reduction to a minimum of the time and distance between the death of the body and its final disposal. One weighty objection to burial is, that it must be as far from the city as convenient, notwithstanding the cruel inconvenience and expense to the mourning relatives in the performance of their sacred duties. Their strong claims to sympathy and consideration appear to have been wholly ignored in the Frankston scheme. But in Melbourne now, hundreds of pious mourners visit the graves of their departed relatives weekly, and even more frequently, to plant and carefully tend flowers around them. They would be cruelly debarred from performing this pious duty by the extra cost and time involved in frequent journeys, even by railway, of 52 miles. Cremation would abolish this difficulty entirely. Instead ot having to neglect these duties altogether, or to travel, say weekly or daily to Frankston to fulfil them, they would have the actual pure ashes themselves, in an elegant urn or other receptacle, in either the mortuary chapel, or family household, where they could fulfil their cares and soothe their feelings by daily viewing them, and decking them with fresh flowers.

As regards economy, compare a central City Crematory and Mortuary Chapel, costing perhaps £2000 or £3000, and 2s. 6d. or 3s. worth of fuel, and a fee of a guinea, with a Cemetery 26 miles off, costing for land £15,000, fencing £24,000, and several thousands more for a branch railway to it. But these are of minor importance concerning the state contribution only. The salient point is, what will be the charges for each funeral to bereaved mourners—the people? The deaths in Melbourne may now be taken at 10,000 yearly (10,412 in 1889, and 9,297 in 1890, Hayter), *i.e.*, 25 to 28 daily. £10 is surely a low average for ordinary funerals now, and transport is always and necessarily, a formidable extra; and however performed, the 26 miles cannot but add largely to the expense, falling upon the unfortunate mourners in the shape of undertakers' bills, thus augmented by at least 25 or 30 per cent.

The fees, also, of unknown amount, would also fall upon them, and to provide the projected embellishments upon the scale hinted at, the fees must be anything but light. Even supposing that the increase altogether might not exceed 50 per cent., £15 for each funeral, multiplied by 10,000, would be at least £150,000 to be paid yearly *by the people*, beside the contribution of the state. Cremation would perform the whole service for probably £1 1s. each, or £11,000 a year, in a few crematories costing perhaps £2000 each.

Your Committee for all these reasons confidently recommends Cremation as incomparably the best solution of every difficulty, particularly on hygienic, sentimental, and economical grounds.

Your Committee, however, also feels called upon to remark here that not only in the Bill in question, but also in the Cemeteries Act of 1890 (No. 1072, now in force), some of the most important facts which should be kept in view in disposing of the dead seem to have been entirely ignored. Its framers appear to rely, with most mistaken confidence, upon hermetically closed coffins and cemented vaults to prevent the escape of the poisonous gases generated in decomposition. This is a fallacy. *Such escape cannot be prevented.* Your Committee cannot do better than repeat the decisive testimony of Sir John Simon, the eminent Sanitarian (quoted in the Duke of Westminster's letter to the "*Times,*" dated December 9, 1889):—

"The leaden coffin sooner or later yields, and gives vent to its fatal contents. The most successful attempt at hermetical enclosure does not reach beyond postponement of the effusion through the atmosphere of the products of decomposition. Overcrowding the dead causes the soil to be saturated and supersaturated with decomposing animal matter, polluting the water-springs and vitiating the air; and it is by the air, vitiated by organic matter undergoing decomposition, that epidemics and infectious diseases most readily diffuse their poison and multiply their victims."

Your Committee has made its deliberate recommendation upon the evidence before it. It is perhaps scarcely necessary to say that that recommendation does not include that those who prefer burial should not be as free as the advocates of cremation to do what *they* prefer. At the same time, it seems clear that both the *public* advantages of cremation, and the *public* dangers of burial, are infinitely more important and practical than any *private* predilections either way.

(Signed)

Llewellyn D. Bevan, D.D., Member.
J. Talbot Brett, M.D., ,,
D. A. Gresswell, M.D., ,,
William C. Kernot, M.A., ,,
William Lynch, ,,
Orme Masson, M.A., ,,
William L. Mullen, M.D., ,,
James Edward Neild, M.D., ,,
G. A. Syme, M.D., ,,
H. K. Rusden, Hon. Secretary.

Art. XXI.—*Report of the Port Phillip Biological Survey Committee*, 1892.

Your Committee regret that there are no results to report as received from the specialists in Europe to whom material was forwarded, though we have information that the work is in hand. During the course of next year, Professor Spencer, who is on the Committee, is visiting Europe, and hopes to arrange for an early publication of the descriptions.

Professor Tate, of Adelaide, has returned the specimens of the Nudibranch Mollusca, as he finds himself unable, through pressure of other duties, to undertake their determination.

Dr. Dendy has continued his studies on the Sponges, and has worked out the classification and much of the detailed anatomy of the Calcarea Heterocœla. He is publishing a Synopsis of this work in the Proceedings of our Society, and anatomical accounts in the European journals.

Your Committee have incurred no expenses during the year.

A. H. S. Lucas, *Hon. Secretary*.

Nov. 8, 1892.

MEETINGS OF THE ROYAL SOCIETY.

1892.

[N.B.—The remarks and speeches in the discussions are taken down verbatim by a shorthand writer, and afterwards written out at length with a typewriter, for reference and reproduction, if required; and therefore, more is seldom given herein than an indication of their general drift. If any person should wish to refer to the verbatim report, he can apply to the Secretary to the Society, who will give him an opportunity of perusing and copying it, or if he resides at a distance, so much as he requires will, upon payment of the cost of reproducing it, be forwarded to his address.]

ANNUAL MEETING.

Thursday, March 10th.

The President (Professor KERNOT) was in the chair.

The minutes of the last meeting were read and confirmed.

ELECTION OF OFFICE-BEARERS AND MEMBERS OF COUNCIL.

The following Office-bearers and Members of Council were duly elected:—President—Professor W. C. Kernot, M.A., C.E. Vice-Presidents—E. J. White, F.R.A.S., and H. K. Rusden, F.R.G.S. Hon. Treasurer—C. R. Blackett, F.C.S. Hon. Librarian—A. Dendy, D.Sc. Hon. Secretaries—Professor W. Baldwin Spencer, M.A., and A. Sutherland, M.A. Members of Council—J. E. Neild, M.D., C. A. Topp, M.A., LL.B., Professor Laurie, LL.D., R. L. J. Ellery, F.R.S., G. S. Griffiths, F.R.G.S., Professor Orme Masson, M.A., D.Sc., H. Moors. Rev. E. H. Sugden, B.A., B.Sc.

The PRESIDENT referred to the services rendered in past years to the Society by the retiring Librarian, Dr. Neild.

Annual Report.

The following Report and Balance Sheet were taken as read, and on the motion of Mr. Ellery, they were adopted:—

The Council of the Royal Society herewith presents to the Members of the Society the Annual Report and Balance Sheet for the year 1891. The following meetings were held, and papers read during the session:—

On the 12th March, at the Ordinary Meeting held after the Annual General Meeting, T. S. Hall, M.A., "On a New Species of Dictyonema;" A. Dendy, D.Sc., "A Preliminary Account of *Synute pulchella*, a New Genus and Species of Calcareous Sponge;" T. S. Hall, M.A., and G. B. Pritchard, "The Geology of the Southern Portion of the Moorabool Valley."

On the 2nd April, R. Etheridge, Jun., F.G.S., and A. Smith Woodward, "On the Occurrence of the Genus Belonostomus in the Rolling Downs Formation of Central Queensland."

On the 11th June, Professor W. Baldwin Spencer, "On the Anatomy of *Ceratella fusca*;" A. Dendy, D.Sc., "Additional Observations on the Victorian Land Planarians;" A. H. S. Lucas, M.A., B.Sc., "On a New Species of Fresh Water Fish from Lake Nigothoruk, Mount Wellington, Victoria;" Professor W. Baldwin Spencer, "Land Planarians from Lord Howe Island."

On the 9th July, A. Dendy, D.Sc., "Description of a New Species of Land Nemertean (*Geonemertes australiensis*);" R. L. J. Ellery, F.R.S., "The Present State of the International Photographic Charting of the Heavens."

On the 13th August, A. Dendy, D.Sc., "On the Mode of Reproduction of *Peripatus leuckartii*;" A. Dendy, D.Sc., "Short Descriptions of New Land Planarians;" Professor W. C. Kernot, "Notes on the recent Flood on the Yarra."

On the 10th September, G. B. Pritchard, "On a New Species of Graptolitidæ;" A. Dendy, D.Sc., "On the Presence of Ciliated Pits in Australian Land Planarians."

On the 8th October, A. H. S. Lucas, M.A., "Notes on the Distribution of Victorian Frogs;" R. L. J. Ellery, F.R.S, "Notes on the Magnetic Shoal near Bezout Island, North West Australia."

On the 12th November, G. S. Griffiths, F.R.G.S., "The Geology of Barwon Heads;" A. Dendy, D.Sc., "Description of some Land Planarians from Queensland."

On the 10th December, Professor W. Baldwin Spencer, "Preliminary Notice of Victorian Earth-worms. Part I—The Genera Megascolides and Cryptodrilus;" H. H. Anderson and J. Shephard, "Notes on Victorian Rotifers;" Professor W. Baldwin Spencer, "Note on the Habits of *Ceratodus forsteri*."

The following Members and Associates were elected during the year:—Members, A. Dudley Dobson, J. W. Barrett, M.D.; Country Members, John Desmond, John Dawson; Associates, W. J. Strettle, W. L. Mullen, M.D., Miss Agnes Ross Murphy.

Your Council regrets to have to record the loss by death of the following Members of the Society:—Hon. J. G. Beaney, J. P. Bear, Henry Edwards, Johnson Hicks, G. LeFevre, M.D., John Wall, Hon. Sir Wm. McLeay, the Right Rev. Charles Perry, D.D.

During the course of the year, your Council received with great regret the resignation of A. W. Howitt. Though this was necessitated by pressure of official duties, it is hoped that Mr. Howitt may before long find himself again able to take an active part in the work of the Society. A. Dendy, D.Sc., was elected by the Society to fill the vacancy thus created.

During the course of the year, also, J. Cosmo Newbery, B.Sc., who was leaving for England on a scientific commission, resigned the Vice-Presidency of the Society, and H. K. Rusden was unanimously elected to fill the vacant office. From 1870-77, and again from 1886-91, Mr. Rusden had been closely identified with the Society in his position as one of the Hon. Secretaries, and in nominating him for the post of Vice-President, the Council expressed its warm appreciation of the services which, in the capacity of Secretary, he had rendered to the Society, in the work carried on by which he had taken an important and active share.

The Librarian reports the addition to the Library during the year of 1076 publications. It may be noted that a Manuscript Catalogue of the Library has now been drawn up rendering it more available for reference. The Assistant

Librarian is in constant attendance to afford assistance to those desirous of consulting the volumes. Your Council has had under consideration the exchanges which are made with other Societies and hopes to be able, in the future, to add considerably to the value of these in consequence of the increased amount of publications which now emanate from the Society.

The most important publication of the year has been that of Part I of Dr. Dendy's "Monograph of the Victorian Sponges."

The Committee appointed by the Council to distribute the collections of animals obtained from Port Phillip experiences very great difficulty in obtaining any information from specialists at home to whom the various collections have been sent for investigation. It hopes, however, to obtain reports during the coming year, and is endeavouring to hasten the work, though this must naturally take a long period of time in completion. The Council desires to place on record its high appreciation of the labours of J. Bracebridge Wilson, Esq., M.A., by whom the collections have almost entirely been made.

As will be seen from the list of papers read before the Society during the past year, a considerable number of original scientific investigations have been carried on by Members. Your Council trusts that the amount of work recorded in its publications may increase year by year.

Dr. *The Hon. Treasurer in Account with the Royal Society of Victoria to March 1, 1892.* Cr.

To Balance from 28th February, 1891		£342 14 6	By Printing and Stationery	£579 17 0
,, Government Grant—			,, Rates	4 15 0
Balance of Vote for 1890-91	£150 0 0		,, Gas and Fuel	9 14 2
Instalments for 1891-92	250 0 0		,, Salary, &c., of Assistant Secretary	72 18 4
		400 0 0	,, Shorthand Records	11 11 0
,, Entrance Fees		10 10 0	,, Hall-keeper's Allowance	6 0 0
,, Subscriptions—			,, Collector's Commission	34 8 7
Members	160 13 0		,, Insurance	3 10 0
Country do.	29 8 0		,, Postages	37 15 0
Associates	54 12 0		,, Repairs and Furnishing	8 15 0
Arrears	2 8 0		,, Books and Periodicals	38 17 6
		274 1 0	,, Freight	8 16 9
,, Rent of Rooms		14 5 0	,, Refreshments	5 12 6
,, Sale of Transactions		0 7 6	,, Binding	25 1 0
,, Interest		33 0 0	,, Incidentals	9 15 0
			,, Interest	1 8 11
			,, Balance, 28th February, 1892	216 2 3
		£1,074 18 0		£1,074 18 0

Dr. PUBLISHING AND RESEARCH FUND. Cr.

	£	s.	d.		£	s.	d.
To Fixed Deposit in Bank	£300	0	0	By Fixed Deposit in Bank of Australasia	£300	0	0
,, Interest on same	15	0	0	,, Interest transferred to General Account ..	15	0	0
	£315	0	0		£315	0	0

Compared with the Vouchers and Bank Pass-book and Cash-book, and found correct,

C. R. BLACKETT, (Signed) H. MOORS, AUDITOR.
HON. TREASURER. *26th February*, 1892.

Professor SPENCER, in accordance with notice of motion, moved the repeal of Rules 52 to 58 inclusive. He did not think the Society was large enough to be broken up into Sections, and further, such breaking up would affect the Society's maintenance and welfare as a whole. In his opinion, Sections could not be carried on with any benefit to the Society, as a number of their members interested in any particular work set themselves apart and formed what was practically an independent Society, and the Council which must be the central authority lost control over the actions of members. Their experience of the Sections which had already been in existence was such as to create a feeling against their continuance, and in favour of merging all into one Society working together as one body.

Mr. ELLERY seconded the motion. Until he had had practical experience of the working of Sections he had favoured their establishment, but he was now of the opinion that they tended to lessen interest in the doings of the parent Society and to reduce the attendance. He thought it would be wise to abandon the Sections, at all events until the Society became very much stronger. The Royal Society of London had no Sections. Should the motion be carried, they should not interfere with existing Sections until the lapse of a certain period.

Mr. WHITE considered that if the Sections had been kept under control no trouble would have been occasioned. As the Rules provided that the Council "may" prevent the formation of Sections, there was no need for the resolution.

Mr. BLACKETT referred to the merging of the Microscopical Society into the Royal Society, and probably it might be considered by members of the former body, which was afterwards carried on as a Section of the Royal Society, that they had been somewhat unfairly dealt with. He agreed with others that the Sections had been somewhat unsuccessful.

Mr. SUTHERLAND supported Mr. White's view. There was no necessity for the motion, the object of which was merely to get rid of Section G. It could not be expected that people would attend the ordinary meetings of the Society and listen to some abstruse paper on a subject they knew nothing of, while they waited for the paper to be read in which they were interested. Royal Societies were not favourable fields for special papers in any particular branch, although many people were good enough to attend meetings and suffer the infliction of hearing papers read in which they had not the slightest interest, and so provide audiences for the readers. If it was intended merely to get rid of Section G, then Section G had no desire to remain if it was not wanted, and it had already taken steps to withdraw. The Engineering and Physical Sections had had meetings which were rendered more pleasant than any mixed meetings could be. It should be borne in mind that the Sections acted as feeders to the general Society.

Dr. Dendy considered that the more the Sections were increased so were the expenses. The Council practically lost all control over the Sections.

Professor Spencer said that his motion was general, and did not apply to any particular Section. They had given Sections a fair trial, and he did not think they had been a real success.

Professor Orme Masson said that if the motion were carried, it did not follow that Section G could not remain. He would urge that the motion be carried, for the reason that it would not be an arbitrary abolition of any existing Section. It would simply be a certificate from the Society that it did not care to create new Sections.

Mr. Ellery drew attention to Rule 54, which provided that meetings should be for scientific objects only. If that Rule had been kept in view, all difficulty might have been avoided.

Mr. Jaeger hoped that the abolition of the Rules would not preclude the reading of any papers on Art.

Mr. Ellery.—Certainly not. The formation of Section G was the result of many years' discussion. It was urged that Art and Literature should be more thought of in the Society than they were.

Mr. Rusden thought it was hard to suppose that the Rules were framed without consideration and wisdom. Rule 30 provided against anything objectionable occurring in any Section, and that Rule had been overlooked. If it had not been overlooked, no paper would have been read without being submitted to the Council.

Mr. White agreed with Mr. Ellery that the Society was not strong enough for Sections. As the Council had the right of vetoing Sections, why not leave the matter to it.

The PRESIDENT'S opinion was that the passing of the motion would not abolish existing Sections, but would take away the power of establishing new Sections in the future.

Professor ORME MASSON said that the passing of the motion would show that the Society was against having Sections, and the result would in all probability be that Section G would abolish itself.

Mr. SUTHERLAND said that Section G did not intend to abolish itself, but to sheer off and have an independent existence.

Mr. BLACKETT mentioned the fact that no minute books had been kept by the Sections.

Mr. WHITE moved "that in the present state of the Society the formation of Sections was not advantageous to it, and that in the future no Sections be allowed"

Mr. RUSDEN.—The Society should request the Council not to appoint Sections.

Dr. JAMIESON was opposed to the formation of Sections, as the more numerous they were, the more they tended to impoverish the Society. It was not necessary, in his opinion, to alter the Rules, as in accordance with the sentiments expressed that evening the Sections would be abolished.

Professor LAURIE could not understand why it was necessary to legislate for the future.

Professor SPENCER'S motion, on being put, was carried.

Mr. Albert Swanson and Mr. J. B. L. Mackay were elected as Members.

Mr. G. B. Pritchard and Mr. L. J. Balfour were nominated as Associates.

The Librarian's Report showed that 203 publications had been added to the Library since last meeting.

Professor SPENCER gave a summary of his paper on "Victorian Earthworms. Part II. The genus Perichæta."

The PRESIDENT wished to know if Professor Spencer agreed with Darwin's theory of the production of the humus.

Professor SPENCER thought that the work done by earthworms in other countries was largely done by ants here.

Thursday, May 12th.

The President (Professor KERNOT) in the chair.

The minutes of the last meeting were read and confirmed.

Mr. Wilsmore, Associate, signed the Roll.

Mr. W. H. Archer and Dr. J. W. Barrett were elected as new Members of Council, from which Dr. J. E. Neild had retired.

Mr. R. J. A. Barnard, M.A., and Mr. G. B. Pritchard, were elected as Associates.

The Librarian's Report showed that 191 new publications had been added to the Library since the last meeting.

Mr. MARTIN GARDINER'S paper on "Confocal Quadrics, &c.," was taken as read.

Dr. DENDY read a paper entitled "Further Notes on the Oviparity of the larger Victorian Peripatus, generally known as P. leuckartii."

Mr. ALEXANDER SUTHERLAND read a paper on "The Responsibility of Criminals."

Mr. ARCHER said that they had heard Mr. Sutherland's very able and comprehensive address, which was however full of contestable points. Mr. Sutherland's conclusion appeared to be, that while it was a gross act of injustice to punish a man for what he could not help doing, yet he must be punished because it would not be right to stick to abstract justice. The word "responsible" was used a number of times in the paper, but if a man could not help himself, how could he be held to be responsible? Although Mr. Sutherland had stated that the incorrigible boy at school had no more right to be punished than a Maori should be for having a brown skin, yet he afterwards said that the boy ought to be punished because it would assist him in forming his character. Did not that indicate on the part of the youth a sense of right and a power of self-control? As to lunatics in asylums, it was known that a large proportion had what were called lucid intervals, during which their medical attendants would reason with them and treat them as intelligent men. That was a proof that they recognised in their patients a power of distinguishing right from wrong, and of exercising a control over their actions. They could determine to do what they saw was right.

Professor LAURIE considered there were some points in the paper which must inevitably give rise to difference of opinion, and he was rather sorry it had raised the question of free-will. Discarding free-will, and holding any doctrine that might be preferred, it was not necessary to go to the opposite extreme and to say that every person who fell into crime was to be regarded, not as an object of blame, but solely of pity. The fact was, that persons who did wrong frequently blamed themselves, and admitted that they deserved punishment. That showed that they could not wholly do away with the sense of blame for wrong done. Mr. Sutherland's great point should not be lost sight of. namely, that the aim of government in inflicting punishment was to deter crime. The aim of government should be to suppress crime, and it was justified in doing all it could to attain that object. Punishment, or the fear of punishment, was a great factor in suppressing crime—in preventing a person who contemplated committing crime from falling into it. At least, that should be the aim of punishment. He was entirely in accord with Mr. Sutherland, that government was entitled to say how it was best to inflict punishment, but at the same time he did not see any reason why the moral aspect of crime, even from the deterrent view. should be omitted. It was quite true that people were swayed by fear of punishment, but when the State laid down certain rules, the violation of which would lead to punishment, it did not hold out a threat to deter people from doing what they would otherwise like to do. To many people, the State was an embodied conscience. People did not come into the world knowing what was right or wrong, nor did they evolve propositions as to right or wrong from their personality; they were taught by others, and in a great measure by the laws of the State, as to what was right or wrong. A great many people regarded the laws which the State had laid down with regard to crime as laws which, from a moral point of view, should not be transgressed, so that the deterrent power of the State appeared to him to act, not only from the fear of punishment, but also because of a moral standard which the majority of people adopted, and which they were not likely to transgress. It should be borne in mind, that the punishment inflicted by the State for crime, so far from reforming the criminal, had the opposite effect, and it was a question worthy of consideration whether the State should not adopt some form of restriction adapted to the various needs of those with whom it had to deal. There were, undoubtedly, persons in whom hereditary traits were very strong, who were borne almost irresistibly towards crime, and for the security of society the State might deal with those persons in a different way from that in which others were treated. Still, with regard to a great number, it should be borne in mind that the humanitarian spirit of the age demanded that the possibility of reformation should be kept in view. The trend of modern thought was away from the old idea of retribution; but he thought they should recognise the elements of truth, even in that old theory of retribution, and the elements of truth were, that when something was committed which was regarded as criminal—acts of violence or fraud—there was a healthy feeling of resentment. He did not think that feeling should be suppressed, though it should be woven in with the other ideas of reformation. It should also be borne in mind that, when men were punished, they very frequently felt that they deserved it. While he thoroughly agreed with Mr. Sutherland that the State was perfectly warranted, for the suppression of crime and the protection of society, in adhering to any punishments which had been adopted to bring about this aim, he did not think, on consideration of the whole question, that the meral aspect could be entirely left out.

Dr. Jamieson agreed with the conclusion arrived at in the paper, that punishment must be inflicted without yielding to any particular philosophical opinions one might hold about free-will. The crux of the question related to capital punishment. If that punishment was to be applied mainly for deterrent purposes, and for its influence on others for reformative purposes, was it not absurdly unfair that it should be inflicted on a person who was held not to be fairly responsible for what he did. It was a question how far capital punishment was allowable at all on any supposition of necessitarianism. A School of Criminal Anthropologists was in existence, who were prepared to carry out their ideas to perfectly logical conclusions—especially what was called the Italian School. Lambrosa went so far as to lay down as a principle that there are instinctive criminals, and that it was as absurd to punish such a person as it would be to punish a person for having small-pox; that there existed no right in any sense of the word to punish such a person for retributive or deterrent purposes. He thought the common sense of most people would incline them to object to that view, as being an extreme and dangerous doctrine. It was based very much on the assertion or opinion, that the criminal was a criminal in virtue of a certain defective construction of his brain; that the proof of that consisted in the fact that, given a certain number of persons who were known to be criminals, it would be found that they had smaller heads than the average person; that they had a less facial angle; that the top part of their face and head sloped backwards; that their head, on the average, was a little wider transversely—being wide relatively to its length; that such persons, on the average, had badly shaped ears; that the ridge over the eyes projected; that in very many of them there was a secondary ridge above the eye-brows, which was very prominent; that in a considerable number of them the lower jaw was largely developed, and projected in front of the under jaw. Whilst that generalisation might be freely admitted, it was dangerous to apply the test to individuals. There had been notorious criminals in existence whose heads were full sized, whose facial angle was good, whose ears were good and whose jaws were in proper position, and it would be altogether unsafe to base a man's responsibility for certain acts he had committed on the size or shape of his head. An attempt was undoubtedly being made to popularise that doctrine at the present time, and to say that given a man who exhibited a certain shape of head, who had imperfectly formed ears, who had prominent ridges over his eyes, and so on, and given the further fact that he had committed a crime, that that man should be held to be irresponsible, and should not suffer the consequences of his crime. The conclusion seems to be, that the criminal type of person represented a degenerated type—a development of the lower type, with brains constituted similarly to those of the lower race, and therefore should not be held responsible for doing any wrong act. He thought it would be extremely dangerous to allow a doctrine of that kind to be carried to its logical conclusion. Popular opinion was easily led astray in a similar matter, namely, the influence on the brain of disease or of injuries to the head, and the probability that thereby a man would be rendered irresponsible. It was perfectly true that disease of the brain was almost certain to interfere with a man's intellectual capacity, and would make him incapable of controlling himself. That general principle might be admitted; but it was dangerous and absurd to infer that, when a man was suffering from any kind of disease, he was to be held to be irresponsible. It was known, that there were structural diseases of the brain that did not necessarily involve the mental faculties. That the mental faculties were affected to a considerable extent was well known, but it was absurd to infer irresponsibility, and to declare that a man was not to be punished for his wrongful acts. Especially did it become dangerous and absurd when it was attempted to apply the doctrine to individuals. It was extremely dangerous to apply the doctrine of anthropology to criminal cases. In spite of recent discoveries, we did not know half as much as we would like to know about the functions of the brain, or as much as we hope some day to know. Physiologists know that there are parts of the brain that are well defined, that there are parts that control movements, that there are parts which deal with hearing, speech, and sight, but when it came to the question of learning what particular part of the brain is exclusively concerned with the mental faculties, they would have to depend on what was little more than inference. It was probable that the front part of the brain is that which is concerned with the intellectual and moral faculties. There might be extensive injury to that front part of the brain—parts of it might be lost or degenerated as the result of disease—but he did not know that it always followed that the mental or moral faculties were deteriorated in proportion to the amount of brain lost. The average unscientific person was apt to apply to individual cases, apparently logically, but still dangerously and unfairly, the scientific generalisation, which was fair enough as regards a particular disease. As to the measure of responsibility of people unmistakably insane, that was a difficult question, with which he was not then prepared to deal.

Dr. Mullen said it was absolutely necessary that lawyers should act on precedents. It was far more important that the law should be as certain as it could be, than that it should be just. There were many points in it that were unjust, but the prerogative of mercy could be exercised by the Crown. Of course the law was the true embodiment of everything that was excellent, and it did not deal with motives. Although the motive for an act might influence the amount of punishment inflicted, it could not influence the responsibility of the person who had done wrong. The responsibility of criminals was mixed up with the most important question of the protection of society. If a man had stolen a £5 note, he would join in the cry against the wrongdoer, because others might steal a £5 note from him. He unhesitatingly said that the modern idea of the responsibility of criminals, and consequent punishment, was not the best way to protect society. In the beginning of this century nearly all the felons were hanged, and the adventurous spirits were drafted off to the wars. The consequence was, to use a vulgar expression, that the breed was stopped. Now, however, owing to the manner in which felons were treated (imprisonment for a short period), there was being developed a race as devoid of moral sense as a child born blind was of sight; it was nothing less than propagation of the species. We were developing a typical immoral race; and if anyone were to go to the East end of London and pick out ten children of from 8 to 10 years of age, he could predict with tolerable certainty what would become of nine of them, partly by heredity and partly by surroundings. The question to be considered was not so much their responsibility, because the law made them responsible, but how were they going to protect society from criminals. He would not enter into the discussion of such questions as free-will, because they were not practical. As to the responsibility of the insane, that was a question to which it was impossible to give an answer. He might as well ask the President if a bridge over the Yarra were injured, what strain it would bear. The President would want to know what bridge it was, the particular kind, the size and other things which to an ordinary layman would look absurd, and experts would differ as to the amount of strain. He might as well ask Mr. Sutherland how long it would take for a boy to construe a chapter of Cæsar. He would want to know all about the boy and his class, and what chapter was referred to. When they came to speak of lunatics, each case must be considered singly. The law did not recognise that there were dozens of forms of insanity which ran into one another. Originally, there was but one class of insanity. Then the law took note of delusions, but it stopped there; a mad man was either a maniac or delusionally insane. Those laws were laid down by very worthy gentlemen, who knew nothing but what they found by metaphysical reasoning in the four corners of their rooms. Mr. Sutherland had laid down rules for the guidance of lunatic asylums; the Act of Parliament did not allow the medical officers to punish any lunatic.

Lunatics, knowing that they could not be punished, did not commit crimes. He knew the case of one inmate who would say to the doctor at times, "if you don't lock me up, I will do something." The older warders would say, "I think you had better lock him up." Such men knew when the impulse to do some violent act was upon them, and knew it could not be resisted. Then in puerperal mania, he had known a woman to say, "doctor, if you don't take the child away, I will kill it; if the servant goes out, I will kill it." The woman was perfectly aware of the illegality of the act, but could not help herself, but even the presence of the servant girl would deter her. That was a strong case, as it appealed to the sentiments. In order to show that the punishment of a criminal, sane or insane, would not deter others, he referred to the case of a woman in Brunswick who, on the same night that Deeming was condemned to death, deliberately, as far as a lunatic could act deliberately, went into a house and exploded dynamite, and when she was about to be arrested she tried to blow herself up. The lawyers would say she was partially insane, whatever that might mean; she certainly had a sufficiency of reason to know right from wrong, but the punishment of the other criminal had no deterrent effect on her. Mr. Rusden had alluded to the fact, that lunatics and criminals received the same punishment, viz., incarceration. He supposed there was no sane man living who would care to be locked up as a patient in an asylum, but it was certain that that punishment had never prevented a man from going insane. As to the punishment of lunatics, some were responsible and some were not, but that was a matter on which, as to justice, they should go to experts. As to the protection of Society, he would say they were responsible. In the present state of the law, the judges get out of the difficulty as best they can. In a case of puerperal mania, in which the patient admitted to the doctor that she knew she was doing wrong, the judge said to the jury—"Gentlemen, she said she knew she was doing wrong, but it is for you to say whether she meant what she was saying." That was the way in which he got out of the difficulty. The question of sudden impulse is a dangerous one to deal with. The question ought to be—"Has this man got brain disease; has he got a certain kind of brain disease affecting certain functions? Yes." The lawyers did not take it that way. They seized upon the metaphysical point of right or wrong.

The law said that, if the man had a sufficient idea of right or wrong, he was responsible. The Executive sometimes stepped in and, as he thought, wrongly pardoned the man who was a danger to society. In one of our asylums there was a terrible case of homicidal mania, and in his opinion, that man should be removed simply for the protection of society.

Mr. RUSDEN called attention to an article in the *Forum*, on the Elmira Prison in America. The conclusion it drew was that, while the population was increasing three per cent. the criminality was increasing fifty per cent., and the writer attributed that result to the humanitarian treatment of criminals.

After a few words in reply by Mr. SUTHERLAND, on the motion of Colonel GOLDSTEIN, seconded by Professor ORME MASSON, the discussion was adjourned to the next meeting.

Thursday, June 9th.

The President (Professor KERNOT) occupied the chair.

The minutes of the preceding meeting were read and confirmed.

Mr. J. B. Pritchard, an Associate, signed the Roll and was introduced to the meeting.

The LIBRARIAN reported that 114 publications had been received since the last meeting.

Mr. SUTHERLAND read a paper "On the Nest and Eggs of the Victoria Rifle Bird" (Ptilorhis victoriæ), by Mr. D. Le Souëf.

The discussion on "The Responsibilty of Criminals" was resumed.

Colonel GOLDSTEIN said that, in continuing the discussion of Mr. Alex. Sutherland's paper on "The Responsibility of Criminals" read at the last meeting, it would be necessary to state a few of the difficulties that occurred to the unscientific public mind, which tended to prevent the formation of just opinions on the subject. One difficulty was the great divergence apparent between the views advanced by those scientific and professional gentlemen to whom the public looked for advice. Our legal luminaries held the view that all men were responsible for their crimes, except in the case of acute mania, when it could be proved that the accused did not know the difference between right and wrong; while the medical fraternity, though by no means unanimously, urged irresponsibility whenever there was any form of brain disease, no matter how slight, or even where it was only suspected. It was as well, perhaps, for the general well-being, that society was still willing to accept the guidance of our legal, rather than of our medical, friends. But as theories that were flung broadcast among the people were certain to obtain some adherents, and as such theories, if largely appealing to our sympathies, might lead to dangerous changes in public opinion, it was well that scientific societies should meet and discuss all such theories, for the benefit of the public, and in order that our laws might be wisely ordained; law being the crystallisation of public opinion. Another difficulty arose from confusion in the terms used, and their true significance. For instance, "retributive punishment" was frequently described as "revenge," which of course was quite incorrect; yet many writers, Mr. Sutherland also, used the phrase in this sense. Then there was the extremely narrow view advanced by some writers that, early in the world's history, punishment was retributive only; that later, it was sought to be made deterrent; and that as it had failed to be deterrent, it should therefore seek to be reformatory only. He alluded to this as a narrow view, because he hoped to indicate presently that punishment should partake of all three qualities—that it should be retributive, deterrent and reformatory. There was another difficulty that must frequently occur to the unscientific mind, how to reconcile such statements as Mr. Sutherland's, that "the treatment of criminals was not a matter of abstract justice, but of pure policy. It was not concerned with ethics, but with the preservation of law and order." Spencer laid down as the fundamental law of human justice, "that each individual ought to receive the benefits and the evils of his own nature and consequent conduct; neither being prevented from having whatever good his actions normally bring to him, nor allowed to shoulder off on to other persons whatever ill was brought to him by his actions." The question of the responsibility of the criminal was a large one, and was to be looked at critically from so many points of view, that it was only by long and patient study we could hope to solve it, and to measure out punishment to the criminal, with the view to the gradual reduction of crime. So much was this felt, that it had justly been considered necessary to examine the criminal class in a thoroughly scientific manner. Hence the new Science of "Criminal Anthropology," which had led to the holding of International Congresses, the first of which had been held at Berne in 1885, the second in 1889 at Paris, and the third was to be held this year at Brussels. There had also been established a few years back the International Criminological Association. An enormous amount of useful work had been done, but the new Science was only in its infancy. Numerous articles and books on this subject had been published in Europe and America, so that the first results of enquiry were within reach. Havelock Ellis, in 1890, had published a book called "The Criminal," which was a valuable compilation of the opinion of those who had taken a leading part in the work. His (Colonel Goldstein's) attention had been directed to three articles in the "International Journal of Ethics," which fairly represented some of the views held. One was "The Theory of Punishment," by the Rev. Hastings Rashdall; another "The Prevention of Crime," by Dr. Tönnies; and the third was a discussion on these by Professor James Seth, of Dalhousie College, According to Professor Seth, the new Science of Criminology was founded on the theory that crime was a pathological phenomenon, and that the proper treatment of the criminal was, accordingly, that which sought his cure rather than his punishment. He claimed that this was an advance in human feeling as well as in intelligence. It might be suggested that, as these latter day views of criminology were the result of special studies, or studies by specialists, we should do well to raise the question, were specialists, as a rule, well trained in philosophy. Or, to put it more distinctly, had these particular specialists any fair amount of knowledge of the ultimate causes of the various phenomena of the universe? Because so far as specialists were deficient in general philosophy, so far must we guard against being led to avoid generalising on the results of their undoubtedly valuable accumulations of evidence.

The Rev. Hastings Rashdall objected to the retributive theory of punishment, and expected that with the necessary moralization of communities, the sphere of criminal law ought gradually to extend; while Dr. Ferdinand Tönnies, of Kiel University, asserted that all punishment as punishment should cease, though he had no better substitute to offer than a system of fines; while he looked to further research for other means of preventing crime than could be found in the threatened or real consequences of what the criminal had done. Professor Seth, in discussing both these opinions, raised the question whether the newer and older views of punishment were mutually exclusive, and if not, what was their relation to one another, and seemed to favour the idea that punishment must be reformatory only. He asserted "that society was now so securely organised, that it could afford to be not only just, but generous as well." Would not this be rather dangerous pleading if adopted in our Law Courts? Most thinking people would agree with Professor Seth in this adverse criticism of the diverse views advanced by Mr. Rashdall and Dr. Tönnies, and also when he much qualified the idea that crime was a "pathological phenomenon," by urging that "it was only an analogy or metaphor after all, and like all metaphors, might easily prove misleading if taken as a literal description of the facts;" that "to resolve all badness into insanity did not conduce to clear thinking," and that "normal crime, if it had anything to do with insanity, was rather a cause than a result." He said that "To reduce crime to a 'pathological phenomenon' was to sap the very foundation of our moral judgment, merit as well as demerit, reward and punishment, were thereby undermined. Such a view might be scientific, it was not ethical, for it refused to recognise the commonest moral distinctions." One of the articles of the International Criminological Association, quoted by Dr. Tönnies, said, "Punishment was an act of justice, and the essence of punishment was retribution. From this standpoint, satisfaction was the primary object of punishment, and the other objects included reformation and deterrence." We might justly take this as a fair statement of the facts. While we acknowledged that retribution could only be made in trivial crimes against the property or person, when crimes became more serious, retribution became more or less impossible. Punishment then must be deterrent, while all punishment should be inflicted with a view to the ultimate reform of the criminal, bearing in mind that in order to secure reformation the conscience of the criminal must be awakened. He must be brought to see that his punishment is just before we could hope for any betterment. In "The Criminal," by Havelock Ellis, one could not fail to be struck with the mass of evidence gathered in the biological and pathological examination of the criminal. But it must be observed that a fair examination of the evidence led to the opinion that the bulk of what were called criminal physiological characteristics were also to be met with in the non-criminal and respectable classes, while many of the so-called criminal characteristics were due to the professional exercise of crime. Lombrosa had been often cited as the greatest living exponent of criminal anthropology, yet he was called rash and unscientific. Ellis spoke of his work as "by no means free from faults. His style was abrupt; he was too impetuous, arriving too quickly at conclusions, lacking in critical faculty and in balance. Thus at an early date he was led to over-estimate the atavistic element in the criminal, and at a later date he has pressed too strongly the epileptic affinities of crime." Yet this was the authority who was often quoted, especially by medical witnesses who advocated irresponsibility of the criminal. Of all his vast mass of investigation, extending to about 30,000 cases, Lombrosa himself had declared that "perhaps not one stone would remain upon another, but that, if this was to be the fate of his work, a better edifice would arise in its place." To illustrate the length to which enthusiastic specialists would go in advocating their own views, Despine, who wrote a good work in 1868, "Psychologie Naturelle," had considered the criminal as "morally mad," and therefore irresponsible, and had said, "No physiologist had yet occupied himself with the insanity of the sane." Was not this evidence of the "illusions of enthusiasm?" We might treat the question of responsibility from an ethical, a metaphysical, a clinical, or a practical point of view, and we must arrive at the conclusion that sane or insane, every criminal must, for the protection of society, be treated as responsible. He had been asked to say something on the treatment of the criminal, but he thought that hardly came within the scope of the present enquiry. It would be sufficient to say that the trend of modern thought was in the direction of abolishing fixed limits to sentences; that our prisons should be made into Reformatories, where every hour would be profitably occupied, and that when prisoners were reported fit, they should be allowed out on parole. Also, that the surest way to check the increase of the criminal class, is to remove criminal children to a healthy environment.

Mr. RUSDEN remarked that Colonel Goldstein had omitted to mention the system of indeterminate sentences, which he believed to be one which would soon be adopted. Mr. Havelock Ellis mentioned it as having been introduced into America some time ago. To Mr. Frederick Hill belonged the honour of first suggesting this fruitful reform. Lunatics were dealt with on this principle. A lunatic was not liberated until two medical gentlemen certified that the treatment to which he had been subjected had been successful, and that he was fit to be released. At present the law fixed a maximum, and in some cases, a minimum sentence, and the criminal was released very much the worse for his imprisonment after a short definite period, fixed without regard to reason. If the system of indeterminate sentences were given a fair trial, he thought it would be found much more satisfactory than that at present in vogue. He did not believe it was possible to reform a man who had grown accustomed to commit crimes, but with first offenders this system might be very successful.

Mr. ALEXANDER SUTHERLAND said that whilst there was little to cavil at in Colonel Goldstein's paper, there was one point as to which he thought he detected an uncertain sound—viz., with regard to the nature of punishment. Colonel Goldstein had said that punishment might either be retributive, deterrent, or reformatory. If punishment were reformatory, it ceased to be punishment at all. One could not logically speak of reformatory punishment. In that case, it was simply a mode of treating criminals which was reformatory. He agreed with Mr. Rusden that, if a man were allowed to grow up a criminal, he could not be reformed. The leading authorities were agreed on that point. Beyond the age of 10 or 12, the chance of reform was apparently slight. If a man lived up to the age of 20 as a criminal, nothing practically would reform him. Not only were there good authorities for that statement amongst the leading writers in England, but it could be shown that, even in this colony, such was the fact. Lord John Russell had inaugurated the Penfold scheme—a reformatory scheme in which criminals, when improved to a certain extent, were to be sent to Australia with so much money in their pockets. Two shiploads of criminals, certificated as having been reformed, had been sent to Australia about 1849 or 1850. Two-thirds of the men who had entered the scheme never reached Australia, and those that were sent were the best. These men had not improved the population; but our records of crime showed that, instead of being reformed, when they had got a sum of money in their pockets, and were landed on a new shore to start a new career, they had turned out, as a rule, miserable failures. But it was fair to remember, that the ranks of crime included many characters. There was the criminal who was of an energetic character, and whose energies had been directed into an unfortunate channel. There was the man who had mutinied in the Army, or the man who had merely knocked a hare over which happened to run in front of him. Then again, there was the man whose daughter had been ruined by some wealthy man, and who had avenged himself. These were not criminals in the proper sense of the term. They were on a different footing, and might have a fair chance in a new country, where that very energy and impetuosity that had carried them into a wrong grove in one direction, might make them most successful in another. Many of the world's greatest men would have been great nuisances if they had taken a wrong track; Lord Clive was an instance. Marlborough, too, whose energy would perhaps have been thrown into a wrong channel if his country had not needed his services, had found an outlet for it in slaughtering Frenchmen, and so had become a hero. Passing from the question of reformation, there remained the theories of retribution and deterrence. No philosophical people would hold that punishment should be retributive—that if a man were struck, he should be resolved to return the blow, merely as a matter of retribution, although he would be perfectly entitled to take precaution to prevent a repetition of the act. Retribution was not according to modern views, and there only remained the deterrent view, which should be widened out into a question of placing a sufficiently strong deterrent motive in the balance of the motives that actuated a man to ensure his actions taking a right direction. There were three great objections to the view that criminals should be eliminated by simply putting them to death:—First, there was the practical one, that the feeling of the race was against it. The second objection was, that the process would have to be repeated time after time. If the least desirable people were singled out at the present moment and got rid of, although the remainder of the population would be improved, but in twenty or thirty years there would be just as much difference between the then respectable classes and the lower classes as there was now, and these would have to be exterminated. In a couple of centuries, people of the character of the judges, who sat upon the bench at the present moment, would be chloroformed as being objectionable people, Then again, was everybody who broke the laws to be chloroformed? At present penalties were awarded on a graded scale, and there were felonies, misdemeanors, &c. The weeding out process would require an arbitrary scale. Would they let off first offenders, or would they draw the line at the second offence? However it was arranged, such violent and arbitrary lines must appear objectionable to the public conscience. The third objection was that nature had arranged the matter in her own way in a far more efficacious style. Although the genus criminal seemed to occur in a sporadic way, it really obeyed certain laws. To make his meaning plain, he would draw their attention to the extensive area from which we inherit our natures. Everybody had two parents, and four grandparents, and eight great grandparents, and so on. In the fourth generation, there were thirty-two ancestors, and in the sixth, sixty-four. In the course of a century and a half, these sixty-four ancestors had each contributed a sixty-fourth part to any one individual's characteristics. Generally, there was a certain accidental blending of all these sixty-four characters, so as to produce a particular result. Take for instance the case of a musician. Out of the sixty-four, there might perhaps have been six or eight who were rather above the average in music. It generally happened there were as many below the average as would balance this, and then the result was an ordinary person who was neither much above nor below the average in musical capacity. But where it happened that a certain number of the sixty-four were rather above the average, and there were none much below it, and where, added to a musical capacity, there was sufficient industry and inventiveness, the result was a musician. The result of all this theory was that criminals, if not compelled to herd together, would work out their own salvation in generation after generation. If they were compelled to herd together, they invariably died out. A criminal woman very rarely left posterity that would survive two or three generations. With regard to men, too, in following up the history of Australia he had been surprised to observe that there was so little trace of convict blood that had been poured out on these shores so profusely. Australia was not less moral than any similar Anglo-Saxon community. The question was sometimes asked, why we were not deeply tinted with the convict element. There were two classes of convicts. One class who had not inherited the criminal character, but who had been sent out for committing crimes, chiefly by reason of their super-abundant and mis-directed energy, had made excellent settlers, whilst the real criminals had been killed by drinking the plentiful rum of the early settlement days, or being knocked on the head in brawls, and had left no posterity. If nature were left to work in her own way, the matter would come right in the end. The criminal nature would either not perpetuate itself, or the average would be rectified in succeeding generations as the area extended. Therefore, the crude notion of chloroforming the criminal should be disregarded for several reasons. It was not in accordance with the humanitarian views of the present day, and it was founded on a wrong impression of the law of heredity. If criminal were made to pair with criminal, the result would no doubt be a very bad race indeed, supposing they bred. But they would not; and, moreover, they did not and could not be compelled to pair with one another. In conclusion he believed that, at the present time, things should be allowed to remain as they were, and that the pressure of public opinion, and where necessary, of sharp public punishment, would cast sufficient weight on the right side of the motive to induce people to act as best suited the community. Beyond this, there was no need to interefere. We should follow the old lines as much as possible, making our laws as humanitarian as the interests of society would allow.

The PRESIDENT suggested that a definition of criminality and insanity might be desirable.

Mr. WHITE asked Mr. Sutherland upon what statistics he had based his statement that the early convicts were dying out. Not long ago the early criminal records of Tasmania had been sent to Melbourne and destroyed, and shortly afterwards the same had been done with those of New South Wales. He would be much relieved if it could be proved that the criminal class was dying out, but he was unable to take such an optimistic view, and would like to ask Mr. Sutherland the basis of his statement.

Dr. JAMIESON said he hardly thought a definition of either criminality or insanity was practicable. He doubted whether there was any definition of insanity except the bald and unsatisfactory one that it was some departure from the normal mental condition, about which there could be no doubt. As to criminality, he thought there was more difficulty still. The idea of criminality varied indefinitely almost from one generation to another, and in different races. In fact within a very short time it had been made an offence punishable by law to buy or sell a pound of sugar. It was not an offence for a man to sell a cigar or glass of whisky at 8 o'clock at night, but it was an offence to sell a pound of sugar at that hour. The idea seemed to be that criminality was the doing of certain things which the majority had agreed ought not to be done, and the doing of which should be punished. Such an offence was called a crime. It was well known that there were habitual criminals, people who made it their business to commit offences against the law, but it was difficult to get at the root and origin of this tendency. He believed a great many offences were due to intellectual defects. There was a clear enough distinction between a man being weak and being wicked, but it was quite certain that weakness very soon led to wickedness, and a person who was weak in body or mind ran far greater risk of falling into criminality than a person fairly endowed with mental ability and physical power. The man who was mentally weak was liable to be led into crime by stronger minded and less scrupulous persons, and the man who was weak in body was at a disadvantage in earning his living, and fell into such straits that he was tempted to break the law and appropriate that to which he had no right. This habit would grow in both cases, and he did not see why a person without any special criminal tendency might not, if constantly exposed to temptation, become by force of habit a habitual criminal. This much was clear enough, and capable of proof, but when it came to a question of moral defect, it was difficult to say how far it was natural and how far acquired. It was just as probable that people failed in moral capacity just as they did in intellectual capacity, but it did not necessarily follow that both defects should be co-existent in the same person. A man might be strongly endowed mentally, and yet be weak in moral qualities, and it had been observed that some people who were well endowed morally were rather poor in intellectual constitution. But it was difficult to say how far what was called moral defect was natural, and how far it was acquired. It might be admitted as a likely enough thing that there were people insufficiently endowed with moral qualities, who readily enough became criminals, independently of their intellectual capacity, and as a mere matter of theory it might be admitted that the moral endowment could be so poor that the person of necessity became a criminal. He would not like to say on theoretical grounds that this was not so, but the difficulty was in proving it to be so, and to recognise a theoretical deficiency of moral endowments, apart from pure mental capacity, as a ground of irresponsibilities, was excessively dangerous doctrine. But this seemed to be the doctrine held by the modern school of criminal anthropologists, who went so far as to say that they could tell pretty accurately what would be the physical characteristics of the habitual criminal. He did not think any of them would profess to be able to tell from the physical characteristics of a man, without knowing anything about his conduct, whether or not he was a criminal, and this was the difficulty of safely applying the doctrine, however rational it might be as a general principle, to individual cases. For that reason he thought that any attempts to save criminals from the consequences of their actions on such grounds should certainly not be encouraged, but should on the contrary be discouraged very strongly. With regard to the question of punishment, he agreed with Mr. Sutherland that reformation could not properly be spoken of as a form of punishment, although the criminal might regard in that light any efforts made by the authorities in that direction. He feared that retribution could not be got rid of. If one man inflicted injuries upon another that could be measured pecuniarily, he was fined to a proportionate extent. Without a doubt there was retribution in that. The man who had not the money to pay was entitled to be punished by having something taken out of him as a *quid pro quo*. He was not prepared to drop the old-fashioned idea of retribution. Of course punishment was also deterrent. It had a deterrent effect upon the offender himself, inasmuch as things were made so unpleasant for him that he would not be likely to repeat the offence. The extreme deterrent was the taking away of life. After all, people value their life more highly than anything else, and death was the strongest possible deterrent the law could inflict. It practically amounted to this, that the community recognised certain crimes as being of such an atrocious character, that it simply decreed that those who committed them should not only be banished from human society, but should have their existence terminated, not only as a strong deterrent, but to prevent the possibility of the act ever being repeated by them. It was not done with any view of exterminating the breed, that was a hopeless task he was afraid. The meeting was greatly indebted to Colonel Goldstein for the manner in which he had brought the matter before it. He was mistaken in thinking that because a man had malformation of the brain, or some disease, that he was therefore insane. He did not think many members of the medical profession would hold such crude doctrines as that. It was quite certain that there might be diseases of the brain without any indication of insanity, and, although it was very unlikely, there might be mental derangement without any demonstrable disease of the brain. As to other matters, he was sure there were not many who would be inclined to differ greatly from what Colonel Goldstein had said.

The Rev. E. H. SUGDEN said that, in a definition of criminality, something was wanted which would connect the selling of an article after hours and the taking of life in cold blood. The anti-social spirit that both acts displayed constituted them crimes against society. It seemed to him that, in order to lessen the criminal population, the artificially made crimes against society ought to be lessened as much as possible. A glance at the list of indictable offences would show that ninety-nine out of every hundred were not wrong in themselves, but were wrong because society had made them wrong. Taking the view that the criminal was an offender against society, it seemed to him that the proper punishment would be to send him to Coventry, if some reasonable method of doing so could be indicated. If a reasonably fertile and productive part of the earth could be fenced off and made a dumping ground for criminals, where they could be left to develope a State for themselves on their own anti-social lines, it would be a very comfortable thing for Society, and perhaps a very salutary discipline for themselves. This he was afraid was somewhat utopian, but if the social instinct could be aroused in the so-called criminal classes, a great deal of crime would be prevented. If a man could be taught to entertain a real and tender regard for any living thing, a great deal had been done to prevent him from committing crime. In spite of Mr. Sutherland and others, the Christian Church still believed that the criminal could be reformed, if he could only be got to love someone, and that the one Person whom it was easiest and most effectual to bring him to love was our common Master. It seemed to him these were the lines on which the best results would be obtained. The natural punishment for one who manifested the anti-social spirit would be to shut him out of society, and the only remedy would be the promotion of the social spirit in him.

Thursday, July 14th.

The President (Professor KERNOT) occupied the chair.

On the motion of Mr. GRIFFITHS, seconded by Mr. RUSDEN, the minutes of the preceding meeting were taken as read and duly confirmed.

Mr. G. C. W. Officer, Member, and Mr. Strettle, Associate, present for the first time, signed the Roll, and were introduced to the meeting.

Mr. Donald Clarke, of the School of Mines, Bairnsdale, was elected a Country Member.

The PRESIDENT announced that the following gentlemen had been nominated, and would be balloted for at the next meeting:—Rev. Walter Fielder, Associate; L. J. Balfour, Member; Douglas Howard, Associate.

Professor SPENCER, in the absence of the Hon. Librarian, reported that since the last meeting, 92 volumes and periodicals had been received, and the Council had determined to proceed with the binding of the books belonging to the Library, and 53 volumes had been sent to the binders for that purpose.

The Rev. A. CRESSWELL read a paper entitled "Notes on the Lilydale Limestone," illustrating his remarks by specimens and blackboard drawings.

Mr. GRIFFITHS considered that the geologists of Victoria were under a debt of obligation to the Rev. Mr. Cresswell, for having undertaken the description of this interesting bed of limestone. So far as his recollection went, this was the only bed of crystalline limestone found in Victoria in the Silurian, either upper or lower. The only other deposits of crystalline limestone known to him were some beds in Gippsland, in one of which Mr. Sweet had discovered some very interesting fossil fish. It was to him a source of wonder that the bed described by Mr. Cresswell, lying so near Melbourne, had remained for so many years without any description that was accessible to the public. Mr. Cresswell had been so successful as to obtain a large number of interesting fossils, and no doubt his paper would stimulate geologists generally to pay more attention to the bed of limestone at Lilydale.

Mr. DENNANT regretted very much he never had an opportunity of visiting Lilydale, and was much gratified to see that this matter had been taken up by Mr. Cresswell. He was particularly glad that some palæontological work would embellish the pages of the "Transactions." He did not know whether this bed was definitely known to extend further in the east, but he had heard it said by those who knew the country, that there were outcrops of limestone on the Upper Yarra, about fifteen miles to the north-west of the Emerald Township and Gembrook, but he had never had an opportunity of personally verifying the fact. It would be interesting to know whether this was really an extension of the limestone which outcropped at Lilydale.

Mr. SWEET said he had visited the limestone beds at Lilydale on several occasions, and had taken considerable interest in them. He was therefore very pleased that Mr. Cresswell had taken the matter up, and hoped he would continue his labours until he had given them a complete list of all he had found.

Mr. PRITCHARD said there were some other specimens which he had obtained on a recent visit, and which were very interesting. The first was a coral which Mr. Cresswell had mentioned, namely, Heliolites. A large quantity of this material had been obtained on the last visit, and was in a very perfect state of preservation, so that it would be a good specimen for description. There was another fossil which occurred there rather commonly, but which up to the present had not received any mention at all, although it had been discovered four or five years ago. It was a kind of operculum, which had been handed to Professor McCoy, but had never been described. It seemed to correspond with the *Cyclonema australis*, and he thought it would be well if something were done in connection with the specimens he had mentioned. There were several other specimens of the coral type, some of which were very nteresting, and which he had not been able to identify at all. He would be glad to hand them over to any Member who would undertake a description of them.

Mr. HALL said that Mr. Pritchard had forgotten to mention that one of the specimens of which he had spoken, the operculum of some shell, had been discovered wedged into the mouth of an Euomphalus. Whether it belonged to the Euomphalus or not was a matter which would admit of discussion. They were all obliged to Mr. Cresswell for his interesting paper.

The PRESIDENT said that he had been in the vicinity of the Upper Yarra a good many times, but did not remember noticing any limestone. However, he had not been on a geological expedition, and it was perfectly possible there was plenty of limestone which he had not noticed.

Rev. Mr. CRESSWELL, in reply, said that if any limestone did exist on the Upper Yarra, it was just in position to be a repetition by flexure of the limestone at Lilydale. It was a mistake to suppose there were no other beds of Upper Silurian limestone in Victoria. There were two very extensive thick beds in Gippsland, one at Walhalla, near Cooper's Creek, and another at Deep Creek, about seven or ten miles from Walhalla. They were nearly parallel seams of limestone, and might be a repetition by flexure. The fossils were very similar in both. These beds had been known for a considerable number of years, and were alluded to in the Geological Survey Reports. In conclusion, he expressed his indebtedness to Mr. Pritchard, who had lent him the fossil which formed the chief matter he had spoken about that evening, and recorded his thanks to Mr. David Mitchell and his foreman, Mr. Fuller, for statistical information.

A "Preliminary Note on the Glacial Deposits of Bacchus Marsh," by Messrs. C. G. W. Officer and L. J. Balfour, was read by Mr. OFFICER.

Mr. DENNANT said that there were a number of questions raised by the paper which he would like an opportunity of speaking upon at considerable length, and as time would not permit of a protracted discussion that evening, he moved "That the discussion on the paper be postponed till the next meeting."

Mr. CRESSWELL seconded the motion for the reasons stated by Mr. Dennant.

The motion was agreed to.

REPORT OF THE CREMATION COMMITTEE.*

The Report of the Cremation Committee was read by the Hon. Secretary, Mr. RUSDEN.

On the motion of Professor SPENCER, seconded by Dr. BRETT, the Report was received.

The PRESIDENT said that a model had been procured which would illustrate the working of the Gorini incinerator, which was the process adopted at Milan, where cremation appeared to be practised to a very considerable extent, and in a way not calculated to offend or disgust in any respect. The Crematory and its surroundings were pleasant and attractive. Milan was one of the largest and busiest cities in the northern parts of Italy, and the Crematory was as near to the centre of Milan as the present Melbourne Cemetery was to the centre of Melbourne.

Mr. F. CHAMBERLAIN produced the model and explained its construction.

Dr. GRESSWELL was heartily in accord with the strong recommendations of the Cremation Committee. He felt that it was a reform that was bound to come, although he was not very sanguine as to its coming quickly. However, he felt satisfied with the progress being made as

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* *Vide Suprà*, p. 222.

indicated in the Report, and hoped that the Report would encourage those who were interested to make further efforts. With reference to the observations in the Report in regard to Japan, it was an interesting fact that for a very long time past, Cremation had been the rule in Japan, but upon the introduction of European civilisation into Japan fifteen or twenty years ago, it was thought right to follow the European customs in the matter, and substitute burial for Cremation. They soon discovered their error, and reverted to their former practice.

Dr. BRETT moved, "That the Report be adopted by the Society, and printed in its Proceedings." He took considerable interest in the subject of Cremation, and had seen it practised in nearly every country in the world.

Mr. G. A. SYME seconded the motion, which was carried unanimously.

Thursday, August 11th.

The President (Professor KERNOT) occupied the chair.

The minutes of the preceding meeting were read by the Secretary, and duly confirmed.

Dr. Barrett, Member, and Mr. Barnard, Associate, present for the first time, signed the Roll, and were introduced to the meeting.

The PRESIDENT announced that the following gentlemen had been nominated, and would be balloted for at the next meeting:—W. H. Steele, M.A., Associate; Frederick Chamberlain, Member; Alfred Stillwell, Member; and A. Purdy, M.A., Associate.

The following gentlemen were balloted for, and duly elected:—The Rev. Walter Fielder, Associate; Douglas Howard, Esq., Associate; and L. J. Balfour, Esq., Member.

The Librarian's Report stated that 69 publications had been received from various parts of the world, and 44 bound volumes from the binders.

Adjourned discussion on "Preliminary Note on the Glacial Deposits of Bacchus Marsh," by C. G. W. Officer, B.Sc., and L. J. Balfour.

Mr. OFFICER said that since the paper was read he had, together with Mr. Balfour, traversed the whole of the district covered by the paper, and he wished to make one or two corrections. The first was with regard to the sections described on the Myrniong Creek. It had been stated that the glacial deposit was overlaid by older basalt. This part of the map was outside of that published by the Geological Survey, and he would like to say that this basalt was probably to be referred to the upper and newer basalt, and not the older. In the note, it had also been stated that a certain section was probably an example of contorted till. On further examination, however, this had proved to be not till, but what was called Mesozoic sandstone, and the apparent contortions were due to concretionary action. Also at another section where the glacial deposit was overlaid with sandstone, it had been difficult to decide whether that sandstone was simply associated with till, or belonged to the Mesozoic sandstone in the surrounding district. They were now of opinion that the overlying sandstone was probably of Mesozoic age. On the Korkuperrimul Creek the glacial till was overlaid by basalt, which they thought was to be assigned to the upper basalt. But the evidence on which the distinction between upper and lower basalt was often drawn, seemed to be somewhat feeble.

The Rev. Mr. Cresswell said he had a few criticisms to offer upon the paper which Mr. Officer had kindly lent him, and he would begin by recording his appreciation of the value of the paper. It was a most interesting and complete paper, although he was not able to agree with all the conclusions arrived at by the authors. From the evidence adduced by other observers, as for instance Mr. Selwyn, Sir Richard Daintree, Dr. Lendenfeld, and Mr. Dunn, there could be no doubt that in former ages there had existed distinct glaciers in the Alpine districts of Victoria and New South Wales, but it seemed to him to be very questionable whether those glaciers extended any distance from those particular regions. He would begin by making a general criticism upon the terms used. He thought it somewhat misleading to apply the term "till" to two formations which, according to the authors' showing, were so very widely separated in the geological series—one being apparently a Pleistocene glacial deposit of some kind, and the other being a glacial deposit belonging to the Miocene age. He thought it far better to keep the term "till" for well-known and acknowledged deposits of glacial nature belonging to the Pleistocene age. To apply the term to both formations tended to confusion. He was one of those who believed that till was not a Moraine profonde, but owed its origin to Moraine matter, redistributed partly by aqueous action, and the boulders contained in it were mostly the result of icebergs which had broken away from glaciers and deposited the débris in the clay. Still less was he inclined to believe that these particular formations were instances of a ground Moraine, and he doubted that they necessarily indicated that there had been glaciers on the very spot where they had been found. With regard to the striated pebbles, no one could have the smallest doubt as to their being striated, and having been striated by glacial action. They were evidently striated-glaciated pebbles. He very much doubted, however, that they had been scratched by any rocks where they were now found. So far as his memory served him, the Upper Mesozoic sandstones were particularly soft, and incapable of scratching these pebbles, and he therefore imagined that they must necessarily have come from a very considerable distance—probably from the Alpine regions of either New South Wales or Victoria—and not from the neighbourhood where they were now found. These remarks applied to the upper till, or, as he would call it, the upper glacial formation. With regard to the lower glacial formation, he was not very well acquainted with the nature of the Silurian rocks in the neighbourhood, but unless they contained quartzites very abundantly, he did not know of any rock likely to be capable of imparting the striæ to these pebbles in the Silurian area. He believed that these pebbles, although no doubt glaciated, had been brought from a considerable distance by alluvial and other action. As to the striæ on the Silurian rocks, he would be very sorry indeed to insult their friends' powers of observation, by implying that they could possibly have made a mistake if they had had the opportunity of observing them upon an extended scale; but considering that they had not had such an opportunity, but had only found the striæ here and there in small patches, he would venture to ask them whether they might not have mistaken the unequal wearing of the edges of the rock. He understood from the paper that these grooves were not found in the Mesozoic sandstone, but only in connection with the lower drift on the Silurian rocks, and he was particularly struck by the remark made in the paper, that these grooves invariably ran north and south, that was to say, exactly coincident with the strike of the strata, and these Silurian strata were tilted up at an angle of 70 degrees. He did not know the extent of the patches uncovered, but considering that the observers were most anxious no doubt to see what they saw, was it not possible that they might have mistaken the unequal wearing of the edges of the Silurian strata. He had frequently seen on the smooth upturned edges of the Silurian strata appearances of very deep grooves, owing to the unequal wearing. But even supposing them to be veritable grooves, it was not beyond the range of possibility that they might have been formed by an iceberg charged with hard pebbles underneath grounding in the neighbourhood on the spot. With regard to the roche moutonnée, he laboured under the disadvantage of never having been on the particular spots which had been mentioned, so that he was unable to judge from his own observation whether they were really instances of roche moutonnée. He would just conceive it possible, therefore, that the hummocky appearance might have been caused by diluvial action. For instance, at Lilydale, there was an appearance of hummocky rock, which was simply caused by the action of the waves on the seashore. Messrs. Officer and Balfour objected to the idea of marine action having anything to do with the phenomena they instanced, but he would venture to point out that there was indisputable evidence that the whole continent had been submerged thousands of feet under the sea. He had seen gravel on the top of Mount Useful covered with basalt, and this was generally put down on the geological maps as marine gravel. There was some doubt as to the age of that particular gravel, but there could be no doubt as to the age of the drifts at Castlemaine and Bendigo, and other places, which would represent a submergence of at least 2000 feet. It was a very moot point as to whether these drifts had been caused by pluvial action, extending over a considerable pluvial period; but he believed, with Selwyn and others, that they were caused by marine action. Although he had appeared to criticise the paper somewhat adversely, he quite admitted it was a very debateable question. Not being an extreme glacialist, he was, perhaps, inclined to minimise the evidence adduced, but he could quite conceive that others who were extreme glacialists would concede that the authors had fully proved their point.

Mr. GRIFFITHS said that for purposes of discussion the paper might be divided into two parts—the part which was purely descriptive, and the part which offered explanations of the appearances described. The latter part might be divided into three principal propositions which were put forward although not formally stated. The first was that there were evidences locally of two glacial epochs—one early in the Permian, the other early in the Tertiary. The second was that the boulder clay of each of these was due to land ice, and not to marine transport by icebergs. The third was that the submergence of the continent sufficient to float an iceberg at Bacchus Marsh, would reduce the land surface to such a small area that it would be too limited in area to breed icebergs, and too warm to accumulate ice on account of its insularity. With respect to the descriptive part of the paper, he had found many discrepancies between the descriptions given by the authors of the paper and the statements made by the officers of the Geological Survey. The Government officers had given a section showing a thick bed of what had since been termed Triassic conglomerate, which the authors of the paper had attributed to a different period, but did not give a tripartite division, which Messrs. Officer and Balfour stated to exist in the section described on the Werribee River. The Government officers, who were men of experience, had failed to recognise any glaciated rocks in this section, although they had stated that a glacial conglomerate existed in the district. Of course, it sometimes happened that through want of sufficient data, errors had crept into the Geological maps, and he simply pointed this out as showing that it was advisable to carefully weigh the evidence adduced before accepting it. Although the Government geologists had not seen their way to describe the bottom member of this section as a glacial deposit, they had pointed out that the Mesozoic sandstone was composed of two members, the upper being a sandstone and the lower being a conglomerate, and stated that this conglomerate was due to marine action. They recognised a difference, but attributed it to a different cause. With regard to the first proposition, that there was evidence of two glacial epochs, it certainly did seem upon examination of the specimens and photographs as if there was evidence to show that the bottom member had had a glacial origin. There were undoubted grooves and striæ, and the Silurian rocks were certainly marked as if a plane, with grooves, such as a carpenter would use in his ornamental work, had passed over them. Such was the appearance of rocks which had undergone grinding by the passage over them of a glacier. There was a good deal of weight in Mr. Cresswell's criticism with regard to the rocks having a north and south direction so far as their strike was concerned, and the edges of the Silurian rock being uptilted to a high angle, and varying degrees of hardness and wearing unequally, and all this would have to be taken into consideration before coming to a final conclusion; but, nevertheless, looking at the photographs of the portion of the rock that had been uncovered, it certainly suggested a glacial origin for the rock to his mind. In the second place, the boulders in the till were certainly to a large extent striated, and as suggested, appeared to have been deposited there by ice. There was also another feature which was favourable to the proposition suggested by the authors, namely, the great variety of rock which was found in this clay bed. Such a heterogeneous collection of rocks collected together in one place without any stratification at all, and most of them more or less striated, was certainly to his mind suggestive of glacial action, and pointed to a glacial origin for the deposit. Then again the rocks were not only varied, but they did not correspond with the rocks in the neighbourhood. If the conglomerate was due to coastal action, it would agree with the rocks found in the locality, but that fact, that this was not the case, indicated that the boulders had been brought some considerable distance; and it was well known that a glacier does collect rocks in this manner, and that in a coastal conglomerate no such heterogeneous collection of rocks is found. This was another point in favour of the hypothesis of the authors. It seemed to him that the specimens and descriptions all favoured a glacial origin for this bed, but whether one could go further and agree with the authors of the paper, that the bed was of Permian age, was another matter. In arriving at that conclusion, it was necessary to take a number of matters into consideration. In the first place, the conglomerate was associated with a bed of rock which was known to be of Mesozoic age. In the second place, there were no Permian rocks described in Victoria, and it was well known that there was a great break in the sequence, the sandstones which were the Upper Devonian rocks being the last rocks met with before reaching the Mesozoic sandstones. There was no such break in the neighbourhood of Sydney, where there was a complete sequence from the Upper Devonian to the Oolite. On the Sydney side the country was sinking and the deposits accumulating, but in Victoria, the other end of the sea-saw, the country was elevated and erosion was going on. Therefore, in Victoria, one did not look for Permian rocks, and if this were a bed of Permian age, it was an interesting fact which required more evidence than was at present available. Its association with the Mesozoic rocks had led the Government geologists to associate it with the beds above it with regard to age, and he did not see any reason for disturbing that conclusion. With regard to the upper glacial deposit, the deposit on top of the Mesozoic sandstone, the rocks in the clay were of the same heterogeneous character, and included granites and porphyries which were striated, and had all the general characteristics of a glacial deposit; but there was one very great difference between the two beds, as had been pointed out by Mr. Cresswell. The lower bed lay upon a surface that had been smoothed and planed apparently by the action of ice, but the upper bed lay upon a sandstone surface as rugged and rough as a mountain peak; and in the fractures which were found in this rugged surface hard clay, very much like a boulder bed, and rocks, including granites, had been jammed down hard, and presented a very different appearance indeed to the bed which lay below it upon the Silurian. If the upper bed were due to glacial origin, certainly the circumstances were very different to those of the lower bed. No heavy mass of ice had ever passed over this till, because if it had, it would have planed all the soft sandstone as smooth as the Silurian had been planed below it. Therefore, if it were due to glacial action, the till and rocks must have been deposited where they were now found by the thin edge of the glacier, an edge which had no weight, but which at the same time was sufficiently strong to carry a burden of rocks and tip them out laterally. This was a possible explanation. It might also have been caused by a very small glacier indeed from some steep mountain close by, removed by erosion, the glacier itself having no weight or body, but able to bring down stones and tilt them out. This was a very strong point of difference between the two beds of so-called glacial till. Then, with regard to the age assigned to the upper body as being Miocene, he failed to see that there was any evidence at present that would enable them to assign such an early age to the bed. Messrs. Officer and Balfour stated that it was overlaid by a Miocene lava, but he understood them now to retract that statement, and to say they believed that the lava was the recent lava which was found all about the little cavities. Miocene lava was found there, but the Government geologists had not represented it as overlying the Mesozoic sandstones, but stated that it was intrusive and pushed its way through. They represented it as projecting from below, and the Mesozoic sandstone lying upon it. The later lava was distributed all over the country, and lay sometimes on the Silurian, and sometimes on the Mesozoic sandstones, and sometimes upon the conglomerates, which had been described by the authors. Therefore, there was no evidence that he could see, which would justify these gentlemen in attributing to this upper boulder clay the age which they had given to it. Their second proposition was to the effect that the boulders of both these epochs were due to land ice and not to icebergs. With regard to that, the grooves and striæ of the Silurian ran from north to south. As Mr. Cresswell had pointed out, that might be produced by the character of the rock itself; but if there were grooves and striæ there, they were just as one would expect to find them, because the highland there was always found to the north of this point, and ice travelling from the mountain cap must have taken a north and south direction. Had these marks been produced by the grounding of icebergs, one would expect to find something quite different. Icebergs would travel first of all upon the general trend of the coast, which was from west to east. They would travel with the currents of those seas, and as the prevailing winds in this locality were from west to east, so the currents were from west to east, and one would expect to find the icebergs travelling with the currents and with the winds and along the coast line, all three of which ran from west to east. Therefore, if they produced any striæ at all, these striæ would run from west to east. But it was known that icebergs when they grounded did not produce striæ, in fact could not do so. When an iceberg grounded it swung round on its heel, and if it produced any marks at all on the rock, in the first place it bruised the rocks, and in the second place the rocks which had been embodied in the iceberg and touched the rocky bottom in the bed of the sea, produced marks which were arcs of circles. Icebergs never made straight lines. Then there was another line of argument, which to his mind entirely disposed of the iceberg theory. The Mesozoic sandstone was essentially of fresh or brackish water formation. The only fossils found in the Mesozoic, were two fresh water mollusca and the vegetable remains of ferns. Apart from this, the formation had all the characteristics of sedimentary beds which had been formed in a lake. It was known to most geologists, that the Mesozoic sandstone was a fresh water lake deposit. Our mountains at the time it was formed were very much higher than they are now, and a series of lakes were formed between their shelving sides, and as the lakes got filled up with the sand which now formed the Mesozoic sandstone, the water rose higher. There was very little doubt that it was never anything else than a shallow fresh water lake, perhaps of considerable dimensions. He would like to know how icebergs were going to float in fresh shallow water. An iceberg had one part above water and eight parts below. How were icebergs to float? This was not a marine deposit, and although 2500 feet in thickness, we might depend upon it this Mesozoic sandstone had accumulated gradually, and as it accumulated at the bottom of the lake, the water had risen. No iceberg ever could have floated in these waters, and therefore, in his opinion, no icebergs could ever have caused these marks. There was also another important piece of evidence that should not be disregarded. Around all the remains of all these ancient lakes in Victoria, below the sandstone bed was found a bed of conglomerate. This was apparently the case at Bacchus Marsh, with regard to the conglomerate under discussion. The officers of the Government Geological Survey attributed the bottom member to the action of the water on the coast. Wherever the margin of this sandstone was found, the conglomerate was found under it. On the whole, the evidence was rather favourable to a glacial origin for the bottom deposits at Bacchus Marsh, and he attributed them to land ice, not to icebergs.

With regard to the third proposition, that the immersion of the Continent sufficient to float icebergs would reduce the land surface to such a small area that it would have a mild insular climate. If these beds were due to a deposit in the lakes, they were not due to immersion in the ocean, and the argument of the authors fell through, because they assumed that the high-water level was the high-water level of the ocean, whereas it appeared to him to be the high-water level of various fresh-water lakes.

Mr. Dennant said he would allude principally to the claim made by these gentlemen for a post-Miocene glacial epoch, or at any rate, even if not post-Miocene, some portion of the Tertiary time, which would include the Eocene, Miocene, and Pliocene. Consequently, if there were glaciers in Victoria at that time, the climate must have been a cold one, for it would be impossible to have a glacier with the temperature the same as at present. If we started with the Eocene, it was well known that there was a very rich fauna in the Eocene, perhaps the richest of any found in any part of the world, but it was essentially a tropical fauna, and no one who had examined the fauna of the Eocene period would doubt for a moment but that he was in the same latitudes as the West Indies and the Tropics generally. Passing from the Eocene to the Miocene, the climate was certainly getting cooler, but was still very much warmer even than our present climate. The shells indicated a climate becoming more and more like the present, but very far indeed from being a glacial one. Passing to the Pliocene, during the last twelve years, two very rich marine deposits had been found in the Pliocene, one in the older Pliocene near Adelaide, and another in the west of our own Colony, at Limestone Creek; in each of these there was a rich fauna. The climate indicated was slightly colder than that of the Miocene, and in both deposits was found a large number of living shells. In the late Pliocene or almost Pleistocene of Victoria, the living shells amounted to 81 per cent., but they were not those generally found on the present shores of Victoria, or of Southern Australia, but those more frequently found living in the northern parts of the Continent. Consequently, at the time they were deposited the climate was warmer than now, and approximated to the climate of the northern parts of the Continent. It might be concluded that in the older

Tertiary period, there must have been, on the whole, a warm climate, and during that period it would be impossible to expect that any glacial phenomena could have been produced. Besides this, no shells had been found that would indicate Arctic conditions. It was well known that in the glacial till of Europe, Arctic shells were frequently found, and it was possible to trace these deposits by the shells. Where then could the Tertiary glacial epoch of Victoria be placed? Paleontologically, there was no room for it. It might perhaps be mentioned that the sea was certainly close to Bacchus Marsh during Tertiary times. Undoubted evidence of this had been given by Mr. Reginald Murray in one of his reports. A statement had also been made that the pebbles, &c., which had been found, were not known to exist in Victoria. He would like to know what these were, for no list of rocks was given as those not found in any other part of the colony. Then again, amongst these rocks, granite, schist, felspar and sandstone were mentioned, but no mention was made of the Tertiary limestone or any rock of undoubted Tertiary age. If this were a post-Miocene or late Tertiary deposit, he thought we should have some of these rocks amongst those which had been transported.

Mr. James Dunn said that the conglomerate which he regarded as of glacial origin lay at the base of the coal measures. If the conglomerates that he described were the same as those described by the authors of the paper, it was out of the question to speak of roches moutonnées. In fact those who had passed through Bacchus Marsh would have observed the rounded appearance of the hills. This was characteristic of the Mesozoic deposits of every part of the colony, and was certainly due to diluvial action, and he did not think any weight could be laid upon that characteristic feature of the landscape as indicating any glacial action whatever. He was glad the matter had been brought forward, and the authors of the paper had done very good service in making such carful observations, which would enable those who wished to do so to examine the spots referred to for themselves.

Professor Spencer said that, twelve days since, he had gone with Mr. Dunn to the deposit he had described, for the purpose of being shown what were undoubtedly roches moutonnées. There could not be the slightest doubt about the presence of these at Derinal.

Mr. Pritchard said he would like to make a few remarks on the diversity of opinion as to the age of these beds. The Bacchus Marsh beds had been originally set down as Triassic, and the coal measures in Newcastle and in the neighbourhood of Sydney were originally set down as belonging to the Mesozoic period, so that originally the Bacchus Marsh sandstones had been placed on a lower level than the Newcastle coal series. At the present time, the Newcastle coal series were known to belong to the carboniferous age, and the only fossil remains which had been hitherto found in the Bacchus Marsh sanstones were three species of the genus Gangamopteris. The genus itself had been found in the coal measures of New South Wales, in connection with Glossopteris and other genera, which were now looked upon as Mesozoic, and which had always, up to the present time, been looked upon as characteristically Mesozoic, but having been found together with characteristic Palæozoic plants and marine fossils, they were looked upon now as an extension of the range of the genus Glossopteris. This would seem to point to the conclusion that the Bacchus Marsh sandstones might belong to the carboniferous age. Some authorities looked upon the Bacchus Marsh sandstone as belonging to the carboniferous period.

Mr. Dennant said he only referred to the roches moutonnées in connection with the claim made for Tertiary age. He understood that Mr. James Dunn placed his deposit in the carboniferous era, and evidently referred to a different epoch to that which these gentlemen referred to when they spoke of a post-Miocene glacial epoch. If the fauna did not indicate necessarily the climate, at all events any glacial epoch that might have occurred during Tertiary times must have been of a very spasmodic nature.

Mr. Cresswell asked whether the proposition that the upper glacial bed was a post-Miocene deposit had not been withdrawn.

Mr. Officer said that in the paper it had been stated that this bed probably belonged to the Tertiary, but they had not attempted to assign it to any particular era in Tertiary times. In fact they had expressly stated that they were unable to find out its relation to the Miocene beds.

Mr. Dennant said, that being the case, most of his remarks need not have been made, for he was only claiming that there was no evidence of a Tertiary glacial epoch in Victoria in that neighbourhood.

Dr. Dendy said there seemed to be one aspect of the question that had not been touched upon, viz., its bearing on the latest glacial theory in Europe and America. He believed, according to this theory, the glacial epoch was attributed to astronomical causes, and it was a remarkable fact that according to this theory, if they had had a glacial epoch in the northern hemisphere, it followed as a natural consequence that there must have been one in the southern hemisphere alternating with it. The European geologists, according to this theory, had confidently predicted that we should find in Australia evidences of a Tertiary glacial epoch. Therefore, he thought it probable that the glacial evidences discovered by Messrs. Balfour and Officer might be Tertiary. With regard to the question of climate in connection with the fauna, the fact that tropical fauna was found in some of these Miocene rocks was rather a strong proof in favour of the glacial theory, because it had been shown that in the glacial epoch in the northern hemisphere there had been a series of unusually warm periods alternating with a series of unusually cold ones. We should therefore expect to find fauna of tropical character in connection with any glacial epoch which might have happened here.

Mr. Officer, in reply, said that with regard to the term "Till," he thought it a very good term indeed to apply to any deposit which could be shown to be moraine profonde. As to Mr. Cresswell's contention that till was not ground moraine, but was due to water action, the boulders having been transported by icebergs, that was a theory which would not bear inspection. As to the roches moutonnées, gentlemen did not seem to be quite satisfied as to the genuineness of the article. He had seen many examples of roches moutonnées, but he had seen very few better specimens than those he had described. With regard to the age which they had assigned the lower deposit, they had stated in the paper that it was simply a matter of probability. Their remarks had been based on the fact that in Europe and South Africa, the glacial conglomerates were of Permian age. Mr. Griffiths had stated that in New South Wales there was no break from the Devonian period to the Mesozoic. Professor David had stated that at the close of lower

Carboniferous times there was a distinct break in the flora, and at the close of Permo-carboniferous times there was also a distinct break in the flora. He was inclined to agree with Mr. Pritchard with regard to the Mesozoic sandstones. They had been assigned to Mesozoic age, simply on the evidence of three species of Gangamopteris. Seeing that these occurred associated with Glossopteris in Permo-carboniferous beds in New South Wales, and, as it had been stated by Professor David that Gangamopteris was a more primitive form than Glossopteris, it would almost seem as if these beds were of an earlier age than Mesozoic. Mr. Griffiths had also said he did not think that any ice ever passed over the till at the quarry where the fracture in the sandstone occurred. On his last visit to the same quarry, he had found a similar fracture filled with till-bearing striated stones at a much higher level, and about half-a-mile further up the creek there was a great thickness of this till, exposed at a height between sixty or seventy feet. If that had been accumulated under a glacier, the glacier which could have accumulated it must have extended much further down the valley, and it was probable it did over-ride these stones. The sandstone rock was very soft, and would not show striæ. It had been subjected to much denudation. The rocks also dipped at a considerable angle up to 35 degrees, and a glacier coming down the valley of soft sandstone would be rather likely to fracture them and give them a rugged appearance. On the whole, he did not think anything had been said which would lead them to suppose these deposits were due to anything else than glacier ice.

Mr. Steele read a paper on "The Conductivity of Copper Sulphate Solutions."

The President said that as it was now past ten o'clock, the other papers would be held over till the next meeting.

Thursday, September 8th.

The President (Professor Kernot) in the chair.

The minutes of the last meeting were read and confirmed.

Mr. Hogg signed the Roll Book and was introduced to the members.

Mr. Fredrick Chamberlain and Mr. Alfred Stillwell were elected Members, and Mr. A. Purdie, M.A., and Mr. W. H. Steele, M.A., Associates.

The PRESIDENT welcomed to the meeting Professor Haswell, of the University of Sydney, and President of the Linnæan Society of New South Wales.

The Librarian's report showed that 98 new volumes had been added to the Library.

Dr. BARRETT read a paper on "Snake-bite."

In reply to Mr. Ellery, Dr. BARRETT said that snake-bite was usually not a dangerous affection in Victoria. The natural remedy for a severe bite was the expulsion of the poison by downward bandaging. He thought a great deal was to be said in favour of strychnine.

Mr. ELLERY instanced two cases of recovery from snake-bite, but in one case the man was subject to epilepsy ever afterwards. In the other case, injections of ammonia had the effect of causing a cure.

In reply to a question by Dr. Brett, as to the length of time taken in the absorption of the poison, Dr. BARRETT said it was impossible to state how long it would take for the poison to take effect if it were injected into the sub-cutaneous tissue. If the poison were shot into the vein, no bandaging would save the patient.

Mr. HOGG considered that ammonia and strychnine were not antidotes, strictly speaking, but merely had the effect of making a patient recover from a comatose state.

Mr. FENTON said that in Victoria in ten years there were thirty-eight deaths from snake-bite, but a great many of those were insignificant bites. Not more than about six of those cases were over twenty years of age. The remainder were all young children. In India there were 22,000 deaths from snake-bite, and that would give about ninety per mean of population.

Dr. JAMIESON said that no statistics were kept of the number of cases of snake-bite. His impression was, that real cases of snake-bite were much less frequent than the supposed cases, and the symptoms usually presented by those supposed to have been bitten were not due to snake-bite at all. The strychnine treatment for real snake-bite was not at all irrational. The poison could not be extracted once it was absorbed, but the patient could be kept alive by stimulants—alcohol, ammonia, or strychnine. The last was a rational remedy if cautiously used, and if the patient could be kept alive for a sufficient length of time the poison would be thrown off by the kidneys, or might be rendered inert by the action of the liver. The injection of permanganate of potash was to his mind an irrational mode of treatment. It interfered with the circulation, and it could only act on the poison by meeting it on the spot were it existed and destroying it in a chemical way, as any similar substance would be destroyed in the test tube. It was, therefore, haphazardous treatment, as it was uncertain if the permanganate would meet the poison. The time occupied in injecting the permanganate might be utilised to better advantage by excision of the bitten part, or by suction or pressure.

Mr. Lucas was of opinion that the best thing to do was to keep the patient alive, if possible, by stimulants, until the proteid was oxydised.

Professor Haswell agreed with Dr. Barrett as to the fallacy of statistics on this subject. He was of opinion that the only light on the matter was to be obtained by means of experiments on animals carefully conducted, with very careful and accurate weighing and measuring of the poison and the antidotes, and the effects of both. He was glad to announce that there was a prospect of some results being obtained from experiments of this nature. Dr. Martin, Demonstrator of Physiology at the Sydney University, was engaged in researches as to the effects of the poison of the Australian snakes.

Mr. Frost had some experience in estimating the time occupied by the poison in circulating through the system. He had caused a tiger snake to bite a rat, and the rat was dead in a minute and a half. It was probable that the poison was injected into the vein. The tiger snake possessed fully three times more poison than any other snake. He had seen a tiger snake emit poison at the third successive bite which would be sufficient to kill a small animal. It was difficult in experiments with small animals to estimate the amount of strychnine necessary to kill the animal. After injecting strychnine into a rat, the rat recovered from snake-bite, but afterwards it died from the effects of the strychnine.

Dr. BARRETT said that in the *Medical Journal* for 1876 would be found a collection of replies to a circular issued by Dr. McCrae to medical men. He got a return of 253 cases of snake-bite, and 10 per cent. had died without any treatment. It was interesting to note that Australian snakes ejected only a small quantity of poison, while the Indian snake ejected a very large quantity. It was a question whether the doses were in proportion to the size of the animals met with by the snakes. In India of course the animals would be much larger than those met with in Australia. He agreed with the opinion expressed by Professor Haswell, that careful experimenting in the laboratory is the only means of settling the question as to the size of the doses.

Professor SPENCER read some notes on "The Structure of the Poison Fang in certain Australian Snakes."

Professor HASWELL said that he had an opportunity of inspecting Professor Spencer's sections, and there could be no doubt that they proved his deductions.

A paper by Mr. A. J. Campbell, F.L.S., on "Three Rare Species of Eggs," was then taken as read.

Dr. DENDY read a paper on a "Synopsis of the Australian Calcarea Heterocœla, with a proposed Classification of the Group and Descriptions of some New Genera and Species."

An exhibition of specimens followed, and the meeting terminated.

Thursday, October 13th.

Mr. WHITE (Vice-President) in the Chair.

The minutes of the last meeting were read and confirmed.

Dr. DENDY read the Librarian's Report, which showed that 110 new publications had been added to the Library.

A paper by Mr. T. S. Hall, M.A., on "Two New Tertiary Stylasterids," was read by Mr. PRITCHARD.

Mr. PRITCHARD considered that the paper was very interesting, on account of its being the first description of

Stylasterids from Australian Tertiaries. Since looking over Mr. Hall's paper, he had found numerous Stylasterids in his own collection.

Dr. DENDY read notes on "The Method of Reproduction of Geonemertes australiensis."

Mr. E. F. J. LOVE, M.A., exhibited and explained Professor Rowlands' Photographs of the Solar Spectrum.

Thursday, November 10th.

The President (Professor KERNOT) in the Chair.

The minutes of the preceding meeting were read and confirmed.

Professor A. Liversidge, F.R.S., was elected an Honorary Member.

Mr. Steele signed the book, and was introduced to the Members; Mr. Isaac Tipping, C.E., was nominated as an Associate.

The following Members, composing the Antarctic Committee, were re-elected:—The President, and Messrs. Ellery, Rusden, and Griffiths.

The following Members, composing the Port Phillip Biological Committee, were re-elected:—Prcfessor Spencer, Dr. Dendy, Rev. A. W. Cresswell, and Messrs. Bale, Lucas, McGillivray, and Bracebridge Wilson.

The Members composing the House Committee, with Mr. Blackett as Convener, were re-elected.

Mr. LOVE presented and read the Report of the Gravity Survey Committee.* The President and Professors Lyle and Masson, and Messrs. Ellery, White, and Love, were re-elected as Members of Committee.

The PRESIDENT explained that the apparatus which had been used by the Committee, and which was set up in the Observatory, was in perfect order and fit for use.

Mr. W. H. STEELE, M.A., read a paper on "Physical Constants of Thallium."

Mr. LOVE said the paper was a valuable contribution to electrical science. It had brought out an important point,

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* *Vide Suprà*, p. 218.

namely, that silver wire as now obtained is very much more pure, and altogether very much better than what was supposed to be pure silver twenty-five years ago. The metal Matheson worked with in making the experiments for the British Association, was supposed to be the purest that could be got, and up to the present that had never been disputed, but after Mr. Steele's work there need be no hesitation in asserting that silver wire had been produced in this Colony of a considerably higher degree of purity than what was supposed to be chemically pure some years ago.

Professor MASSON desired to know what steps Mr. Steele took to ascertain the degree of purity of his Thallium. He also wished to know how far Mr. Steele's coefficient of specific resistance agreed with Matheson's determination of some years ago.

Mr. STEELE said he was not then in a position to reply to the question relating to the degree of purity of his Thallium. As to the conductivity of Thallium, the "Dictionary of Chemistry" referred to it, but the results were not given with absolute certainty. According to the figures he had quoted in his paper, the conductivity of Thallium is slightly better than lead, but a great deal worse than tin.

Mr. BLACKETT considered that the lead used by Mr. Steele, being ordinary commercial lead, would have given better results if it had been purified by re-crystallisation.

Mr. STEELE said that the purity of the lead made no difference. He merely measured the specific resistance of lead, and he might have used an alloy.

The PRESIDENT said that the elasticity of the Constants was of interest.

Mr. STEELE believed that the particular specimen of Thallium he had used, was imported into the Colony for the purpose of having its elasticity tested, and that had been done by Mr. William Sutherland, prior to his use of the specimen.

A paper on "The Lichenology of Victoria. Part I," by the Rev. F. R. M. Wilson, was presented by Mr. W. H. Archer, F.L.S., and taken as read.

Mr. D. McAlpine read notes prepared by himself and Mr. P. W. Farmer, M.B., Ch. B., "On a Poisonous Species of Homeria found at Pascoe Vale, causing the death of cattle and other animals feeding upon it."

Mr. Blackett, in reply to the President, explained that Mr. Wilkinson, with his assistance, had been making an investigation of the plant, and he was confident that there was no trace of alkaloid in it. They did not hope to isolate any particular poison from the plant. The corrosion of the mucous membrane of the cow's stomach, which was referred to in the paper, ought, if it existed, to be detected from the extract. He drank a spoonful of the extract, but it did not produce any after effect, although he found it disagreeable and nauseous.

Mr. McAlpine said that the symptoms could be better explained when the chemical analysis was completed, and a second paper would be presented when that was done. Although two extracts had been experimented on with negative results, yet there was the fact that the rabbits had died. The corrosion of the stomachs of the animals that had eaten the plant was a surprising thing, and he hoped that chemical analysis would throw light on the symptoms recorded in the notes.

Mr. White asked if the plants were more dangerous at certain seasons than at others.

Mr. McAlpine said that in West Australia, at certain seasons, it was known not to cause death. Cows seemed to avoid the plant.

Mr. White said that might prove that the flowers and not the leaves were poisonous.

Mr. McAlpine thought that the bulbous part contained the poison.

Thursday, December 8th.

The President (Professor Kernot) occupied the chair.

The minutes of the preceding meeting were read and confirmed.

Mr. Isaac Tipping was ballotted for as a Member, and declared duly elected.

Rev. F. R. M. Wilson and Mr. P. W. Farmer were nominated as Members.

The PRESIDENT said that Mr. Lucas, who had been well known to those present for many years past as a member of the Society, and a writer of valuable papers, and also as a Member of the Council, was about to leave the Colony, having accepted the headmastership of the Newington College in Sydney. He thought that every member would agree with him when he said they were very sorry indeed to lose Mr. Lucas. He trusted that his removal to Sydney would be a step in the direction of prosperity and emolument. and in the name of the Society he wished Mr. Lucas every happiness, prosperity, and success in the new sphere which he was about to fill. He did not know whether he would continue his connection with this Society, or whether his contributions would fall into the hands of the Royal Society of New South Wales. He might, perhaps, be permitted to express a hope that he would not be in a very great hurry to abandon the Royal Society of Victoria for that of the sister Colony.

Mr. LUCAS said, I thank you very much, Mr. President and Gentlemen, for the very kind way in which you have taken leave of me. I have not the remotest intention of severing my connection with this Society. I should be very sorry indeed to lose touch with the many friends and fellow workers, the advantage of whose society I have enjoyed during the last ten years. I have every confidence in the future of this Society, and no one will watch its progress and success with more interest and pleasure than myself.

Dr. DENDY, the Hon. Librarian, reported that 77 publications had been received since the last meeting. The liberality of the Council had enabled them to send 93 complete volumes to the binder.

Professor SPENCER said that, according to the rules of the Society, the Officers, and some of the Members of the Council retired, but were eligible for re-election. He might say it was no use nominating Mr. Sutherland to the position of Secretary for the following year, as he was about to leave the Colony for an extended visit to Europe, and would not be able to serve the Society for the next three years. So far as he (Professor Spencer) was concerned, he did not want to sever his connection with the Council, if he could help it.

He would be at the first meeting next year, but not at any of the subsequent ones. He thought it might, perhaps, be left with the Council to appoint someone to do his work while he was away.

The PRESIDENT thought it would be wise to fall in with Professor Spencer's request. If the Society gave him leave of absence to visit Europe, he would still remain Secretary to the Society, and as the Society's Secretary might be able to represent the Society to the Societies of Europe and America, and thus do useful work.

Dr. BARRETT said the Medical Society had a custom of empowering all distinguished members visiting Europe to represent the Society at all scientific gatherings. A written document to that effect was given, and was very often found useful in travelling. He thought it the very least this Society could do.

Mr. HOGG moved, "That Professor Spencer be granted leave of absence to visit Europe and America, and that he be empowered by a suitable letter to represent this Society at the meetings of other Societies and scientific bodies."

Dr. BARRETT seconded the motion, which was carried.

Mr. WHITE said it often happened that, by the 1st March, scarcely one nomination had been received, and to save the Council from the invidious position of always nominating themselves, he would suggest that some gentleman present, who was not a Member of the Council, would move that the old Officers and retiring Members of Council, should be re-elected as far as possible. This would not prevent other nominations, if any, being received before the 1st March.

Mr. LUCAS nominated all the retiring Members of Council who were eligible for re-election.

Mr. F. A. CAMPBELL seconded the nomination.

Professor SPENCER nominated Mr. Hogg as a Member of the Council.

Dr. DENDY seconded the nomination.

Mr. WHITE nominated Mr. F. A. Campbell as a Member of the Council.

Mr. GRIFFITHS seconded the nomination.

Mr. GRIFFITHS said it had been suggested to him that it would be only a graceful act on the part of the Society to acknowledge the services of Mr. Sutherland as Secretary, and he begged to move, "That we place upon the minutes the Society's appreciation of the services of Mr. Sutherland, and regret that he is about to leave us for some time."

Mr. Rusden seconded the motion, which was carried.

A paper entitled "Some Fallacious Observations on Sneezing" was read by Dr. J. W. Barrett.

The President said that having done a good deal of sneezing himself during the past fortnight, since the grass had become dry and the smell of hay had been about, his impression was that a large portion if not the whole of the blast of air came through the mouth.

Dr. Jamieson said that like most people he had been led by his reading to think that sneezing was a purposive act, carried out with a view to expelling some foreign body from the nose. Since talking to Dr. Barrett about it, however, he had made observations for himself, and had come to the conclusion that, as a matter of fact, in the act of sneezing the air was exploded through the mouth. Still, he would not like to say it was always so, as a little observation amongst children led one to believe that a good blast of air must sometimes pass through the nose, because it was not uncommon to observe an ejection of mucus following too soon after to be the result of exudation in consequence of the act. However, he agreed very fully with what Dr. Barrett had said. The explanation usually given in books rested on the assumption that such striking phenomena could not be without purpose, and as coughing had such a clear purpose, it was easy and natural for people to think that sneezing had a similar purpose. Still, Dr. Barrett seemed to be pushing the matter to the other extreme when he said that, as a matter of fact, the upper part of the nasal passages was actually closed off, with the deliberate intention of preventing air going through the nose in sneezing. It was very true that many reflexes had a definite object in view. Winking protected the eye; the pupil contracted so as to guard the back of the eye from the sudden entrance of strong light; but certainly more striking phenomena than even coughing or sneezing did occur which were entirely purposeless, or in some cases worse than purposeless. In one's practice, one sometimes came across the case of a child which had sustained a severe burn on the skin, and some time afterwards it might happen that the child was seized with violent general convulsions. The child's violent strugglings, and the comatose condition which followed, had no effect in healing the burn or allaying the irritation. We were not, therefore, of necessity to suppose that any violent manifestation, such as sneezing, served a good purpose. The irritation of the nose which usually preceded sneezing was very regularly accompanied with watering of the eyes, so that the flow of the water from the eyes would largely contribute to the washing out process. The question was one of considerable interest, and it was very striking to find that nearly all the best authorities on physiology seemed, as he really believed after thinking the matter over, to be manifestly wrong in the interpretation they put upon it.

Mr. Hogg said that several instances occurred to him which seemed to show that a blast came through the nose in the act of sneezing. If one irritated the nose with snuff, immediately one sneezed a portion of the snuff was blown on the handkerchief, and it was very obvious that the snuff had come down the nasal passages. It could hardly be supposed that it had been washed down, it certainly seemed to have been blown down by a blast of air. If one were so unfortunate as to sneeze when in the act of drinking, the liquid would be forced down the nasal passage, which seemed to indicate that there was some blast of air down the nose. Whether it was entirely through the nose, or entirely through the throat, was another question. Different people sneezed in different ways, and the noise produced was different. A friend of his in sneezing made a noise exactly like others did in coughing; it was a noise not coming from the mouth or nose, but from the pharynx, as in coughing. Of course the question could be set at rest by experimenting, but it seemed to him that there must unquestionably be a blast down the nostrils.

Dr. Dendy said he was very susceptible to hay fever, as it was called, but he thought it was a great mistake to call it hay fever. When he lived in London, if he emerged from the underground railway, the sudden strong light and the dust would cause him to sneeze violently. The smell of grass would bring it on, and so would the dust of Melbourne, and it was always accompanied with violent watering of the eyes and running of the nose. He was inclined to agree with Dr. Barrett.

Mr. Rusden said he was often troubled with persistent sneezing. Usually the blast came through the mouth, but he had tried the experiment of closing the mouth tightly, when an explosion through the nose took place and expelled the foreign body that was the cause of the trouble.

Mr. Griffiths said the matter had been brought before him by Dr. Barrett a few days ago, and observations that he had made since then seemed to confirm what had been said by several gentlemen, for it appeared that the air blast did proceed through the mouth and not through the nose. On one occasion, finding himself engaged in a series of sneezes, he had determined to make a strong effort to close his mouth, and had found very great difficulty indeed in keeping his mouth closed; in fact, had failed to make a complete closure. So far as he had succeeded in making a perfect closure, he found that the air forced its way, at the cost of very considerable inconvenience, through the nasal passage, and seemed to blow some mucus from the glottis into the posterior part of the nose, and in that way set up considerable irritation and annoyance, which would not have been experienced had the sneeze been allowed to pursue the normal course. It had occurred to him that the curtain of the soft palate might be forcibly closed for the very purpose of preventing the foreign matter, such as mucus lying in the glottis, from being shot straight out of the air passage of the throat right into the back part of the nose, on account of the irritation that would be set up by transferring this substance from the glottis to the nose. Such a transfer would be followed by considerable inconvenience, giving rise to further efforts to expel from the back of the nose that which had no right to be there, and which would not be there but for attempting the unusual course of trying to stop the mouth.

Mr. Haig said that his experience in sneezing was certainly that the blast came entirely through the mouth. In fact he felt that the nasal passage was closed both before and after the sneeze. The inspiration before the sneeze was always through the mouth, never through the nose. Some of the discharges that were spoken of as coming through the nose might come afterwards; as, for instance, the snuff. The sneeze might come first with a blast through the mouth, then the watery discharge would take place through the nose, and with it the snuff.

Mr. FIELD said that if the nose were held when about to sneeze the noise in one's ears was almost deafening. He had found that by placing his finger upon a certain nerve upon the top of the head when about to sneeze, the sneeze would be stopped altogether.

Dr. BARRETT, in reply, said a considerable amount of information had been furnished by the discussion. Members on the whole were inclined to agree with him, that in uncomplicated sneezing the bulk of the air passed through the mouth. With regard to the remarks of Mr. Hogg, if any voluntary effort were made, the statement that the air passed through the mouth no longer held good. Unless it was a pure uncomplicated sneeze, it was impossible to reason with any degree of accuracy. If the mouth were closed firmly enough, the air was bound to go though the nose, or something had to give way. If you have the whole force of the expiratory muscles at work, it is questionable which is strongest, the tissues of the pharynx or the expiratory muscles. If one sneezed with a closed mouth, one stood a good chance of breaking the membrane, for a tremendous pressure would be put upon a membrane, which might not be very sound. In pure, uncomplicated sneezing, the bulk of the air passed through the mouth. The case of children, as instanced by Dr. Jamieson, was in point. Most children had enlargement of the pharyngeal tonsil, which gave rise to the loud breathing and the bulk of the ear troubles in children. When this was the case, one could no longer reckon upon the air going the proper way. He did not think the inconvenience spoken of by Mr. Griffiths was due to expulsion of mucus from the glottis. Under the circumstances mentioned, Mr. Griffiths had got his palate inverted in part, and then, his palate acting feebly, a certain amount of mucus dropped down into the pharynx. With regard to hay fever, what was called hay fever really meant abnormal sensibility of the aperture of the nose, and, consequently, unusual liability to stimulant. Thus, a stimulant which would produce practically no result in one person with normal sensibility, would produce an abnormal result in a person suffering from hay fever, and produce, not only a flow of water from the nose, but also from the eyes. The last speaker had referred to the stoppage of the sneeze by a pressure on a nerve. A sneeze could be stopped in a score of ways. How it was done would be rather a formidable matter to discuss off-hand, but the additional stimulus set up by another nerve would destroy the effect of the stimulus imparted by the first. Thus, a pistol shot, fired alongside a person about to sneeze, would probably put an end to the sneeze.

Dr. Dendy then read a note on a "New Species of Leucosolenia from the Neighbourhood of Port Phillip Heads."

The meeting then terminated.

LAWS.

Amended to December, 1892.

I. The Society shall be called "The Royal Society of Victoria." Name.

II. The Royal Society of Victoria is founded for the advancement of science, literature and art, with especial reference to the development of the resources of the country. Objects

III. The Society shall consist of Ordinary Members residing within ten miles of Melbourne; Country Members residing beyond that distance; Life Members (Law XXV), Honorary Members (Law XXIV), Corresponding Members (Law LII), and Associates (Laws XXV, XXVI, and LIII), all of whom shall be elected by ballot. Members and Associates.

IV. His Excellency the Governor of Victoria, for the time being, shall be invited to accept the office of Patron of the Society. Patron.

V. There shall be a President, and two Vice-Presidents, who, with twelve other Members, and the following Honorary Officers, viz., Treasurer, Librarian, and two Secretaries of the Society, shall constitute the Council. Officers.

VI. The Council shall have the management of the affairs of the Society. Management.

VII. The Ordinary Meetings of the Society shall be held once in every month during the Session, from March to December inclusive, on days fixed and subject to alteration by the Council with due notice. Ordinary Meetings.

VIII. In the second week in March, there shall be an Annual General Meeting, to receive the report of the Council, and elect the Officers of the Society for the ensuing year. Annual General Meetings.

IX. All Office-bearers and Members of Council except the six junior or last elected Members, shall retire from office at the Annual General Meeting in March. Should a senior Member's seat become vacant Retirement of Officers.

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in the course of the year, it shall be held by his successor (under Law XIII) as a senior Member, who shall retire at the next Annual General Meeting. The names of such Retiring Officers are to be announced at the Ordinary Meeting in December. The Officers and Members of Council so retiring shall be eligible for the same or any other office then vacant.

Election of Officers. X. The President, Vice-Presidents, Treasurer, Secretaries, and Librarian shall be separately elected by ballot (should such be demanded), in the above-named order, and the six vacancies in the Council shall then be filled up together by ballot at the General Meeting in March. Those members only shall be eligible for any office who have been proposed and seconded at the Ordinary Meeting in December, or by letter addressed to one of the Secretaries, and received by him before the 1st March, to be laid before the Council Meeting next before the Annual Meeting in March. The nomination to any one office shall be held a nomination to any office, the election to which is to be subsequently held. (Votes required.) No ballot shall take place at any meeting unless ten members be present.

Members in arrear. XI. No Member, whose subscription is in arrear, shall take part in the election of Officers or other business of the meeting.

Address by the President. XII. An address shall be delivered by the President of the Society at either a Dinner, Conversazione, or extra meeting of the Society, as the Council may determine in each year.

Vacancies. XIII. If any vacancy occur among the Officers, notice thereof shall be inserted in the summons for the next meeting of the Society, and the vacancy shall be then filled up by ballot.

Duties of President. XIV. The President shall take the chair at all meetings of the Society and of the Council, and shall regulate and keep order in all their proceedings; he shall state questions and propositions to the meeting, and report the result of ballots, and carry into effect the regulations of the Society. In the absence of the President, the chair shall be taken by one of the Vice-Presidents, Treasurer, or Ordinary Member of Council, in order of seniority.

XV. The Treasurer may, immediately after his election, appoint a Collector (to act during pleasure), subject to the approval of the Council at its next meeting. The duty of the Collector shall be to issue the Treasurer's notices, and collect subscriptions. The Treasurer shall receive all moneys paid to the Society, and shall deposit the same before the end of each month in the bank approved by the Council, to the credit of an account opened in the name of the Royal Society of Victoria. The Treasurer shall make all payments ordered by the Council on receiving a written authority from the chairman of the meeting. All cheques shall be signed by himself, and countersigned by one of the Secretaries. No payments shall be made except by cheque, and on the authority of the Council. He shall keep a detailed account of all receipts and expenditure, present a report of the same at each Council meeting, and prepare a balance-sheet to be laid before the Council, and included in its Annual Report. He shall also produce his books whenever called upon to do so by the Council. Duties of Treasurer.

XVI. The Secretaries shall share their duties as they may find most convenient. One or other of them shall conduct the correspondence of the Society and of the Council, attend all meetings of the Society and of the Council, take minutes of their proceedings, and enter them in the proper books. He shall inscribe the names and addresses of all Members and Associates in a book to be kept for that purpose, from which no name shall be erased except by order of the Council. He shall issue notices of all meetings of the Society and of the Council, and shall have the custody of all papers of the Society, and, under the direction of the Council, superintend the printing of the Transactions of the Society. Duties of Secretaries.

XVII The Council shall meet on any day within one week before every Ordinary Meeting of the Society. Notice of such meeting shall be sent to every Member at least two days previously. No business shall be transacted at any meeting of the Council unless five Members be present. Any Member of Council absenting himself from three consecutive meetings of Council, without satisfactory explanation in writing, shall be Meetings of Council. Quorum.

considered to have vacated his office, and the election of a Member to fill his place shall be proceeded with at the next Ordinary Meeting of Members, in accordance with Law XIII.

Special Meetings of Council.

XVIII. One of the Secretaries shall call a Special Meeting of Council on the authority of the President or of three members of the Council. The notice of such meeting shall specify the object for which it is called, and no other business shall be entertained.

Special General Meetings

XIX. The Council shall call a Special Meeting of the Society, on receiving a requisition in writing signed by twenty-four members of the Society, specifying the purpose for which the meeting is required, or upon a resolution of its own. No other business shall be entertained at such Meeting. Notice of such meeting, and the purpose for which it is summoned, shall be sent to every Member at least ten days before the meeting.

Annual Report. Auditors.

XX. The Council shall annually prepare a Report of the Proceedings of the Society during the past year, embodying the Balance-sheet, duly audited by two Auditors, to be appointed for the year at the Ordinary Meeting in December, exhibiting a statement of the present position of the Society. This Report shall be laid before the Society at the Annual Meeting in March. No paper shall be read at that meeting.

Expulsion of Members.

XXI. If it shall come to the knowledge of the Council that the conduct of an Officer, a Member, or an Associate is injurious to the interest of the Society, and if two-thirds of the Council present shall be satisfied, after opportunity of defence has been afforded to him, that such is the case, it may call upon him to resign, and shall have the power to expel him from the Society, or remove him from any office therein at its discretion. In every case, all proceedings shall be entered upon the minutes.

Election of Members and Associates.

XXII. Every candidate for election as Member or as Associate shall be proposed and seconded by Members of the Society. The name, the address, and the occupation of every candidate, with the names of his proposer and of his seconder, shall be communicated in writing to one of the Secretaries, and shall be read at a meeting of Council, and also at the following meeting of the Society, and the ballot shall take place at the next following Ordinary Meeting of the Society. The assent of at least five-sixths of the number voting shall be requisite for the admission of a candidate. Votes required to exclude.

XXIII. Every new Member or Associate shall receive due notice of his election, and be supplied with a copy of the obligation*, together with a copy of the Laws of the Society. He shall not be entitled to enjoy any privilege of the Society, nor shall his name be printed in the List of Members until he shall have paid his admission fee and first annual subscription, and have returned to the Secretaries the obligation signed by himself. He shall, at the first meeting of the Society at which he is present, sign a duplicate of the obligation in the Book of the Laws of the Society, after which he shall be introduced to the Society by the Chairman. No Member or Associate shall be at liberty to withdraw from the Society without previously giving notice in writing to one of the Secretaries of his intention to withdraw, and returning all books or other property of the Society in his possession. Members and Associates will be considered liable for the payment of all subscriptions due from them up to the date at which they give written notice of their intention to withdraw from the Society. Members shall sign laws. Conditions of Resignation

XXIV. Gentlemen not resident in Victoria, who are distinguished for their attainments in science, literature, or art, may be proposed for election as Honorary Members, on the recommendation of an absolute majority of the Council. The election shall be conducted in the same manner as that of Ordinary Members, but nine-tenths of the votes must be in favour of the candidate. Honorary Members.

XXV. Ordinary Members of the Society shall pay two guineas annually, Country Members and Associates shall pay one guinea annually. Those elected after the Subscriptions

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* The obligation referred to is as follows:—

ROYAL SOCIETY OF VICTORIA.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Royal Society of Victoria, and to observe its laws, as long as I shall remain a Member or Associate thereof.

(Signed)

Address

Date

first of July shall pay only half of the subscription for the current year. Ordinary Members may compound for all annual subscriptions of the current and future years by paying £21; and Country Members may compound in like manner by paying £10 10s. Any Country Member having compounded for his subscription, and coming to reside within ten miles of Melbourne, must pay either the balance £10 10s. of the Ordinary Member's composition, or one guinea annually while he resides within ten miles of Melbourne. The subscriptions shall be due on the 1st of January in every year. At the commencement of each year there shall be hung up in the Hall of the Society a list of all Members and Associates, upon which the payment of their subscription as made shall be entered. During July, notice shall be sent to all Members and Associates still in arrears. At the end of each year, a list of those who have not paid their subscriptions shall be prepared, to be considered and dealt with by the Council.

Life Membership.

Entrance fees, &c.

XXVI. Newly-elected Ordinary and Country Members shall pay an entrance fee of two guineas, in addition to the subscription for the current year. Honorary Members, Corresponding Members and Associates shall not be required to pay any entrance fee If the entrance fee and subscription be not paid within one month of the notification of election, a second notice shall be sent. and if payment be not made within one month from the second notice, the election shall be void. Associates, on seeking election as Ordinary or Country Members, shall comply with all the forms prescribed for the election of Members, and shall pay the entrance fee prescribed above of Ordinary or Country Members respectively.

Duration of Meetings.

XXVII. At the Ordinary Meetings of the Society the chair shall be taken punctually at eight o'clock, and no new business shall be taken after ten o'clock.

Order and mode of conducting the business.

XXVIII. At the Ordinary Meetings business shall be transacted in the following order, unless it be specially decided otherwise by the Chairman :—

Minutes of the preceding meeting to be read, amended if incorrect, and confirmed.

New Members and Associates to enroll their names, and be introduced.

Ballot for the election of new Members or Associates.

Vacancies among officers, if any, to be filled up.

Business arising out of the minutes.

Communications from the Council.

Presents to be laid on the table, and acknowledged.

Motions, of which notice has been given, to be considered.

Notice of motion for the next meeting to be given in and read by one of the Secretaries.

Papers to be read.

XXIX. No stranger shall speak at a meeting of the Society unless specially invited to do so by the Chairman. Strangers.

XXX. Every paper before being read at any meeting must be submitted to the Council. Papers to be first laid before Council.

XXXI. The Council may call additional meetings whenever it may deem it necessary to do so. Additional Meetings.

XXXII. Every Member may introduce two visitors to the meetings of the Society by orders signed by himself. Visitors.

XXXIII. Members and Associates shall have the privilege of reading before the Society accounts of experiments, observations, and researches conducted by themselves, or original papers, on subjects within the scope of the Society, or descriptions of recent discoveries, or inventions of general scientific interest. No vote of thanks to any Member or Associate for his paper shall be proposed. Members may read papers.

XXXIV. If a Member or Associate be unable to attend for the purpose of reading his paper, he may delegate to any Member of the Society the reading thereof, and his right of reply. Or depute other Members.

XXXV. Any Member or Associate desirous of reading a paper, shall give in writing to one of the Members must give notice of their papers.

Secretaries, ten days before the meeting at which he desires it to be read, its title and the time its reading will occupy.

Papers by Strangers

XXXVI. The Council may for any special reason permit a paper such as is described in Law XXXIII, not written by a member of the Society, to be read by one of the Secretaries or other Members.

Papers belong to the Society.

XXXVII. Every paper read before the Society shall be the property thereof, and immediately after it has been read shall be delivered to one of the Secretaries, and shall remain in his custody.

Papers must be original.

XXXVIII. No paper shall be read before the Society or published in the Transactions unless approved by the Council, and unless it consist mainly of original matter as regards the facts or the theories enunciated.

Council may refer papers to Members.

XXXIX. The Council may refer any paper to any Member or Members of the Society, to report upon the desirability of printing it.

Rejected papers to be returned

XL. Should the Council decide not to publish a paper, it shall be at once returned to the author.

Members may have copies of their papers.

XLI. The author of any paper which the Council has decided to publish in the Transactions may have fifty copies of his paper on giving notice of his wish in writing to one of the Secretaries, and any further number on paying the extra cost thereof.

Members and Associates to have Transactions.

XLII. Every Member and Associate whose subscription is not in arrear, and every Honorary and Corresponding Member is entitled to receive one copy of the Transactions of the Society as published. Newly-elected Members shall, on payment of their entrance-fee and subscription, receive a copy of the volume of the Transactions last published.

Property.

XLIII. Every book, pamphlet, model, plan, drawing, specimen, preparation, or collection presented to or purchased by the Society, shall be kept in the house of the Society.

Library.

XLIV. The Library shall be open to Members and Associates of the Society, and the public, at such times and under such regulations as the Council may deem fit.

XLV. The legal ownership of the property of the Society is vested in the President, the Vice-Presidents, and the Treasurer for the time being, in trust for the use of the Society; but the Council shall have full control over the expenditure of the funds and management of the property of the Society. Legal ownership of property

XLVI. Every Committee appointed by the Society shall at its first meeting elect a Chairman, who shall subsequently convene the Committee and bring up its report. He shall also obtain from the Treasurer such grants as may have been voted for the purposes of the Committee. Committees elect Chairman.

XLVII. All Committees and individuals to whom any work has been assigned by the Society shall present to the Council, not later than the 1st of November in each year, a report of the progress which has been made: and, in cases where grants of money for scientific purposes have been entrusted to them, a statement of the sums which have been expended, and the balance of each grant which remains unexpended. Every Committee shall cease to exist at the November meeting, unless then re-appointed. Report before November 1st.

XLVIII. Grants of pecuniary aid for scientific purposes from the funds of the Society shall expire on the 1st of March next following, unless it shall appear by a report that the recommendations on which they were granted have been acted on, or a continuation of them be ordered by the Council. Grants expire

XLIX. In grants of money to Committees and individuals, the Society shall not pay any personal expenses which may be incurred by the Members. Personal expenses not to be paid.

L. No new law, or alteration or repeal of an existing law, shall be made except at the Annual General Meeting in March, or at a Special General Meeting summoned for the purpose, as provided in Law XIX, and in pursuance of notice given at the preceding Ordinary Meeting of the Society. Alterations of laws.

LI. Should any circumstance arise not provided for in these Laws, the Council is empowered to act as may seem to be best for the interests of the Society. Cases not provided for.

Corresponding Members.

LII. The Council shall have power to propose gentlemen not resident in Victoria, for election in the same manner as Ordinary Members, as Corresponding Members of the Society. The Corresponding Members shall contribute to the Society papers which may be received as those of Ordinary Members, and shall in return be entitled to receive copies of the Society's publications.

Privileges of Associates.

LIII. Associates shall have the privileges of Members in respect to the Society's publications, in joining the Sections, and at the Ordinary Meetings, with the exception, that they shall not have the power of voting; they shall also not be eligible as Officers of the Society.

MEMBERS

OF

The Royal Society of Victoria.

Patron.

Hopetoun, His Excellency The Right Hon. John Adrian Louis Hope, G.C.M.G., Seventh Earl of.

Honorary Members.

Agnew, Hon. J. W., M.E.C., M.D., Hobart, Tasmania

Bancroft, J., Esq, M.D., Brisbane, Queensland.

Clarke, Colonel Sir Andrew, K.C.M.G., C.B., C.I E, London.

Forrest, Hon. J., C.M.G., Surveyor-General, West Australia.

Hector, Sir James, K.C.M.G., M.D., F.R.S., Wellington, N.Z.

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Neumeyer, Professor George, Ph. D., Hamburg, Germany.

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Verbeek, Dr. R D. M., Buitenzorg, Batavia, Java.

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Mills, H. W., Esq., Glan-y-mor, Brighton.
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Moors, E. M., Esq., University, Sydney, N.S.W.
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Remfry, Josiah Richard, Esq., Branxholme, Victoria.
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Ross, Joseph, Esq., M.D., Warrnambool.

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Smith, Mrs. Elderson, London Chartered Bank, 410 Brunswick-street Fitzroy.
Steele, W. H., Esq., M.A., Sherwood-street, Richmond.
Stewart, C., Esq., 9 Murphy-street, South Yarra.
Strettle, W. S., Esq., Ormond College, Carlton.

Tate, Frank, Esq., B.A., Training College, Grattan-street.

Wilsmore, C. N., Esq., B.Sc., University, Melbourne.

LIST OF THE INSTITUTIONS AND LEARNED SOCIETIES THAT RECEIVE COPIES OF THE "TRANSACTIONS AND PROCEEDINGS OF THE ROYAL SOCIETY OF VICTORIA."

England.

Agent-General of Victoria	London
Anthropological Institute	London
Biological Society of Liverpool	Liverpool
Bodleian Library	Oxford
British Museum	London
Colonial Office Library	London
"Electrician"	London
Foreign Office Library	London
Geological Society	London
Institute of Mining and Mechanical Engineers	Newcastle
Institution of Civil Engineers	London
Linnæan Society	London
Literary and Philosophical Society	Liverpool
Marine Biological Laboratory	Plymouth
Natural History Museum	London
Naturalists' Society	Bristol
"Nature"	London
Owens College Library	Manchester
Patent Office, 25 Southampton Buildings	London
Philosophical Society	Cambridge
Royal Asiatic Society	London
Royal Astronomical Society	London
Royal Colonial Institute	London
Royal Gardens	Kew
Royal Geographical Society	London
Royal Microscopical Society	London
Royal Society	London
Statistical Society	London
University Library	Cambridge

Scotland.

Botanical Society	Edinburgh
Geological Society	Edinburgh
Royal College of Physicians' Laboratory	Edinburgh

Royal Observatory	Edinburgh
Royal Physical Society	Edinburgh
Royal Society	Edinburgh
Royal Scottish Society of Arts	Edinburgh
Scottish Geographical Society	Edinburgh
University Library	Edinburgh
University Library	Glasgow

Ireland.

Natural History and Philosophical Society	Belfast
Royal Dublin Society	Dublin
Royal Geological Society	Dublin
Royal Irish Academy	Dublin
Trinity College Library	Dublin

Germany.

Gessellschaft für Erdkunde	Berlin
Grossh. Hessische Geologische Anstalt ...	Darmstadt
Königl. Botanische Gesellschaft	Regensburg
Königl. Offentl. Bibliothek	Dresden
Königl. Preussische Akademie der Wissenschaften ...	Berlin
Königl. Sächs Gesellschaft der Wissenschaften ...	Leipzig
Königl. Societät der Wissenschaften ...	Göttingen
Naturforschende Gesellschaft	Emden
Naturforschende Gesellschaft	Halle
Naturforschende Gesellschaft	Leipzig
Naturhistorisch Medizinischer Verein ...	Heidelberg
Naturhistorische Gesellschaft	Hanover
Naturhistorisches Museum	Hamburg
Naturhistorisches Museum	Hanover
Naturwissenschaftlicher Verein	Bremen
Naturwissenschaftlicher Verein	Frankfurt
Oberhessische Gesellschaft für Natur & Heilkunde ...	Giessen
Schlesische Gesellschaft für Vaterländ. Cultur. ...	Breslau
Verein für Erdkunde	Darmstadt
Verein für Erdkunde	Halle
Verein für Naturkunde	Kassel

Austria.

K. K. Akademie der Wissenschaften	Wien
K. K. Geologische Reichsanstalt	Wien

K. K. Geographische Gesellschaft ... ... Wien
K. K. Naturhistorisches Hofmuseum ... ... Wien
Imperial Observatory ... ... Prague

Switzerland.

Geographische Gesellschaft .. .. Berne
Geogr. Commerc. Gesellschaft ... ... St. Gallen
Geogr. Commerc. Gesellschaft ... ... Aarau
Schweizerische Naturforschende Gesellschaft .. Berne
Société de Physique et d'Histoire Naturelle ... ... Genève

France.

Académie des Sciences et Belles-Lettres et Arts ... Lyon
Feuilles des Jeunes Naturalists ... ... Paris
Société Académique Indo-Chinoise ... ... Paris
Société de Géographie ... ... Paris
Société Nationale de Cherbourg ... ... Cherbourg
Société Zoologique de France ... . Paris

Italy.

Biblioteca Nazionale Centrale Vittorio Emanuele .. Rome
British and American Archæological Society ... Rome
Museo di Zoologia ed Anatomia Comp., R. Universitá Turin
Ministero dei Lavori Pubblici ... ... Rome
Reale Academia di Scienze ... ... Palermo
Reale Academia di Scienze, Lettre ed Arti ... ... Lucca
Regia Academia di Scienze, Lettere ed Arti ... Modina
Societá Geografica Italiana ... ... Rome
Societá Toscana di Scienze Naturali ... ... Pisa

Spain and Portugal.

Real Academia de Ciencias Exactas, Fisicas y Naturales Madrid
Sociedade de Geographia ... ... Lisbon

Holland and Belgium.

Académie Royale de Belgique ... ... Bruxelles
Bataviaasch Genootschap van Kunsten en Wetenschappen ... ... Batavia
Natural Science Society ... ... Amsterdam

Natuurkundig Genootschap	Groningen
Nederlandisch Botan. Vereeinging ...	Nijmegen
Magnetical and Meteorological Observatory ...	... Batavia
Société Hollandaise des Sciences	... Haarlem
Société Macologique Royale de Belgique ...	Bruxelles
Société Provinciale des Arts et Sciences ...	... Utrecht

Denmark, Sweden, and Norway.

Académie Royale	Copenhagen
Kongelige Danske Videnskabernes Selskap ...	Copenhagen
Société des Sciences	Christiania

Russia and Roumania.

Institut Météorologique de Roumanie ...	Bucharest
Jardin Botanique Impérial	St. Petersburg
La Soc. de Naturalists de l'Université de Kazan	... Kazan
Soc. de Naturalistes Kiew	... Kiew
Société des Naturalistes de la Nouvelle Russie	... Odessa
Société Impériale des Naturalistes ...	... Moscow
Société Impériale Russe de Géographie ...	St. Petersburg

India and Mauritius.

Royal Asiatic Society, Ceylon Branch ...	... Colombo
Geological Survey of India	... Calcutta
Madras Literary Society	.. Madras
Meteorological Society	... Mauritius
Natural History Society	... Bombay
Royal Bengal Asiatic Society	... Calcutta

China and Japan.

Astronomical Observatory	Hong Kong
China Branch of the Royal Asiatic Society ...	... Shanghai
Imperial University	.. Tokio
Seismological Society of Japan	... Tokio

Canada.

Canadian Institute	... Toronto
Geological and Natural History Survey of Canada	... Ottawa
Royal Society of Canada	... Montreal

United States.

Academy of Natural Sciences	Davenport
Academy of Natural Sciences	Philadelphia
Academy of Sciences	San Francisco
American Academy of Arts and Sciences	Boston
American Geographical Society	New York
American Philosophical Society	Philadelphia
Bureau of Ethnology	Washington
Colorado Scientific Society	Denver
Cooper Union for the Advancement of Science and Art	New York
Denison University	Ohio
John Hopkins University	Baltimore
"Kosmos"	San Francisco
Maryland Historical Society	Baltimore
Natural Academy of Sciences	Washington
Office of Chief of Engineers, U.S. Army ...	Washington
Philosophical Society	Washington
"Science"	New York
Smithsonian Institute	Washington
Society of Natural History	Boston
Society of Natural Sciences	Buffalo
United States Geological Survey	Washington

Mexico.

Ministerio de Fomento	Mexico
Observatorio Meteorologico, Magnetico Central ...	Mexico
Observatorio Astronomico National	Tatubaya
Sociedade Cientifica, Antonio Alsate	Mexico
Sociedad de Ingenieros de Jalisco	Guadalajara
Secretaria de Fomento	Guatemala

Argentine Republic.

Academia de Ciencias	Cordoba
La Museo di Plata	Buenos Ayres

Australia.—Victoria.

"Age"	Melbourne
"Argus"	Melbourne
Athenæum	Melbourne
Astronomical Observatory	Melbourne
Australian Health Society	Melbourne
"Australian Journal of Pharmacy" ...	Melbourne
Chief Secretary's Office	Melbourne

Department of Mines and Water Supply ...	Melbourne
Eclectic Association of Victoria	Melbourne
Field Naturalists' Club of Victoria	Melbourne
Free Library	... Echuca
Free Library	... Geelong
Free Library	Bendigo
Geological Society of Australasia	Melbourne
German Association	Melbourne
Gordon Technical College...	... Geelong
Government Entomologist	Melbourne
Medical Society	Melbourne
Parliamentary Library	Melbourne
Pharmaceutical Society of Australasia ...	Melbourne
Public Library	Melbourne
Office of the Government Statist	Melbourne
Royal Geographical Society	Melbourne
Railway Library	Melbourne
School of Mines	... Ballarat
School of Mines	Castlemaine
School of Mines	Bendigo
School of Mines	Maryborough
School of Mines	Bairnsdale
School of Mines	... Stawell
The Exhibition Trustees	Melbourne
University Library	Melbourne
Victorian Chamber of Commerce (Manufactures)	Melbourne
"Victorian Engineer"	Melbourne
"Victorian Government Gazette"	Melbourne
Victorian Institute of Surveyors	Melbourne
Working Men's College, Latrobe Street ...	Melbourne

New South Wales.

Australian Museum	... Sydney
Astronomical Observatory	... Sydney
Department of Agriculture	... Sydney
Department of Mines	... Sydney
Linnæan Society of New South Wales ...	... Sydney
Parliamentary Library	... Sydney
Public Library	... Sydney
Royal Geographical Society	... Sydney
Royal Society	... Sydney
Technological Museum	... Sydney

South Australia.

Parliamentary Library	... Adelaide
Public Library and Museum	.. Adelaide
Royal Society of South Australia	... Adelaide

Queensland.

Parliamentary Library	Brisbane
Public Library	Brisbane
Royal Geographical Society	Brisbane
Royal Society of Queensland	Brisbane

Tasmania.

Parliamentary Library	Hobart
Public Library	Hobart
Royal Society of Tasmania ...	Hobart

New Zealand.

Auckland Institute and Museum	Auckland
Colonial Museum and Geological Survey Department	Wellington
New Zealand Institute ...	Wellington
Otago Institute	Dunedin
Parliamentary Library	Wellington
Public Library	Wellington

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