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Art. I.—*New Genera and Species of Australian Hemiptera.*

By DR. E. BERGROTH, C.M.Z.S., Lond.

(Communicated by Professor W. Baldwin Spencer, F.R.S.)

[Read 9th March, 1916.]

In a paper published many years ago[1] I have described a number of new Australian Hemiptera communicated to me by Mr. Charles French, of Melbourne. Of the material sent to me by Mr. French I had retained for further study a number of species, partly belonging to difficult groups, and among them I have found some forms which are undescribed and of which descriptions are given in the present paper. One new species of Myodochidae belongs to a genus hither known only as Palearctic, and of the three new genera of this family here described two are remarkable by showing a decidedly closer affinity to Palearctic than to Indo-Australian genera, but this is probably due to our imperfect knowledge of the Myodochidae of the Oriental and Australian regions, the members of this family being of small size and much neglected by collectors.

Fam. PENTATOMIDAE.

Eumecopus vermiculatus, n. sp.

Oval, ochraceous, head above with six percurrent fuscous or partly dark ferruginous stripes, beneath with four not well-marked pale fuscous stripes, pronotal cicatrical areas mottled with pale fuscous, an impressed spot between ocelli and eyes, and basal half of the postfrenal part of the scutellum black, connexivum traversed through its whole length by a piceous band, pleural evaporative area tinged with ferruginous, membrane blackish-fuscous, the outer veins paler towards apex, abdomen beneath with a broad percurrent sublateral ferruginous band which inwardly is rather diffuse and disintegrated into small spots, and with a median vitta on the sixth segment and the basal lobes of the female genital segment ferruginous, spiracles fuscous; first two antennal joints dark sanguineous, base of basal joint pale ochraceous, third joint pale reddish, its apical half (except extreme apex) black (last two joints wanting), rostrum dark testaceous, last joint piceous, legs purplish-red,

1 Proc. Roy. Soc. Victoria, vii., pp. 287-302 (1895).

femora toward the base ochraceous, but with some longitudinal rows of subconfluent purplish spots, tibiae above toward the base with an ochraceous streak, tarsi pale reddish, apex of last joint infuscated; above rather thickly punctate with fuscous or black, the points largely placed in transverse irregularly waved or tortuous dark ferruginous or brownish lines, head impunctate but with the dark stripes punctulate, a medium line to pronotum (narrowed toward base), a small callus at basal angles of scutellum, apical half of its postfrenal part, and veins and costal margin of corium impunctate, the piceous connexival vitta punctulate, pleurae rather sparingly punctured with fuscous, on posterior half of propleurae with black. Head slightly broader than long and a little shorter than pronotum in the middle, juga at apex somewhat convergent over the clypeus a little before its apex, first antennal joint about two-thirds the length of the head and passing its apex by more than the half, second joint half the length of first, third $4\frac{1}{2}$ times longer than second, the articulation between the second and third joints distinct, but not admitting of free mobility, rostrum somewhat passing base of abdomen, its second joint a little shorter than third and fourth together. Pronotum with the lateral margins broadly and slightly sinuate, their apical third minutely denticulated, basal margin slightly sinuate, humeral spines short, directed outwards, their anterior margin forming a straight continuation of the pronotal lateral margins. Scutellum with the postfrenal part a little longer than broad and parallel in the middle. Hemelytra passing apex of abdomen by almost one-third the length of the membrane, corium reaching beyond middle of last connexival segment, its apical margin slightly sinuate behind the middle. Abdomen a little broader than the closed hemelytra, the apical angles of the segments right-angled, moderately prominent, venter irregularly finely striolate and finely remotely punctulate, impunctate in the middle, the median furrow rather broad but shallow, reaching apex of fifth segment, the distance between the exterior margin of the sublateral ferruginous vittae and the lateral margins of the abdomen occupying one-third of the distance between the spiracles and the abdominal margins, basal lobes of female genital segment somewhat rugose and sparingly granulate. Length (excl. membrane), ♀ 20 mm.

Queensland.

Somewhat related to *E. vittiventris*, Stäl, but with very much shorter second antennal joint, anteriorly denticulated pronotal lateral margins, and different colour-markings.

EUMECOPUS ADVERSIDENS, n. sp.

Elliptical, above purplish brown, thickly punctate, seven stripes to head, two spots before middle of pronotum and its lateral margins as far as to base of humeral spines, a callus at basal angles of scutellum and more than the apical third of its postfrenal part, costal and apical margins of corium, its veins, a jaggered vitta in the exocorium and in the basal half of the mesocorium, a spot behind middle of mesocorium emitting a narrow vitta obliquely forwards to the cubital vein and two less distinct vittae backwards to the apical margin, and several mottlings to pronotum, scutellum, and mesocorium pale ochraceous and impunctate, connexivum red, its exterior margin ochraceous interrupted by black at the incisures, membrane black, the exterior veins whitish grey toward apex; beneath ochraceous, head with a faint brownish vitta along the bucculae, pleurae and venter punctate with pale reddish brown, posterior part of propleurae more darkly punctate, middle of venter and its lateral borders as far as to the pale spiracles impunctate, a spot at basal and apical angles of the segments black, basal lobes of female genital segment infuscated; rostrum testaceous, last joint piceous, legs purplish red, coxae, trochanters, base and two or three streaks of femora, and a broad more or less complete subbasal annulation to tibiae ochraceous, last two tarsal joints pale red. Head longer than broad and slightly longer than pronotum in the middle, clypeus a little longer than juga, apical tooth of bucculae directed forward and somewhat outward, and very slightly downward, largely visible from above, black at tip, rostrum reaching base of fourth ventral segment, second joint distinctly longer than third and fourth together; (antennae wanting). Pronotum with the lateral margins rather deeply arcuately sinuate, their apical third finely crenulate, humeral spines rather long, directed outwards and a little forwards and upwards. Scutellum shorter than head and pronotum together, the postfrenal part a little longer than broad and narrowing from base to apex. Hemelytra passing apex of abdomen by more than one-third the length of the membrane, apical margin of corium slightly sinuate near middle. Abdomen very slightly broader than the closed hemelytra, ventral furrow rather deep, reaching apex of fifth segment, basal lobes of female genital segment rugose. Length (excl. membrane), ♀ 17.5 mm.

West Australia.

A well-marked species coming nearest to *E. acanthopygius*, Stål, but easily distinguished by many characters.

POECILOMETIS ELLIPTICUS, n. sp.

Elliptical, above ochraceous, rather thickly but not regularly punctured with dark fuscous or blackish, head with the lateral margins from eyes to apex of antenniferous tubercles and four percurrent vittae black, the outer vitta on each side broad, paler on the juga, and on the vertex longitudinally divided by an ochraceous line near its inner margin immediately inside the ocellus, the inner vitta on each side narrow, juga entirely punctate, but punctuation on vertex arranged in three rows on each side, the ochraceous parts of the head, the pronotal lateral margins (narrowly), a callus at the basal angles of the scutellum, somewhat less than the apical half of its postfrenal part, and the outer margin of the connexivum impunctate, membrane fuscous-black with whitish veins; beneath luteous, a sublateral vitta to anterior half of propleurae, two round spots at base of front acetabula, one round spot at base of middle acetabula, spiracles, and a ring surrounding them black, head finely and sparingly punctured with brown, pleurae punctate with fuscous, blackly and more coarsely so on the metapleural evaporative area, venter coarsely but very remotely punctate with black, the punctures becoming fuscous in the centre of the disk and toward the lateral margins; rostrum and legs testaceous, last joint of the former piceous, femora and tibiae spotted with fuscous, last tarsal joint fuscous. Head as broad as long and as long as pronotum in the middle, rostrum reaching middle of second ventral segment, its second joint subequal in length to the last two joints combined; (antennae wanting). Pronotum with the lateral margins obtusangularly sinuate before middle, their apical third bluntly and obscurely crenulated, the humeral angles a little prominent, almost right-angled. Scutellum as long as head and pronotum together, the postfrenal part almost one-half longer than broad, narrowing from its base, rather narrowly rounded at apex. Hemelytra passing apex of abdomen by a little less than half the length of the membrane, apical margin of corium straight. Abdomen behind the middle slightly broader than the closed hemelytra, the apical angles of the segments a little prominent, right-angled, ventral furrow reaching apex of fifth segment, broad and shallow, almost obliterated in the fifth segment, sixth male ventral segment in the middle somewhat shorter than the two preceding segments together, male genital segment very deeply sinuated, the bottom of the sinuosity arcuate, filled up with a pale membrane. Length (excl. membrane), ♂ 14 mm.

Queensland.

Apparently allied to the insufficiently described *P. uniformis* Schout., but without the conspicuous black impunctate area of the corium, and remarkable by the coarse puncturation of the evaporative areas and venter.

Poecilometis gibbiceps, n. sp.

Rather broadly oval, luteous, above rather thickly but not uniformly punctured with dark fuscous or blackish, head mostly not or very sparingly punctate, but with four densely punctulate dark fuscous stripes, the outer one on each side percurrent, the two inner stripes only extended through the vertex or much less distinctly indicated before it, six more or less distinct longitudinal stripes to pronotum and two oblong spots to mesocorium, all composed of more thickly set dark punctures, the outermost pronotal stripe placed close to the lateral margin, the next on each side oblique, subparallel with the sublateral stripe, the two median stripes forming a straight continuation of the outer stripes of the head, the anterior mesocorial spot placed just before the middle at the cubital vein, the posterior spot a little behind the middle at the radial vein, two apical spots to pronotum extended to the posterior margin of the cicatrical areas, and a more or less distinct vitta to anterior half of mesocorium sparingly punctate, lateral margins of pronotum (narrowly), a pronotal median vitta (very narrow or obliterated in the posterior half), a callus at basal angles of scutellum, an almost percurrent median vitta to it (sometimes longitudinally punctate in the middle) and its apex (broadly), the veins of the corium, its apical and costal margins (the latter at least from base to middle), and exterior margin of connexivum impunctate, membrane blackish with whitish veins, head beneath extremely finely almost concolorously punctulate, only the bucculae and a small area adjacent to their posterior part punctured with fuscous, pectus with a fuscous sublateral streak in the anterior half of the propleurae and with an irregular sublateral spot to mesopleurae, an oblong exterior spot to the evaporative area, and a triangular spot at interior end of this area plumbeous, all pleurae (including acetabula) more or less sparsely punctate with fuscous, a subquadrate spot adjoining the base of the four anterior acetabula and the space between the exterior margin of the irregularly rugose but impunctate evaporative areas and the lateral margin of the metapleurae impunctate, abdomen beneath with the extreme apical angles of the segments infuscated and with a small subimpressed comma-shaped fuscous spot immediately before and slightly on the inside of the spiracles which are also often narrowly encircled by fuscous, the ventral surface finely and sparsely punctate with brown, the punctures darker and more aggregated inside the level of the spiracles where they form a longitudinal band largely interrupted in the basal half of the segments within the spiracles by a transverse subtriangular exteriorly truncate spot in which the very fine punctures are colourless, as they also are in the median part of the disk and in a broad percurrent sublateral vitta inwardly reaching the spiracles, the ventral puncturation sometimes almost entirely concolorous, the only remains of the darkly punctate intraspiracular vitta being a few fuscous points forming a curved vitta between the basal margin of the segments and the interior end of the transverse impression beginning behind the spiracles, and a small transverse cluster of fuscous points of the apical margin of the segments; antennae (at least the three first joints), rostrum (except the piceous apical joint), and legs dark testaceous, femora and tibiae finely dotted with brown. Head a little broader than long, and about one-fourth shorter than pronotum in the middle, clypeus a little longer than juga, narrowing from base to near apex, its apical part deflected, juga with their apices approaching each other over the clypeus behind its apex, the apical part of their inner margin almost perpendicularly deflected (a character well seen from the front), vertex gibbous, first antennal joint rather stout, slightly curved, somewhat shorter than head and passing its apex by about three-fourths its own length, second joint one-third shorter than first, third twice the length of second (last two joints wanting), rostrum reaching base venter, first joint reaching base of head, second slightly shorter than the last two together. Pronotum with the lateral margins almost straight or very slighly sinuate, their anterior third very obscurely crenulated, humeral angles a little prominent, right-angled. Scutellum subequal in length to head and pronotum together, the postfrenal part distinctly longer than broad, narrowing from the base. Hemelytra slightly passing apex of abdomen, costal margin of corium straight near the base, then ampliately rounded, apical margin straight. Abdomen broader than the hemelytra, beneath somewhat flattened in the middle, but with the ventral furrow only reaching middle of third segment, fourth and fifth ventral segments in the male a little before the median part of the apical margin with a transverse series of stiff hairs arising from minute brown points, sixth male ventral segment in the middle as long as the two preceding segments together, its basal margin obtusely subangular in the middle, male genital segment constructed much as in *P. ellipticus*, but with the lateral margins of the sinuosity more distinctly rounded. Length, ♀ 13 mm., ♀ 14.5 mm.

Queensland; West Australia.

A very distinctive species, readily recognised by the structure of the head, etc. In the shape of the body it is somewhat similar to *P. edwardsti*, V. Duz., but is still broader and laterally more rounded.

Judging from the various localities it is distributed throughout Northern Australia.

Paramenestheus abditus, n. sp.

Oblong-oval, drab-coloured, above rather thickly punctured with dark fuscous, exocorium appearing lighter owing to its finer and paler puncturing, inner margin of juga, a vitta on clypeus continued to base of head, two broader short basal vittae to head between ocelli and eyes, the pronotal cicatrical areas, a subquadrate callus near basal angles of scutellum on the inner side of the black foveae, a median vitta in basal half of scutellum, two parallel vittae in its apical half not reaching apex and continued divergently from middle of scutellum toward its base, the lateral margins of its postfrenal part the veins of corium and clavus, and a vitta in apical half of mesocorium not far from the radial vein impunctate and generally paler, the postfrenal lateral margins of the scutellum and the radial vein much paler, whitish, a spot at inner end of pronotal cicatrical areas and at apex of scutellum, and a vitta on the mesocorium close to the postero-median part of the radial vein composed of subconfluent blackish points, membrane greyish, the veins scarcely darker, spiracles and extreme basal angles of the ventral segments fuscous, head beneath punctured the same as above, pleurae with two percurrent vittae composed of aggregated blackish points and separated by a rather broad very remotely punctate band, the exterior vitta with closer and darker punctures, and bordered on its outer side with an irregular interrupted impunctate vitta, lateral border of propleurae subbiseriately punctate, venter mostly impunctate, but on each side with a black-punctured posteriorly evanescent vitta forming a continuation of the inner pleural vitta, and with a faint trace of a similar sublateral vitta, sixth ventral segment punctured with fuscous in its posterior median part; antennae brownish rufescent, their first two joints, the rostrum (except the piceous apical joint), and the legs pale testaceous, femora and (less distinctly) tibiae dotted with fuscous. Head and antennae constructed as in the type of the genus (*P. terricolor* Bredd.), rostrum reaching middle of metasternum, second joint twice longer than the last two joints together. Pronotum at apex distinctly broader than head, apical angles produced in a very short apically truncate lobelet, lateral margins somewhat laminate and a little rounded. Scutellum shaped as in the typical species. Hemelytra slightly passing apex of abdomen. Sixth male ventral segment in the middle as long as the fifth and half the fourth together, its basal margin rounded; male genital segment moderately ascending, the apical margin depressed, trisinuate, the lateral sinuosities very shallow, the median one much deeper. Length, ♂ 9.5 mm.

Queensland.

Apparently coming nearest to *P. semoni*, Horv., but with somewhat shorter head, much darker three last antennal joints, different colour markings, differently sculptured scutellum, and otherwise punctured venter; the male sexual characters are probably also different, but this sex of *P. semoni* is still unknown.

Fam. MYODOCHIDAE.

Getes, n. gen.

Body subovate, beneath transversely strongly convex, somewhat compressed. Head shorter than broad and broader than apex of pronotum, a little longer than anterior lobe of pronotum, immersed to the eyes, clypeus slightly longer than juga, ocelli placed very near the eyes, antenniferous tubercles perpendicularly descending, contiguous to the eyes and ending slightly beneath the level of their lower angle, antennae rather long and slender, all joints linear, first joint passing apex of head by half its length, second twice the length of first, third one-fourth shorter than second, fourth as long as third, thicker than the two intermediate joints, bucculae very short, rostrum reaching middle of metasternum, first three joints subequal in length, fourth shorter, basal joint reaching base of head, longer than first antennal joint. Pronotum trapeziform, twice as broad as head, transversely impressed a little before middle and with a depressed apical collar, all margins straight, only the narrowly sublaminate or, rather, carinate lateral margins very slightly rounded near apex. Scutellum as long as broad, with a slightly raised smooth median line. Corium with the costal margin straight in its basal fourth, then somewhat ampliately rounded, apical margin straight, shorter than the claval suture, radial vein furcate behind the middle, forming an elongate triangular apical cell; clavus with four rows of punctures and somewhat confusely punctate between the two median rows which join before middle of clavus, proceeding as a single row to its base, the commissure as long as the scutellum. Posterior angles of metapleurae acute. Venter of the female with the fifth segment extremely short in the middle. Front femora a little thicker than the others, unarmed; middle and hind tibiae with a row of spine-like bristles beneath.

This genus does not seem to have any near ally among the described tropical genera, but is closely related to the Mediterranean genus *Hyalochilus*, Fieb., from which it differs in having the eyes a little less prominent beyond the pronotal apical angles, the bucculae shorter, the first antennal joint produced farther beyond the apex of the head, the second joint longer, the fourth not fusiform, the scutellum shorter, the front femora less slender, etc.

Getes fusciceps, n. sp.

Head dark fuscous, clothed with extremely fine and short recumbent white hairs, clypeus testaceous, still paler at the tip, pronotum and corium (with clavus) stramineous, rather thickly and finely punctured with ferruginous or brownish, anterior lobe of pronotum (excepting apical and lateral margins and a longitudinal median line) the abdomen ferruginous, impunctate, pronotal lateral margins testaceous with a small stramineous spot at the ends of the transverse impression, scutellum testaceous, brown-punctured, the median line and a sublateral vitta stramineous, impunctate, the apex fuscous, corium with a faint brownish spot just behind middle of costal border and with the apical angle fuscous, membrane whitish, between the veins with fuscous streaks and spots, pectus piceous, punctate, propleurae partly paler; antennae, rostrum, and legs testaceous, last antennal joint fuscous, apex of femora stramineous preceded by a fuscous annulation in the two posterior pairs, the spine-like bristles of the four posterior tibiae black. Hemelytra reaching apex of abdomen, corium with the costal border and veins impunctate, near the claval suture with the two ordinary punctulate lines, the smooth space between these lines broadest a little behind the middle and with a few punctures at this place. Length, ♀ 3.8—4.4 mm.

Tasmania.

The hind tarsi are not visible in the carded specimens, but as the first joint of the middle tarsi is only as long as the two other joints combined, it is probably not much longer in the posterior tarsi. In one specimen the pale impunctate sublateral vittae of the scutellum are lacking, but this specimen is abnormally developed also in other respects

Dieuches distanti, n. sp.

Black, clavus (except the black base) fuscous, posterior part of propleurae, and the abdomen castaneous, lateral borders of prothorax from before middle of anterior lobe to a little beyond apex of posterior lobe, an abbreviated median line and a spot on each side of this to posterior pronotal lobe, apex of scutellum a prominent basal streak at exterior margin of clavus and a much shorter streak at the opposite claval margin, basal half of corium (excluding a vitta at middle of claval suture, a median suffusion, and an oblong costal spot, which are fuscous), a large triangular costal spot in apical half of corium, a small spot at exterior basal angle of membrane, and a large rounded apical spot to it, epipleura of corium (except two oblong fuscous spots), posterior angle of metapleura, and a lateral spot to fourth and fifth abdominal segments whitish; antennae, rostrum (except the testaceous two intermediate joints), and legs fuscous, a broad subbasal annulation to fourth antennal joint, trochanters, base of front femora, and a little less than basal half of middle and hind femora whitish. Head impunctate, as long as anterior pronotal lobe, ocelli placed near eyes, first antennal joint a little longer than anteocular part of head and passing the apex by half its length, second joint about double the length of first rostrum reaching middle coxae. Pronotum as long as broad, the laminate lateral margins reaching the base, anterior lobe finely and sparsely punctate, more than one-half longer than the posterior lobe which is rather coarsely and thickly punctate, basal margin straight. Scutellum somewhat indistinctly punctate. Corium in its basal half finely punctured (mostly in rows) with fuscous, the white preapical costal spot finely and sparsely punctate with pale fuscous, its anterior margin transverse, the posterior margin oblique. Prosternum with a conspicuous foveate impression on each side of the base of the acetabular fissure, finely transversely strigose and minutely sparsely punctate, anterior prosternal border and posterior part of propleurae coarsely and thickly punctate.

Abdomen almost glabrous, the pale lateral spot of the fourth segment oblong, that of the fifth subquadrate. Anterior femora moderately incrassated, beneath biseriately spinous almost down their whole length, anterior tibiae in the male armed beneath with about four acute tubercles; intermediate femora (♂) beneath in the basal half with a few spines; first joint of posterior tarsi about three times longer than the two other joints together. Length, ♂ 7.8 mm.

West Australia.

Notable by having (at least in the male) also the middle femora spinous beneath; not nearly allied to any described Australian species. The eyes are red in the type, but this character cannot be relied on in dry specimens.

Named after Mr. W. L. Distant, to whom we owe so much of our quantitative knowledge of the Australian Hemiptera.

Paradrymus, n. gen.

Body ovate, somewhat depressed above, strongly transversely convex beneath, distinctly punctate all over except on the venter. Head broader than apex of pronotum, equal in length to anterior pronotal lobe, very slightly exserted, as long as broad, clypeus conspicuously produced beyond the juga, eyes globose, strongly prominent, but not large, the very small ocelli placed behind the level of the posterior margins of the eyes, about as far from them as from the median line of the head, the space between eyes and apex of antenniferous tubercles a little shorter than the eyes, bucculae small, rounded, throat horizontal, antennae long and slender, first joint passing apex of head by about one-third its length, second the longest, third and fourth subequal in length, each of them longer than first, rostrum slender, reaching beyond hind coxae, first joint distinctly longer than first antennal joint, almost reaching base of head, second subequal in length to the last two put together, third much longer than fourth. Pronotum subgradually narrowed from base to a little beyond middle, then more strongly rotundately narrowed to apex, transversely distinctly impressed somewhat behind the middle, at apex with a distinct but narrow linear collar, at base more than two times broader than head, lateral margins narrowly laminate but more broadly so at the ends of the transverse impression where they are angularly dilated inwards and very slightly sinuate exteriorly, basal margin almost straight, anterior lobe somewhat convex, posterior lobe with a longitudinal impression in the middle of its anterior half. Scutellum equilaterally triangular, its basal half with a triangular, medially somewhat impressed elevation emitting a keel to the apex. Prosternum about as long as meso- and metasternum together; posterior margin of metapleura straight, forming a right angle with the lateral margin. Hemelytra entirely covering the abdomen, corium with the median vein distinct in its apical part, obliterated toward the base, the costal margin straight in its basal third, then somewhat ampliately rounded, apical margin straight, shorter than the claval suture, clavus with three rows of punctures, its commissure shorter than half the length of the scutellum, the next inmost vein of the membrane curved strongly inwards in its basal half. Abdomen with the connexivum reflected, the sutures of the three basal ventral segments crenulate, fourth segment anteriorly with two sublateral glandular spots but with no such spot near the posterior margin, sixth male ventral segment deeply emarginate at apex with the apical angles very acute, male genital segment with a small oblong tubercle near apex. Front femora incrassated, beneath in the whole apical half longitudinally impressed, the impression terminated on its anterior side by a row of very small thick-set teeth with one much larger tooth in the middle of the row, in the male moreover provided with a small tubercle at the basal end of the impression; all tibiae almost bare, without spine-like bristles, front tibiae straight, in the female triangularly a little dilated at apex, much more strongly so in the male, which has the dilatation angularly inflected and armed with a spur beneath; first joint of hind tarsi about one-half longer than the two other joints together.

This genus is on the whole more related to *Drymus*, Fieb., which is chiefly represented in the Palearctic region, than to any other described genus, and in its general aspect it is also rather similar to that genus, from which it differs mainly by the longer head with more projecting clypeus and longer rostrum, by the structure of the scutellum, the differently curved costal margin of the corium, the lack of distinct foveae in front of the fore acetabula, the shape of the sixth male ventral segment, and the somewhat differently armed fore femora.

Paradrymus exilirostris, n. sp.

Black, finely and very thickly subgranularly punctate, posterior lobe of pronotum and sometimes corium pale testaceous, somewhat less densely punctured with fuscous, but corium usually fuscous with two spots on exocorium and three spots (one median and two apical) on mesocorium testaceous, the apical and the narrow laminate lateral margins of pronotum dark testaceous, paler at the ends of the transverse impression, membrane fuscous, the veins and a few more or less distinct spots testaceous, abdomen beneath indistinctly punctulate, its lateral borders paler, sometimes the whole venter brown, antennae fuscous, apical half of last joint (except extreme apex) pale testaceous, rostrum and legs testaceous, femora fuscous. Second joint of antennae not quite twice, and third joint one-half longer than first. Rostrum nearly reaching apical margin of second ventral segment. Pronotum more than one-half broader than long. Hemelytra reaching apex of abdomen. Sixth male ventral segment in the middle somewhat longer than fifth. Length, ♂ ♀ 4.8—5.6 mm.

Queensland; Victoria.

TAPHROPELTUS AUSTRALIS, n. sp.

Head black, finely and very thickly punctate, slightly longer than anterior pronotal lobe, the postocular part very short, antennae rather stout, a little longer than half the length of the body, the first two joints testaceous, second two-thirds longer than first, the last two joints fuscous, third a little shorter than second, fourth as long as third, reddish at apex, rostrum testaceous, reaching middle of mesosternum. Pronotum distinctly transversely impressed behind middle, anterior lobe black, finely and very thickly punctate, with a round foveate median impression before the base and on each side between this and the lateral margins with a smaller somewhat obsolete foveola, almost one-half longer than the posterior lobe which is stramineous, finely and more sparsely punctulate with brown, longitudinally slightly impressed in the middle of its anterior half, with five dark fuscous vittae, one in the middle and two oblique ones on each side starting from the same point near the humeral angles, the narrowly laminate not sinuate pronotal lateral margins whitish. Scutellum black, finely punctulate, the apex, the apical end of the median keel, and a lateral vitta white, these vittae beginning a little before the middle and becoming narrowly linear posteriorly where they join the apex. Corium and clavus stramineous, the former almost impunctate, only in the basal half (mostly along the veins) with a few very small brownish punctures, the veins, a somewhat sinuous submedian fascia (not entering the clavus), and an oblong spot at the apical angle dark fuscous, the two ordinary punctured lines near the claval suture, and the two exterior ones of the three similar claval lines placed extremely close to each other both on the corium and on the clavus, all these five lines composed of very small points; membrane variegated with whitish and fuscous, the veins pale. Body beneath piceous, almost impunctate, acetabula pale ferruginous. Legs stramineous, all coxae and the fore femora pale ferruginous, the latter with a spine a little in front of the middle and a row of very small teeth between the spine and the apex, fore tibiae almost straight. Length, ♀ 3 mm.

Victoria.

This fine little species is somewhat similar to the Mediterranean *T. nervosus*, Fieb., but the posterior pronotal lobe is more marked with fuscous vittae, the antennae are differently coloured, etc.

The genus *Taphropeltus*, Stål, was hitherto known only from the western Palearctic region, but seems to be widely dispersed in the Old World. I have an undescribed *Taphropeltus* from Java, and *Scolopostethus putoni*, B. White, from New Zealand, probably belongs here, as Buchanan White compares it with *Sc. contractus*, H. Sch., which is a *Taphropeltus*.

Myocara, n. gen.

Body elongately ovate. Head a little shorter than pronotum, slightly broader than the pronotal apical collar, but a little narrower than the pronotum just behind the collar, immersed almost to the eyes, impunctate, distinctly longer than broad, the anteocular part also longer than broad, triangularly produced in front of the antennae, acute at apex, clypeus scarcely longer than juga, the space between eyes and base of antennae shorter than an eye, the small ocelli almost contiguous to the eyes, throat horizontal, bucculae very short, semicircular, antennae rather long and slender, first joint passing apex of head by half its length, second twice as long as first, third somewhat shorter than second and a little longer than fourth, which is not thicker than the others, rostrum reaching far beyond base of venter, first joint as long as first antennal joint, but not reaching base of head. Pronotum (in the brachypterous form) but a little broader than long, at the base almost twice broader than head, gradually a little narrowing from the base to near apex, where it is rather strongly roundedly narrowed to the depressed collar which is separated from the impunctate anterior pronotal lobe by an impressed punctate line, the lateral margins narrowly depressed, not sinuate, apical and basal margins straight, the somewhat convex anterior lobe twice as long as the thickly punctate posterior lobe which is depressed, especially in the middle. Scutellum distinctly longer than broad, almost flat, punctate. Hemelytra in the brachypterous form reaching base of last dorsal segment, apical margin of corium rounded, clavus and basal half of corium coarsely and thickly punctate, apical half of corium more superficially and sparingly punctate, clavus with the puncturation arranged in four rows, the commissure as long as the scutellum, radial vein only reaching middle of corium, basal half of exocorium with a single row of close punctures, the apical half fused with the mesocorium owing to the abbreviated radial vein, membrane rudimentary, appearing only as a narrow coriaceous strip attached to the apical margin of the corium. Pectus punctate. Abdomen impunctate, last female dorsal segment with the apical margin angularly sinuate in the middle, fourth ventral segment with two sublateral glandular spots near base and a third one behind the middle, fifth female, ventral segment very short in the middle. Front femora somewhat incrassated, beneath in the apical half with two small spines; middle and hind tibiae with a few stiff bristles; first joint of hind tarsi twice as long as the two other joints together.

Type: RHYPAROCHROMUS ACUMINATUS, Dall.

Allied to the Neotropical genus *Esuris*, Stål (as represented by its type[1]), from which it differs by the very long rostrum, the longer scutellum, the much longer hind metatarsus, and by having the radial vein of the corium very distinct in its basal half; from the Indian genus *Lua*, Dist., it is distinguished by the less incrassated and less convex subglabrous body, the narrower, apically more pointed head, the much less transverse pronotum, the narrower scutellum, the (basally) very distinct radial vein, and by having the basal joint of the antennae produced much beyond the apex of the head.

The species upon which this genus is founded has stood for many years in our catalogues among the "species incerti generis," and Distant says nothing of it in his revision of the Hemiptera of the British Museum, although he must have seen the type.

MYOCARA ACUMINATA, Dall.

Queensland.

Apart from some generic characters detailed above, I have little to add to Dallas's description which fits the specimen before me so well that I feel sure of the identity.

1 The Guatemalan *E. purpurata*, Dist., is possibly an *Esuris*, but that the North American *E. astanea*, Barb., does not belong to this genus is clear from several characters.

The impressed points of the upper side of the body bear a very small round whitish scale, visible only when viewed vertically from above. The last antennal joint, which is missing in Dallas's type, is pale testaceous. The tergum of the abdomen and the female genital segment are castaneous. The apex of the femora is of the same testaceous colour as the tibiae and tarsi. The male is still unknown.

I know only the brachypterous form of this insect, but Dallas had before him both this form and an immature specimen of the macropterous form. Although he does not mention it, I suppose that the macropterous form has the pronotum somewhat broader at the base with comparatively shorter anterior lobe, the ocelli a little larger, and the corium less rounded at apex. It is probable that *Esuris* and *Lua* also are pterygo-dimorphous, as the Australian genus *Euander*, Stål, has proved to be.

Fam. HENICOCEPHALIDAE.

Systelloderes aetherius, n. sp.

Smooth, shining, subglabrous, darkish testaceous, hemelytra and abdomen opaque, the former fuscous, the latter greyish brown, somewhat mottled with pale testaceous, pubescent, more longly pilose at and near apex, rostrum and legs pale testaceous, sparingly shortly pilose. Head as long as the pronotum in the middle, basal lobe slightly broader than long and a trifle broader than the width across the eyes, somewhat flattened, its lateral margins moderately rounded, eyes small, antennae about as long as head and half the pronotum together, very slightly pilose, first joint very short, the three following joints equal in length, each as long as the basal lobe of the head. Pronotum a little longer than broad, basal margin rather deeply arcuately sinuate, apical lobe a little broader than head, with an extremely fine impressed longitudinal line in the middle, median lobe one-third (♂) or one-fourth (♀) narrower than basal lobe, in the male subequably rotundately narrowing toward apex, in the female subparallel from base to beyond middle, then rather suddenly narrowed, in the middle with a longitudinal impression not widening posteriorly and not quite reaching the base. The basal margin in the middle somewhat produced backwards over the apical part of the basal lobe, which is almost three times longer at the sides than in the middle, slightly (♀) or more distinctly (♂) narrowed from base to apex. Scutellum broader than long, somewhat flattened, the lateral margins straight. Hemelytra a little shorter than the abdomen. Legs short, fore femora rather strongly incrassated, about $2\frac{1}{2}$ times longer than broad, above longitudinally convex, beneath straight, fore tibiae gradually widened from the base to the apex where they are but little narrower than the femora at their greatest breadth, hind femora shaped almost as the front femora and not longer, but slightly narrower and a little more compressed, reaching middle of venter, hind tibiae a little shorter than the femora, subparallel from apex to near middle, then strongly narrowed toward the base. Length, ♂ ♀ 3.3 mm.

Queensland.

The genus *Systelloderes* is new to Australia, but is probably of the same world-wide distribution as *Henicocephalus*. It is represented in the Neotropical region by a few (partly undescribed) species, in North America by one, and in Europe by one species. No species has hitherto been recorded from Africa or Asia, but I know an undescribed species from the Philippine Islands, and the insect described by Enderlein from Crozet Island under the name *Phthirocoris antarcticus* is doubtless the larva of a *Systelloderes*.

Fam. REDUVIIDAE.

ONCOCEPHALUS QUOTIDIANUS, n. sp.

Pale testaceous, head above and pronotum with the typical linear fuscous markings and black ocellar spot, a broad lateral vitta to head and two narrow vittae on the throat between the eyes fuscous, scutellum (except the apical process) black, hemelytra with the same fuscous markings as in *O. confusus*, Reut. (and most other species), but with the ground-colour paler down the middle of the corium and in the basal part of the exterior membranal cell, connexivum with two fuscous lines, the outer line placed immediately within the lateral margin, breast and venter typical in colour and markings, close to the ventral lateral margin a narrow fuscous vitta which is somewhat darker and a little dilated just before the apical angles of the segments; antennae testaceous, first joint (except basal part) tinged with pale fuscous, apex of second and the whole third and fourth joints fuscous; rostrum fuscous, beneath, first joint also above, and second joint around the base pale testaceous; legs whitish testaceous, fore and middle coxae irrorated with fuscous, hind coxae with four shining black vittae, the three interior ones confluent at the base, the outermost vitta much shorter than the others and not reaching the base, front femora densely mottled with pale fuscous, beneath with two dark fuscous vittae, middle and hind femora rather broadly fuscous at apex, front tibiae with a subbasal, a submedian, and an apical fuscous annulation, middle and hind tibiae with an incomplete annulation very near the base and the extreme apex fuscous, but with no trace of the fuscous ring placed before the middle in almost all other species, the tarsi fuscous at apex. Head with the anteocular part a little longer than the remainder, eyes viewed from above hemispherical, as long as broad, their anterior and posterior curvatures equally strong, seen from the side (in the ♂) occupying almost the whole height of the head, the throat between the eyes as broad as the base of the first rostral joint, antennae (♂) with the first joint as long as the distance between its base and the ocelli, above with very few and short semidecumbent hairs, beneath glabrous, second joint twice the length of first, linear, shortly semierectly pilose, still more shortly and sparingly so toward the base, first and second rostral joints equal in length. Pronotum as long as broad, with a lateral tubercle somewhat in front of the transverse impression, the apical margin distinctly angularly sinuate, the tubercle of the apical angles directed outwards and somewhat upwards, its anterior margin transverse, the posterior margin obliquely sinuate, the lateral margins granulated between the apical and lateral tubercles, the pronotal lobes subequal in length, anterior lobe slightly, posterior one twice broader than long, the humeral angles acute, slightly prominent. Scutellum slightly recurved at apex. Prosternum with the apical spinules short, curved. Fore trochanters with about three small teeth, fore femora as long as pronotum and postocular part of head together and three times longer than broad, beneath with about eleven teeth and two setiferous granules between each pair of teeth, the superior subbasal sinuosity broad and rather shallow, fore tibiae reaching trochanters, fore tarsi less than one-third the length of tibiae; hind femora somewhat passing apex of abdomen (♂), a little shorter than the tibiae. Length, ♂ 14 mm.

Victoria.

Allied and very similar to *O. confusus*, Reut., but smaller and narrower, and with the anteocular part of the head a little longer, the eyes seen from above shorter and more globular with their anterior and posterior curvatures equally strong (in *confusus* longer than broad with the anterior curvature less pronounced), the throat broader between the eyes, the second antennal joint perceptibly shorter and more shortly setose, the fore tarsi shorter, and the posterior legs quite differently coloured.

[Proc. Roy. Soc. Victoria, 29 (N.S.), Part I., 1916].

Art. II.—*Heteropterous Hemiptera collected by Professor W. Baldwin Spencer during the Horn Expedition into Central Australia.*

By DR. E. BERGROTH, C.M.Z.S., Lond.

(Communicated by Professor W. Baldwin Spencer, F.R.S.)

Before the expedition to Central Australia, organized and equipped by Mr. Horn twenty years ago, no Hemiptera (and scarcely any insects at all) were known from those regions. The collections brought home by the expedition are therefore of unusual interest. The Hemiptera are not represented by a great number of species, nor could they be expected to be so, considering the aridity of the territory. More recently Central Australia has been visited by Mr. H. J. Hillier, whose collections are now in the British Museum. They were made east of Lake Eyre, whereas the Horn expedition explored the tracts west and north-west of this lake. Of the Hemiptera collected by Mr. Hillier some new species, mostly Pentatomidae (three of which were also found by the Horn expedition), have been described by Mr. Distant, but so far as I know he has not yet published any list of all the collected species.

Fam. THYREOCORIDAE.

1. Adrisa, sp.

Crown Point.

Allied to *A. mayri*, Sign., but probably distinct.

Fam. SCUTELLERIDAE.

2. Choerocoris paganus, Fabr.

Illamurta, James Range.

Fam. PENTATOMIDAE.

3. Oechalia consocialis, Boisd.

Stevenson River.

4. Oncocoris desertus, n. sp.

Oval, pale ochraceous, beneath still paler, whitish, a small spot at outer basal angle of connexival segments and at base of acetabula, two small widely separated basal spots to fourth and fifth ventral segments, spiracles, scattered dots to femora, and the stridulatory spicula of the hind femora brown, membrane pale greyish with whitish veins, last rostral joint, except base, pitchy black; above finely and sparsely punctured with brown but with impunctate areolets here and there, connexivum almost concolorously punctulate; beneath more palely and, on the venter, more finely and remotely punctulate, the latter with its middle part and lateral borders (as far as the spiracles) impunctate; at exterior end of pronotal cicatrical areas, behind interior part of these, at basal angles of scutellum, and in each pleura with a small cluster of dark fuscous punctures. Head slightly shorter than its breadth and than the pronotum in the middle, a little incised at apex between juga and clypeus, first antennal joint scarcely reaching apex of head, second a little longer than third which is pale ferruginous above toward the tip (last two joints wanting), rostrum slightly passing hind coxae. Pronotum $2\frac{1}{4}$ times broader than long in the middle, lateral margins straight, only behind the apical angles a little sinuate, lateral angles obtuse, scarcely prominent. Scutellum with a small elevated impunctate callus at basal angles. Hemelytra somewhat passing apex of abdomen. Male genital segment with the apical margin sinuate in the middle and with the apical angles slightly callose. Length (excl. membrane), ♂ 8 mm.

Illamurta, James Range.

A very pale, finely punctured species, easily recognisable from the others.

N.B.—The genus *Kalkadoona*, Dist., from Central Australia, which Distant placed among the true Pentatominae, belongs to the division Platycoriaria of the subfamily Halyinae. It has the typical ventral stridulatory vittae of that group and is closely related to *Oncocoris*, Mayr. I saw the type of *Kalkadoona centrimaculata*, Dist., in the British Museum.

5. Alcaeus hermannsburgi, Dist., Ann. Mag. Nat. Hist. (8) VI., 373 (1910) [*Muritha*]; Bergr., Ent. News. XXIII., 23 (1912).[1]

Crown Point; near Storm Creek; Charlotte Waters; Stevenson R.

6. Eumecopus superbus, Dist.

Paisley Bluff, Macdonnell Range.

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1 Bibliographical references are here appended only to the species not included in the "Catalogue des Hémiptères" of Lethierry and Severin or in Kirkaldy's Catalogue of the Pentatomidae.

7. Eumecopus y-nigrum, n. sp.

Elliptical, ochraceous, above (excluding head) and on the pleurae and epipleurae rather densely but irregularly punctured with brown, the punctures placed in a network of dark ferruginous tortuous lines, three small basal spots to scutellum, the apical half of its postfrenal part, and a spot behind middle of corium impunctate or almost so, head above with four longitudinal brown or dark ferruginous bands, the inner ones of which are in their apical half (rarely throughout) longitudinally divided by ochraceous, and beneath on each side with three similar bands, the outermost being in its basal half (between eyes and base of antennae) broader and partly visible from above, scutellum with a large black **Y**-shaped marking reaching the middle of the postfrenal part where it occupies the whole breadth of the scutellum, the anterior branches of this figure exteriorly not quite reaching the lateral margins, anteriorly reaching the basal fourth of the scutellum, connexival segments with a transverse brown spot at base and apex, their apical angles ochraceous tipped with brown or entirely brown, membrane brownish, basal and outer borders black, the veins whitish grey, evaporative area of metapleurae greyish brown, abdomen beneath on each side with a broad purplish brown or dark fuscous band outwardly reaching a little beyond the spiracles and emitting a transverse fascia to the lateral margin along the basal and apical margins of the segments, the disk between the longitudinal bands sparingly punctured with brown and on the sixth segment usually with a brown median vitta, basal half of male genital segment dark brown or black, lobes of female genital segment more or less spotted with fuscous; antennae fuscous or blackish, the two first joints reddish brown, all or at least the last three joints at base and second joint at apex yellowish testaceous, rostrum and legs ochraceous, last joint of the former piceous, some streaks and spots to femora, more than apical half of tibiae and their whole upper lateral keels purplish brown, apex of last tarsal joint reddish. Head almost as long as the pronotum in the middle and as broad as long, the ochraceous parts impunctate, the dark vittae finely punctured, antennae five-jointed, first joint two-thirds the length of head and passing apex of head by more than its half, second subequal in length to first, somewhat nodosely dilated at base, third not quite twice the length of second and well separated from it by a distinct articulation, fourth slightly shorter than third, fifth a little longer than second, rostrum somewhat passing middle of third ventral segment or (usually) reaching base of fourth. Pronotum with the somewhat sinuate lateral margins finely serrulated from apical angle to beyond middle, the short humeral spines directed outward. Hemelytra passing apex of abdomen. Abdomen beneath broadly but not deeply grooved from its base to apex of fifth segment; apical margin of male genital segment on each side with two subconical processes separated by a deep incision, the middle of the margin with a short triangular process preceded by two tubercles and not reaching the apex of the two acute convergent appendages which protrude from the interior of the segment; last female ventral segment at middle of apical margin and female genital lobes palely setose. Length (excl. membrane), ♂♀ 20—22 mm.

Var.: membrane whitish hyaline, its basal border brown.

Bagot's Creek; Alice Springs; River Finke near Horse-shoe Bend; Stevenson R.; Dalhouse Springs.

A very distinct species to be placed in Stål's group *d.* The males of this species are not smaller than the females.

8. Eumecopus horni, n. sp.

Elliptical, ochraceous, six percurrent longitudinal punctulate stripes to upper side of head brownish ferruginous, lateral borders of pronotum (excluding extreme margins from apex to beyond middle), a percurrent median pronotal vitta, lateral areas of scutellum (except middle part of margins), a subangular vitta behind middle of mesocorium, and connexivum black, the latter with a few small subconfluent spots at base and apex of the segments, the lateral margins and apical angles ochraceous; membrane fuscous, basal and exterior borders black, the veins greyish white; pronotum, scutellum, and corium punctured with dark fuscous, more thickly and confluently so on pronotum and scutellum, pronotal cicatrical areas almost impunctate and emitting an impunctate streak to the apical margin, scutellum with an oblong callose spot near basal angles and a smaller basal median spot impunctate, the apical half of its postfrenal part very sparingly almost concolorously punctulate; head beneath on each side with three fuscous longitudinal bands, the outermost in its basal half broader and partly visible from above, the two inner ones narrow and composed of close-set punctures; pleurae and venter punctured with fuscous, the latter with the broad lateral borders (not quite reaching the spiracles) and three discal longitudinal bands impunctate, a percurrent sublateral ventral vitta, an oblong median spot to the sixth segment, and spots to the female genital lobes dark fuscous; antennae fuscous, irrorations to upper side of first joint and a rather narrow basal annulation to third joint ochraceous (fourth joint wanting); rostrum and legs ochraceous, last joint of the former black, numerous small round spots to femora mostly arranged in rows, and tibiae, except a median annulation, fuscous (hind legs wanting). Head one-fourth longer than broad and subequal in length to the pronotum in the middle, clypeus conspicuously surpassing apex of juga, first joint of antennae as long as anteocular part of head and passing its apex by about half its length, second joint more than twice the length of first, cylindrical, not at all incrassated in its basal part, third joint above one-third shorter than second, rostrum reaching middle of fifth ventral segment, second joint longer than third and fourth taken together. Pronotum with the lateral margins slightly sinuate in the middle, serrulate in their anterior half, the short humeral spines directed outwards. Scutellum with a foveolate impression in the basal angles. Hemelytra passing apex of abdomen by about one-third the length of the membrane. Abdomen beneath deeply grooved from its base to the apex of the fifth segment. Length (excl. membrane), ♀ 19 mm.

Alice Springs.

The antennae are incomplete in the type, but from the great length of the second joint there can be little doubt that they are four-jointed. The species is related to *E. armatus*, Fabr., but is at once distinguished by the structure of the antennae. It is not impossible that *E. calidus*, Stål (nec Walk.) belongs to *horni.*

9. Eumecopus eyrei, Dist. Mag. Nat. Hist. (8) VI., 378 (1910).

Crown Point; Illamurta, James Range; Finke River near Horseshoe Bend; Stevenson R., Sullivan Creek.

Crown Point; Illamurta, James Range; Finke River near Bend; Stevenson River.

This species, which is known to me also from West Australia, is easily recognised from the good description, but it is not allied to *E. vittiventris*, Stål, as Distant says, belonging in fact to another group of the genus and coming very near *E. fuscescens*, Stål. The second antennal joint is somewhat variable in length, being sometimes, as in Distant's type, little more than one-third the length of the first joint, but usually at least one-half its length; the fifth joint, which was lacking in the type, is a little shorter than the fourth and of the same colour. The male genital segment is similar to that of *E. fuscescens.*

10. Poecilometis spenceri, n. sp.

Suboval, ochraceous, four longitudinal stripes to upper side of head (the exterior ones narrowing in the anteocular part), an oblong spot behind middle of corium at apex of rimula, membrane (except the greyish white veins), a lateral vitta to head under the margin, a vitta in the anterior half of the propleurae, spiracles, a median streak to sixth ventral segment, and last joint of rostrum and of tarsi black, the first two antennal joints ochraceous sprinkled with small fuscous points, blackish on their outer side (except apex of second joint), third joint blackish excepting base and apex (last two joints wanting); above rather thickly and strongly but not uniformly punctured with black, the puncturation becoming denser in seven percurrent stripes on the pronotum (the three median ones parallel, the outermost placed immediately within the lateral margin), in the narrow basal part of the exocorium, and in an oblong area before middle of mesocorium close to the cubital vein, whereas an anteriorly three-branched scutellar vitta (posteriorly reaching a little beyond the frena), a narrow area interiorly bordering the rimula, a spot behind middle of mesocorium near cubital vein, and a somewhat waved vitta behind the rimula are but sparingly punctured, a percurrent median stripe to head, two stripes to vertex between the ocelli, a median line on anterior half of pronotum, the pronotal lateral and basal margins, a callus at basal angles of scutellum, anterior half of costal margin, apical margin and veins of corium, and exterior margin of connexivum impunctate; beneath less strongly and somewhat less thickly punctured with black, the puncturation getting thinner in the middle of the venter; femora and tibiae rather densely dotted with black. Head as long as broad and one-fourth shorter than the pronotum in the middle, first antennal joint as long as head and passing apex of head by about four-fifths its length, second joint somewhat shorter than first, third as long as first, rostrum reaching a little beyond base of abdomen. Pronotum with the slightly sinuate lateral margins bluntly crenulated in their apical third, the lateral angles subacutely a little prominent with a small sinuosity behind the angles. Hemelytra reaching a little beyond abdominal apex. Abdomen with apical angles of sixth segment shortly and acutely triangularly produced backward, ventral furrow very distinct, reaching apex of fifth segment, but much shallower in fourth and fifth segments. Length, ♀ 18.5 mm.

Alice Springs.

In this very distinct species the apical angles of the sixth abdominal segment are shortly spinously produced as in the genus *Eumecopus*, but on account of the short head and the only subacutely prominent, not spinous, humeral angles it must be referred to *Poecilometis*, with which it also agrees in its general aspect.

11. Cephaloplatus nubifer, n. sp.

Oval, somewhat convex, about one-half longer than its greatest width, testaceous, paler beneath, a narrow impression at basal angles of scutellum and a spot at basal angles of connexival and ventral segments black, middle of sterna, a curved vitta to pleurae, spiracles, ventral sutures in the middle, and last rostral joint piceous, in specimens with well pronounced colouring a waved fuscous transverse line between pronotal humeral angles; membrane dull greyish with fuscous veins and spots; moderately thickly but somewhat irregularly punctured with fuscous, the laminately expanded lateral borders of the prothorax more remotely and coarsely punctate, connexivum very remotely punctured, a spot behind middle of corium, a rather narrow median vitta to venter, and ventral lateral borders impunctate, pronotum, scutellum, and corium with clusters of thick-set punctures, four of these clusters placed in a transverse row before middle of pronotum, four at basal margin of scutellum, one at scutellar lateral margins before their middle, and three in the corium placed successively, the hindmost at the apical margin; almost the whole front femora, apical part of middle and hind femora, and upper side of all tibiae sprinkled with round fuscous spots. Head as broad as long, a little incised at apex, lateral margins in front of eyes with an angular prominence directed outwards, then rounded, juga contiguous in front of clypeus, rather narrowly rounded at apex, second antennal joint a little passing apex of head, with an obscure dark annulation before the tip (last three joints wanting). Pronotum in the middle as long as head, apical angles subacutely produced forwards, reaching (in the normal position of the head) a little beyond anterior margin of eyes, lateral margins scarcely or very minutely crenulated, slightly sinuate behind middle and with a small indentation immediately behind apical angle, lateral angles obtuse, a little prominent. Scutellum somewhat granulated (more distinctly so when seen in profile), laterally distinctly sinuate behind middle, postfrenal part but slightly narrowing from its base and as broad as long, comparatively broadly rounded at apex. Hemelytra almost or quite reaching apex of abdomen, costal margin of corium obscurely crenulate in its basal part, membrane rather small, half the length of corium. Abdomen with the apical angles of the segments bluntly prominent, male genital segment with the apical margin obtusangularly sinuate, its apical angles slightly prominent. Length, ♂ 9.5—10 mm.

Macdonnell Range; Alice Springs.

Not closely allied to any previously described species. I have also seen an undetermined specimen of it in the British Museum.

N.B.—In the males of *Cephaloplatus*, which were unknown to Stål, the sixth ventral segment is rounded at the base, not angular as in the allied genus *Dictyotus*, Dall.

Hypolcus, n. gen.

Body oval, somewhat depressed. Head about as broad as long and almost as long as pronotum in the middle, a little convex, lateral margins subacutely narrowly carinated, rotundately angular, scarcely or very slightly sinuate behind middle, clypeus parallel in its basal half, then narrowing toward the tip, juga a little longer than clypeus, but neither meeting nor convergent in front of it, subacute at apex, ocelli about three times more distant from each other than from the eyes which are rather small but prominent, touching apical margin of pronotum (in the normal position of the head), narrowly oval when seen obliquely from before, their vertical diameter being much longer than the horizontal, interocular space over four times broader than an eye, antenniferous tubercles small, not visible from above, antennae five-jointed, first joint very short, little more than twice longer than broad, the three following joints on the whole subequal in length though somewhat variable in this respect, second not quite reaching apex of head, fifth a little longer than fourth, the four last joints successively increasing in thickness, bucculae low, percurrent, neither ampliated nor angular at anterior end, rostrum reaching beyond hind coxae, first joint slightly passing bucculae, second shorter than the last two together, third shorter than second but longer than fourth. Pronotum with the apical margin neither elevated nor levigate, rather deeply arcuately sinuate behind interocular space of head, truncate behind eyes, lateral margins not or very obscurely crenulated, not reflexed but laminately dilated, gradually more widely so toward the apical angles which are produced forward in a subtriangular, apically subtruncate lobe almost reaching or slightly passing the level of the anterior margin of the eyes, lateral angles subrotundate or obscurely notched, not prominent, postero-lateral and basal margins straight. Scutellum a little longer than broad and about as long as pronotum and head together, with a small levigate callus near basal angles, lateral margins a little sinuate almost in the middle, frena scarcely passing middle of scutellum, the postfrenal part of which is a little longer than broad, gradually somewhat narrowing from its base to the rounded apex. Hemelytra slightly passing apex of abdomen, rimula reaching far beyond middle of corium, the apical margin of which is straight or very slightly sinuate before apical angle, membrane with simple veins. Sterna longitudinally grooved in the middle; metasternal orificia not produced in a fold or furrow. Abdomen beneath furrowed in the middle, unarmed at base, apical angles of the segments scarcely prominent. Tibiae above flattened and margined.

Allied to *Lubentius*, Stäl, from which it differs in the structure of the head and pronotum.

12. Hypolcus apricus, n. sp.

Above black or dark fuscous, thickly punctured, the dilated lateral borders of the pronotum, the calli at the basal angles of the scutellum, a small basal median spot to it, a semicircular concolorously punctate spot occupying its apex, base of exocorium, a spot behind middle of corium at apex of rimula, several mottlings to pronotum, scutellum, and corium, basal and lateral borders to abdominal tergum, connexivum from its base to beyond middle of second segment, and an interiorly rounded median lateral spot to the remaining connexival segments ochraceous; beneath testaceous, a spot at basal and apical angles of ventral segments, spiracles, and an interior apical spot to female genital basal lobes fuscous or pitchy black, pectus moderately densely and rather strongly punctured with fuscous, head and venter more finely and, especially in the male, thickly punctulate with fuscous, rather roughly or granularly so on venter owing to the anterior margin of the small points being elevated, an interiorly rounded lateral spot (smaller but more sharply defined in the male) to ventral segments without the fuscous puncturation; antennae black, first joint and usually the articulations (very narrowly) of the other joints testaceous; rostrum and legs testaceous, the former darkened at apex, two usually broad and subconfluent annulations to apical half of femora, a subbasal and broad apical annulation to tibiae, and the tarsi fuscous. Rostrum reaching middle of third ventral segment. Pronotum with the lateral margins almost straight. Ventral furrow deep from its base to apex of fourth segment, narrow and very shallow in the last two segments; male genital segment with a triangular median impression, apical margin sinuate in the middle. Length (excl. membrane), ♂ 8.5—9 mm., ♀ 9.5—10 mm.

Crown Point; Finke River near Horse-shoe Bend; Dalhousie Springs. Idracowra.

13. Turrubulana plana, Dist. Ann. Mag. Nat. Hist. (8) VI., 386 (1910); Bergr., Ent. News XXIII., 25 (1912).

Stevenson River.

In the above quoted paper I have made some remarks on the characters and systematic position of this insect. It has a superficial resemblance to a miniature *Atelocera* (near which Distant placed it), but there is no real relationship between these two genera.

The monotypic genera *Lubentius*, *Hypolcus*, and *Turrubulana* form a well defined little group not represented outside the Australian continent. They may be distinguished as indicated below.

1 (4) Head about as long as broad, not longer than pronotum in the middle, anteocular part moderately narrowing from base to apex, laterally more or less distinctly unisinuate. Apical margin of pronotum neither levigate nor elevated

2 (3) Head rounded at apex owing to juga and clypeus being equal in length; bucculae rather high. Lateral margins of pronotum narrowly depressed throughout, at apex with a short blunt tooth directed outwards - - *Lubentius*, Stål.

3 (2) Head shortly bicuspidate at apex owing to juga being longer than clypeus; bucculae low. Lateral margins of pronotum rather broadly laminately depressed, gradually more broadly so toward the apex, which is subtriangularly lobately produced forwards to about the level of anterior margin of eyes - - - *Hypolcus*, Bergr.

4 (1) Head one-half longer than broad and longer than pronotum in the middle, anteocular part strongly narrowing from base to apex, laterally bisinuate. Apical margin of pronotum levigate and subelevated behind interocellar space of head. Lateral margins of pronotum as in *Lubentius* - - - - *Turrubulana*, Dist.

Distant has described an Australian genus *Pseudaelia* which he says is allied to *Lubentius*, but from its characters—especially the structure of the rostrum and abdomen—it is evident that it is only distantly related to this genus and cannot be placed in the same group.

14. PIEZODORUS RUBROFASCIATUS, Fabr.

Alice Springs.

PETALASPIS, n. gen.

Body obovate, convex before middle, the head and the anterior part of pronotum being rather strongly declivous in the same plane. Head a little broader than long, narrowing toward the rounded apex, laterally moderately sinuate, clypeus scarcely longer than juga, subparallel, eyes rather large but not much projecting, ocelli four times more distant from each other than from eyes, antenniferous tubercles partly visible from above, antennae five-jointed, first joint not reaching apex of head, bucculae percurrent, rostrum somewhat passing hind coxae, first joint as long as bucculae, second scarcely longer than third, fourth slightly shorter than third. Pronotum at apex as broad as head, the area between the non-elevated apical margin and the cicatrical areas still more thickly and finely punctulate than the remainder of the disk, lateral margins obtuse, broadly and slightly sinuate, humeral angles a little prominent, right-angled, postero-lateral margins sinuate before base of corium, basal margin rather deeply sinuate. Scutellum with straight lateral margins and frena reaching far beyond its middle, acute at apex but with a laminate appendage horizontally projecting on each side from under the apical part; this appendage beginning immediately behind the frena, slightly narrowed from the base to its subtruncate apex and extending backwards beyond the true apex of the scutellum (cf. fig. 1). Hemelytra but little passing apex of abdomen, corium with slightly rounded apical margin, membrane with numerous simple veins. Metasternum with a robust median ridge raised above the level of the coxae, sinuate posteriorly for reception of the ventral basal tubercle, and continued forwards to apex of prosternum, being narrower but roundedly more raised under the prosternum and obliquely subtruncate at apex. Abdomen beneath (♂) roof-shaped, armed at base with an acute tubercle directed forwards, apical angles of the

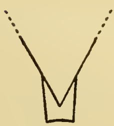

Fig. 1.

segments acutely a little prominent, each of the two male genital segments visible from below. Tibiae cylindrical, not sulcate above.

By the remarkable structure of the scutellum and other characters closely allied to *Vitellus*, Stål, but the pronotal humeral angles are not produced in a spinous process, the sternal keel is much shorter, and the scutellar apical appendage is larger and differently shaped. As in *Vitellus* this appendage is not visible when the hemelytra are closed.

15. Petalaspis tescorum, n. sp.

Straw-coloured, finely and rather thickly almost concolorously punctate, cicatrical areas and a longitudinal median line of pronotum, and scutellar apical appendage impunctate, an apical dot to clavus black, membrane (including veins) vitreous, centre of mesosternum (except the ridge) orange, apical margin of last dorsal segment and of last connexival segment above and beneath, and male internal genital appendages dark sanguineous. Second antennal joint not quite twice the length of first, third as long as second and somewhat shorter than fourth (fifth wanting). Sternal keel in the middle of its prosternal part very thin, translucent and almost vitreous. Sixth male ventral segment in the middle slightly longer than the two preceding segments together; first male genital segment short with subtruncate apical margin, second genital segment longitudinally bluntly ridged in the middle, on the sides with a transversely oval impression, apical margin sinuate but in the middle with a short narrow parallel process forming a continuation of the median ridge. Length, ♂ 9.5 mm.

Stevenson River.

16. Roebournea diversa, Dist.

Tempe Downs, Macdonnell Ranges.

Distant placed this insect in *Basicryptus*, H. Sch., and Van Duzee, who gave a very good description of it under the specific name *tumidifrons*, placed it with a reservation in the genus *Phyllocephala* Lap. It belongs to a very distinct genus described by Schouteden under the above name. Van Duzee mentions only one fuscous vitta on either side of the venter, but normally there are two such vittae on each side. In the larvae, which have four-jointed antennae, the head and pronotum are constructed much as in the *imagines*, and they are also similarly coloured, but the pronotum has a very distinct black transverse median spot which is acutely indented laterally, and the abdomen has above and beneath a prominent black transverse spot at the middle of the lateral borders of each segment; there is also a rounded black spot in the middle of the last four ventral segments, and the disk of the venter is remotely punctured with fuscous without the papillate sculpture of the *imago*.

To the many specimens collected at the above locality is appended a label to the effect that this species is "living at the base of the stalks and amongst 'Porcupine grass' (*Triodia pungens*)."

Fam. COREIDAE.

17. Mictis profana, Fabr.

Sullivan Creek.

18. Amorbus alternatus, Dall.

Palm Creek.

19. Aulacosternum punctipes, Stål.

Illara, James Range.

20. Leptocoris mitellatus, n. sp.

Red, pronotum rarely tinged with ochraceous, a large quadrate median spot on vertex more or less extended forwards over clypeus and juga, the pronotal calli, scutellum, a large transverse spot in anterior part of pleurae, two ventral patches, one on each side, extended from base of fourth to near middle of sixth segment and connected with each other along apical margin of fourth and fifth segments, antennae, rostrum, and legs black, hemelytra fuscous, clavus and corium more or less tinted with reddish and with a prominent obliquely transverse red spot occupying apex of endocorium and extended a little over interior basal angle of membrane, bucculae, acetabula, anterior margin of prosternum, spiracles, and (narrowly and more or less distinctly) posterior margin of pleurae and of ventral segments and lateral margins of abdomen whitish. Head with the juga slightly shorter than the clypeus and apically not raised above it, the low and blunt oblique anteocular elevations and the postocular calli with short and rather stiff black hairs, rostrum somewhat variable in length, reaching base of second or third ventral segment. Pronotum thickly but extremely finely subrugulosely punctulate, darkly pilose at the lateral margins and sparsely but more longly so on the collar which is but slightly convex, broader in the middle than at the sides, and not raised above the level of the calli, the disk with a median keel beginning between the calli and evanescent toward the middle or base, the lateral margins straight or slightly sinuate before middle, subcarinate, very narrowly if at all reflexed, scarcely indented at the ends of the transverse impression posteriorly terminating the collar. Scutellum indistinctly punctate. Hemelytra somewhat passing apex of abdomen, corium and clavus very finely alutaceous, scarcely punctate at all, clothed with a very short and fine decumbent pale sericeous pubescence, membrane dull. Pleurae impunctate, sericeously pubescent. Abdomen beneath with the dispersed puncturation almost imperceptible except in the two black patches where it is more distinct, middle of ventral disk rather longly palely pilose; second male genital segment with its median apical part almost vertically ascending, viewed from behind with a round impression on each side of the middle, the apical margin unisinuate, the apical angles conically produced straight backwards, the three appendages protruding from the interior of the segment pale testaceous, the middle one shorter than the others, narrowly triangular, acuminate at apex, the lateral ones with a small tubercle beneath at their base, viewed from below parallel from base to middle, where the outer margin is angularly bent, being oblique in its apical half; seen from the side the apical half of the lateral appendages is curved with the convexity upward. Length (excl. membrane), ♂ 10 mm., ♀ 10.5—11.8 mm.

Near Glen Helen, Macdonnell Range; Illamurta, James Range.

Belongs to the same group as *L. fimbriatus*, Dall. (the only Australian species hitherto known), but it is little more than half the size of that species, and the coloration both above and beneath is totally different, excepting the head which is similarly coloured.

21. Leptocoris vulgaris, n. sp.

Brick-red, pronotum (except calli and lateral margins), scutellum, clavus, corium, and in some specimens also middle of vertex slightly infuscated, a subapical fascia to prosternum, all acetabula, posterior part of pleurae, an apical laterally abbreviated mostly narrow fascia to the last three or four (rarely all) ventral segments, antennae, rostrum, and legs (excluding coxae) dark fuscous or blackish, membrane fuscous with an olivaceous tint. apical margin of prosternum and acetabula, and often also extreme posterior margin of pleurae whitish. Head with the oblique anteocular elevations rather narrow and well pronounced, juga slightly shorter than clypeus and apically not raised above it, rostrum variable in length, reaching base of second or apex of third ventral segment. Pronotum thickly and finely punctate, shortly palely pilose at the lateral margins and on the collar which is distinctly convex and raised above the level of the calli, the disk with a median keel running from between the calli backwards and becoming very fine or evanescent toward the base, the lateral margins almost straight, narrowly depressed and a little reflexed, distinctly angularly indented at the ends of the transverse impression posteriorly terminating the collar. Scutellum scarcely punctate. Hemelytra passing apex of abdomen, corium and clavus thickly and very finely punctured, their sericeous pubescence rather indistinct owing to its extreme shortness, membrane dull. Pleurae very finely rugulose and thinly sericeous. Abdomen beneath almost impunctate, rather shortly and thinly pilose; second male genital segment with its median part obliquely ascending without impressions, apical margin bisinuate, apical angles subconically produced obliquely backwards, distinctly divergent, the three appendages protruding from the interior of the segment pale testaceous, the middle one shaped as in *L. mitellatus*, the lateral ones viewed from beneath parallel, viewed obliquely from below with a small tubercle near the outer margin beyond its middle, the space between the tubercle and the apex curved with the convexity upward. Length (excl. membrane), ♂ 8—9 mm., ♀ 9—10 mm.

Bagot's Creek; near Glen Helen, Macdonnell Range; near Dalhousie Springs. Illamurta, James Range.

Allied to the preceding species, but readily distinguished, apart from the smaller size and quite different colouring, by more distinctly punctured upper side, narrower and more raised anteocular ridges, more distinctly depressed and reflexed pronotal lateral margins with their distinct subapical indentation, more raised and convex pronotal collar, shorter and paler pilosity on the pronotal lateral margins and collar, less distinctly sericeous corium, shorter ventral pilosity, and differently constructed second male genital segment. It was apparently the commonest of the Heteroptera met with during the Horn expedition; very numerous specimens were collected, especially near Glen Helen.

Fam. MYODOCHIDAE.

22. Spilostethus pacificus, Boisd.

Ayer's Rock, on *Wahlenbergia gracilis*.

23. Spilostethus mactans, Stål.

Dalhouse Springs.

24. Germalus sexlineatus, n. sp.

Dull, pale dingy ochraceous incuding antennae, rostrum, and legs, a dot on upper side of antenniferous tubercles, two dots (one on a level with the other) on upper side of first antennal joint, and one dot on under side of this joint black, a streak between the exterior upper dot of first antennal joint and the tip of the joint, a small spot near humeral angles of pronotum, apical angle of clavus and of corium, a spot at apical margin of connexival segments, and on the abdominal tergum three narrow vittae to the penultimate segment, a narrow fascia connecting the posterior ends of these vittae, and a broad median vitta to the last dorsal and the male genital segment fuscous, these abdominal markings tolerably well visible through the transluecent membrane, a slightly oblique longitudinal line on each side of vertex and six percurrent narrow vittae on pronotum rusty red, three or four slightly infuscated sublateral spots to each ventral segment, femora sparsely dotted with black, except front side of fore femora. Head a little over two times broader than long and slightly broader than base of pronotum, impunctate, with an oblique impressed line between ocelli and base of ocular peduncle, this peduncle directed outwards and a little backwards, its anterior margin very short, less than one-third the width of an eye, whereas its posterior margin is much longer and almost but not quite touching latero-anterior margin of pronotum, eyes viewed from above slightly more than twice longer than broad, ocelli not quite twice more apart from each other than from the nearest point of the eyes, the distance between the ocelli being as long as between them and the posterior angle of the eyes, antennae a little longer than head and pronotum together, second joint twice the length of first, third one-third shorter than second, fourth subequal in length to third, bucculae slightly passing apex of antenniferous tubercles, rostrum reaching middle of intermediate coxae, first two joints subequal in length, third a little shorter than second and equal to fourth. Pronotum one-half broader than its median length, slightly narrowing from base to apex, sparsely and finely punctured with brown, a transverse postapical fascia not reaching lateral margins and the basal border impunctate, the two median reddish vittae nearer to each other than to the following pair, apical margin straight in the middle, obliquely truncate behind the ocular peduncle of the head, lateral margins almost straight. Scutellum as long as broad and one-third shorter than pronotum in the middle, finely and rather thickly punctured with fuscous, but with the usual triradiate impunctate elevation. Breast finely and rather thickly punctate with blackish on the propleurae, with pale brownish on the meso- and metapleurae. Hemelytra (♂) reaching a little beyond apex of abdomen, corium with three percurrent rows of very small thick-set brown punctures, first row in its basal third running near the costal margin, then gradually somewhat deviating from it, second row placed in the middle, third near the claval suture and continued from its apex along apical margin of corium to apex of first row, clavus parallel in its basal third, then a little widening toward the commissure which is a little longer than half the length of the scutellum, with two rows of punctures similar to those of the corium, one along basal half of outer margin, the other along the commissure and continued a little way along the inner margin, basal part of clavus moreover with some extremely fine almost colourless punctures partly forming a row, corium and clavus for the rest impunctate. Abdomen impunctate, third, fourth, and fifth connexival segments partially exposed, extending a little beyond the costal margin of the closed hemelytra; male genital segment semicircular, beneath with a small round pit a little before apex. Length, ♂ 4.7 mm., incl. membrane, 5 mm.

Stevenson River.

Allied to *G. roseobistriatus*, Kirk. (by its describer wrongly referred to the genus *Geocoris*), but with the head broader as compared to the pronotum, different colouring of the head, scutellum, and abdomen, etc.

N.B.—Montandon has separated from *Germalus* a species from New Caledonia as belonging to a distinct genus, *Neogermalus*. The only difference is that in *Neogermalus* the ocular peduncle has the anterior margin shorter and the posterior margin more approaching or even contiguous to the latero-anterior margin of the pronotum, and that the eyes therefore are more oblique. The length and direction of the ocular peduncle are, however, very inconstant in the genus *Germalus*, and some of its described species certainly form distinct and gradual transitions from species with longer ocular peduncle directed a little forwards to such with shorter peduncle directed more or less backwards. In my opinion generic characters cannot, either in *Germalus* or in *Geocoris*, be taken from the shape and direction of the ocular peduncles. The more new species are detected, the more numerous the transitions become. The same is true of the size of the scutellum. It therefore seems to me that *Neogermalus* cannot be ranked as even subgenerically distinct from *Germalus*. Montandon holds *Ophthalmicus* *membraneus*, Montr., as the type of *Neogermalus*, but I think there can be no doubt that the insect described by him under that name is quite distinct from Montrouzier's species. Montrouzier says in his description : " dessus du corps brun-foncé ou même noir," and the length of his species is 5.5 mm., whereas all species of *Germalus* are very pale in colour, and the length of the species described as *membraneus* by Montandon is 4.3—5 mm. There is nothing in Montrouzier's short description indicating that he had a *Germalus* before him, and his species belongs in all likelihood to the genus *Geocoris*. Being a *nomen false citatum*, Montandon's *membraneus* cannot according to the nomenclatural rules be maintained, and I propose for this species the name *Germalus montandoni*.—Under the specific name *dissidens* Montandon has described, as questionably belonging to *Germalus*, a species with black head, pronotum, and scutellum; but this species differs from *Germalus*, apart from the colour, by the structure of the metasternal orificia, which is always of great systematic importance and never variable to any great extent in the same genus. It clearly belongs to a distinct genus which may be briefly characterised thus :

Nesogermalus, n. gen.—Antenniferous tubercles on the outer side armed with a tooth. Metasternal orificia constructed as in *Geocoris*, subrotundate, callosely margined, not produced in a ridge. Other characters as in *Germalus*, Stål.—Type : *Germalus ? dissidens*, Mont.

25. Stenophyella sabulicola, n. sp.

Whitish testaceous, head with a black lateral spot behind the eyes, tergum of abdomen with two percurrent black vittae well visible through the pellucid hemelytra but in the dorsal genital segment resolved into small subconfluent black points, mesosternum in the middle with two pale brown vittae and between them with a narrow impressed percurrent median blackish vitta continued, though not impressed, through the metasternum ; thickly and finely punctured, corium and clavus more coarsely and subseriately punctate, abdomen beneath extremely finely, almost imperceptibly punctulate, the puncturation concolorous with the following exceptions : a cluster of black points on outer side of antenniferous tubercles and in the middle of the two brownish mesosternal vittae, a longitudinal band composed of black points near anterior half of pronotal lateral margins and somewhat within lateral margins of venter from its base to apical margin of fifth segment. Head slightly shorter than pronotum in the middle, and with the eyes but slightly prominent beyond pronotal apical angles, vertex three times broader than an eye, with an impressed longitudinal line on each side extended from near the ocelli to the level of anterior end of eyes, first two antennal joints on their outer side studded with very small black granules, rostrum reaching a little beyond front coxae, first joint not quite reaching anterior margin of eyes, second as long as first, reaching anterior margin of prosternum, third and fourth together slightly longer than second, of equal length, apical half of fourth joint black. Pronotum as broad as long and two-thirds broader at base than at apex, lateral margins straight, basal margin a little rounded between its lateral lobules. Scutellum equilaterally triangular, with a percurrent narrow smooth median ridge. Orificia short, curved, callosely margined, apically lobulately subprominent. Hemelytra reaching somewhat beyond base of female dorsal genital segment, inner half of mesocorium quite hyaline and impunctate, only with a row of punctures along the cubital vein, apical margin of corium straight with a small obtusangular sinuosity near apex of clavus and a very slight and short sinuosity a little before middle, clavus with a single row of punctures between the vein and the suture, which is shorter than apical margin of corium, claval commissure slightly shorter than scutellum, veins of membrane straight and simple. Abdomen in the female with the last dorsal segment rather deeply arcuately sinuate at apex, in the middle only half the length of the preceding segment, female dorsal genital segment more than twice the length of last dorsal segment, produced beyond the ventral genital segments, tapering toward the apex which is rather deeply but narrowly cleft, fifth ventral segment (♀) in the middle sinuate to the very base for reception of the sixth segment. (Last antennal joint and fore and hind legs wanting in the type). Length, ♀ 7.5 mm.

Stevenson River.

Differs from *S. macreta*, Horv. (the only other known species of the genus) by its larger size and by having the eyes narrower and less prominent, the rostrum (especially its second joint) shorter, the scutellum medially keeled, the mesocorium hyaline only in its inner half, the black punctures of the head and pronotum differently distributed, etc. If the specimen described by Horváth really be a male, the apex of the abdomen is bifid in both sexes of this genus.

26. Dieuches, n. sp.

Bagot's Creek.

A single mutilated specimen, unfit for description.

Fam. REDUVIIDAE.

27. Poecilobdallus formosus, Stål.

Bagot's Creek; Tempe Downs.

The colour of the upper side of the head is in some specimens as described by Stål, but usually it is black, excluding the part situated before the antennae, which is red with the clypeus blackish; the postocular part has above a yellow median line. The abdomen, which was lacking in the single type-specimen described nearly 60 years ago, is black with the broad, rather strongly rounded connexivum from its base to the middle of the sixth segment above and beneath, and a median ventral spot of very variable size red; this ventral spot sometimes small, placed at base of third segment, sometimes large, reaching from apex of second to near apex of fifth segment.

28. Havinthus longiceps, Stål.

Finke River near Bend; Dalhousie Springs. Idracowra. Illamurta.

This species is extremely variable in colouring and in the development of the granulation, and it is hardly possible to describe its varieties as they are connected by numerous transitional links.

29. Oncocephalus confusus, Reut.

Bagot's Creek.

Fam. VELIADAE.

30. Microvelia australica, n. sp.

Oblong, black with a cinereous bloom, a transverse apical spot to pronotum and the margin of its produced posterior part, connexivum (except extreme lateral margin and segmental sutures), lateral borders of venter, and an apical spot to last ventral segment luteous, a longitudinal line to pronotum velvet-black, acetabula and legs testaceous, the latter here and there infuscated. Head as long as broad, rostrum scarcely passing prosternum, dark testaceous, last joint piceous, antennae blackish, first two joints, except apices, dark testaceous, second joint as long as first, third a little longer than second, fourth the longest, slender. Pronotum rugulosely punctate behind the middle, lateral angles obtusely a little prominent. Hemelytra whitish, all veins and a vitta to the median discal area fuscous. Wings lacteous. Hind legs distinctly longer than middle legs; intermediate tibiae shorter than femora, posterior tibiae as long as femora and trochanters together. Length, 2 mm.

Palm Creek.

This is the first *Microvelia* recorded from Australia.

Fam. NEPIDAE.

31. Laccotrephes tristis, Stäl. Oefv. Vet. Ak. Foerh. XI., 241 (1854); Freg. Eugenies resa, Ins. III., 266 (1859); Ferrari, Ann. Hofmus. Wien III., 186 (1888).

Bagot's Creek; Alice Springs.

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Art. III.—*The Petrology of the Silurian Sediments near Melbourne.*

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(Communicated by Professor E. W. Skeats, D.Sc.)

1.—Introduction.

Silurian sediments form the base rocks of the city of Melbourne. Typical outcrops are exposed along the River Yarra from Princes' Bridge upwards, in Hawthorn and Kew, and also in the northern and western suburbs, Coburg and Moonee Ponds. Carefully selected specimens were taken from most of the outcrops. The rocks are remarkably uniform in megascopic and microscopic characters over the whole of Melbourne, so that the comparatively small collection of specimens may be taken as representative.

The rocks consist entirely of shales, mudstones and sandstones, thinly bedded. The beds average one or two feet in thickness. The shales and mudstones are loosely compacted but in certain cases are firm and tough where silicified. The sandstones contain much aluminous material. In some cases they are partially cemented into semi-quartzites by secondary silicification. In most cases the cement consists of fine clayey material, in which case the rock weathers down to a soft, porous, crumbly sandstone. The quartzite beds stand out in prominent relief from these. There has been an extensive replacement of the sandstones by limonite along the bedding planes.

These sediments are steeply folded and fractured around Melbourne. In general the strike is northerly, but owing to the complications of movements, such as sagging and pitching of the folds, and to the presence of numerous fractures, the strikes vary greatly from that of the main fold axes.

Some fairly large faults occur. In the bed of the Merri Creek at Coburg (see "Description of Sections," Rock No. I.) there occurs a well-developed fault breccia composed of angular fragments of sandstone, resembling the neighbouring Silurian sandstones, set in a matrix of the same material, and now almost entirely replaced by limonite. Small displacements are very widespread.

2.—Composition of the Sediments.

The sandstones, mudstones and shales are all highly aluminous. The principal allothigenic minerals identified microscopically are quartz, more or less fresh felspars, muscovite, and biotite. The accessories noted are tourmaline, iron oxides (magnetite or ilmenite), zircon, rutile, and perhaps anatase and sphene. Secondary or authigenic minerals present are sericite, limonite, leucoxene, quartz, and possibly pyrite, subsequently altered to limonite. Carbonates may occur to a small extent but no effervescence with acid was observed with the powdered rocks. Chlorite after biotite is present in some sections.

(*a*). *Essential Minerals.*—The detrital quartz ranges to about 0.5 mm. as a maximum in the sandstones. In some of the sandstones small well developed quartz veins have been formed by secondary solution and redeposition.

The quartz is angular in habit. It does not show any crystal boundaries. It frequently shows strain polarisation effects as the result of pressure. Inclusions of such minerals as apatite are sometimes found.

The felspar is found in two conditions. The greater amount occurs as turbid grey patches throughout the section of about the same size as the quartz, and in some cases in nearly as large an amount. These patches show, in some cases, remains of lamellar twinning. They consist essentially, as far as can be determined, of fine aggregates of secondary sericite. The original felspars have probably been altered by percolating solutions producing secondary mica. In some cases these sericitic patches have been subsequently stained by limonite impregnations.

A few unaltered grains of oligoclase occur in most of the sections. The refractive index, twin lamellation, and such extinction as can be observed refer it to oligoclase. These again are of the same order of magnitude as the quartz.

No felspar has been identified in the mudstones and shales, though possibly originally present.

Mica occurs in three forms:—1, As long ragged clear crystals of muscovite sometimes nipped in between the neighbouring sand grains. These are clearly detrital and average about one millimetre in length. 2, As secondary sericite after felspar, and also throughout the groundmass constituting most of the clayey matter of the groundmass. This may be partly allothigenic and partly authigenic as is certainly the case with that representing felspar remains.

The above minerals are characteristic of every sandstone examined.

3, As biotite. This occurs in several of the sandstones. It is generally pleochroic from a pale greenish yellow to a darker tint. In some sections it is nearly as plentiful as the muscovite. It has the same relative size. The colour may be partly due to iron-staining. In some cases it has been altered to chlorite.

(*b*). *Accessory Minerals.*—Tourmaline is the chief accessory. It is to be found in every sandstone sectioned. It was not identified in the shales or mudstones. It occurs as rounded detrital grains showing marked pleochroism from greenish-brown to colourless. It sometimes shows good crystal boundaries.

Zircon occurs in most of the sections. It is generally in more or less rounded grains showing the remains of crystal faces. It is always clear and colourless.

Rutile occurs in rounded detrital grains. These are mostly dark reddish brown, but in one case a dark grey grain was identified.

Black Iron ores occur throughout the rocks in irregular grains, either as magnetite or ilmenite.

A certain amount of carbonaceous material may occur in some of the rocks, but cannot be differentiated from the iron oxides.

Anatase and sphene possibly occur, but their identification was not definite, owing to the very small size of the grains.

(*c*). *Secondary Minerals.*—Limonite is the chief secondary mineral. It replaces quartz and mica and probably also felspars. It is responsible for the general colour of the sandstones. It is not so prominent in the shales. Pale-green chlorite occurs as an alteration product of the biotite. Secondary quartz veins are present in some of the sandstones. Secondary rutile occurs as fine needles in sericitic matter, possibly after biotite.

Separation of Minerals with Heavy Liquid.

A heavy liquid separation was undertaken to isolate other minerals which might be represented in small quantity. A promising sandstone No. 13 (see "Description of Sections") from Studley Park was crushed in a mortar and passed through a 120 mesh sieve and then the fine muddy material was panned off with water. This method of separating the fine material saved any small particles of heavy minerals which might be present, but got rid of the fine quartz and micas.

The washed product was then divided into two portions by an electromagnet. The demagnetised product was then again separated into two portions, a heavier and a lighter by means of flotation in acetylene tetrabromide S.G. 2.938, following the general method described by T. Crook, A.R.C.Sc. (Dublin), F.G.S., in Hatch's "Petrology of the Sedimentary Rocks."

The heavy portion was then examined under the microscope in media of different refractive indices. The following minerals were thus recognised :—Tourmaline, zircon, rutile, magnetite, sapphire, topaz, a little biotite and chlorite, some quartz, probably attached to some of the other minerals during flotation, and perhaps kyanite.

The tourmaline is abundant, and in many cases shows good crystal boundaries. It contains many microscopic inclusions of other minerals, and of gas bubbles. It is generally yellow brown to dark brown, but some fragments polarise from a blue green to a pure green.

Zircon comes next in abundance. The crystals show almost perfect crystal faces and are in many cases zoned. Faces shown include prisms and pyramids.

Rutile occurs as dark brown prisms generally, with pinacoidal terminations.

Magnetite was also noticed in the demagnetised (?) product. It shows characteristic rectangular outlines. It was probably too small in this case to separate itself efficiently from the sand under magnetic influence.

Sapphire occurs as deep blue, slightly pleochroic, irregular, angular grains, showing low polarisation colours, and is fairly plentiful.

Topaz occurs as rounded and irregular grains, and in many cases has many inclusions, some dark, which are probably iron ores.

A little biotite altering to chlorite was found. In one case the chlorite showed a fine spherulitic structure.

A doubtful crystal of kyanite was recognised, but as only one grain was found it is not considered wise to positively assert its presence.

3.—Description of Rock Sections.

Note.—The rock sections are included in the collection of the Geological Department of the University.

(*a*). *Coburg Specimens.*—Rock No. 1 consists of a hard breccia composed of angular sandstone fragments set in a matrix of finer material largely replaced by iron oxides.

Microscopically the rock fragments show quartz, muscovite, and tourmaline set in a groundmass of quartz and secondary mica. The rock is clearly a fault breccia. It is to be found about 100 yards east of the Newlands Street West bridge over the Merri Creek in the creek bed.

No. 2 is a typical micaceous sandstone. It is a yellowish loosely compacted rock showing quartz grains and flakes of muscovite. Microscopically it shows quartz, muscovite and tourmaline. This specimen was obtained from the road section just west of the cemetery in Elizabeth Street.

No. 4a is a light yellow mudstone. Microscopically all that can be recognised are minute fragments of quartz and muscovite set in a micaceous clayey groundmass. Spots of reddish-brown mineral with cubical outlines are possibly limonite after pyrite. It was obtained just to the west of the Newlands Street West bridge over the Merri Creek.

(*b*). *Moonee Ponds Creek Specimens.*—No. 3 is a dark, fine-grained sandstone, splitting well along the bedding planes. The split faces are covered with small flakes of muscovite. The rock shows dark bands. Microscopically the section shows quartz, muscovite, biotite, altered plagioclase, oligoclase (fresh), zircon, tourmaline, rutile, and ilmenite or magnetite, and dark bands of carbonaceous material. Some of the quartz grains contain inclusions of apatite. The tourmaline shows good crystal faces in some cases. Secondary minerals present are sericite, chlorite after biotite, a little carbonate, and limonite. The specimen was obtained from a cliff section on the creek about 100 yards north of the Brunswick Road bridge.

(*c*). *Hawthorn Specimens.*—No. 5 was obtained from a small point on the left bank of the River Yarra, just below the bend up stream from the Glen Tea Gardens. It is a dense grey sandstone, showing quartz and muscovite. Deposition of limonite has taken place along joint planes.

The section shows quartz, muscovite, tourmaline, zircon, fresh oligoclase and altered plagioclase, magnetite or ilmenite, leucoxene and green biotite, also possibly sphene. Some carbonaceous matter is present. Secondary limonite and sericite and clayey interstitial matter are also present.

(*d*). *Kew Specimens.*—i., Victoria Street Bridge Section—Rock No. 17 from the north side of Victoria Street at the top of the hill above the bridge is a fine grey sandstone traversed by veins of limonite and secondary quartz. Microscopically the section shows quartz, muscovite, tourmaline, zircon, and carbonaceous material, set in a fine groundmass of quartz and sericite. Sericite after felspar is common. The secondary quartz veins are probably later than the limonite impregnations, as they cut through them in places. The quartz veins crossing small cracks may have offered an obstruction to subsequent iron-bearing solutions.

No. 19 is a light-grey micaceous sandstone showing quartz, muscovite, tourmaline, zircon, biotite, and oligoclase in a fine groundmass of quartz and sericite. Secondary minerals present are limonite, sericite, and chlorite. This rock was obtained about two chains below No. 17 on the north side of the cutting.

No. 20 is a yellowish loosely compacted micaceous sandstone similar to No. 2 from Coburg. It was obtained about half a chain below No. 19. It shows quartz, muscovite, tourmaline, oligoclase, altered plagioclase, biotite, zircon, rutile, chalcedony fragments, and possibly anatase. Secondary minerals are limonite, leucoxene after ilmenite, sericite, and chlorite.

No. 22 is a hard, porous, greyish-white quartzite, showing flakes of muscovite. Microscopically it shows quartz, muscovite, tourmaline, altered plagioclase, magnetite or ilmenite, zircon, leucoxene after ilmenite, and rutile in a groundmass of fine quartz and sericite. Secondary rutile occurs in very fine needles in cloudy sericitic patches, possibly altered biotite. It was obtained from a prominent bed six chains from No. 17 on the same side.

ii., Studley Park Specimens.—No. 6 is a hard, compact sandstone traversed by secondary quartz and limonite veins. The section shows quartz—some with apatite inclusions—a very little muscovite, zircon, rutile, tourmaline, magnetite or ilmenite, sphene, and secondary sericite and limonite. The location of all Studley Park specimens is shown on the sketch map (see below).

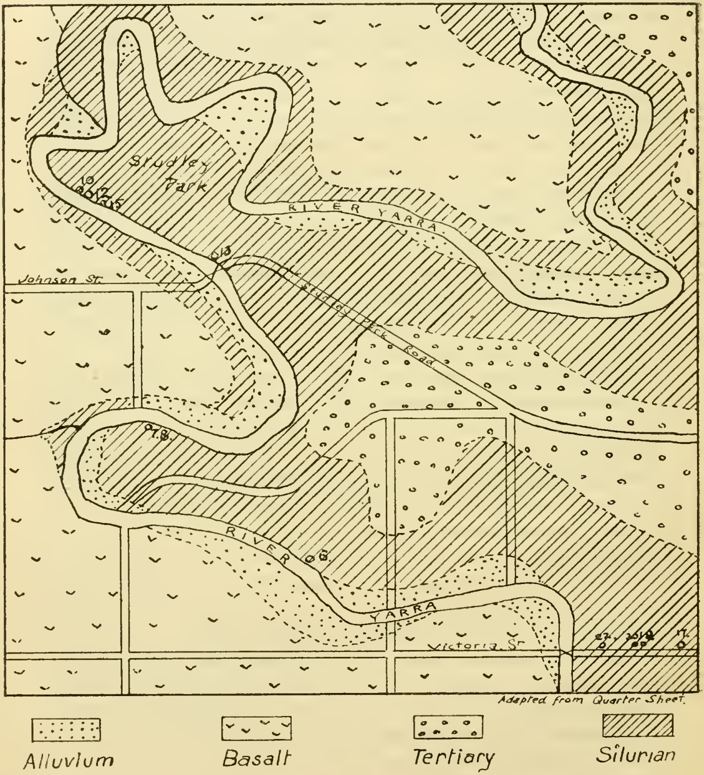
No. 8 is a micaceous mudstone with grey and yellowish bands. Microscopically it shows distinct current bedding. Minerals identified in the section include quartz, muscovite, and tourmaline, with secondary sericite and limonite. Some of the limonite is probably secondary after pyrite judging by its crystal outline.

No. 10 is a white mudstone from the crest of an anticline on the river path, about a quarter of a mile N.W. of Johnston Street Bridge. Microscopically it shows quartz, muscovite, biotite, chlorite, sericite, and limonite. It is fairly even grained, with a few larger fragments of quartz here and there.

No. 12 is a yellowish, hard, dense quartzite with secondary quartz and limonite veins. Microscopically it shows quartz, muscovite, oligoclase, altered plagioclase, tourmaline—brown and grey—zircon, cherty and sericitic interstitial matter, chlorite and limonite.

No. 13 is the rock selected for separation by heavy liquid. Microscopically the following minerals were identified:—Quartz, muscovite, tourmaline, oligoclase, altered plagioclase, magnetite, zircon, rutile, biotite, and secondary sericite and limonite.

No. 15 is a banded grey and yellow shale showing muscovite along the bedding planes. Under the microscope the section shows quartz,



GEOLOGICAL MAP of KEW

0 ½ 1 mile.

muscovite, and carbonaceous material in a clayey groundmass. It is very even grained.

(*e*). *South Yarra Specimen.*—No. 9 was obtained from the cliff section on the left bank of the River Yarra just below the Church Street Bridge. It is a hard, tough, cherty looking rock. Under the microscope it shows small angular fragments of quartz, and a little muscovite, tourmaline, and rutile, in a very fine sericitic groundmass. It seems to have suffered considerable pressure. Secondary limonite is also present throughout the rock.

4.—Metamorphism.

Practically no metamorphism of the rocks has occurred. Although intensely folded and fractured no cleavage is developed. No contact metamorphism has taken place.

The series is intruded by two series of dykes, one basaltic and the other of the nature of quartz porphyry. The only alteration is that due to the percolation of solutions containing iron derived from the dykes. The sediments are largely impregnated with limonite at the contacts.

5.—Deposition of the Sediments.

Chapman[1] refers the Melbournian sediments to a warm shallow sea on the evidence of the prevalence of the brachiopod Lingula, and the almost complete absence of the corals. This view is supported by the writer. The general fineness in grain suggests that the sediments were deposited some distance from the shore. Conglomerates occurring at Keilor, about 10 miles from Melbourne, probably represent the nearest part of the shore line sediments of the Silurian sea.

The admixture of relatively coarse sand with the fine materials of the shales suggests that the sediments may have been laid down under flood conditions or under rapid variations in the strength of the currents. This view is supported by the relative thinness of the beds and the rapid alternation of sandstone and shale.

6.—Origin of the Constituent Minerals.

Two sources are possible for the material of the sediments :—

i. They may have been derived from a pre-Silurian igneous rock ; or, ii., They may have been derived from a pre-Silurian sediment. Both sources are also possible.

1. "On the Palaeontology of the Silurian of Victoria." Proceedings of Section C, p. 213, Australasian Association for the Advancement of Science, Melbourne, 1913.

Jutson[1] believed that the Silurian sediments at Warrandyte were derived solely from a sedimentary series because no pebbles of igneous rock were found by him in the Warrandyte conglomerate.

Junner,[2] in his paper on the Diamond Creek area, concludes that the sandstones of that district were derived to a "fair extent" from pre-Silurian igneous rocks. He gives the following reasons for his view :—

1. The abundance of muscovite.
2. The presence of biotite, plagioclase, and chlorite, which is usually derived from unstable iron magnesium minerals.
3. The occurrence of zircon and rutile crystals in the quartz grains in the sandstones may indicate an igneous origin for such quartz.
4. The constant presence of tourmaline suggests such an origin.
5. The absence of metamorphic minerals, etc., shows that they were not derived from metamorphic rocks.

The last does not show, however, whether the Silurian sediments were derived from igneous or sedimentary rocks. Muscovite and tourmaline, whilst suggesting an originally igneous origin, are stable minerals and may easily be handed down from one sediment to another. Similarly, quartz grains containing zircon and rutile may easily have suffered more than one transportation before coming to their final resting place.

The presence of biotite, plagioclase and chlorite suggests that the rocks were derived to some extent direct from pre-Silurian igneous rocks, especially if the felspar were fairly fresh.

The writer finds felspar to be present in two conditions in his sections; the one much decomposed but showing traces of twin lamellation, and the other quite clear and fresh. The natural inference from this fact is that the decomposed material has suffered more handling than the fresh. This would suggest that the clear material has been directly derived from an igneous source, possibly granitic, whilst the decomposed material has been derived from an older sediment. No pre-Silurian granites, however, are known near Melbourne with certainty. The You-Yangs granite may be pre-Silurian.

The writer inclines to the view that both origins are probable for the rocks of the Melbourne district. This view is strongly supported

1. "The Structure and General Geology of the Warrandyte Gold-field, &c." Proc. Roy. Soc. Victoria, vol. xxii., pt. II., 1911.

2. "General and Mining Geology of the Diamond Creek Area." Proc. Roy. Soc. Victoria, vol. xxv., pt. II., 1913.

by the fact that the plagioclase occurs in two conditions. The presence of biotite and chlorite supports the view of an igneous origin for part of the sediments.

The strain polarisation of some of the quartz may have been produced, not in situ but in an older sediment. Our known Ordovician rocks have suffered much greater stresses than the Silurian. All the quartz does not show strain polarisation.

The Ordovician sediments of Victoria have not yet received any attention petrologically. When they are examined they will probably show the presence of much similar material to that of the Silurian. An Ordovician quartzite section in the writer's possession shows zircon and tourmaline.

In conclusion the writer wishes to gratefully acknowledge the invaluable help and guidance of Professor Skeats through all stages of the work, and to Dr. Summers for various suggestions.

[Proc. Roy. Soc. Victoria, 29 (N.S)., Pt. I., 1916].

Art. IV.—*The Paleontological Sequence of the Lower Ordovician Rocks in the Castlemaine District.*

Part I.

By W. J. HARRIS, B.A.

(With Plate I.).

[Read 11th May, 1916].

Victorian economic geology, more particularly in so far as it is concerned with the origin and occurrence of auriferous lodes, is so intimately associated with the folding of palaeozoic strata and the resulting problems, that any reliable guide to the order of superposition of the various beds is likely to be useful. The absence of conglomerates and other well defined bands deprives geologists of benchmarks that would be of assistance in working out the folding of the rocks in localities where good exposures are wanting. Recognition of the part certain favourable beds play in the enrichment of lodes, more particularly at Ballarat, and to a lesser extent at Bendigo, Daylesford, and elsewhere, has accentuated the importance of obtaining a working knowledge of the stratigraphical relations of the rocks of these localities. In the absence of this knowledge even expert opinion is liable to err. Mr. E. J. Dunn states that "the South Eureka rocks appear to be well up in the Castlemaine zone . . . Spring Gully appears to be still higher. . . . The Fryerstown belt is in the Castlemaine zone."[1] These three localities seem on palaeontological evidence to be all Upper Bendigonian, and hence much more favourable for quartz mining than the above makes them appear. The researches of Dr. T. S. Hall and others have resulted in the subdivision of the Victorian Lower Ordovician rocks into four series—Lancefield, Bendigo, Castlemaine and Darriwil, in ascending order. The relations between the three lower series are clearly shown in several areas, and are generally known, but, though the Darriwil series is recognised as somewhat above the Castlemaine series, its exact stratigraphical position has remained in doubt. This paper includes, among other efforts, an attempt to co-ordinate the Castlemaine and Darriwil series.

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1 Dunn, E. J., Rec. vol. iii., part ii., Geol. Surv. Victoria.

I. Area.

The area over which these observations extend includes about 100 square miles. Its approximate boundaries are, on the north and east the granite massif of Mount Alexander, on the west the Muckleford Creek, and on the south a line drawn from Strangways through Tarilta, Glenluce, and Fryerstown to the Elphinstone Tunnel on the Melbourne to Echuca railway.

II. Previous Workers.

A. R. C. Selwyn[1] as early as 1853 made a section of the beds from the Campaspe to the Loddon along a line passing through Mounts Alexander and Tarrengower.

The late Dr. T. S. Hall[2] in a paper to this Society on the Geology of Castlemaine (1894) shows that the differences between the graptolites of the various outcrops are due to the stratigraphical relation of the beds. From the palaeontological evidence he was able to demonstrate their succession and outline six zones. He also gives a general account of the geology of the district. His paper deals particularly with the area to the south and the east of the town of Castlemaine and forms the basis for all later palaeontological work on this area. The general lines of the classification of the graptolite zones indicated in this paper have since been independently confirmed in other districts. The writer during the years 1912-1915 examined all but three or four of the outcrops previously visited by Dr. Hall, and is able to attest the accuracy of the deceased worker's observations. One who has traversed the rough hills around Castlemaine can thoroughly appreciate the painstaking and accurate work which, without the aid of present-day facilities for travelling, Dr. Hall carried out over twenty years ago. The difficulties in the way have resulted in a scientifically fertile field lying idle for more than two decades.

Mr. W. Baragwanath[3] deals with portion of the area in Memoir 2 of the Geological Survey of Victoria. Axial lines are plotted and a section given showing the succession of the strata. The section is evidently based mainly on observed dip. No particular section line is marked on the map, but the section appears to be along a line from Forest Creek through Quartz Hill to Gaol Hill. If so, it errs in not showing a ge-anticline on the Cemetery Reef where the lowest

1 Geology and Mineralogy of the Mt. Alexander Goldfield, Parl. Papers, 1853-4, vol. ii., et Q.J.G.S., vol. x.

2 Proc. Roy. Soc. Victoria, vol. vii. (n.s.), 1894.

3 Castlemaine-Chewton Goldfield. Mem. 2 Geol. Surv. Vic.

beds north of Forest Creek occur. These beds are on the Wattle Gully horizon, and *Didymograptus bifidus* is found at more than one place along the line. The beds to the east are only Middle Castlemainian, while, further east still, on the east side of Forest Creek, Upper Castlemaine graptolites are found.

Mr. H. Herman,[1] in a brief description of the lodes of Castlemaine, gives a section, apparently based on the one just mentioned, and marks on it three zones—viz., Bendigo, Wattle Gully, and Castlemaine. The above criticism applies to this section also. From a palaeontological standpoint both are in error in showing the central beds too high in the series.

Besides these papers there are others dealing incidentally with the district. These, and also Dr. Hall's other papers on graptolites, will be referred to when necessary.

III. Characteristics of Fossiliferous Rocks.

Graptolites are widely distributed throughout the district and have been found at more than one hundred localities. They occur in slates of every colour. The slates of the *Oncograptus* zone often bear a distinct resemblance in colour and texture to certain Upper Ordovician rocks, particularly those exposed along the Saltwater River near Digger's Rest, but in the state of our knowledge no importance should be attached to lithological resemblance. With isolated exceptions graptolites in this district are found only in slates or fine mudstones which as a rule are less common than sandstones. Limestone of Ordovician age is absent. Quartz grit ridges and bands of coarse sandstone occur, but, though it may be possible to do so, no attempt has so far been made to correlate them. One is therefore compelled to rely entirely on the fine sediments, often so cleaved that the fossils are difficult to break out. This will be the more readily understood when it is realised that the cleavage is rarely parallel to the lamination and often crosses it at an angle of 30° or more. It is therefore difficult or impossible to obtain a good idea of the facies of some outcrops, though if the beds are Upper Castlemaine *Didymograptus caduceus* may often be recognised along the broken edge of a slab.

IV. Limitations of Mathematical Stratigraphy.

It is almost unnecessary to say that no method of working out the problems of rock folding in an area is more accurate than measure-

1 Economic Geology and Mineral Resources of Victoria. Bull. 34, p. 24, Geol. Surv. Vic.

ment and plotting by strike, dip, and pitch, and if it were always possible to employ this method, palaeontology, as it is used here, would lose much of its value. Anyone who has worked over a considerable area of country where exposed sections are few, knows how really limited, under such circumstances, the mathematical method is, and, where sections do occur, how interdependent the mathematical factors are. In the constantly varying angle of dip according to the portion of an anticline or syncline exposed at the surface, anything like accuracy is impossible and with the long low curves of pitch one is at a complete loss. Added to these difficulties, there is at Castlemaine the problem of overturned beds which occur in the east of the area and render valueless observations of dip obtained in shallow cuttings. These are often vitiated also by surface drag or warp diagonal to the directions of dip and strike, which gives a false dip.

V. Stratigraphical Value of Graptolites.

In the slates of Castlemaine there is sufficient evidence to be obtained of the life history of many species of graptolites to afford a fairly complete set of zonal fossils. The evidence is cumulative and not isolated, and that of the many species that together make up a facies is rarely at fault. From a zonal standpoint Dr. Hall[1] has used the Dichograptidae—*Tetragraptus approximatus* (Nich.), *T. fruticosus* (J. Hall), and *Didymograptus bifidus* (J. Hall)—with conspicuous success in his classification of the Lower Ordovician rocks of Victoria. Miss Elles[2], regarding the rise and fall of a genus and species, observes that "a certain resemblance of thecal characteristics, number of thecæ in a given space, inclination of ventral and apertural margins to the axis of the stipe, and the amount of thecal overlap may be regarded as (a) of genetic origin and therefore (b) of systematic importance; and further, that a natural group with relatively few stipes was evidently developed from multiramous forms, so that of the usually accepted classification the Dichograptidae are highly important chronologically." There seems no doubt that the gradual progression from multiramous to simpler forms is world wide. At Castlemaine *Clonograptus* is common in the lower beds, and *Tetragraptus* and *Goniograptus* are more common in the lower than in the higher beds. *Diplograptus* occurs infrequently in the middle beds, but becomes more com-

1 Recent advances of our knowledge of Victorian Graptolites and elsewhere.

2 Graptolite Fauna of the Skiddaw Slates. Q.J.G.S., vol. 54 (1898), p. 529 ff.

mon later, while *Trigonograptus*, *Oncograptus*, *Lasiograptus*, and *Glossograptus* appear still later. The Upper Ordovician and Silurian graptolites are quite distinctive. Only the broadest outline seems possible at present, and conclusions drawn from observations on one side of the world may not be applicable to conditions on the other. For example, Elles, Wood and Ruedemann[1] all agree in deriving *Dichograptus octobrachiatus* from *Loganograptus logani*. In Victoria, as Dr. Hall[2] has pointed out, the order of occurrence is reversed, for while *D. octobrachiatus* is found in Upper Bendigo beds, *Loganograptus* is Upper Castlemainian. Differences such as this in the distribution of genera make one hesitate to generalise.

VI. Dr. Hall's Classification of Castlemaine Graptolites.

The following classification is that given in Dr. Hall's paper on the Geology of Castlemaine.[3] The zones are arranged in descending order as there set out.

1. Zone of *Loganograptus logani*.
2. Zone of *Didymograptus caduceus*. (Victoria Gully Beds.)
3. *Phyllograpto-caduceus* zone.
4. Burns' Reef beds. (*Phyllograptus typus*, with no predominant associates.)
5. Zone of *Didymograptus bifidus*. (Wattle Gully Beds.)
6. Zone of *Tetragraptus fruticosus*.

The facies of each zone is not given in detail, though it is briefly discussed. In another place Dr. Hall[4] states that "*Phyllograptus typus* long persists and is survived a short time by *P. angustifolius*. Specimens of *Diplograptus* appear in the higher beds but not apparently in the lower. A species of *Clonograptus* occurs in the lower beds, but soon disappears. *Loganograptus logani* puts in an appearance in the highest zones, and ranges into the Darriwil series."

VII. Proposed Revised Classification.

The table recorded below[5] shows the classification proposed. The beds are arranged in descending order and Dr. Hall's numbering is retained to render comparison easier. Beds above the Castlemaine series are prefixed with the letter "A."

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1 Graptolites of New York, I. N.Y. Mus. Mem. 7 (1894), table op. p. 554.

2 Graptolite-bearing Rocks of Victoria. Geol. Mag. (n.s.), Dec. iv., vol. vi. (1899), pp. 442-443.

3 Geol. of Castlemaine. Proc. Roy. Soc. Victoria, vol. vii. (n.s.), 1894, p. 88.

4 Graptolite-bearing Rocks, op. cit., p. 443.

5 Vide p. 55.

GRAPTOLITE ZONES OF THE CASTLEMAINE DISTRICT.

Series and Division.	No. of bed on map.	Locality of Typical Development – Castlemaine.	Zonal Fossils.	Other Characteristic Fossils.
Darriwil (W. J. Harris and T. S. Hall)—				
Upper (or Darriwil of Dr. T. S. Hall)	A	Guildford-Strangways Road	Glossograptus, sp. indet. Trigonograptus Lasiograptus (absence of C. morsus)	Diplograptus, cf. angustifolius. ,, gnomonicus, sp. nov. Didymograptus caduceus. ,, v-deflexus, sp. nov.
Middle	A	Guildford-Strangways Railway	C. morsus Trigonograptus (absence of Oncograptus)	Diplograptus gnomonicus, sp. nov. Didymograptus caduceus. ,, v-deflexus, sp. nov. Phyllograptus, sp.
	A	Chinamen's Creek	Cardiograptus morsus Oncograptus Trigonograptus	Diplograptus gnomonicus. Didymograptus caduceus. ,, v-deflexus, sp. nov. Phyllograptus, sp.
Lower	A	Woodbrook Road	Oncograptus upsilon Trigonograptus (absence of C. morsus)	Didymograptus caduceus. ,, v-deflexus. Phyllograptus, sp. Didymograptus caduceus, var. manubriatus
Castlemaine—				
Upper	1	McKenzie's Hill	D. caduceus (max. develop.) Loganograptus logani	Didymograptus, spp. Diplograptus, spp.

GRAPTOLITE ZONES OF THE CASTLEMAINE DISTRICT (*Continued*).

Series and Division.	No. of bed on map.	Locality of Typical Development—Castlemaine.	Zonal Fossils.	Other Characteristic Fossils.
Castlemaine—				
Upper (*cont.*)	2	Victoria Gully	D. caduceus (absence of P. typus)	Dichograptus, cf. octonarius. Diplograptus, spp.
Middle	3	Victoria Gully East	D. caduceus (small) P. typus	Dichograptus, cf. octonarius. Clonograptus, sp.
	4	Burns Reef	P. typus (absence of D. bifidus)	As in bed 3
Lower	5	Wattle Gully	D. bifidus (absence of T. fruticosus)	P. typus. P., cf. angustifolius. G. crinitus. D. octobrachiatus T. pendens. Clonograptus, spp. T. similis.
Bendigo—				
Upper	6	Daphne Reef	T. fruticosus (3-branched)	As in Wattle Gully Beds, and G. macer. G. thureaui.
Middle	7	South Fryerstown Race	T. fruticosus (4-branched)	G. macer. T. pendens T. similis. P. cf. typus. Didymograptus latus.

Only forms of fairly certain identity are given in this table; more extended search will probably extend the range of some of the species. The horizontal Didymograpti present difficulties which minimise their suitability for use as zonal fossils, though it is probable that detailed work with them will lead to instructive results. Other forms such as *T. serra* and *T. quadribrachiatus* appear to range through all zones. *T. serra* is very common in some of the beds of the Darriwil series as constituted in this paper, *Goniograptus* is represented in the Middle Castlemaine beds by one specimen of a new species and only one specimen of *D. octobrachiatus* has been found in Victoria Gully beds. Only three specimens of *Triaenograptus*, T. S. Hall, are known, and only two of these were found in situ. The futility of using such species in an account of zonal distribution is obvious, and, with a view to simplicity, it has been thought better to give only the more useful species.

VIII. Classifications Compared.

It is apparent that this scheme of classification supplements the older one. The following notes on the two classifications will serve to show resemblances and differences :—

1. Beds of the Darriwil series, as previously constituted, have for the first time been recorded from the Castlemaine district.

2. The meaning of the term Darriwil has been extended so that in the Darriwil series are now included not only those beds referred to the Darriwil by Dr. Hall, but also previously unrecognised beds between these and the Upper Castlemaine (*Logano-caduceus*). zone. I at first constituted these beds a new series under the name "Yapeen," but I found later that apparently all these beds did exist in the Darriwil district, and it seemed advisable to retain that name for the series, thus giving it an extended meaning. This alteration involved many alterations in the text, but was made too late to enable the whole paper to be recast.

3. The Castlemaine series remains as described by Dr. Hall. The two zones of the Middle Castlemainian are not always distinguishable, and it was at first thought better to unite them. However, as Dr. Hall[1] after mature consideration separated them (they appear as one zone in an earlier paper), it was decided to make no change. The test for distinguishing them, "the comparative rareness of *D. caduceus*"[2] in the lower bed, is weak and not always applicable.

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1 Geol. Castlemaine, op. cit.

2 Geol. Castlemaine, p. 70.

4. Bendigo beds lower than any described in the earlier paper have been recorded South of Fryerstown. In them occur *T. fruticosus* (4-branched form), and *D. latus* (T. S. Hall). Dr. Hall mentions the latter species as probably indicating Lower Bendigonian. This discovery has involved the division of the *T. fruticosus* zone into two—one characterised by the three-branched form, and the other by the four-branched. The question arises as to what differences should be tolerated in any one zone, for between the typical beds of these zones (placed with the lower zone in this paper), are beds containing three and four-branched forms. At Tarilta, Bendigo, and at one outcrop on the Fryers-Chewton Road, the three-branched form is found with *D. bifidus*, the zonal fossil of the succeeding zone. The same merging of zone into zone is present throughout all the series, and shows that any division of palaeontological development into stages must not be too arbitrary. While, therefore, a number of zones can be distinguished, yet between all of them are transitional beds which serve to link them. This will be again referred to in this paper.

IX. Stratigraphical Relations and Typical Sections.

To obtain a definite idea of the gradual change of facies at the various outcrops it is necessary to work across the area from east to west. If it were possible to travel in a straight line west from the Elphinstone Tunnel this would involve a walk of ten miles. An equally or even more instructive section could be made by starting south of Fryerstown and going east to Limestone Creek—a distance of some seven miles; but exposures along this line are less common. In either case the presence of gullies and the concealment of the bed rock by recent alluvium make it necessary to zig-zag and to piece together evidence obtained from north and south of the direct line. The pitch of the numerous small anticlines and synclines being unknown it is impossible to say what the dip will be north or south of any observed outcrop, the whole country having, as Dr. Hall[1] has pointed out, a resemblance to a troubled sea, wave succeeding wave in every direction. The surface "drag" of rocks on the east or west slopes of hills make surface indications of dip almost valueless. To add to the difficulty a dip may change from easterly to westerly without a syncline or an anticline having been observed. The sections included in this paper have therefore been made diagrammatic. This was the more necessary since west of Castlemaine comparatively few observations of dip can be made.

1 Geol. Castlemaine, p. 65.

(*a*) *The Elphinstone Tunnel—Castlemaine Section.*

This section for the first five miles is based mainly on the evidence of the cuttings on the Melbourne-Echuca Railway from the Elphinstone Tunnel (72 miles) to the 77-mile post south of the town of Castlemaine. The section for the next two miles is based on observations made on the hills south and south-west of Castlemaine. West of this in a direct line evidence is scanty. The graptolites of the railway cuttings have been described by Dr. Hall[1]. With the record of his observations I have rarely found it necessary to disagree, but, thanks to greater facilities for travelling, the opportunity has presented itself of filling in more detail. The rocks at the western entrance to the tunnel dip west owing to inversion. *Tetragraptus fruticosus* is to be found in a small drainage channel south of the railway, indicating the Upper Bendigonian horizon. The fine anticline mentioned by Dr. Hall[2] is now obscured by surface soil, but calculating its position, I paced west, and was fortunate in locating the "repeat" outcrop of *T. fruticosus* near the 72-mile post. The calculation was afterwards found to have been unnecessary as the anticline is clearly shown on the side of the road to the north of the line. The next observed graptolite beds occur in the second cutting. Here two bands of fossiliferous slate occur, and an anticline causes both to be repeated; while still another band occurs further west. All are Wattle Gully (*D. bifidus*) beds—Lower Castlemainian.

The next outcrop, a few chains east of the 73-mile post (all mile posts mentioned are those on the railway), has *Phyllograptus typus* associated with the small form of *Didymograptus caduceus. D. bifidus* is not found. The horizon is Middle Castlemainian. Just past the 73-mile post the large form of *D. caduceus* occurs, and since it again occurs along the line of strike less than half a mile to the south and is there associated with *Diplograptus* sp. and *Loganograptus logani*, I have felt justified in indicating this as Upper Castlemaine. Three chains further west of the mile post the same zone repeats, and about three hundred yards still further west *Oncograptus upsilon* may be found in light-coloured slates with a westerly dip, and a little further on *Trigonograptus*. These beds are best developed at the 73½-mile railway bridge. Here they are thick almost horizontal beds of blue slate—probably the corrugated trough of a geo-syncline. Fossils are common, but a very troublesome cleavage—common in nearly horizontal beds—makes extrac-

1 Geol. Castlemaine, op. cit.
2 Geol. Castlemaine, p. 66.

tion difficult, and specimens are poorly preserved. *Oncograptus upsilon* and varieties of *Didymograptus caduceus* occur as typical forms, and *Didymograptus v-deflexus* sp. nov. and *Trigonograptus* are also found. *Cardiograptus morsus*, nov. sp., is absent, which agrees with the evidence of other localities, and indicates that this form is characteristic of a higher horizon. *Oncograptus* occurs a little to the south on the same strike and in the creek bed half-a-mile to the north, and even north of this.

The next beds present some difficulty. Separated from the *Oncograptus* beds by recent deposits, but only 200 yards from them, typically Middle Castlemaine beds occur. *Phyllograptus typus*, J. Hall, and small forms of *Didymograptus caduceus*, being found in fair numbers in a narrow band of decomposed white slate. These beds also occur to the south, where they are succeeded on the west by Upper Castlemaine beds in the usual order. Along the railway the next beds are also Upper Castlemaine. As the evidence of other localities is very strongly against the Middle Castlemaine being within 600 feet of the *Oncograptus* beds, these Middle Castlemaine beds seem difficult to fit in. Faulting is apparently responsible for their juxtaposition. More than this statement the evidence does not warrant, but the common occurrence of slickensided faces and the experience of miners shows that faulting is common in these rocks. Between this outcrop and the 74-mile post Upper Castlemaine beds are found, and they are also well represented at the mile post. This zone again repeats, and then no fossils are found until Chewton is reached. Further search may reveal some, probably Middle Castlemaine, as such beds are exposed on the hills to the south and to the north (at Burns' Reef). Just past the Chewton Railway Station (75 miles) *D. bifidus* and *P. typus* re-appear on the summit of the Chewton ge-anticline on the strike of Dr. Hall's original Wattle Gully beds, Wattle Gully itself crossing the railway line immediately to the west. Higher beds—Middle Castlemaine—occur along the same strike at Quartz Hill north of the line, but southwards all the beds are either of the same horizon (Lower Castlemaine), or lower, as at Lost Gully (Daphne Reef) and Mount Eureka (The Monk), where Upper Bendigo beds outcrop. The Wattle Gully zone outcrops to the north in Cemetery Gully, and even further north in Dirty Dick's Gully. This is interesting, as the zone has seemingly never been previously recorded north of Forest Creek. At one spot a large variety of *D. bifidus*, with branches about 40 mm. in length, is found. The only other Castlemaine locality where it occurs is in Steele's Gully south of the line. This northerly occurrence of *Didymograptus bifidus* marks the apex of a ge-anticline not shown in Messrs. Baragwanath or Herman's section. Several occurrences of *D. bifidus* between Chewton and 76½ miles indicate smaller anticlines. Near Aberdeen Hill, Middle Castlemaine beds are found, and then, after repetition, an ascending series of Upper Castlemaine between the Vincent Street bridge and the 77-mile post. The railway soon after this ceases to be of value, and the section has been worked out westward on less complete evidence. The most westerly occurrence of Middle Castlemaine beds noted in this locality is near New Chum Gully, though isolated outcrops may exist further west. With this exception, all graptolites found between a north and south line through the 77-mile post and the Harcourt-Campbell's Creek railway line are Upper Castlemaine.

So far the stratigraphical relations of the members of the Castlemaine series and some members of the Bendigo and a higher series, have been traced from the apex of a ge-anticline at the Elphinstone Tunnel exposing Upper Bendigo beds, through a syncline at 73½ miles, exposing beds containing *Oncograptus* and higher than the Castlemaine series, to the main apex of the Chewton ge-anticline exposing Wattle Gully (Lower Castlemaine) beds. These beds recur at intervals for about a mile, and then disappear under higher beds which rest on the western limb of this ge-anticline.

(*b*) *Water Race Section.*

Parallel to the whole length of the previous section and mostly within the same compass there is an almost complete section along the water race to the south. It is supplemented in part by outcrops along the ridge of hills between the race and the railway section already traversed in detail and by beds exposed south of the race on either side of the Chewton-Fryerstown Road.

Leaving the railway half way between the 72 and 73 mile posts, *Didymograptus bifidus* is first found, and after an unfossiliferous stretch, several Upper Castlemaine outcrops the first of which, as before mentioned, can be correlated with an outcrop on the railway. The beds then pass through Middle Castlemaine to Lower Castlemaine, several *D. bifidus* outcrops occurring between White Horse Gully and the Chewton-Fryerstown Road. From this road to the Monk the race is unfossiliferous, but at the Monk a small outcrop of the Bendigo series occurs, the beds on either side being still Lower Castlemaine. Between the Monk and the offtake of the South Campbell's Creek race five outcrops yield *D. bifidus*, some also yielding a number of undescribed specimens. Another unfossiliferous stretch follows, but is in turn followed by the most prolific area in the district. In the area between Scott's Gully and New Chum Gully the outcrops are so numerous that they cannot well be shown on a map of small scale. The general succession from Middle to Upper Castlemaine is clear.

Sections Compared and Additional Data.

There are, then, in more or less detail, four lines of section along which the succession of beds from Upper Bendigo to Upper Castlemaine may be traced.

(a) That along the railway from Elphinstone Tunnel to Castlemaine, showing an ascent from Upper Bendigo to Upper Castlemaine and beyond, then a descent to Lower Castlemaine and a second ascent to Upper Castlemaine.

(b) That along the water race to the south, where the succession is the same, though more detailed.

(c) That along the hills between these two lines showing Middle and Upper Castlemaine beds.

(d) That east and west of the Chewton-Fryerstown Road, where the succession from the Upper Bendigo to Middle Castlemaine is well shown.

A fifth line along the South Campbell's Creek water race and hills from the Monk via Sebastopol Hill to Campbell's Creek shows an ascending series from Lower Castlemaine to Upper Castlemaine. From south of Fryerstown to the Limestone Creek the succession is from Lower or Middle Bendigo upwards, but an area between Guildford and Tarilta has not been examined. In addition a somewhat incomplete record is seen north of Forest Creek, and here the succession is the same. About the Vaughan-Tarilta "trap" area (Ba 80 and 81)[1] the beds pass from Upper Bendigo or transitional Wattle Gully (*T. fruticosus* and *D. bifidus*), to Middle Castlemaine as one goes west. The lowest beds in the district are those south of Fryerstown.

The evidence of all these sections is corroborative and supplementary, and, as they are parallel and contiguous, also cumulative. Few places offer more opportunity for checking one's work, and it is unthinkable that beds with a distinctive and foreign facies could exist between the Middle and Upper Castlemaine beds as distinguished by Dr. Hall and amplified here. The repetition of Middle and Upper Castlemaine beds to the east and west of Victoria

1 G.S. Vic., ¼ S., 15 S.W.

Gully especially leaves no room for doubt as to the succession of these beds.

X. Darriwil Series.

(As before stated, Dr. Hall's term Darriwil has been extended to include new beds.)

The stratigraphical position of the series, which has as its associated fossils *Trigonograptus*, sp., *Didymograptus caduceus* (Salter), *D. v-deflexus*, sp. nov., *Oncograptus*, spp., *Glossograptus*, sp., *Diplograptus gnomonicus*, sp. nov., and other forms as yet undescribed, is on the negative evidence afforded by the work of others and myself, above the Castlemaine series. The soundness of Dr. Hall's subdivision of the Castlemaine series, confirmed, as it is, by the work of Mr. T. S. Hart[1] at Daylesford and by my own at Castlemaine, permits of no other conclusion. With the exception of the outcrops mentioned (at 73½ miles), *Oncograptus* has not been found east of Castlemaine. To the west of the town the *Oncograptus* facies prevails, beds with *Oncograptus* or its associated forms being numerous and widespread. One of the most easterly outcrops is in a cutting on the Woodbrook Road near the north-west of the municipality of Castlemaine. The material taken from the cutting is very much decomposed and cleavage is troublesome. *Oncograptus upsilon*, T. S. Hall, is common, *D. caduceus* in most of its varieties is exceedingly common, and *T. serra*, Brong, is common. *Trigonograptus* is not uncommon, while *Diplograptus sp.*, and *Didymograptus v-deflexus*, sp. nov., are found. *Phyllograptus* does not seem to occur. *Diplograptus gnomonicus, sp. nov.*, may be present, but it is so delicate that even if it be present it is not likely to be found in the material available. Along the same line of strike the nearest beds are 1½ miles to the south, and are Upper Castlemaine. About 400 yards west of this Woodbrook Road locality another outcrop occurs in which *Phyllograptus* is common, and is there, as in some other parts of the district, and also at Steiglitz, associated with *Oncograptus*. Half-a-mile south of this second *Oncograptus* locality, and apparently on the same line of strike, fossils are to be found on the road east of the Sanitary Depot. A small excavation was made here and exposed beds that yielded *D. caduceus*, *Oncograptus upsilon* and *Trigonograptus* all in profusion. Further excavation would probably yield a larger variety. The species of *Trigonograptus* occurring in these beds is apparently not *T. wilkinsoni*, T. S.

1 Proc. Roy. Soc. Victoria (n.s.), vol. xx. (1907), quoted by Hall, T. S., A.A.A.S. (1909), p. 319.

Hall, but *T. ensiformis*, J. Hall. I doubt if I have ever found *T. wilkinsoni*. A specimen of *Phyllograptus* was found in a fragment of rock, but not in situ. West of this locality similar beds are found, but not being well exposed, their graptolites cannot be given in detail, though *Oncograptus*, *D. caduceus*, *Diplograptus gnomonicus*, sp. nov., *Didymograptus v-deflexus*, sp. nov., and one specimen of *Glossograptus* may be recorded.

To the south is the Military Rifle Range. On it uppermost Castlemaine beds may be seen with characteristic forms, including *D. caduceus* and *Loganograptus logani*. In these beds an occasional *Oncograptus* may be found, but it is extremely rare. About 400 yards to the west of the Range there is a cutting on the Maldon line exposing thick beds of blue slate badly cleaved. *D. caduceus* and *Oncograptus upsilon* were obtained here, and a few yards to the south, on a small race, *D. caduceus*, *D. forcipiformis*, and *Goniograptus speciosus*, T. S. Hall. Still going west and a little south, the next beds, 300 yards further, on McKenzie Hill, yield a collection of forms difficult to specify; the beds are typically Upper Castlemaine. A rare *Trigonôgraptus* or *Oncograptus* may be found, but by far the most common form is *D. caduceus* and its varieties. This is the bed taken as typical of the *Logano-caduceus* (uppermost Castlemaine) zone, but though *Loganograptus logani* is common here, it is rare at other outcrops in the district.

The only other places where *Oncograptus* has been found in close relation to a recognised zone are near Yapeen and south of Guildford, and at both these places the nearest beds are Upper Castlemaine. West of these outcrops other forms are found and will be described, but Lower and Middle Castlemaine forms are conspicuously absent.

The field relations of the Darriwil beds near Yapeen and at Guildford and Woodbrook seem to indicate a high horizon for them. Along the line of strike in every case where fossils have been found they have been Upper Castlemaine. Occasional *Oncograptus* forms are found in Upper Castlemaine beds, and, as will be shown, there is a gradual progression from Upper Castlemaine through the *Oncograptus* beds to the original Darriwil zone.

(b) *Nature of Facies.*

A consideration of the *Oncograptus* facies involves the question of the subdivision of the beds of the series. The Bendigo and Castlemaine succession has long been known, but, while the graptolites of these two series are widely distributed, our knowledge of

Darriwil forms has been limited to those from one or two outcrops in the Darriwil district. As well preserved specimens are rare, the Darriwil forms are more difficult to identify specifically than those of lower horizons. While it was known that the Darriwil series was characterised by species of "*Tetragraptus*, *Didymograptus*, *Loganograptus*, *Diplograptus*, *Climacograptus*, *Glossograptus*, *Trigonograptus*, *Lasiograptus*, and others not determined,"[1] its exact relationship to lower beds had remained obscure and fossils found in other localities had thrown little light on the point. The presence of *P. typus*, J. Hall, with *Loganograptus* and large *D. caduceus* at Steiglitz was puzzling[2], and an assemblage of Newham forms "suggested the presence of both Darriwil and Castlemaine series."[3] The country to the west of Castlemaine had never been critically examined, and it was known to contain much that was new to the graptolite succession. Difficult forms found by officers of the Geological Survey half a century ago were still undescribed, and the chance of clearing away certain anomalies was deemed possible. It took time to acquaint oneself with these new forms, but having done so their order of development soon appeared. It soon became apparent that the beds could not be called Upper Castlemaine without altering the meaning of the term, nor for the same reason could they be called Darriwil, without widening the meaning of the term. The beds spread over an area of more than thirty square miles at Castlemaine, probably over a greater area at Macedon and Woodend, and south of Steiglitz, and occur also at Ingliston, Melton, and probably at other localities, and three zones seem to be recognisable.

In the Darriwil district all zones seem to be represented, the Upper or typically Darriwil, on Sutherland's Creek (W.L.S. 1, ¼ S.), and the lower or *Oncograptus* zone at Steiglitz.

In view of this all the beds, as already described, have been included in an extended series, for which the term Darriwil has been retained, and of which the previously known Darriwil beds form, as already stated, the upper zone. If, therefore, in earlier work "Darriwil" is read as "Upper Darriwil," no confusion will arise.

The vertical distance between the Middle and Upper Darriwil zones should be capable of measurement at Guildford, and they merge into one another through transitional beds.

No zone above that of *Tetragraptus fruticosus* has such a distinctive and characteristic association of species as these Darriwil

1 Hall, T. S., Australian Graptolites. Fed. Hbk. of Aust., B.A.A.S. (1914), p. 291.

2 Ibid., Reports on Graptolites, II. Rec. Geol. Surv. Vic., vol. iii., part 3 (1914), p. 290.

3 Skeats, E. W., and Summers, H. S., Geol. and Petr. Macedon District. Bull. Geol. Surv. Vic. 24 (1912), p. 41. Quoted from Hall, T. S., Geol. Surv. Vict. Prog. Rept., IX. (1898), p. 126.

beds. *Trigonograptus*, *Didymograptus v-deflexus*, sp. nov., and varieties of *Didymograptus caduceus*, range through all the series. *Oncograptus upsilon*, T. S. Hall, and *Diplograptus*, spp. indet., characterise the lower beds, *Cardiograptus morsus*, gen. et sp. nov., the middle beds, and *Diplograptus gnomonicus*, sp. nov., ranges through the Middle and Upper beds. *Strophograptus trichomanes*, Rued., also occurs. While it is impracticable in this part of the paper to discuss details of structure, a few points which will be dealt with more fully in the second part may be briefly indicated.

(a) The close resemblance of the thecae of *D. caduceus*, *Oncograptus*, and *Cardiograptus*[1] indicating a probable line of development.

(b) The progressive development in form of rhabdosome from *D. caduceus* to the Dicranograptid structure of *Oncograptus* and the biserial (?) *Cardiograptus*. *Diplograptus gnomonicus* may represent further development in the direction of simplification, for, while I have provisionally included it in the genus *Diplograptus*, its affinities with that genus are doubtful (Plate I., figs. 5 and 6). It may be of interest to note its close resemblance to a form figured by Ruedemann[2] as *Phyllograptus anna*, J. Hall. While these figures are given as of a phylogenetic, or senile, form of *Phyllograptus*, they differ from a typical specimen of that genus in (1) the presence of only two stipes. (Unless the drawings are misleading, the stipes normally shown as dark ridges along the medial plane, are absent, but a virgula is shown instead). (2) The more rapid alteration of the angle of inclination of the thecae. This will be seen by contrasting figs. 28 and 30 with others on the same plate. Except for the somewhat greater width the two figures bear a striking likeness to *D. gnomonicus*, which is certainly not a *Phyllograptus*. Another case of resemblance which may be more than a coincidence is presented by juvenile forms of *Oncograptus* and *Cardiograptus*, which recall the form described by Ruedemann[3] as *D. caduceus*, Salter, var. *nanus* (Plate I., fig. 9). Did the tendency, which in America ceased at this mutation, continue further and lead to the development of *Oncograptus* and *Cardiograptus*? It would appear not unlikely, for the horizon on which these forms are found seems to be that of *Diplograptus dentatus* in North America.

1 Since this paper was written Mr. R. A. Keble has intimated that after a close examination of Cardiograptus he has recognised a third branch which was probably at right angles to those on the plane of the laminae. Such a habit infers a phyllograptid structure which was hinted at by the late Dr. Hall in a verbal communication to the writer.

2 Grap. N.Y., I., pp. 715-716, plate 15, figs. 28 and 30.
Ibid., p. 698, fig. 90.

3 Grap. N.Y., p. 698, fig. 90.

(c) *Stratigraphical Horizon.*

Such being the forms present little doubt would have arisen as to the stratigraphical position of the beds but for the presence of *Phyllograptus* and *Goniograptus* which in this district were thought to have disappeared in the Middle Castlemaine[1] beds. In New Zealand, however, *Phyllograptus* is recorded in association with typical Upper Castlemaine (zone 1) forms[2]. The discontinuity of its range is therefore not so great as appears at first. (See Note 2 infra.) A similar anomaly with *Phyllograptus* is recorded by Ruedemann[3], who in a table showing the range of different species records *P. augustifolius* for Beds 1, 2, 3, and 6 of the Deep Hill Series, while he omits it from Beds 4 and 5. No possible arrangement of the beds will make all genera range continuously, and it must be left to later work to supply an adequate explanation. The polyphylogenetic origin of *Goniograptus* may be held to lessen the importance to be attached to its occurrence. To place the Victoria Gully Beds above the Darriwil Beds—which would be necessary to provide a continuous range for *Phyllograptus*—would break the continuity of the range for several other genera—for example, *Loganograptus*, *Trigonograptus*, *Oncograptus*, and *Glossograptus*. The fauna of the original or Upper Darriwil beds seems good evidence that these forms have been correctly placed, unless we are to suppose that these Darriwil beds are themselves Middle Castlemaine, a theory which I do not think sufficiently well supported to need combating. The presence of at least three genera of the Diplograptidae indicates a high horizon.

(d) *The Evidence from Didymograptus caduceus* (Salter).

The evidence to be derived from the study of the development of *Didymograptus caduceus* seems to point to a high position for

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1 Geol. Castlemaine, op. cit.

2 Bell, J. M., Parapara Subdivision, N.Z. Geol. Surv. (n.s.), Bull., No. 3.

The forms recorded are said to be from one horizon, *Tetragraptus*, *Didymograptus*, *Loganograptus*, *Climacograptus* and *Phyllograptus* occurring on the same slab.

Figures are given of the following species—the comments in parentheses are mine.

- *Rastrites* (obscure fragments which may or may not belong to that genus).
- *Didymograptus extensus* (several figures representing two or more species of horizontal *Didymograptus*).
- *Tetragraptus quadribrachiatus (T. Serra).*
- *Loganograptus octobrachiatus* (non *L. Logani* vel *D. octobrachiatus*. An identical form is found in Upper Castlemaine beds here).
- *Phyllograptus typus.*
- *Diplograptus sp.*
- *Didymograptus caduceus* (typically Upper Castlemainian (zone 1) form).
- *Climacograptus* (doubtful identification).

3 Grap. N.Y., I., p. 506. (Bed 4 is omitted from the table throughout).

the Darriwil beds. Dr. Hall[1] states that in the Bendigo beds "*D. caduceus* is rare and small, and it is interesting to notice as we pass up through a long succession of rocks above these of Bendigo that it increases in relative numbers and at the same time attains a much larger size till it reaches its maximum near the horizon of the uppermost Castlemaine beds, where it crowds the rocks to almost entire exclusion of other forms. It then enters on the period of its decline, and is but sparingly represented by stunted forms at Darriwil, and perhaps ranges into the Upper Ordovician." Later Dr. Hall[2] expresses his doubt as to the occurrence of *D. caduceus* with *T. fruticosus*, and I have not found them together. With *D. bifidus*, *D. caduceus* is rare and small. In the Middle Castlemaine beds it is fairly common but small. In the Victoria Gully beds it is very numerous, and the specimens are larger than those of the lower beds. Here the rhabdosome is of horse-shoe shape, the stipes are of even width throughout, and a long nema is often present. In the McKenzie's Hill beds *D. caduceus* is even more common than in the Victoria Gully beds, where Dr. Hall[3] estimated it to comprise 80 per cent. of the fauna. In typical specimens from this upper zone the stipes diverge at the angle of about 330°, and the branches widen as they diverge and then narrow somewhat towards their distal extremities. The rhabdosome is now more like the letter V than U. In the beds west of McKenzie's Hill *D. caduceus* varies greatly, though it seems as if the maximum of variation is in the McKenzie's Hill beds. The stipes are longer than ever, but not so wide. Stipes measuring over 60 mm. in length are not at all uncommon. The forms of the two zones contrast in the same way as the tall thin-branched trees of a forest do with the sturdy, wide-spreading trees of the more open country. The contrast is not so great between the higher beds of the McKenzie Hill zone and the lowest *Oncograptus* beds. Measurements of twelve specimens on one slab from an outcrop near the Muckleford Railway Station, showed an angle of divergence varying from 315° to 335°, the average being 325°. Several of the specimens have stipes more than 60 mm. in length. *D. caduceus*, Salter var., *manubriatus*, T. S. Hall, and *D. forcipiformis*, Rued., both late derivatives of *D. caduceus*, are somewhat rare in the McKenzie's Hill beds, and more abundant in the western beds, being more common at some outcrops than at others. As Dr. Hall[4] noted, the thecal

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1 Grap. Rocks of Vict., p. 443.
2 Recent Advances of our Knowledge of Victorian Graptolites. A.A.A.S. (1909), p. 319.
3 Geol. Castlemaine, p. 71.
4 Victorian Graptolites, Part IV. Proc. Roy. Soc. Victoria, xxvii. (n.s.), part i., 1914, p. 109.

characteristics of *Oncograptus* show its relation to *D. caduceus*, and it seems probable that *Oncograptus* and *Cardiograptus*, like *D. forcipiformis* and *D. caduceus var. manubriatus*, are also late derivatives of *D. caduceus*, and had a very limited range. Here, then, is the life history of *Didymograptus caduceus*. Originating when *D. bifidus* was flourishing in the Wattle Gully stage, or perhaps earlier, it outlived that form, and became fairly common in the Middle Castlemaine, as yet showing little if any increase in size. By the time the Victoria Gully stage was reached it had become by far the commonest species, and with favourable conditions reached its zenith in the McKenzie's Hill beds. The common fate of all genera and species now overtook it. It deployed in various directions giving rise to *Oncograptus*, *D. forcipiformis*, *Cardiograptus*, etc. It will be the purpose of the second part of this paper to attempt to show the phylogeny of these and other genera. If the Darriwil beds are placed anywhere but above the Castlemaine beds the development of *D. caduceus* becomes unintelligible.

(*e*) *Transitional Beds.*

Victorian graptolite zones are all based on the rise and fall of species. *T. fruticosus*, *D. bifidus*, and *D. caduceus* originated in that order, lived in association, and one by one disappeared, affording a basis for the subdivision of the rocks in which their remains are found. Dr. Hall[1] has shown how *T. approximatus*, Nich., occurring with Lancefield forms at Inglewood and Clarendon, and with Bendigo forms at Bendigo and in the Mornington Peninsula, indicates the highest beds of the Lancefield, or the lowest beds of the Bendigo series.

Now, *Oncograptus upsilon* and *Trigonograptus* occur similarly at Castlemaine. At McKenzie's Hill the majority of the forms are so characteristic of the Upper Castlemaine of Dr. Hall that I have taken them as typical of that zone—more typical even than McCoy's Barker Street beds, where *D. caduceus* is, on the whole, not so well developed. Yet at McKenzie's Hill *Oncograptus* and *Trigonograptus* are occasionally found, indicating the close proximity of the McKenzie's Hill beds to the Lower Darriwil series. At the Military Rifle Range *Oncograptus* is also found, though here again it is extremely rare, and the beds are typically Upper Castlemaine. The Rifle Range beds, as shown above, are found to be succeeded along their line of strike by *Oncograptus* beds, which, if one pre-

1 Recent Advances Vic. Graps., p. 319.

sumes the northerly pitch found elsewhere near Castlemaine, is what might be expected if the Lower Darriwil beds overlay immediately the Upper Castlemaine. In the same way, as *D. bifidus* succeeds *T. fruticosus*, *Cardiograptus morsus*, gen. et. sp. nov., is, at some localities, found with *Oncograptus upsilon*. Then *Oncograptus upsilon* disappears, and at Guildford beds containing *Cardiograptus morsus*, also contain *Diplograptus*, cf. *angustifolius*, and this latter form is common with Upper Darriwil forms in a neighbouring bed. This is also true of other undescribed forms.

(*f*) *Subdivisions.*

The manner in which the Upper Castlemaine beds merge into beds in which *Oncograptus* occurs has already been discussed. At each of the four outcrops mentioned, in which the nearest beds are Upper Castlemaine, *Oncograptus upsilon* occurs, and *Cardiograptus morsus* does not. If it were at all common in these beds sufficient exploration has been done at least at two of them to reveal it. *Cardiograptus morsus* has never been found in Upper Castlemaine beds. These facts seem to indicate that *Oncograptus upsilon* is representative of the lowest zone of the series. At Macedon, where the Lower Darriwil beds are well developed, *Cardiograptus morsus* appears to be absent, at any rate from some beds, if not from all.

At Castlemaine localities further west than those above mentioned *O. upsilon* and *Cardiograptus morsus* are found in association, both forms being common. At Guildford *O. upsilon* has not been found, though *Cardiograptus morsus* is common. This would suggest that *C. morsus* came in later than *O. upsilon* and outlived it, which is supported by the fact that on the Guildford-Strangways Railway the *Cardiograptus* beds occur both east and west of typically Upper Darriwil beds. These *Cardiograptus* beds contain at least one species, *D. cf. angustifolius*, otherwise restricted to the neighbouring Darriwil. The Upper Darriwil beds at Guildford contain *Loganograptus*, *Diplograptus cf. angustifolius*, *D. caduceus* (varieties), *Diplograptus gnomonicus*, sp. nov., *Trigonograptus*, *Lasiograptus*, *Glossograptus*, and *Didymograptus v-deflexus*, sp. nov. No genus found at the typical Upper Darriwil locality (W.L.S. 1, $\frac{1}{4}$ S., 19 S.W.) is wanting here, except *Climacograptus*, and even at Darriwil *Climacograptus* does not appear to be common, as an examination of slabs in the National Museum, Melbourne, failed to reveal any specimen of the genus. At Darriwil, also (W.L.S. 2 and W.L.S. 3) *Cardiograptus morsus* is found, but not near enough to W.L.S. 1 to render exact correlation possible. It is instructive to find that there it also occurs apparently without *O. upsilon*, though the latter occurs without it further north, near Steiglitz, as already noted.

(*g*) *The Series in other Localities.*

Most of the localities from which, as far as the writer knows, Darriwil graptolites have been obtained, have already been mentioned. They may be summarised as under :—

(1) Between Castlemaine and Muckleford Creek, and south-west of Guildford. (Lower, Middle, and Upper).

(2) At Woodend (eight miles S.W. of Woodend) and Macedon. (Lower.) (They are well represented north of Old Gisborne township, and along the railway south of Macedon R.S.), and at Newham (Upper ?).

(3) Near Ingliston, and perhaps at Coimadai and Melton (Lower).

(4) At Steiglitz (Lower).

(5) South of Steiglitz (W.L.S. 2 and W.L.S. 3, $\frac{1}{4}$ S., 19 S.W.), parish of Coole Bharguk (Middle), and at Darriwil (W.L.S. 1) (Upper).

XI. Summary of Conclusions.

The proposed revised classification is the outcome of a critical examination of a number of sections and localities in which the stratigraphical relations of the beds are those given in the stratigraphical table.

This stratigraphical table shows :—

(a) An agreement in general with Dr. Hall's subdivision of the Castlemaine series.

(b) A new series above the Castlemaine series and between it and including the Darriwil beds of Dr. Hall. This is described as the Darriwil series.

(c) A subdivision of this extended Darriwil series into three zones based on the rise and fall and the association of certain described species and new species (to be described in Part II. of this paper).

(d) A record of the Upper Darriwil series at Guildford.

The stratigraphical position, nature of facies, the evidence supplied by *D. caduceus*, and a list of localities where the Darriwil series is known to occur in other parts of the State of Victoria, have been given in more or less detail.

The country examined to obtain the evidence necessary to erect this new series comprises that already examined by Dr. Hall and a considerable area outside it. The first section given in this paper differs in certain important respects from those of Messrs. Baragwanath and Herman, and the extent of favourable auriferous beds —those in the vicinity of the Chewton ge-anticline appear to be more auriferous than others—is increased.

Bendigonian beds some distance down in the series are shown to occur near Fryerstown, and the succession on every side of the "dome" clearly indicates the pitch.

A map showing the general arrangement of the beds and more than 150 localities visited is given.

Acknowledgments.

In conclusion, I wish to express my indebtedness to all who have assisted me. To the late Dr. T. S. Hall in particular I owe much for placing at my disposal literature and specimens in his possession and for an always kindly interest in my work. His death has deprived the scientific world of its greatest authority on Australian graptolites. Mr. F. Chapman, A.L.S., Palaeontologist of the National Museum of Victoria, has assisted me by elucidating the cryptic symbols on the old Geological Survey plans and by permitting me to examine more closely than would otherwise have been possible specimens collected by officers of the Survey now in the possession of the Museum. From Mr. H. Herman, Director of Geological Survey, and officers of the Mines Department of Victoria, I have received valuable assistance. The re-drawing of plans, etc., has been carried out by the latter in a manner far superior to anything I could have done personally. Mr. R. A. Keble, of the Mines Department, in particular, has been in touch with my work since its beginning, and, besides making many valuable suggestions, has been kind enough to read through the manuscript and assist in moulding it to a publishable form. Dr. Rudolf Ruedemann very kindly forwarded me, through the Smithsonian Institute, his monograph on the "Graptolites of New York," a work of the value of which it is unnecesary for me to speak. It is impossible in any list such as this to do justice in detail to all who have assisted, so I conclude by thanking collectively all who have helped me. For the accuracy of observations and conclusions contained in this paper and not ascribed to others I must hold myself personally responsible.

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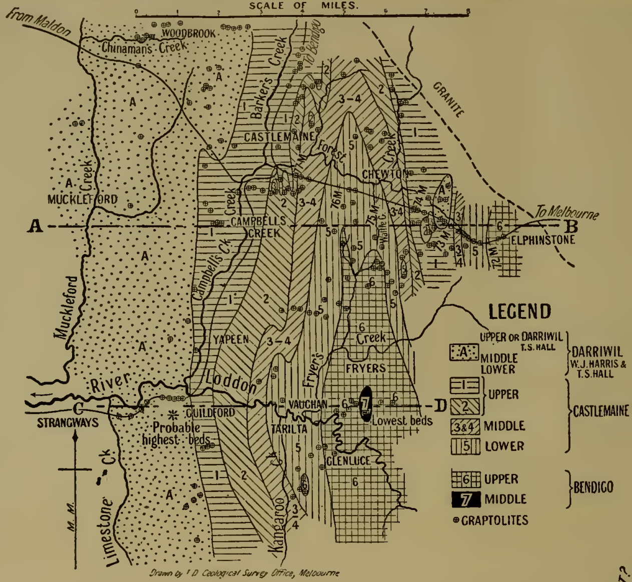

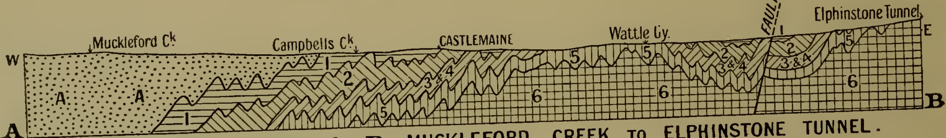

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EXPLANATION OF PLATE I.

(New species figured by W. J. Harris and R. A. Keble).

Fig. 1.—Cardiograptus morsus, gen. et sp. nov. narrow form. × $\frac{3}{2}$. Chinamen's Creek, Q.S. 15 N.W., Note 6.

2.—C. morsus. Another specimen showing typical shape of rhabdosome. × $\frac{3}{2}$. Same locality.

3.—C. morsus. Another specimen, slightly enlarged. Same locality.

4.—C. morsus. A juvenile form showing sicula; lines somewhat hardened to portray structure. × 3. Same locality.

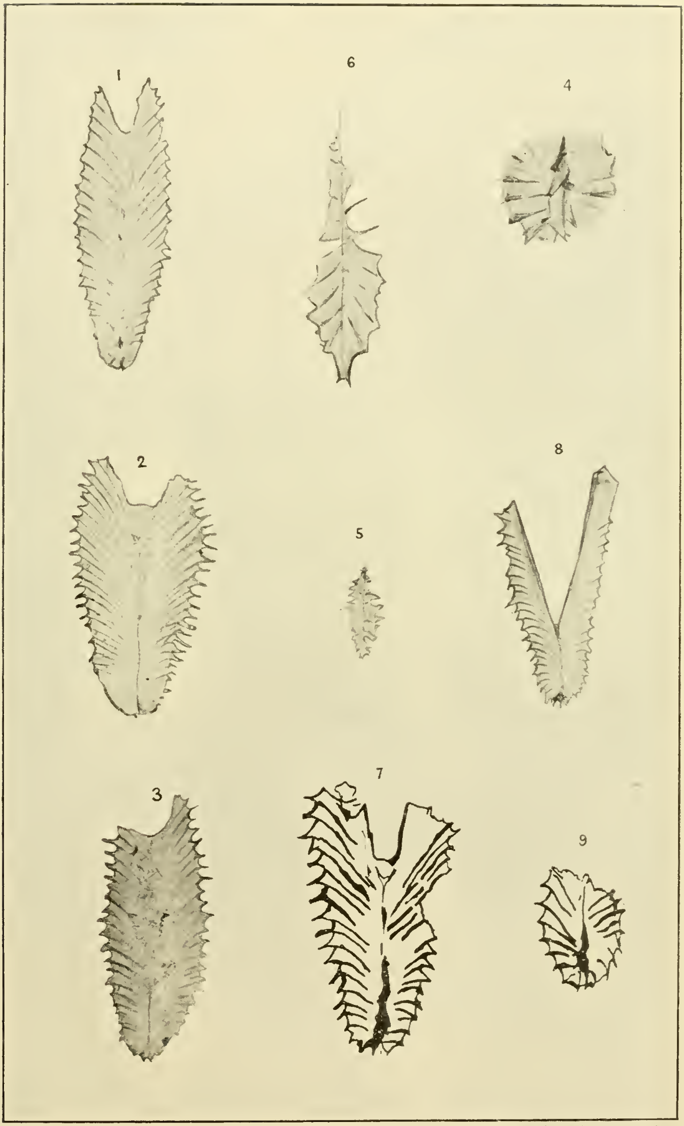
5.—Diplograptus gnomonicus, sp. nov. Typical preservation facies, the reversal of the direction of the thecal walls is indistinctly shown. × 2. Same locality.

6.—D. gnomonicus (mag). Figure shows varying inclination of thecae. × 6. Same locality.

7.—Oncograptus biangulatus, sp. nov. Proximal end of rhabdosome. × $\frac{5}{2}$. Same locality.

8.—O. biangulatus. Typical rhabdosome. × $\frac{3}{2}$. Same locality.

9.—O. biangulatus. Juvenile form. × 2. Same locality.



W.J.H. & R.A.K. Del.

[Proc. Roy. Soc. Victoria, 29 (N.S)., Pt. I., 1916].

Art. V.—*New or Little-known Victorian Fossils in the National Museum.*

Part XIX.—The Yeringian Gasteropod Fauna.

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(Palaeontologist to the National Museum, Melbourne).

(With Plates II.-VI.).

[Read 13th July, 1916].

Introductory.

Of late years a considerable number of Silurian gasteropods have been added to the collection of the Melbourne National Museum, chiefly through the assiduous work of collectors whose names are mentioned in the body of the text, and who have permitted the Museum to benefit by their discoveries. Amongst the more notable genera of Silurian gasteropods herein described are :—*Helcionopsis*. *Temnodiscus*, *Carinaropsis*, *Cyrtostropha*, *Craspedostoma*, *Orthonychia*, *Diaphorostoma* and *Hercynella*, all of which appear to be new to the Southern Hemisphere.

Coelocaulus is here used to replace *Niso* (*Vetotuba*); the murchisonian affinities of the Cave Hill specimens being clearly shown in the Museum examples. The wide area of distribution for this genus in palaeozoic times is thereby extended into the Australian region. A new genus, *Liomphalus*, is herein suggested for smooth euomphalid shells with biconcave surfaces and partially open whorls.

A noteworthy feature of the Yeringian fauna is the comparative abundance of gasteropoda in contrast with their rarity in the Melbournian. The complete list of Yeringian gasteropods comprises 36 species, whilst there are only six species known up to the present time in the Melbournian. This gives a deeper water aspect to the Yeringian sea as a whole, and is concomitant with the data derived from the lithological structure and general stratigraphy of the two groups of beds in question.

So large a proportion of the Victorian Yeringian gasteropods is here described for the first time, comprising sixteen new species, and a variety, that it seemed advisable to make this paper a complete record of all the Yeringian species, so far as the material is sufficiently well preserved for descriptive purposes.

LIST OF YERINGIAN GASTEROPOD FAUNA.

Name.	Lilydale (limestone or mudstone).	Loyola (limestone or mudstone).	Upper Yarra.	Kilmore.	Other Localities.
Helcionopsis nycteis, Cressw. sp.	L				
Helcionopsis elegantulum, sp. nov.	L				
Temnodiscus pharetroides, sp. nov.		M			
Trematonotus pritchardi, Cressw.	L				Thomson R.
Bellerophon fasciatus, Lindström			X		
Bellerophon aff. *fastigiatus*, Lindström				X	
Bellerophon cresswelli, Eth. fil.	L				
Bellerophon pisum, sp. nov.	L				
Carinaropsis victoriae, sp. nov.	M				
Pleurotomaria maccoyi, sp. nov.			X		
Mourlonia duni, Eth. fil.				X	
Mourlonia subaequilatera, sp. nov.	L				
Phanerotrema australis, Eth. fil.	L				
Coelocaulus brazieri, Eth. fil. sp.	L				Marble Cr.
Coelocaulus apicalis, sp. nov.	L				
Cyrtostropha lilydalensis, sp. nov.	L				
Goniostropha pritchardi, Eth. fil.	L				
Gyrodoma etheridgei, Cressw. sp.	L				
Euomphalus centrifugalis, sp. nov.		M	X		
Euomphalus northi, Eth. fil. sp.	L				
Liomphalus australis, sp. nov.	L				
Straparollus debilis, sp. nov.	M				
Omphalotrochus globosum, Schlotheim sp.	L				
Scalaetrochus antiquus, Cressw. sp.	X		X		
Scalaetrochus lindstroemi, Eth. fil. sp.	L				
Craspedostoma lilydalensis, Cressw. sp.	L				
Cyclonema lilydalensis, Eth. fil.	L				
Cyclonema australis, Eth. fil.	L				
Loxonema sinuosa, Sow. sp., var. *australis*, nov.	L				
Orthonychia brevis, sp. nov.		L			
Platyceras minutum, sp. nov.					Deep Creek (Thom. R.)
Platyceras cornutum, Hisinger		L M			
Platyceras erectum, J. Hall sp.					Kilmore D.
Diaphorostoma retrorugatum, sp. nov.	M				
Diaphorostoma incisum, sp. nov.					Thomson R.
Hercynella victoriae, sp. nov.			X		

DESCRIPTION OF THE SPECIES.

Fam. ACMAEIDAE.

Genus **Helcionopsis**, Ulrich and Scofield.

Helcionopsis nycteis, Cresswell sp. (Plate II., Fig. 1).

Tryblidium nycteis, Cresswell, 1893. Proc. Roy. Soc. Victoria, vol V. (N.S.), p. 41, pl. IX., fig. 4.

Capulus nycteis, Cresswell sp., Chapman, 1913. Rep. Austr. Assoc. Adv. Sci., vol. XIV., p. 227.

Description.—Shell sub-ovate, strongly convex along the back, broadening and expanding towards the sides. Form resembling a strongly-arched *Crepidula*. Apex slightly overhanging the pre-apertural area. Side view plano-convex, highest at the middle point between the apex and ventral edge. End view semi-ovate, with a slight cant towards one side. Lines of growth marked by numerous raised concentric ridges, the interspaces relieved by radial striae. Lines of growth in middle of shell about .5 mm. apart.

Dimensions.—Holotype. Length, 31 mm.; greatest width, 20 mm.; height, from back of shell to ventral edge, 15 mm.

Observations.—This shell was originally referred to *Tryblidium* by Mr. Cresswell on account of its resemblance to some Gotland forms described by Lindström. The Gotland specimens are more depressed, with the exception of one species, referred doubtfully to *Tryblidium*,[1] and which appears to belong to *Helcionopsis*, and somewhat related to the above species.

The present writer referred this species to *Capulus* in 1913, on account of the asymmetrical apex, but in the light of the structure shown in the next species described, the relationship appears to be with *Helcionopsis*.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Holotype presented by the Rev. A. W. Cresswell, M.A.

Helcionopsis elegantulum, sp. nov. (Plate II., Figs. 2, 3; Plate VI., Fig. 49).

Description.—Shell sub-ovate, one and a-half times as long as broad; apex acuminate but not prominent; sides gently rounded, back highly arched near apex and depressed convex near ventral border. Growth-lines lamellate and situated about 1.5 mm. apart in the middle of the shell; interspaces marked with numerous radial

1 (?) *Tryblidium radiatum*, Lindström. Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 58, pl. xviii., figs. 1, 2.

riblets, which extend over the edge of the lamellae where well preserved.

Dimensions.—Length, 20 mm. Approximate width when complete, 15.5 mm. Greatest height from ventrum to dorsum, 10 mm.

Observations.—This distinct species is easily separated from the earlier named Victorian form, *H. nycteis*, in the more spacious concentric ornament, its lamellate character, and in the more evenly rounded dorsum.

H. elegantulum is closely allied to *H. eminens*, Barrande sp.[1] from the Lower Devonian (Etage F), Konieprus, Bohemia. It differs from that species in having a more narrowly ovate and higher shell, and agrees in the lamellate and radial ornament.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Holotype presented by Mr. J. S. Green.

Fam. CYRTOLITIDAE.

Genus **Temnodiscus**, Koken, 1896.

Temnodiscus pharetroides, sp. nov. (Plate., II., Figs. 4, 5; Plate VI., Figs. 50, 51).

Description.—The Victorian specimen is in the form of a cast. It shows the compressed initial coil with rapidly widening body-whorl. The latter is expanded on the inner side. The slit-band is keel-shaped and prominent, and the surface of the shell is ornamented with concentric rugae.

Dimensions.—Diameter, 8 mm.; width of last whorl, 6.5 mm.; width of mouth, 8 mm.

Observations.—In form this species resembles Lindström's "*Cyrtolites*" *pharetra*,[2] of the Silurian of Gotland, with the exception that the Victorian species is wider across the mouth at the inner part of the body whorl, its keel is sharper and more salient, and the concentric ornament more rugose.

Another somewhat allied species is Perner's *Temnodiscus ferrigena*,[3] from which the Victorian species differ in the greater umbilical diameter and the more discoidal outline. The ornament in the Bohemian species consists of finely striate growth-lines, as

1 Perner, in Barrande's Syst. Sil. Bohême, vol. iv., tome i., 1903, p. 37; tome ii., 1907, pl. civ., figs. 13-15 and fig. 10 in text.

2 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 83, pl. vi., figs. 39-51.

NOTE.—Some of Lindström's species referred to *Cyrtolites* properly belong to *Oxydiscus*, as pointed out by Koken—Bull. Acad. Imp. Sci. St. Petersb., ser. v., vol. vii., 1897.

3. In Barrande's Syst. Sil. Bohême. vol. iv., tome i., 1903, p. 78, fig. 54 in text; tome ii., 1907, pl. cxiv., figs. 5, 6.

contrasted with the more rugose character of those in *T. pharetroides.*

Occurrence.—Silurian (Yeringian). In ochreous mudstone, Loyola, near Mansfield. Collected and presented by Mr. G. Sweet, F.G.S.

Fam. BUCANIIDAE.

Genus **Trematonotus**, J. Hall,

Trematonotus pritchardi, Cresswell.

Tremanotus pritchardi, Cresswell, 1893. Pro. Roy. Soc. Victoria, vol. V. (N.S.), p. 42, pl. VIII., fig. 1.

Trematonotus pritchardi, Cresswell, Chapman, 1913. Rep. Austr. Assoc. Adv. Sci., vol XIV., p. 227.

Observations.—This species shows some marked resemblances to the Gotland form, *T. longitudinalis*, Lindström.[1] The Victorian species has a more regularly planorbid spiral shell, which is not anteriorly elongated as in *T. longitudinalis.* The interior of the aperture is almost smooth in *T. pritchardi*, whilst the longitudinal spiral lines are undulose, producing with the concentric lines of growth a decided fenestration. A medium-sized example from the Thomson River, Gippsland, has the perforations in the slit-band rather larger than in the Lilydale specimens, and the spiral lines are decidedly more flexuous.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A. Thomson River, Gippsland, 3½ miles N.W. of Mt. Lookout; presented by Mr. G. T. Lovat.

Fam. BELLEROPHONTIDAE.

Genus **Bellerophon**, Montfort.

Bellerophon fasciatus, Lindström. (Plate II., Fig. 6; Plate VI., Fig. 52).

Bellerophon fasciatus, Lindström, 1884. Kongl. Svenska Vet.-Akad. Handl., Bd. XIX., No. 6, p. 75, pl. VI., figs. 13, 14.

Observations.—The Victorian specimen agrees with Lindström's form in having a compressed shell which is hardly umbilicate, and an inconspicuous and blunt keel; the growth lines are gently sinuous.

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1 Kongl. Svenska Vet.-Akad. Handl. Bd. xix., No. 6, 1884. p. 86, pl. iii., figs. 39, 40; pl. iv., figs. 1-7.

Occurrence.—Silurian (Yeringian). In brown mudstone, junction of the Woori-Yallock and the Yarra. Coll. of the Geol. Surv. of Vict. (B23.)

Bellerophon aff. *fastigiatus*, Lindström. (Plate II., Figs. 7, 8).

Bellerophon fastigiatus, Lindström, 1884. Kongl. Svenska Vet.-Akad. Handl., Bd. XIX., No. 6, p. 76, pl. VI., figs. 1-10.

Observations.—A complete cast of a subspherical *Bellerophon* occurs in the Yeringian mudstone of Kilmore. In the moderate compression of the dorsum, the faint keel and conspicuous and fairly narrow umbilicus, it is very close to Lindström's species from the Silurian of Gotland. Probably better preserved specimens will show it to be a new species allied to the northern one.

Dimensions.—Greater diameter, 13.5 mm.; shortest diameter, 11 mm. Width of aperture near base of whorl, 9.5 mm.; height of aperture, 5 mm.

Occurrence.—Silurian (Yeringian). Kilmore. Collected and presented by Mr. G. Sweet, F.G.S.

Bellerophon cresswelli, Etheridge fil. (Plate II., Fig. 12; Plate VI., Fig. 53).

Bellerophon cresswelli, Etheridge, jnr., 1891. Rec. Aust. Mus., vol. I., No. 7, p. 130, pl. XIX., figs. 6-8.

Observations.—This species has already been compared with *B. squamosus*, Lindström,[1] by Mr. Etheridge in his original description, where he states that the shell is not fenestrate as in the Gotland species. It is worth noting, however, that a well preserved specimen in the National Museum shows a faint but definite lattice structure of wavy striae across the growth-lines. The form of the earlier portion of the shell is so distinctly globular that this feature alone separates it from *B. squamosus*.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A., and others.

Bellerophon pisum, sp. nov. (Plate II., Figs. 9-11).

Description.—Shell almost globular, umbilical depression small, moderately deep. Aperture low, sub-crescentic, about four times as broad as high. Growth-lines making a widely open V in the band area. Sinus band distinct, narrow, slightly raised from the surface. Surface of shell marked with interrupted radial striae, seen distinctly between the lines of growth.

1 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 78, pl. v., figs. 17-24.

Dimensions.—Height, 11.25 mm. Width, 10 mm.

Observations.—Lindström has figured a small *Bellerophon* (*B. pilula*) from Gotland,[1] which is even of smaller dimensions than the Victorian, and which is of the same globular shape. Lindström's species differs in the minute but clearly fenestrate ornament which in ours is apparently evanescent on the growth-lines, and also in the weaker sinus band.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A.

Genus **Carinaropsis**, J. Hall.

Carinaropsis victoriae, sp. nov. (Plate II., Figs. 13, 14).

Description.—Shell patelloid, ovate, transversely elongate. Spire prominent, narrowly rounded, depressed on the shoulders and rapidly widening and expanding to the depressed subcircular body cavity. Dorsum moderately convex, and depressed towards the ventral and lateral margins. Surface relieved with shallow sulcate growth-folds and numerous radial folds or shallow riblets. Inner surface shows a thick, broad, umbonal platform, beneath which is a shallow groove corresponding to the carina on the external surface.

Dimensions.—Holotype.—Diameter from spire to ventral margin. 18.25 mm. Extreme width, 22.75 mm.

Paratype.—Diameter from spire to ventral margin, circ. 21 mm. Extreme width, 24 mm.

Observations.—The present species is nearly related to *Carinaropsis ithagenia*, Clark,[2] a fossil of the Ithaca fauna, of Upper Devonian age. The only differences existing between these forms are the more salient spire, the depressed and more obliquely sloping shoulders, and the more irregular growth-lines in the Victorian species.

Occurrence.—Silurian (Yeringian). In olive-brown mudstone, Ruddock's Quarry, near Lilydale. Holotype coll. R. H. Annear. Paratype presented by Mr. J. S. Green.

Fam. Pleurotomariidae.

Genus **Pleurotomaria**, Sowerby.

Pleurotomaria maccoyi, sp. nov. (Plate II., Figs. 15-17).

Description.—Shell trochoid, moderately high, the width and height being nearly equal. Apical angle 80 deg. Whorls about six

1 Tom. supra cit., p. 80, pl. vi., figs. 29, 30.
2 New York State Mus., 57th Ann. Rep., Mem. 6, 1904, p. 323 (footnote), pl. xvi., figs. 18-20.

in number, subangulate and rounded, more convex below than above. Slit band prominent, projecting beyond the contour of the whorls, and bounded above and below by a raised border; surface gently concave, with four crescentic growth-lines in a millimetre. Base moderately convex; umbilicus open. Mouth, subovate. Surface of whorls traversed by close and fine growth-lines, curving backwards to the band above, with a sigmoidal forward and backward curve below. Fine cross-lines between growth-lines visible in a strong light.

Dimensions.—Height about 27 mm. Width at base about 30 mm. Height of body whorl, 18 mm. Width of slit-band, 1 mm. Most of the specimens are more or less distorted, but being fairly numerous, an accurate average idea may be formed of the dimensions.

Observations.—This striking species is not far removed from McCoy's *P. crenulata*, from the Upper Ludlow, of Brigsteer, Kendal, Westmoreland.[1] It differs in the larger number of whorls, in their more depressed contour and in the less deeply incised suture; moreover, the band in *P. maccoyi* is not concave as in the English species.

Another closely related form is Lindström's *P. claustrata*,[2] from the Wenlockian, of Gotland, which resembles the Victorian species in proportionate height and width, in the number of whorls and in the general ornament, with the specific difference that the growth-lines on the whorls of *P. maccoyi* have a distinctly sigmoidal sweep, whereas in *P. claustrata* they are more gently curved. The latter form also has a more excavated slit-band.

The above described examples of *P. maccoyi* were selected many years ago by McCoy from a collection of Survey fossils, and placed in the Museum under the name of *Pleurotomaria*, but without further reference. The species is now identified with his name in honour of his classical work on the gasteropods of the British palaeozoic system.

Occurrence.—Silurian (Yeringian). Moderately common in olive-brown and blue mudstone, from the junction of the Woori-Yallock and Yarra, Upper Yarra district. G.S.V. (B23).

Genus **Mourlonia**, de Koninck.

Mourlonia duni, Etheridge fil.

Mourlonia duni, Etheridge, jnr., 1898. Rec. Austr. Mus., vol. III., No. 4, p. 73, pl. XV., fig. 5; pl. XVI., fig. 2.

1 Brit. Pal. Foss., 1855, pt. ii., p. 291, pl. i., k, fig. 45.

2 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 97, pl. vii., figs. 31-36.

Observations.—This shell was described by Etheridge from the Wellington Caves, New South Wales, and recorded as of Siluro-Devonian age.

The species is not uncommon in the Yeringian series of Victoria. As far back as 1902 I identified it in the Museum collection. Owing to the overlapping of the locality numbers used on the early Victorian Geological Survey specimens, this species was erroneously recorded in my list of Silurian Fossils of Victoria,[1] as from "Anderson's Creek," but which should read "Police Paddock, Kilmore," a locality that has yielded a number of Yeringian species.

Occurrence.—Silurian (Yeringian). In brown, sandy mudstone, Police Paddock, Kilmore, G.S.V. Bb 22. Also a form with flatter whorls, but evidently belonging to the same species; in similar rock, Fraser's or No. 3 Creek, Springfield, G.S.V. Bb 25.

Mourlonia subaequilatera, sp. nov. (Plate III., Figs. 18, 19).

Description.—Shell heliciform. Whorls six or seven, convex, sutures distinct. Slit-band slightly above the median line, narrow, bordered by prominent threads above and below. Whorls ornamented with strong, raised costae, above arcuate and inclined forward to the mouth, and vertically arcuate below. Area between costae finely striate, at right angles to them. Spire low, with pointed apex. Base in the holotype encrusted, but with indication of a wide umbilicus.

Dimensions.—Greatest breadth of shell about 26 mm. Height, from base to apex, 15.5 mm.

Observations.—The above species appears to belong to de Koninck's genus *Mourlonia*, which is a conical or discoidal pleurotomarid with distinct umbilicus. A closely allied species is *Mourlonia aequilatera*, Wahlenberg sp.,[2] a well-distributed Upper Silurian fossil in Europe. The Australian species differs in having the slit-band superior to the median line, and in the costae being more pronounced and intercancellate.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A.

Genus **Phanerotrema**, Fischer.

Phanerotrema australis, R. Etheridge fil. (Plate III., fig. 25).

Phanerotrema australis, R. Etheridge, jnr., 1891. Rec. Austr. Mus., vol I., No. 7, p. 128, pl. XIX., figs. 4, 5.

1 See "*Pleurotomaria (Mourlonia) duni*, Eth. fil." Rep. Austr. Assoc. Adv. Sci., Melbourne Mtg., 1913, vol. xiv., p. 218.

2 *Helicites aequilatera*, Wahlenberg. Petrifacta Svecana Telluris, 1818, p. 73. *Pleurotomaria aequilatera*, Wahl. sp. Lindström, Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 111, pl. ix., figs. 20-29.

Observations.—This large and handsome form of the pleurotomarid group bears close relationship with both *Phanerotrema balteata*, Phillips sp.,[1] from the Wenlock series, and *P. labrosa*, J. Hall sp.,[2] from the Lower Helderberg series. By the discovery of a fine, nearly complete specimen of *P. australis* in the Cave Hill limestone by Dr. E. Brooke Nicholls, it is possible to add some notes of interest to the original diagnosis of the less complete specimen described and figured by Mr. Etheridge.

Dimensions.—Height from base of columella to apex of whorls, 92 mm.; greatest width of shell, 90 mm. Height of penultimate whorl, 13 mm. Height of last whorl, 68 mm. Approximate width of aperture, 55 mm.; approximate length, 66 mm. Distance of slit-band from base of shell, 50 mm. Distance of slit-band from last suture, at mouth, 37 mm. Width of slit-band at mouth, 6.5 mm.

Comparisons.—Body whorl—Depressed and even slightly concave as in *P. labrosa*. In *P. balteata* it is gently convex. Spire—Moderately well developed as in *P. balteata*. Sutures—Deeply channelled as in *P. balteata*.

The Australian species appears to exceed in size any other of this group, and as remarked by Mr. Etheridge, is a more obliquely elongated shell.

Occurrence.—Silurian (Yeringian). In friable limestone,[3] Cave Hill, Lilydale. Presented by Dr. E. Brooke Nicholls.

Fam. MURCHISONIIDAE

Genus **Coelocaulus**, Oehlert.

Amongst Silurian *Murchisoniidae* there occurs a peculiar generic type of shell characterised by its turrited form, with flat whorls, especially in the earlier stages, and a conspicuous, persistent umbilicus. This type of shell is widely distributed, occurring in various Silurian faunas of Europe, North America and Australia. The slit-band is often obscure in shells of this type where the later whorls are not preserved, but in specimens where the last two whorls are found, the latter are subangularly convex with an infra-median slit-band, and show a relationship to the genus *Hormotoma*, Salter, as emended and typified by Mrs. Longstaff (Miss Jane Donald),[4] in the species *H. cingulata*, Hisinger[5]

1 (*Pleurotomaria balteata*). Mem. Geol. Surv. Gt. Brit., vol. ii., pt. i., 1848, p. 358, pl. xv., figs, 1, 2.

2 (*Pleurotomaria labrosa*). Pal. N. York, vol. iii., 1859, p. 339, pl. lxvi., figs. 1-5.

3 This matrix is a calcareous sand composed of granules largely of algal origin, together with fragments of crinoids.

4 Quart. Journ. Geol. Soc., vol. lv., 1899, p. 257.

5 *Turritella cingulata*, Lethaea Svecica, 1837, p. 39, pl. xii., fig. 6.

Although related to *Hormotoma* by the form of the later whorls and the position of the slit-band, the open and persistent umbilicus is a very distinct feature in the shells under notice. Consequently forms of this type of Devonian age were generically separated as *Coelocaulus* by Oehlert in 1888.[1] In 1897 Ulrich[2] referred the Onondaga (Silurian) species, *Murchisonia logani*, to the same genus.

Coelidium was more recently suggested as a genus name to replace *Coelocaulus* by Clarke and Ruedemann,[3] but has not been adopted, even in America, apparently on insufficient grounds of pre-occupation.

The Australian Silurian and Devonian faunas both contain representatives of this interesting genus. In 1877 de Koninck described a Devonian species from the Yass district in New South Wales under the name of ? *Niso darwinii*,[4] a form which undoubtedly species congeneric with de Koninck's, from the Silurian of Cave belongs to this genus. In 1890 Mr. R. Etheridge, jnr.,[5] described a Hill, Lilydale, Victoria, to which he gave the name *Niso* (*Vetotuba*) *brazieri*, at the same time remarking on the close correspondence between de Koninck's and his species.

Whilst examining some senile forms of the Lilydale specimens of this type, and in particular one found by Mr. J. S. Green, I noticed the presence of a sinus-band in the later whorls which confirmed a determination as *Murchisonia* made many years ago by McCoy on a Museum specimen presented by Dr. G. B. Pritchard.

Referring in this place to other occurrences of *Coelocaulus*, we may note Lindström's Silurian example—"*Murchisonia*" *compressa*[6] from the Silurian of Gotland, which has a similar wide and open umbilicus extending apparently to the apex.

The Upper Silurian of Petropaulowsk in the Russian Oural appears to contain examples of this genus, represented by "*Cerithium*" *helmerseni*, de Verneuil,[7] judging from the form of the shell with its compressed whorls; but the figure does not indicate an umbilicated base, nor does the description throw light on this point.

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1 Bull. Soc. d'Etudes Scientifiques d'Angers, p. 20.

2 Geol. Surv. Minnesota. Palaeontology, 1897, vol. iii., pt. 2, p. 1019.

3 "Guelph Fauna in the State of New York." University State of N. York, 57th Ann. Rep., vol. iii., Mem. 5, 1903, pp. 65 and 67.

4 Mem. Soc. Roy. Sci. Liége, 2nd ser., vol. ii., 1876-7. See also Mem. Geol Surv. N. S. Wales, Pal. No. 6, 1898, p. 101, pl. iv., fig. 11.

5 Rec. Austr. Mus., vol. i., No. 3, 1890, p. 63, pl. viii., figs. 4, 5; pl. ix., figs. 2, 3. See also Mem. Geol. Surv. N. S. Wales, Pal. No. 6, 1898, p. 101 (footnote).

6 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 129, pl. xii., fig. 18.

7 Geol. de la Russie D'Europe. Murchison, Verneuil and Keyserling, 1845, vol. ii., p. 342, pl. xxii., fig. 4.

In the Lower Devonian of the Karnic Alps, in beds adjacent to Silurian rocks, a *Murchisonia*-like shell has been described and figured by Frech,[1] referred to *Murchisonia davyi*, Barrois, and compared with Lindström's *M. compressa* previously cited. The Lower Devonian fauna of Bohemia is also fairly rich in examples of *Coelocaulus*. In Bassler's "Bibliographic Index of American Ordovician and Silurian Fossils"[2] there are no less than twelve American species listed, seven of which are of Upper Silurian (Niagaran) age, three of Ordovician age, and two of Lower Devonian.

Coelocaulus brazieri, Etheridge fil. (Plate III., Figs. 20-22).

Niso (Vetotuba) brazieri, R. Etheridge, jnr., 1890. Rec. Aust. Mus., vol. I., No. 3, p. 62, pl. VIII., figs. 4, 5; pl. IX., figs. 2, 3. Cresswell, 1894. Proc. R. Soc. Vict., vol VI. (N.S.), p. 158. Chapman, 1907. Rec. Geol. Surv. Vict., vol. II., pt. I., pp. 11, 17.

Description, emended.—Shell turriculate, elongate-conical, slowly tapering to a blunt apex. Apical angle from 25 deg. to 30 deg. Sides gently convexly curved. Whorls about 12 in full-grown examples; surface convex to nearly flat. Sutures fairly well impressed. Slit-band slightly below median line, feebly concave, bounded by raised threads above and below. Traces of spiral threads on the rest of the whorl. Umbilical cavity open from the base to the apex, sides undulating owing to the convex impingement of the whorls on the inner surface. Seen in section the whorls are quadrately globose, and secondary thickening has occurred in some examples, which tend to flatten the external surface of the shell by filling up the suture lines. Length of the largest example about 70 mm., or more when complete.

Observations.—We have already pointed out the relationship of the above and other related forms to *Murchisonia* under the generic heading of *Coelocaulus*. It is interesting to find another species of the same group in Australia, in the Devonian of Yass, viz., *C. darwinii;* thus showing that this peculiar type of shell had as extensive a range as many another Silurian or Devonian genus, and helping to link up the faunas of the two formations.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. From the collection of the Rev. A. W. Cresswell, M.A. Also presented by Mr. J. S. Green and Dr. G. B. Pritchard. In beds of similar age from Marble Creek, Gippsland (Geol. Surv. Vict. —determined by the author).

1 Zeitschr. d. deutschen geol. Gesellsch., vol. xlvi., pt. iii., 1894, p, 458, pl. xxxii., figs. 4*a-d*.
2 United States National Museum, Bull. No. 92, 1915, p. 249.

Coelocaulus apicalis, sp. nov. (Plate III., Figs. 23, 24).

Description.—Shell somewhat like *C. brazieri*, but spire more acute and with a more numerous apical series of whorls. Apical angle about 25 deg. Whorls depressed convex to flat, short and numerous near the apex, numbering altogether about 20. Sutures well marked, but not widely channelled. Slit-band median or slightly below the median line, depressed in earlier convolutions, prominent in later ones and bordered by raised threads above and below. Umbilical axis open to apex. Cast of perforation more regularly cylindrical than in *C. brazieri.*

Dimensions.—A smaller shell than *C. brazieri*, measuring in the type specimen 40 mm. in length and 16.5 mm. at the base (so far as preserved).

Observations.—The above species appears to occupy a middle position between *Coelocaulus brazieri* and *C. darwinii.* From several examples of the latter species collected by Mr. A. J. Shearsby, one is able to note some interesting points of comparison. It is smaller and more slender in the apical half of the shell than either of the Victorian Silurian species; whilst in the numerous whorls and the cylindrical form of the hollow columella it agrees with *C. apicalis.* The examples of *C. darwinii* from the Shearsby collection came from the Middle Devonian of Yass (Portion 208, Par. Waroo), New South Wales. De Koninck gives the Yass district as the locality, and refers it to the Devonian, whilst Mr. Etheridge refers it to "the Upper Silurian, probably Wenlock, beds of Yass."[1]

Genus **Cyrtostropha**, Donald.

Cyrtostropha lilydalensis, sp. nov. (Plate IV., Figs. 26-28).

Description.—Spire of moderate length, turriculate; consisting of eight whorls, including the protoconch. Sides of whorls convex with the sutures deeply incised. Sinus band median. Growth-lines moderately oblique above and curving backward to the band, and forward below; lines conspicuous on the sinus-band. Band bordered with strong raised lines above and below. Rest of whorl relieved with about three threadlike or slightly nodulose lirae above and below the band. Aperture longer than broad, columellar margin slightly produced. Umbilicus closed.

Dimensions.—Length of holotype (incomplete at base), 31 mm.; width at base about 12 mm. Length of body whorl about 14 mm.

1 Rec. Austr. Mus., vol. i., No. 3, 1890, p. 63.

Width of sinus band on body whorl, 1.25 mm. Length of body whorl of a large specimen about 18 mm.

Observations.—The nearest form to the present species appears to be Sowerby's "*Pleurotoma*" *coralli*,[1] which Miss Donald has placed in the genus *Cyrtostropha*.[2] The British species ranges from the Llandovery to the Ludlow series. The present species differs from the British in the more numerous lirae and their slightly nodulose character. Mr. Etheridge has remarked on a species of *Murchisonia* (sp. ind.)[3] from Lilydale, which from the details given seems to belong to the above form, except for there being no mention of spiral lirae.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill Lilydale. Collected by the Rev. A. W. Cresswell, M.A.

Genus **Goniostropha**, Oehlert.

Goniostropha pritchardi, Etheridge fil. (Plate IV., Fig. 29).

Goniostropha pritchardi, Etheridge, jnr., 1898. Rec. Aust. Mus., vol. III., No. 4, p. 71, pl. XV., figs. 1-4.

Observations.—Some examples of the above species are found in the present collection. They are distinguished from *Cyrtostropha lilydalensis* by the shorter habit and more angulate whorls; the lirate ornament in both forms is very similar, but the sinus band in *C. lilydalensis* is not so deeply excavate.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A.

Genus **Gyrodoma**, R. Etheridge, jnr.

Gyrodoma etheridgei, Cresswell sp.

Eunema etheridgei, Cresswell, 1893. Proc. R. Soc. Vict., vol. V. (N.S.), p. 41, pl. VIII., fig. 2.

Gyrodoma etheridgei, Cresswell sp., R. Etheridge, jnr., 1898. Rec. Aust. Mus., vol. III., No. 4, p. 72, pl. XVI., fig. 1.

Observations.—Mr. Etheridge has referred, in the paper above cited, to the question raised by Mr. Cresswell's depiction of the type specimen as having a double band. An examination of the type, which is in the National Museum collection, shows the band to be single, rather depressed, and marked along the middle with a raised spiral thread; hence the slight mistake in the details of

1 J. C. Sowerby. Sil. Syst., 1839, p. 612, pl. v., fig. 26.
2 Quart. Journ. Geol. Soc., vol. lviii., 1902, p. 322, pl. vii., figs. 5, 6.
3 Rec. Austr. Mus., vol. i., No. 7, 1891, p. 129.

the figure. In the earlier whorls of other specimens the band is distinctly depressed and bounded above and below with a raised thread. The longest example, but imperfect, of this fine species in our collection measures 70 mm.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A., who presented the type specimen.

Fam. EUOMPHALIDAE.

Genus **Euomphalus**, Sowerby.

Euomphalus centrifugalis, sp. nov. (Plate IV., Figs. 30, 31; Plate VI., Figs. 54, 55).

Description.—Shell compressed, planorbiform. Outline discoidal, but tending to irregular growth; sometimes almost subovate in outline. Superior face gently convex and sloping to the periphery on the last whorl, the inner series excavate; inferior face flat on the periphery and concave towards the centre. Spire visible on both sides and evolute. Aperture compressed, pyriform. Surface of whorls marked by numerous strong, sharply deflected growth-lines.

Dimensions.—Holotype. Greatest diameter, 14 mm.; at right angles, 10.5 mm. Width of last whorl, 4 mm. Approximate thickness of shell, 2.25 mm.

Observations.—This species bears some resemblance to *E. declivis*, Remeles,[1] of the Lower Silurian limestone obtained from the diluvium deposit of North Germany; especially in the sinuate and oblique character of the growth-lines. In that species, however, the whorls are not so deeply concave, and the body whorl tends to become an open spiral.

In general appearance Lindström's *Oriostoma dispar* may be mentioned,[2] which, by the way, is probably a true *Euomphalus* species. In this form, however, the outer whorl is not so highly convex on the inner side nor so steeply sloping to the periphery. Lindström's shell, being a Gotland species, comes from a bed of similar age as the above.

E. centrifugalis appears to be a thin-shelled ancestor of the *Euomphalus catillus* type,[3] a compressed and striate species well known as a Carboniferous limestone fossil.

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1 Zeitschr. d. deutsch. geol. Gesellsch, vol. xl., 1888, p. 669, pl. xxviii., fig. 3.

2 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 173, pl. xxi., figs. 11-14.

3 Min. Conch., vol. 1, 1814, p. 98., pl. xlv., figs. 3, 4. Phillips' Geol. Yorkshire, vol. ii., 1836, pl. xiii., figs. 1, 2.

Occurrence.—Silurian (Yeringian). Apparently fairly common in the newer Silurian. Holotype, in mudstone from Killara, near Seville, Upper Yarra district; presented by Mr. J. S. Green. Paratype, from brown mudstone, Loyola, near Mansfield; presented by Mr. G. Sweet, F.G.S.

Euomphalus northi, Etheridge fil. sp.

Oriostoma northi, R. Etheridge, jnr., 1890. Rec. Aust. Mus., vol. I., No. 3, p. 64, pl. IX., figs. 6, 7.

Euomphalus northi, Eth., fil. sp., Chapman, 1913. Rep. Aust. Assoc. Adv. Sci., vol. XIV., p. 227.

Observations.—The nearly equilateral spiral form of the shell and the concave external face of the umbilicus show the relationship of the above species to be with *Euomphalus.*

The operculum in *Oriostoma* has a convex or conical exterior, whilst in *Euomphalus northi* it is concave.

Examples in the brephic to neanic stages exhibit a smoother shell than the adult form.

Occurrence.—Silurina (Yeringian). Numerous specimens in limestone, Cave Hill, Lilydale. One fine example with the operculum in situ, was presented by the Rev. A. W. Cresswell, M.A.

Genus **Liomphalus,** gen. nov.

Definition.—Shell discoidal, widely umbilicate and biconcave; whorls smooth and sometimes obscurely keeled along the back. Earlier whorls consisting of a thin shelled series, followed by two or more stout whorls, either closely adpressed or free in the later portion. Early part of series divided into chambers as in *Euomphalus* and *Straparollus* (*S. dionysii*, Montf.). Aperture elliptical or angularly ovate. Type, *Liomphalus australis.* The genus includes *Euomphalus disjunctus*, J. Hall, *E.* (*Straparollus*) *clymenioides*, J. Hall, *E. triquetrus*, Lindström, and *E. gotlandicus*, Lindström.

This generic type may be distinguished from *Euomphalus*, Sowerby (*sensu stricto*) in having smooth, rounded or uniangulate whorls; and from *Straparollus*, Montfort, in having a concave spire; whilst from Lytospira, Koken, it differs in the more closely coiled shell, and in the absence of a scaly ornament.

Name derived from *leios*, smooth, and *omphalos*, an umbilicus.

Liomphalus australis, sp. nov. (Plate IV., Figs., 32, 33).

Description.—Shell moderately large, discoid, compressed. Spire somewhat concave, umbilical surface rather deeply concave, consisting of two or three whorls rapidly widening on the last turn, with free surfaces. Exterior smooth. Aperture suboval to sub-rhomboidal, the angulation when present, situated on or above the median line of the periphery. From the penultimate whorl inwards the shell is divided by deeply concave partitions, the concavity outwards. In some cases the septa are numerous, simulating a cephalopod, but distinguished by the absence of siphuncular openings.

Dimensions.—Greatest diameter of type specimen about 65 mm., when complete. Width of last whorl at 30 mm. from aperture, 16 mm. Length of aperture, 24 mm. Greatest thickness of shell, 13 mm.

Observations.—This species was formerly identified by myself with *Euomphalus disjunctus*, J. Hall,[1] to which species it bears a close resemblance, and it was listed under that name in my paper "On the Palaeontology of the Silurian of Victoria."[2] Upon a closer examination of a fair number of specimens it was seen that the Australian examples were distinct from those of Hall's species from the Upper Pentamerus limestone of New York State, in having a more truly euomphaloid sectional outline to the aperture, which in ours is more angulate, and in the closer coiling of the outer whorls.

In Lindström's *Euomphalus triquetrus*,[3] which I would refer to *Liomphalus*, the outer whorl widens very rapidly, and the aperture becomes everted on the margin, whilst the last quarter turn of the whorl is remarkably free.

In *E. gotlandicus*, Lindström,[4] the shell is closely coiled, and whorls are inflated, with subcircular aperture. The spire in this form is also depressed, otherwise it would naturally fall into the genus *Straparollus*.

Another member of this genus is *Euomphalus* (*Straparollus*) *clymeniodes*, J. Hall,[5] from the Devonian of the United States and Canada (Schoharie Grit, New York, and Upper Helderberg limestone, near Cayuga, Ontario). This is a smaller shell than usual, the largest being about two inches in diameter. It has about four or five whorls as in the Australian species, but, unlike it, has them more evenly increasing in diameter, whilst the volutions are not free. The mouth is subovate.

1 Pal. New York, vol. ii., pt. i., 1859, p. 340, pl. lxv., fig. 8; pl. lxvii., figs. 4*a*, *b*.
2 Rep. Austr. Assoc. Adv. Sci., Melbourne Mtg., 1913, vol. xiv., p. 227.
3 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 140, pl. xiii., figs. 32-35.
4 Op. cit., p. 139, pl. xiii., figs. 19-31.
5 Pal. New York, vol. v., pt. ii., 1879, p. 62, pl. xvi., fig. 15; pl. lxx., figs. 1-5.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Chiefly from the collection of the Rev. A. W. Cresswell, M.A.

Genus **Straparollus**, Montfort.

Straparollus debilis, sp. nov. (Plate IV., Fig. 34; Plate VI., Fig. 56).

Description.—Shell depressed, subcircular. Whorls about five, rounded, coiled in an irregular spiral and increasing slowly in width. Surface relieved with fine threadlike lines of growth, which are only slightly curved. Aperture subcircular.

Dimensions.—Greatest diameter, about 15 mm.; measurement at right angles about 14 mm. Height of shell, 4.25 mm.

Observations.—This species has a somewhat vermiform appearance from its weakly and irregularly coiled shell. Its nearest specific analogues seem to be *S. rudis*, J. Hall sp.,[1] and *S. hecale*, J. Hall sp.,[2] the former from the Middle Devonian (Hamilton group) of West Bloomfield, New York, the latter from the Upper Devonian (Chemung group) of Rockville, New York. *S. rudis* is a larger shell and increases rather rapidly in its later whorls, whilst *S. hecale* is more regularly discoidal in outline. *S. annulatus*, Phillips sp.,[3] from the Devonian of Newton, Devonshire, is another related form, distinguished by its discoidal outline and prominent growth-lines.

De Koninck has figured a related form to the above from the Silurian at Rock Flat Creek, east side of Maneero, New South Wales, under the name of *Euomphalus solarioides*.[4] This species differs in having an ornament of transverse tubercles instead of striae as in the Victorian species.

Occurrence.—Silurian (Yeringian). In brown mudstone, Ruddock's Quarry, near Lilydale. Collected by F. Chapman.

Fam. Turbinidae.

Genus **Omphalotrochus**, Meek.

Omphalotrochus globosum, Schlotheim sp. (Plate IV., Figs. 35, 36).

Trochilites globosus, Schlotheim, 1820. Petrefactenkunde, p. 162

Euomphalus funatus, Sowerby, 1823, Min. Conch., vol. V., p. 71, pl. 450, figs. 1, 2. Id., 1839, Silurian System, p. 626, pl. XII.,

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1 *Euomphalus (Straparollus) rudis*, J. Hall. Tom. supra cit., p. 58, pl. xvi., figs. 6, 7.

2 *Euomphalus (Straparollus) hecale*, J. Hall. Ibid., p. 59, pl. xvi., figs. 10-14.

3 *Euomphalus annulatus*, Phillips. Pal. Foss. Cornwall, Devon and W. Somerset, 1841, p. 138, pl. lx., fig. 172.

4 Mem. Geol. Surv. N. S. Wales, Pal. No. 6, 1898, p. 30, pl. i., fig. 5.

fig. 20. Salter, 1867, Siluria, Ed. 4, p. 531, pl. XXV., fig. 3.

Oriostoma globosum, Schl. sp., Lindström, 1884. Kongl. Svenska Vet.-Akad. Handl. Bd. XIX., No. 6, p. 160, pl. XVII., figs. 24, 25, 29-31; pl. XVIII., fig. 24; pl. XX., fig. 16.

Observations.—The representatives in Victoria of this widely distributed species are rare and small. They are clearly referable to the above form on account of the depressed spire, ventricose whorls and expanding mouth. The ornament, as in the European species, consists of numerous spiral keels, about ten on the body whorl, with an intermediate and finer line. The interspaces are crossed by fine and coarse lines rather closely set and slightly curved.

Dimensions.—Greatest diameter of plesiotype, 11 mm.; height, 9 mm. Width of aperture, 7 mm.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A. Also a fine example presented by Mr. J. S. Green.

Fam. TROCHIDAE.

Genus **Scalaetrochus**, Etheridge, jnr.

Scalaetrochus antiquus, Cresswell sp.

Stomatia antiqua, Cresswell, 1893. Proc. R. Soc. Vict., vol. V. (N.S.)., pp. 41, 43, pl. VIII., fig. 3.

Trochus (*Scalaetrochus*) *antiquus*, Cressw. sp., Chapman, 1913. Rep. Aust. Assoc. Adv. Sci., vol. XIV., p. 229.

Observations.—Some of the Victorian examples of *Scalaetrochus* appear to indicate the presence of a narrow umbilicus,[1] and therefore show affinity to *Omphalotrochus*.

The above species was founded on a fragmentary shell, which is closely comparable with Etheridge's *Trochus* (*Scalaetrochus*) *lindstroemi*.[2] It differs in the slightly convex surface of the volutions, whereas in Etheridge's species they are either flat or concave.

A specimen figured by Lindström from the Silurian of Gotland[3] as *Trochus gotlandicus* shows some affinity with the above, and also with *Sc. lindstroemi*, but it is non-perforate.

De Koninck's *Euomphalus* (*Omphalotrochus*) *clarkei*[4] is closely related to *S. antiquus*, and differs only in the stronger and more irregular growth of the shell.

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1 Rec. Austr. Mus., vol. i., No. 3, 1890, p. 66.

2 Ibid., p. 66, pl. viii., figs. 1, 2.

3 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 146, pl. xiv., figs. 1-11.

4 Mem. Geol. Surv. N. S. Wales, Pal. No. 6, 1898, p. 32, pl. i., fig. 7.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. In brown mudstone, junction of the Woori-Yallock and Yarra; Geol. S. Vict. B23.

Scalaetrochus lindstroemi, Etheridge fil. sp.

Trochus (*Scalaetrochus*) *lindstroemi*, R. Etheridge, jnr., 1890 Rec. Aust. Mus., vol. I., No. 3, p. 66, pl. VIII., figs. 1, 2. Chapman, 1913. Rep. Aust. Assoc. Adv. Sci., vol. XIV., p. 228.

Observations.—The high spiral and angulate sutural margins serve to separate this form from *S. antiquus*. It is fairly common in the Lilydale limestone, but has not yet occurred elsewhere, although an indeterminate form of the genus has been noted by me from Yeringian beds at Marble Creek, Gippsland.[1]

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale.

Fam. Trochonematidae.

Genus **Cyclonema**, J. Hall.

Cyclonema lilydalensis, Etheridge fil. (Plate V., Fig. 38).

Cyclonema lilydalensis, Etheridge, jnr., 1891. Rec. Aust. Mus., vol. I., No. 7, p. 128, pl. XIX , fig. 3.

Observations.—In the collection of the National Museum there is a fair number of quite small specimens of *Cyclonema*. As it had been suggested that these probably represent a new species, it is worth putting on record my conclusions regarding them. These small forms consist of about five whorls. The sides of the volutions are rounded, but as a rule the whorls are rather depressed, though occasionally the spire is fairly high, as in *C. australis*.[2] The ornament is exactly similar to that in full-grown specimens of *C. lilydalensis*, and when the number of whorls is taken into consideration, there being from four to six in the small shells, and eight in the fully developed ones, it will be seen that there is no ground for their separation. Further than this, a series of *Cyclonema* in the Dennant collection shows all gradations from the immature to the adult condition. The increase in size of the later whorls is very rapid, the height of a six-whorled shell being 14 mm., and an eight-whorled shell, 42 mm. Mr. Etheridge, in giving the number of whorls as six in *C. australis*, states that *C. lilydalensis* has a much larger number.

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1 Rec. Geol. Surv. Vict., vol. ii., pt. i., 1907, pp. 11, 17.

2 Rec. Austr. Mus., vol. i., No. 3, 1890, p. 63, pl. ix., figs. 4, 5.

Occurrence.—Silurian (Yeringian). Cave Hill, Lilydale. Young forms in Rev. A. W. Cresswell collection.

Cyclonema australis, Etheridge fil.

(?) *Cyclonema australis*, R. Etheridge, jnr., 1890. Rec. Aust. Mus., vol. I., No. 3, p. 63, pl. IX., fig. 45.

Cyclonema australis, Idem, 1891, ibid., vol. I., No. 7, p. 127, pl. XIX., figs. 1, 2. Chapman, 1913. Rep. Aust. Assoc. Adv. Sci., vol. XIV., p. 227.

Observations.—This species is separable from *C. lilydalensis* by the stronger liration of the shell-surface, and the more distinct and thread-like ornament crossing the interspaces between the spiral ribs.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Rarer than the preceding species.

Fam. DELPHINULIDAE.

Genus **Craspedostoma**, Lindström.

Craspedostoma lilydalensis, Cresswell sp. (Plate IV., Fig. 37).

Naticopsis lilydalensis, Cresswell, 1893, Proc. R. Soc. Vict., vol. V. (N.S.), p. 44 (name only), pl. IX., fig. 7.

Craspedostoma lilydalensis, Cressw. sp., Chapman, 1913. Rep. Aust. Adv. Sci., vol. XIV., p. 227.

Description of Type.—Shell naticoid, with a short, rather depressed spire of about three whorls and a large body whorl. Whorls inflated and ornamented with an obscure open cancellated structure consisting of flattened spiral and longitudinal ribs. Base umbilicated. In a supplementary specimen a part of the columellar area of the everted lip is preserved, which shows relationship to the above genus.

Dimensions.—Compiled from both examples, and approximate only. Width at base, 27 mm. Height of complete shell, circ., ·22 mm.

Observations.—The present species approaches very closely Lindström's Wenlockian form, *C. elegantulum*,[1] in which, however, the ribs are thinner and more conspicuous. In the comparative smoothness of the whorls it shows some relationship also to *C. filistriatum*, Lindström.[2] The genus appears to be restricted to beds of the Upper Silurian epoch.

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1 Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 183, pl. ii., fig. 58; pl. xxi., figs. 20-29.

2 Ibid., p. 183, pl. xxi., figs. 35-38.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Collected by the Rev. A. W. Cresswell, M.A.

Fam. PYRAMIDELLIDAE.

Genus **Loxonema,** Phillips.

Loxonema sinuosa, Sowerby sp., var. *australis*, nov. (Plate V., Fig. 39).

? *Terebra sinuosa*, Sowerby, 1839. Silurian System, p. 619, pl. VIII., fig. 15.

Loxonema sinuosa, Sow. sp., Phillips, 1841. Pal. Foss. Cornwall, p. 99, pl. XXXVIII., fig. 182. Salter, 1859, Siluria, 3rd ed., pl. XXIV., fig. 3.

Observations.—The present specimen is fragmentary, only portions of two whorls being preserved. The form of the shell and the ornament is, however, so well indicated as to leave little doubt of its very close affinity to Sowerby's species. The folds are straight and sharply ridged, and the sinuosity well marked, whilst there is a tendency to form a faint nodose shelf near the basal part of the whorl. This latter constitutes a varietal feature.

L. sinuosa has been recorded in Great Britain from the Upper Llandovery beds, the Lower Ludlows and the Aymestry Limestone. Prof. Phillips also recorded it from the Petherwin Group of Cornwall, referred by Jukes-Browne to the Famennian or Upper Devonian.

Occurrence.—Silurian (Yeringian). In limestone, Cave Hill, Lilydale. Presented by Mr. J. S. Green.

Fam. CAPULIDAE.

Genus **Orthonychia,** Barrande.

Orthonychia brevis, sp. nov. (Plate V., Fig. 40).

Description.—Shell conical, slightly curved, less than a quarter of a volution in 12 mm. Convex side of shell evenly rounded, inner surface elliptically convex. Apex compressed and sulcated on the inner side. Lines of growth faintly marked.

Dimensions.—Length of shell about 38 mm. Width of aperture when complete, about 20 mm.

Observations.—A described species which affords a close comparison with the above is *O. subrectum*, J. Hall sp.[1] This shell, however,

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1 *Platyceras* (*Orthonychia*) *subrectum*, J. Hall. Pal. New York, vol. v., pt. 2, 1879, p. i., pl. i., figs. 1, 2.

is longer and more apically arcuate. It was found in the Upper Helderberg (Lower Devonian) of New York State.

Occurrence.—Silurian (Yeringian). In dark limestone, Loyola, near Mansfield. Collected and presented by Mr. G. Sweet, F.G.S.

Genus **Platyceras**, Conrad.

Platyceras minutum, sp. nov. (Plate V., Fig. 41; Plate VI., Figs. 57, 58).

Description.—Shell minute, consisting of a coiled series of about three whorls. Body whorl rapidly widening. Shell depressed above, gently convex below. Back compressed but rounded. Surface of whorls ornamented with distinct, somewhat salient folds, curving sharply backwards, the interspaces with striated growth-lines. Aperture subangulate, ovoid.

Dimensions.—Greatest diameter of holotype, 4.25 mm. Thickness of paratype, 1.5 mm.

Observations.—This extremely small species resembles the initial portion of a variety of *Platyceras cornutum*, Hisinger sp.,[1] a common Upper Silurian species in Europe. In the holotype the superior face shows the spire to be slightly sunken and evolute. In the paratype, on the inferior face, the spire is involute.

Occurrence.—Silurian (Yeringian). In dark blue limestone, Deep Creek, a tributary of the Thomson River, Gippsland. Collected and presented by the Rev. A. W. Cresswell, M.A.

Platyceras cornutum, Hisinger. (Plate V., Fig. 42).

Observations.—It is practically impossible to specifically separate the many variations of this Silurian type of *Platyceras*, a form which, by the way, also probably extends into the Devonian. It is known from Great Britain, Scandinavia, Germany and the United States. The synonymy is large, and for this Lindström's paper on the Silurian Gasteropoda and Pteropoda of Gotland may be consulted.[2]

The Victorian specimens are of the typical, intermediate form, which is a neritoid shell having a depressed spire. The aperture is broadly ovate, and the growth-lines on the shell well-marked, appearing as irregular concentric folds.

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1 *Pileopsis cornuta.* Lethaea Suecica, 1837, p. 41, pl. xii., fig. 11. *Platyceras cornutum*, His. sp. Lindström, Sil. Gaster. and Pter. of Gotland. Kongl. Svenska Vet.-Akad. Handl., Bd. xix., No. 6, 1884, p. 63, pl. ii., figs. 29-51; pl. iii, figs. 6-9, 19-26.

2 Tom. supra cit., p. 63.

Dimensions.—Two specimens from Loyola measure in greatest length, from outer border of spiral to ventral edge, 46.5 mm. and 30 mm. respectively.

Occurrence.—Silurian (Yeringian). In dark limestone, Loyola, near Mansfield. Collected and presented by Mr. G. Sweet, F.G.S. A small example (cast) in ochreous mudstone. Loyola, near Mansfield; G. Sweet collection.

Platyceras erectum, J. Hall sp. (Plate V., Fig, 43).

Platyceras erectum, Hall, 1879. Pal. New York, vol V., pt. II., p. 5, pl. II., figs. 4-11.

Observations.—The present specimen is a cast in mudstone of a depressed ovate *Platyceras*, partially erect in character and with an open spire. The nearest allied species appears to be J. Hall's *Platyceras. erectum*, found in the Lower Devonian of New York State.

Occurrence.—Silurian (Yeringian). In yellow mudstone. Parish of Wallen, Sect. 44; Geol. Surv. Vict. Bb 15.

Genus **Diaphorostoma**, Fischer (= Platyostoma, Conrad, non Klein).

Diaphorostoma retrorugatum, sp. nov. (Plate V., Figs. 44, 45).

Description.—Based on a cast of the thin shell. Consisting of four rapidly increasing compressed whorls, forming a somewhat ovoid outline. Spire slightly elevated. Body whorl large. Base narrowly umbilicate. Aperture apparently suborbicular to ovate. Shell surface traversed by well-marked irregular folds or corrugations which curve obliquely backwards.

Dimensions.—Approximate length of shell when complete, 35 mm. Greatest width, 26.5 mm. Height, 21 mm.

Observations.—This shell appears to be quite distinct from any figured species hitherto known, but approaches *Diaphorostoma lineatum*, J. Hall sp.[1] in general form. That species occurs in the Upper Helderberg limestone of New York, and in the Hamilton Group of the western part of the State.

The Victorian species is distinguished from *Platyceras* by the large and open body whorl.

Occurrence.—Silurian (Yeringian). A cast in yellow mudstone. Ruddock's Quarry, near Lilydale. Collected by Mr. R. H. Annear.

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1 *Platyostoma lineatum*, J. Hall. Pal. New York, vol. v., pt. ii., 1879, p. 21, pl. x., figs. 1-21.

Diaphorostoma incisum, sp. nov. (Plate V., Fig. 46; Plate VI., Fig. 59).

Description.—Shell depressed, helicoid; spire moderately depressed, rapidly widening to body whorl, of four volutions. Penultimate whorl one-third the diameter of the body whorl. Surface of shell gently convex, marked with numerous closely set, incised growth-lines, which are sometimes undulate and crossed by sparse, radiating folds. Aperture large, subovate.

Dimensions.—Extreme width, circ., 40 mm. Height, 18 mm.

Observations—In general character the above species approaches *D. lineatum*, J. Hall sp., the fossil cited in the comparison of *D. retrorugatum*, but in that species the body whorl does not increase so rapidly in width, and the shell is higher. The concentric ornament also, whilst agreeing in its incised character, is not crossed by so regular a system of radial lines.

Whidborne's "*Capulus ? invictus*"[1] from the Middle Devonian of Devonshire, is almost identical in form with the Victorian species, but the apical spire is smaller or more closely coiled.

Occurrence.—Silurian (Yeringian). In dark limestone, Thomson River, Gippsland. Collected by the Dept. of Mines, Victoria. No. 91F.

Fam. ? SIPHONARIIDAE.

Genus **Hercynella**, Kayser, 1878.

Hercynella victoriae, sp. nov. (Plate V., Figs. 47, 48).

Description.—Shell patelliform, depressed conical, with a sharp apex. Slopes of shell alternately convexly and concavely folded; one side, on the longer axis, is pinched up to form a subangulate ridge extending to the apex. Concentric lines of growth appearing as low folds. Surface of shell radiately marked with close, low riblets, strengthening as they approach the ventral margin.

Dimensions.—Greatest length of holotype, 53 mm. Greatest width, 35 mm. Approximate length, complete, 55 mm.; width, 39 mm. Height 13.5 mm.

Observations.—This interesting species resembles *H. radians*, Barrande sp.[2] in the radial ornament, but is more elongate-ovate in outline, and the vellication or pinching up of the dorsum is more

1 Pal. Soc. Mon., vol. xliv., 1891. Mon. Dev. Fauna S. of England, p. 204, pl. xix., figs. 12-14.

2 Barrande's Syst. Sil. Bohême. Perner, vol. iv., tome i., 1903, pl. xliii., figs. 20, 21; pl. xlviii., figs. 16-24. Tome ii., 1907, pl. cxxi., figs. 15-18.

marked than in the Bohemian species. *H. radians* is found in the Lower Devonian (Stage F of Barrande).

Occurrence.—Silurian (Yeringian). In olive-grey mudstone. Junction of the Woori-Yallock and the Yarra. Collected by the Geol. Surv. Vict. B23.

EXPLANATION OF PLATES.

N.B.—All the photographic figures are enlarged one-sixth over natural size. For exact dimensions, see text.

Plate II.

Fig. 1.—*Helcionopsis nycteis*, Cresswell sp. Side view of holotype. Cave Hill, Lilydale.

,, 2.—*Helcionopsis elegantulum*, sp. nov. Dorsal view of holotype. Cave Hill, Lilydale.

,, 3.—*H. elegantulum*, sp. nov. Side view of holotype.

,, 4.—*Temnodiscus pharetroides*, sp. nov. Lateral view of holotype. Loyola, near Mansfield.

,, 5.—*T. pharetroides*, sp. nov. Back view of holotype.

,, 6.—*Bellerophon fasciatus*, Lindström. Side view. Junction of Woori-Yallock and Yarra.

,, 7.—*Bellerophon* aff. *fastigiatus*, Lindström. Umbilical aspect. Kilmore.

,, 8.—*B.* aff. *fastigiatus*, Lindström. Oral aspect of same specimen.

,, 9.—*Bellerophon pisum*, sp. nov. Umbilical aspect of holotype. Cave Hill, Lilydale.

,, 10.—*B. pisum*, sp. nov. Oral aspect of holotype.

,, 11.—*B. pisum*. Dorsal view of holotype.

,, 12.—*Bellerophon cresswelli*, Etheridge fil. Side view of a senile specimen. Cave Hill, Lilydale.

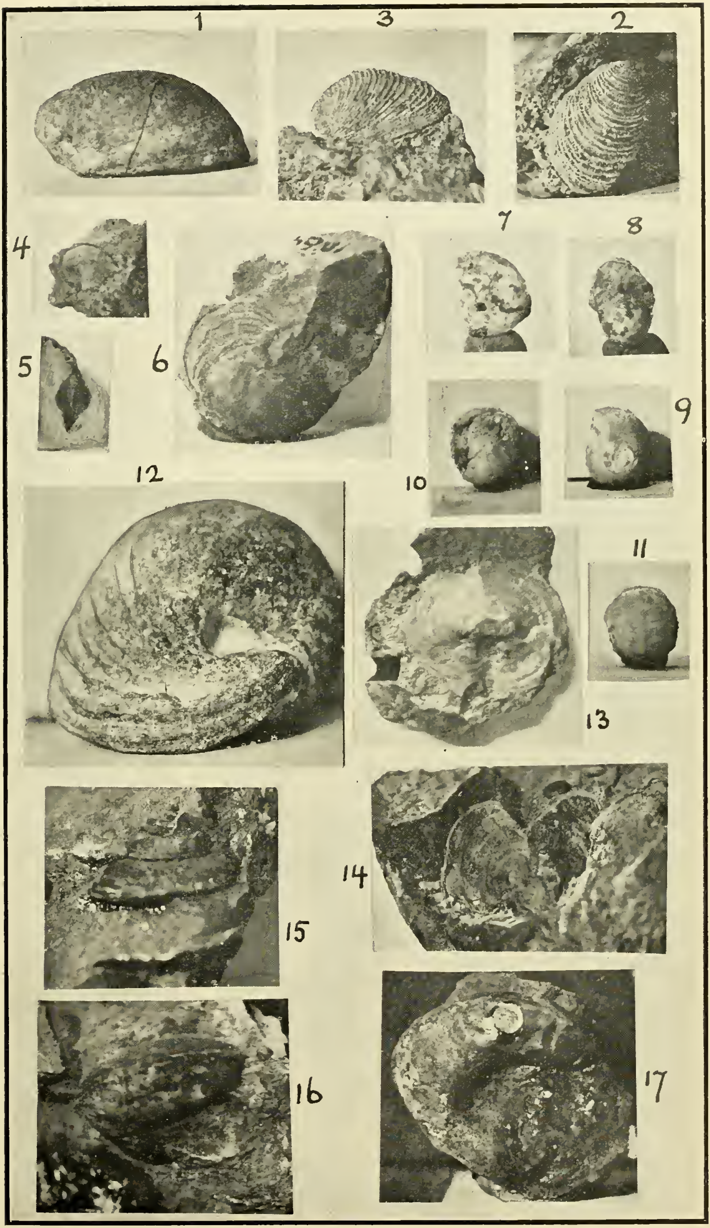
,, 13.—*Carinaropsis victoriae*, sp. nov. Interior of shell of paratype, showing umbonal platform. Ruddock's, near Lilydale.

,, 14.—*C. victoriae*, sp. nov. Exterior of shell, holotype. Ruddock's, near Lilydale.

,, 15.—*Pleurotomaria maccoyi*, sp. nov. Holotype, lateral aspect. Junction of Woori-Yallock and Yarra.

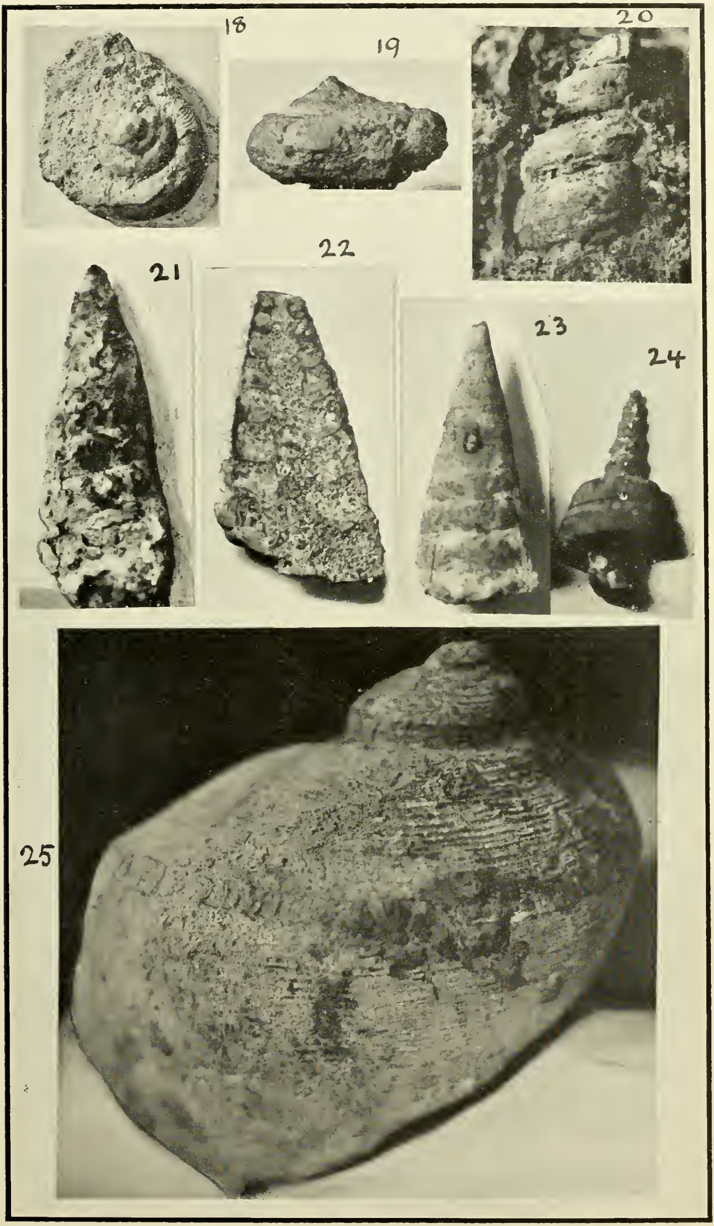
,, 16.—*P. maccoyi*, sp. nov. Paratype. Shell showing slit-band. Junction of Woori-Yallock and Yarra.

,, 17.—*P. maccoyi*, sp. nov. Paratype, showing base of shell. Junction of Woori-Yallock and Yarra.



F.C., Photo.

Victorian Yeringian Gasteropods.



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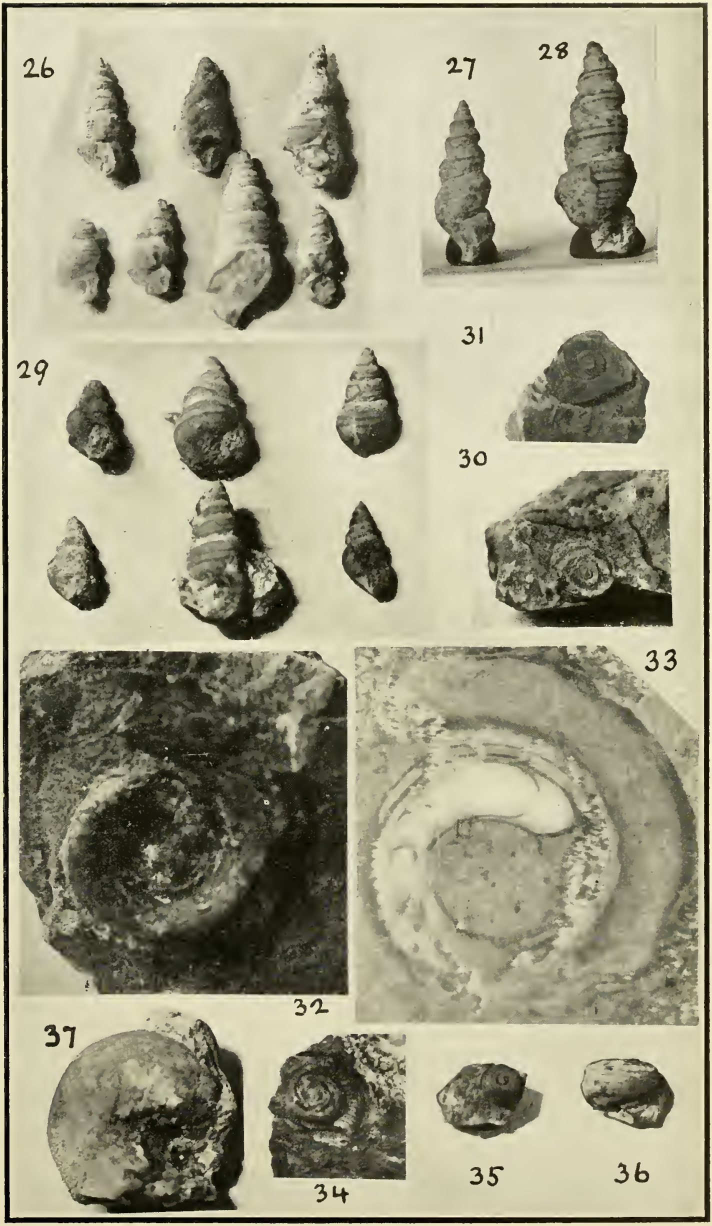
Victorian Yeringian Gasteropods.



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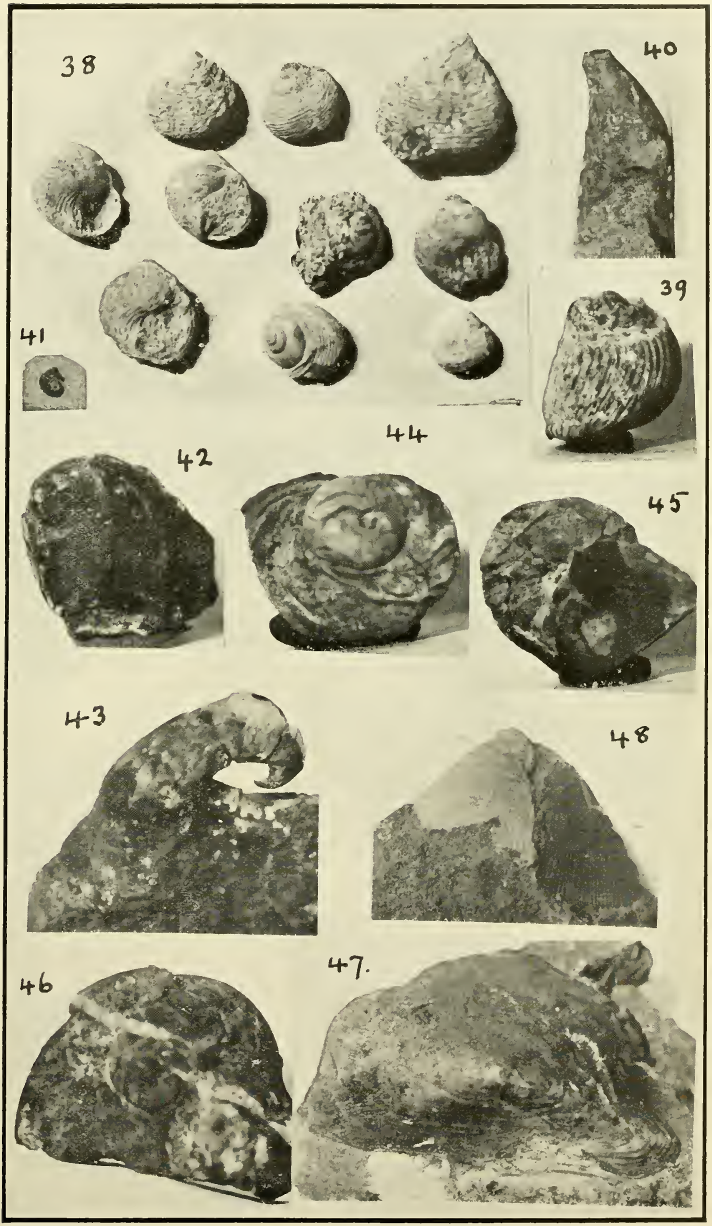
Victorian Yeringian Gasteropods.



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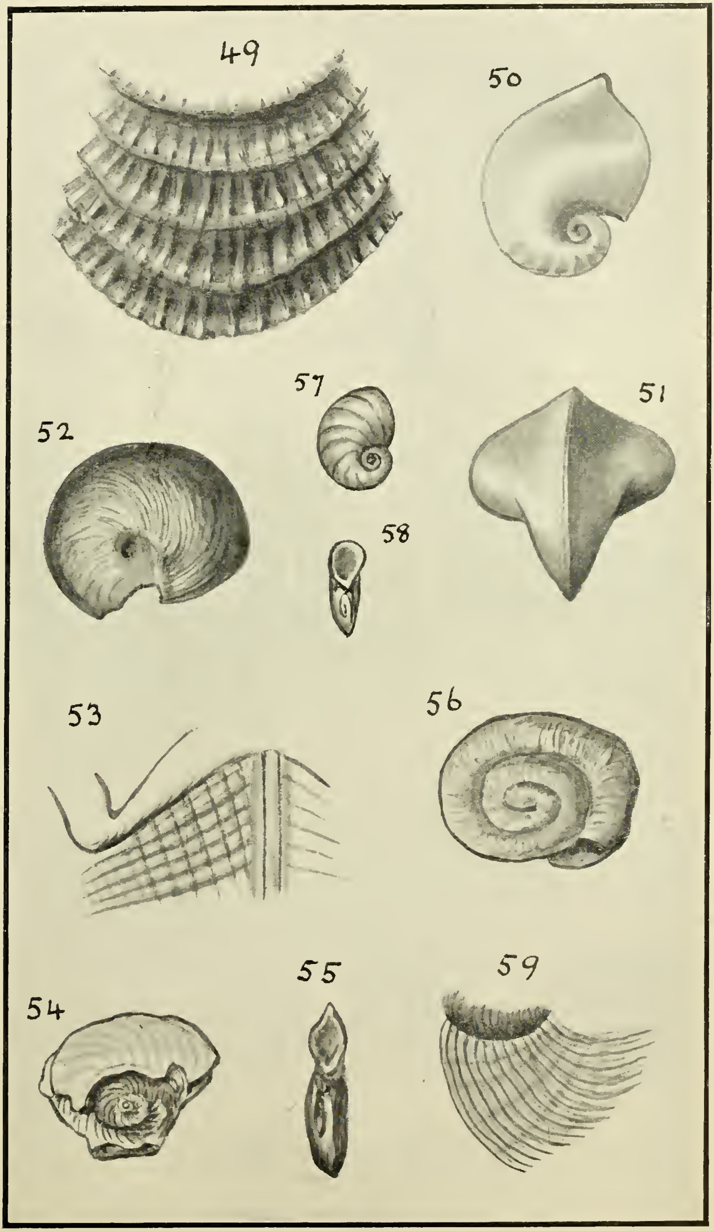
Victorian Yeringian Gasteropods.



F.C. ad nat. del.

Victorian Yeringian Gasteropods.

Plate III.

Fig. 18.—*Mourlonia subaequilatera*, sp. nov. Apical view of holotype, Cave Hill, Lilydale.

,, 19.—*M. subaequilatera*, sp. nov. Side view of holotype.

,, 20.—*Coelocaulus brazieri*, Etheridge fil. sp. Basal part of a senile shell, showing slit-band. Cave Hill, Lilydale.

,, 21.—*C. brazieri*, Eth. fil. sp. A typical specimen. Cave Hill, Lilydale.

,, 22.—*C. brazieri*, Eth. fil. sp. Shell sliced through umbilical axis, showing large, persistent canal. Cave Hill, Lilydale.

,, 23.—*Coelocaulus apicalis*, sp. nov. Holotype, showing short conical habit. Cave Hill, Lilydale.

,, 24.—*C. apicalis*, sp. nov. Plesiotype, showing cast of axial canal. Cave Hill, Lilydale.

,, 25.—*Phanerotrema australis*, Etheridge fil. A well preserved specimen, showing large slit-band and ornament on body whorl. Cave Hill, Lilydale.

Plate IV.

Fig. 26.—A group of *Cyrtostropha lilydalensis*, sp. nov. Cave Hill, Lilydale.

,, 27.—*Cyrtostropha lilydalensis*, sp. nov. Paratype, Cave Hill, Lilydale.

,, 28.—*C. lilydalensis*, sp. nov. Holotype. Cave Hill, Lilydale.

,, 29.—A group of *Goniostropha pritchardi*, Etheridge fil. Cave Hill, Lilydale.

,, 30.—*Euomphalus centrifugalis*, sp. nov. Paratype. Killara, near Seville.

,, 31.—*E. centrifugalis*, sp. nov. Holotype. Loyola, near Mansfield.

,, 32.—*Liomphalus australis*, gen. et sp. nov. Holotype. Cave Hill, Lilydale.

,, 33.—*L. australis*, sp. nov. Median section, showing the open whorls and concamerated shell. Cave Hill, Lilydale.

,, 34.—*Straparollus debilis*, sp. nov. Holotype. Ruddock's, near Lilydale.

,, 35.—*Omphalotrochus globosum*, Schlotheim sp. Cast of shell. Cave Hill, Lilydale.

,, 36.—*O. globosum*, Schl. sp. A well-preserved shell. Cave Hill, Lilydale.

Fig. 37.—*Craspedostoma lilydalensis*, Cresswell sp. Umbilical aspect of plesiotype. Cave Hill, Lilydale.

PLATE V.

Fig. 38.—*Cyclonema lilydalensis*, Etheridge fil. A group of young shells. Cave Hill, Lilydale

,, 39.—*Loxonema sinuosa*, Sowerby, var. australis, var. nov. Whorl of shell showing varietal character of ornament. Cave Hill, Lilydale.

,, 40.—*Orthonychia brevis*, sp. nov. Lateral aspect of holotype. Loyola, near Mansfield.

,, 41.—*Platyceras minutum*, sp. nov. Paratype. Deep Creek, Thomson River, Gippsland.

,, 42.—*Platyceras cornutum*, Hisinger. Loyola, near Mansfield.

,, 43.—*Platyceras erectum*, J. Hall sp. Kilmore.

,, 44.—*Diaphorostoma retrorugatum*, sp. nov. Apical aspect of holotype. Ruddock's, near Lilydale.

,, 45.—*D. retrorugatum*, sp. nov. Umbilical aspect of holotype.

,, 46.—*Diaphorostoma incisum*, sp. nov. Apical aspect of holotype. Thomson River, Gippsland.

,, 47.—*Hercynella victoriae*, sp. nov. Apical aspect of holotype. Junction of Woori-Yallock and Yarra.

,, 48.—*H. victoriae*, sp. nov. Lateral view of a crushed specimen. Paratype, showing radial ornament. Junction of Woori-Yallock and Yarra.

PLATE VI.

Fig. 49.—*Helcionopsis elegantulum*, sp. nov. Enlarged ornament from median dorsal area. × 10.

,, 50.—*Temnodiscus pharetroides*, sp. nov. Holotype enlarged. Lateral aspect. × 4.

,, 51.—*T. pharetroides*, sp. nov. Holotype enlarged. Dorsal aspect. × 4.

,, 52.—*Bellerophon fasciatus*, Lindström. Plesiotype, showing growth-lines. × 3.

,, 53.—*Bellerophon cresswelli*, Eth. fil. Portion of surface of senile example, below aperture; showing character of decussate ornament. somewhat restored. × 2.

,, 54.—*Euomphalus centrifugalis*, sp. nov. Holotype enlarged. Lateral aspect. × 2.

Fig. 55.—*E. centrifugalis*, sp. nov. Holotype enlarged. Peripheral aspect. × 2.

,, 56.—*Straparollus debilis*, sp. nov. Holotype enlarged. Lateral aspect. × 2.

,, 57.—*Platyceras minutum*, sp. nov. Holotype enlarged. Lateral (apical) aspect. × 4.

,, 58.—*P. minutum*, sp. nov. Paratype enlarged. Peripheral aspect. × 4.

,, 59.—*Diaphorostoma incisum*, sp. nov. Holotype. Magnified view of ornament on body whorl. × 3.

CORRIGENDUM.

In part XVIII., of this series, vol. XXVIII., pt. I., 1915, p. 158, line 2 from bottom, for 1834, read 1843.

[Proc. Roy. Soc. Victoria, 29 (N.S.), Pt. I., 1916].

Art. VI.—*Description of a New Genus and two New Species of Victorian Marine Mollusca.*

BY

J. H. GATLIFF

AND

C. J. GABRIEL.

(With Plate VII.).

[Read 13th July, 1916].

Larinopsis, nov. gen.

Shell fragile, turbinate, umbilicate, whorls rapidly increasing in size; peristome continuous, slightly reflexed. With an olivaceous epidermis. Operculum horny, annular, with nucleus intramarginal. The animal is viviparous and marine.

Type of genus: Larina ? turbinata, Gatliff and Gabriel.[1]

The shell was provisionally described as a Larina, a genus erected for the reception of a Moreton Bay (Queensland) form, L. strangei, A. Adams. We asked the question respecting the specimen of the northern type species, obtained in McKenzie River: "Was it obtained at a portion of the river beyond tidal influence?" Mr. C. Hedley states[2] that "The McKenzie flows not into the sea, but into the Fitzroy more than a hundred miles from marine influence," and further adds: "Though destructive criticism of this classification is easy, constructive work of correctly placing the Victorian shell is hard," and suggests the placing of it in the genus Pellilitorina of Pfeffer, which in our opinion possesses quite different characters. He also states: "Somewhat similar features are presented by the Antarctic genera Neoconcha, Smith, and Trichoncha, Smith." These similar features we fail to perceive, and have therefore erected a new genus for our shell.

Marginella problematica, sp. nov. (Pl. VII., Fig. 1).

Shell minute, solid, pyriform, white, semi-transparent, spire completely hidden. Aperture running almost the whole length of

1 Gatliff and Gabriel. Proc. Roy. Soc. Victoria, vol. xxii. (n.s.), 1909, p. 35, pl. 13, figs. 1-6.
2 Hedley. Rec. Austr. Mus., vol. viii., 1912, p. 138.

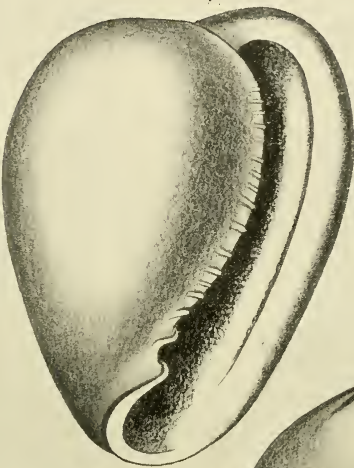


Fig 1

Fig 2

Fig 3

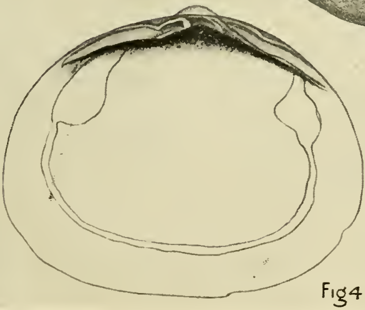


Fig 4

the shell, much curved, with greater width at anterior extremity. Outer lip somewhat thickened, smooth internally, and projecting beyond a slightly flattened summit. Corresponding with the outer lip, the labium is pronouncedly convex, bearing numerous plications, which extend almost the entire length of the aperture, becoming faint posteriorly. The anterior plait is conspicuous and well separated from the remainder.

Dimensions of Type.—Length, 3.50; breadth, 2.50 mm.

Locality.—Dredged Western Port, 8 to 10 fathoms.

Obs.—This strong little species resembles at least two of our Southern Australian forms, *M. halli*, Pritchard and Gatliff, and *M. inaequidens*, May. From the former it is separable by its flattened summit and more triangular shape, and from the latter by its less cylindrical contour, its greater solidity, and in the disposition of the plications, which are stronger in the new species.

Type in Mr. C. J. Gabriel's collection.

Lepton frenchiensis, sp. nov. (Pl. VII., Figs. 3 and 4).

Shell thin, creamy white, semi-transparent, quadrately oval, subequilateral. Umboes fairly prominent, projecting slightly beyond the dorsal margin, which is arched. Ventral margin almost straight, while a decided roundness is seen anteriorly and posteriorly. The surface of shell is irregularly, finely, concentrically striated. The valve is sufficiently transparent to discern from the exterior the pallial line, and adductor scars. Hinge normal.

Dimensions of Type.—Anterior-posterior diameter, 3; dorsal-ventral diameter, 2.25 mm.

Locality.—Dredged Western Port, 8 to 10 fathoms.

Obs.—A single valve is selected as type, joined valves not having been taken. The species bears some resemblance to *L. australe*, Angas, firstly, in contour, and, secondly, in lacking the characteristic shagreen sculpture of the genus. The greater depth proportionately, in having more rounded beaks, and the lesser dimensions being the chief points of difference.

Type in Mr. C. J. Gabriel's collection.

EXPLANATION OF PLATE.

Fig. 1.—Marginella problematica, sp. nov.

,, 2.—Eulima immaculata, Pritchard and Gatliff.

,, 3, 4.—Lepton frenchiensis, sp. nov.

The figures are variously magnified.

[Proc. Roy. Soc. Victoria, 29 (N.S.), Pt. I., 1916].

Art. VII.—*Additions to and Alterations in the Catalogue of the Marine Shells of Victoria.*

BY

J. H. GATLIFF

AND

C. J. GABRIEL.

[Read 13th July, 1916].

In this paper we have added 28 more species to the catalogue, including two new genera, Verticordia and Poroleda. The total number catalogued is now 1080.

The paper includes seven species of the genus Marginella. The Marginellidae of Victoria and Tasmania have hitherto proved a difficult group, but through the close attention bestowed on them by Mr. W. L. May, of Tasmania, many of the difficulties, presented from time to time, have been satisfactorily elucidated. Our work on the group has been greatly facilitated by the gift of numerous typical examples of Mr. May's Tasmanian species. Favoured with this assistance we have been able to critically compare our Victorian forms, and, consequently, augment the list as above.. With a record of 38 species, the genus Marginella is well represented in the waters of Victoria.

Turricula retrocurvata, Verco.

1909. Mitra retrocurvata, Verco. T.R.S., S.A., vol. XXXIII., p. 338, pl. 24, f. 4, 5.

Hab.—In about 40 fathoms, off Ninety Mile Beach.

Obs.—Size of type: Length, 16.5; breadth, 6.25 mm. Quadriplicate.

Turricula acromialis, Hedley.

1915. Mitra acromialis, Hedley. P.L.S., N.S.W., vol. XXXIX. for 1914, p. 730, pl. 84, f. 85.

Hab.—Same as preceding species.

Obs.—Size of type: Length, 9.5; breadth, 4 mm. Quadriplicate.

TURRICULA PUMILIO, May.

1915. Vexillum pumilio, May. P.R.S., Tas., p. 85, pl. 1, f. 5.

Hab.—Same as preceding species.

Obs.—Size of type: Length, 4.3; breadth, 2 mm. Triplicate.

MARGINELLA ANGASI, Brazier.

1870. Marginella angasi, Brazier. Jour. de Conch., vol. XVIII., p. 304, and vol. XIX., 1871, p. 324, pl. 12, f. 3.

1875. Granula angasi, Brazier. Jousseaume, Rev. et Mag. Zool., p. 84.

1883. Marginella angasi, Brazier. Tryon. Man. Conch., vol. V., p. 45, pl. 12, f. 67.

1908. Marginella angasi, Brazier. May, P.R.S., Tas., p. 53.

1915. Marginella angasi, Brazier. Hedley, P.L.S., N.S.W., vol. XXXIX. for 1914, p. 726, pl. 82, f. 66.

Hab.—Portsea, Port Phillip; Western Port; dredged off Wilson's Promontory, and off Ninety Mile Beacth.

Obs.—Size of type: Length, 1.75; breadth, 1 mm. May remarks (*loc. cit.*): "If I have rightly identified the species, then M. halli, Prit. and Gat., is a synonym." His identification is wrong; M. angasi has a slightly elevated spire, in M. halli the spire is totally immersed.

MARGINELLA STILLA, Hedley.

1903. Marginella stilla, Hedley. Mem. Aust. Mus., vol. IV., p. 367, f. 90 (in text).

Hab.—In about 40 fathoms, off Ninety Mile Beach.

Obs.—Size of type: Length, 5; breadth, 2.5 mm. Quadriplicate, lip finely denticulate within.

MARGINELLA SUBAURICULATA, May.

1915. Marginella subauriculata, May. P.R.S., Tas., p. 86, pl. 2, f. 7.

Hab.—Western Port; and dredged off Wilson's Promontory.

Obs.—Size of type: Length, 1.5; breadth, 1.2 mm. Columella with six plaits.

MARGINELLA FREYCINETI, May.

1915. Marginella freycineti, May. Id., f. 9.

Hab.—Dredged off Rhyll, Western Port.

Obs.—Size of type: Length, 2; breadth, 1.2 mm. Triplicate.

MARGINELLA CADUCOCINCTA, May.

1915. Marginella caducocincta, May. Id., p. 88, pl. 2, f. 11.

Hab.—Dredged off Wilson's Promontory.

Obs.—Size of type: Length, 3; breadth, 2 mm. Quadriplicate.

MARGINELLA INCONSPICUA, Sowerby.

1846. Marginella inconspicua, Sowerby. Thes. Conch., vol. I., p. 387, pl. 75, f. 80.

1915. Marginella inconspicua, Sowerby. Hedley, P.L.S., N.S.W., vol. XXXIX., p. 726, pl. 82, f. 64.

Hab.—Dredged off Gabo Island.

Obs.—Size: Length, 5.5; breadth, 3 mm.

MARGINELLA PROBLEMATICA, Gatliff and Gabriel.

1916. Marginella problematica, Gatliff and Gabriel. Antea page 104.

Hab.—Dredged Western Port, in 8 to 10 fathoms.

DAPHNELLA MICROSCOPICA, May.

1915. Taranis microscopica, May. P.R.S., Tas., p. 84, pl. 1, f. 2.

Hab.—Dredged off Wilson's Promontory.

Obs.—Size of type: Length, 1.3; breadth, 0.7 mm. Closely resembling D. excavata, Gatliff.

CASSIS ACHATINA, Lamarck, var STADIALIS, Hedley.

1903. Cassidea turgida, Hedley, not of Reeve. Mem. Aust. Mus., vol. IV., p. 340, pl. 36, f. 1.

1914. Cassidea stadialis, Hedley. Zool., Commonwealth trawler "Endeavour," vol. II., pt. 2, p. 72, pl. 10, f. 4.

Hab.—Dredged in Bass Straits.

Obs.—Size attaining to: Length, 100; breadth, 70 mm. Hedley (*loc. cit.*) states: "Some might regard it as a form of C. pyrum, Lamarck." We consider it to be a large, inflated variety of C. achatina, Lamarck.

EULIMA IMMACULATA, Pritchard and Gatliff. (Pl. VII., Fig. 2).

1900. Stylifer immaculata, Pritchard and Gatliff. P.R.S., Vic., vol. XIII. (N.S.), p. 137, pl. 21, f. 2.

Hab.—Type from Shoreham, Western Port; St. Kilda, and Frankston, Port Phillip; Torquay.

Obs.—Size of type: Length, 3; breadth, 1.5 mm. It was the only specimen obtained at that time, since then we have got others from the localities above indicated, and after critically examining them we have decided to class it as a Eulima. We give another figure of it.

ODOSTOMIA OCCULTIDENS, May.

1915. Odostomia occultidens, May. P.R.S., Tas., p. 90, pl. 4, f. 19.

Hab.—Portsea, Port Phillip; and dredged of Rhyll, Western Port.

Obs.—Size of type: Length, 1.5; breadth, 1 mm. "A very variable species in some particulars."

CERITHIOPSIS DANNEVIGI, Hedley.

1911. Cerithiopsis dannevigi, Hedley. Zool., Commonwealth trawler "Endeavour," pt. I., p. 109, pl. 19, f. 26, 27.

Hab.—San Remo, Western Port; and off Ninety Mile Beach in about 40 fathoms.

Obs.—Size of type: Length, 5.5; breadth, 1 mm.

RISSOA OBELISCUS, May.

1915. Rissoa obeliscus. May. P.R.S., Tas.,.p. 92, pl. 5, f. 24.

Hab.—Same as preceding species.

Obs.—Size of type: Length, 2.2; breadth, 1 mm. "Smooth and polished."

RISSOA SIMILLIMA, May.

1915. Rissoa simillima, May. Id., p. 93, pl. 5, f. 26.

Hab.—Same as preceding species.

Obs.—Size of type: Length, 1.8; breadth, 1.3 mm.

RISSOA AURANTIOCINCTA, May.

1915. Amphithalamus aurantiocinctus, May. Id., p. 96, pl. 6, f. 33.

Hab.—Dredged off Wilson's Promontory.

Obs.—Size of type: Length, 2.5; breadth, 1.4 mm. A smooth shell of five whorls, with two orange bands on the body whorl.

ACANTHOCHITES LACHRYMOSUS, May and Torr.

1912. Acanthochites lachrymosus, May and Torr. P.R.S., Tas., p. 36, pl. 1, f. 1-4.

Hab.—Torquay.

Obs.—Size of type: Length, 33; breadth, 12 mm. (dried specimen).

CHITON EXOPTANDUS, Bednall.

1897. Chiton exoptandus, Bednall. P. Mal. S., Lond., vol. II., p. 152, pl. 12, f. 7.

1912. Chiton exoptandus, Bednall, Torr. T.R.S., S.A., vol. XXXVI., p. 153.

Hab.—Dredged off Newhaven, Phillip Island, Western Port.

Obs.—Size: Length, 27; breadth, 14 mm. A beautiful Chiton, its principal coloration being red.

TEREDO NAVALIS, Linn.

1767. Teredo navalis, Linn. Syst. Nat. ed. 12, p. 1267.

1915. Teredo navalis, Linn. Gatliff and Gabriel, P.R.S., Vic., Vol. XXVIII. (N.S.), pt. 1, p. 117, pl. XIII., f. 10.

Hab.—Lakes Entrance.

Obs.—This species was discussed by the authors (*loc. cit.*), wherein will be found a list of references.

TEREDO PEDICILLATUS, Quatrefages.

1849. Teredo pedicillatus, Quatrefages. Ann. Nat. Sci., Ser. 3, Zool., vol. II., p. 26, pl. 1, f. 2.

1915. Teredo pedicillatus, Quatrefages. Gatliff and Gabriel, P.R.S., Vic., vol. XXVIII. (N.S.), pt. 1, p. 121, pl. XIII., f. 13.

Hab.—Lakes Entrance; Portsea Pier; Brighton boatslip.

Obs.—The previous observations apply also to this species.

Teredo bruguieri, Delle Chiaje.

1792. Teredo norvagicus, Spengler. Skriv. Nat. Selsk., vol. II., p. 102, pl. 2, f. 4-6, B (not binomial).

1828. Teredo bruguieri, Delle Chiaje. Memorie., vol. IV., pp. 28 and 32, pl. 54, f. 9-12.

1894. Teredo edax, Hedley. P.L.S., N.S.W., vol. IX., pp. 501-505, pl. 32, f. 1-5.

1903. Nausitora edax, Hedley. Pritchard and Gatliff, P.R.S., Vic., vol. XVI. (N.S.), p. 98.

1915. Teredo bruguieri, Delle Chiaje. Gatliff and Gabriel, P.R.S., Vic., vol. XXVIII. (N.S.), p. 118, pl. XIII., f. 12.

Hab.—Western Port; Lakes Entrance; Portsea Pier; Brighton boat-slip.

Obs.—In their catalogue, Pritchard and Gatliff recorded this species under the appellation of Nausitora edax, Hedley. This is manifestly a synonym of the common European form.

Teredo fragilis, Tate.

1889. Teredo fragilis, Tate. T.R.S., S.A., vol. XI., p. 60, pl. XI., f. 13a, b, c.

1915. Teredo fragilis, Tate. Gatliff and Gabriel, P.R.S., Vic., vol. XXVIII. (N.S.), p. 122, pl. XIII., f. 14.

Hab.—Brighton boat-slip, and Portsea Pier, Port Phillip.

Obs.—With this addition, five species constitute the representation of the Teredidae in the waters of Victoria. In a communication (these Proceedings, vol. XXVIII., 1915, p. 115, pls. XII.-XIII., figs. 1-4, 6-14), the Teredidae of Victoria were dealt with by the present authors, when it was conclusively shown that T. fragilis, Tate, had erroneously suffered the degradation of a synonym. That such a misunderstanding had occurred is clear from the remarks, and in the figure of the type pallet accompanying it. This is the smallest Victorian form, its nearest ally being T. pedicillatus, Quat. The timber from the first locality was a Eucalypt, in which were associated both forms. The pallets of these species possess distinctive features, which are readily discernible in the figures of above references.

Lepton frenchiensis, Gatliff and Gabriel.

1916. Lepton frenchiensis, Gatliff and Gabriel. Antea page 105.

NEOLEPTON NOVACAMBRICA, Hedley.

1915. Neolepton novacambrica, Hedley. P.L.S., N.S.W., for 1914, vol. XXXIX., p. 701, pl. 79, f. 29-32.

Hab.—Off Ninety Mile Beach, in about 40 fathoms; and off Wilson's Promontory.

Obs.—Size of type: Height, 2; length, 2.2; depth of single valve, 0.6 mm.

ROCHEFORTIA ANOMALA, Angas.

1877. Mysella anomala, Angas. P.Z.S., Lond., p. 176, pl. 26, f. 22.

1878. Mysella anomala, Angas. Id., p. 870.

1901. Rochefortia anomala, Angas. Tate and May, P.L.S., N.S.W., vol. XXVI., p. 433.

Hab.—Dredged in eight fathoms, Point Cook, Port Phillip.

VERTICORDIA TASMANICA, May.

1915. Verticordia tasmanica, May. P.R S., Tas., p. 99, pl. 8, f. 41.

Hab.—Off Wilson's Promontory.

Obs.—Size of type: Height, 4; width, 4.5 mm.

CARDITELLA VINCENTENSIS, Verco.

1908. Carditella vincentensis, Verco. T.R.S., S.A., vol. XXXII., p. 354, pl. 16, f. 20, 21.

Hab.—Off Ninety Mile Beach, in about 40 fathoms.

Obs.—Size of type: Antero-posterior diameter, 3; umbo-ventral, 2.85 mm.

POROLEDA SPATHULA, Hedley.

1902. Leda ensicula, Hedley, non Angas. Mem. Aust. Mus., vol. IV., p. 293, f. 41, in text.

1915. Poroleda spathula, Hedley. P.L.S., N.S.W., vol. XXXIX., for 1914, p. 696, pl. 78, f. 17, 18.

Hab.—Off Ninety Mile Beach, in about 40 fathoms.

Obs.—Size of type: Length, 14; height, 4.5 mm. Tate and May correctly stated that Leda lefroyi, Beddome was a synonym of L. ensicula, Angas. Hedley obtained a new species (P. spathula, *loc. cit.*) off Port Kembla, wrongly identified it as being L. ensicula, Angas, and distributed it as such, and stated in the reference first above cited that Tate and May had been mistaken in their identification; he now admits his error.

Modiolaria radians, Suter.

1908. Dacrydium radians, Suter. T.N.Z.I., vol. XL., p. 355, pl. 27, f. 11.

1913. Dacrydium radians, Suter. Man. N.Z. Moll., p. 872, pl. 51, f. 19a.

1912. Modiolaria rhyllensis, Gatliff and Gabriel. P.R.S., Vic., vol. XXV. (N.S.), p. 167, pl. 9, f. 9, 10.

Hab.—Dredged living, off Rhyll, Western Port, in about six fathoms.

Obs.—From a specimen kindly sent to us by Mr. Suter, we are led to the conclusion that M. rhyllensis is the same as his species, but we prefer to class it as a Modiolaria.

END OF VOLUME XXIX., PART I.

[Published October, 1916.]

[Proc. Roy. Soc. Victoria 29 (N.S.), Part II., 1916].

Art. VIII.—*Oscillatory Adjustments in the Animal Body.*

By W. A. OSBORNE, M.B., D.Sc.
(Professor of Physiology in Melbourne University).

[Read 22nd September, 1916.]

Ostwald has pointed out that if any system be self-adjusting the equilibrium attained must necessarily be oscillatory. As an illustration of this, he cites the thermostat, where the regulator shuts off the heat supply when a certain standard temperature has been exceeded. The result of this withdrawal is a fall of temperature below the desired level; to be succeeded by a rise and so forth. The better the regulating mechanism the smaller are the oscillations, and the best device is that in which the amplitude of the variation is reduced to a negligible quantity. As Ostwald points out, this principle can be extended to human affairs; in politics, for instance, there is always the tendency for opinion to oscillate between radical and conservative positions; in the realm of the aesthetic standards of taste move to and fro between the florid and the austere. I purpose to apply this principle to some aspects of animal physiology, for in the animal body we find numerous adjustments which are relatively constant, and which maintain constancy by self-regulating mechanisms. Amongst the many physiological landmarks in evolution the transformation of a variable into an invariable (temperature, osmotic pressure, etc.) has been conspicuous, but we are compelled to assume that, however close to a fixed standard the adjustment is made, if a self-regulating mechanism is at work a state of oscillatory equilibrium has been established. A number of instances may now be discussed.

I. Respiration.—We owe to Haldane[1] and his school the discovery of the chemical regulation of pulmonary ventilation. If metabolism is not too active as it is in violent exercise there is a remarkable constancy shown in the CO_2 tension of the alveolar air. This means a similar constancy in the tension of CO_2 in the arterial blood, and the standard attained is just that which is adequate to excite the respiratory centre in the medulla oblongata. It does not affect the argument if we hold that CO_2 is the specific excitant, or whether it is the hydrogen ion which is causative. Now, in health, the oscillations above and below the mean of quiet respiration are so damped that they escape recognition (though it is just possible that

1 The Regulation of the Lung Ventilation. J. Physiol., vol. 32, p. 225, 1904.

yawning may find a partial explanation here), but in disease, as Haldane pointed out later, the oscillations may become large and obvious, producing the Cheyne-Stokes breathing, which is so striking a clinical sign. Here we find conformity to the rule that an inadequate or deranged regulator will be made manifest by an increase in the amplitude of the oscillation.

II. Body Temperature.—A great advance in evolution was the rise of the homoiothermal bird and mammal. In poikilothermal creatures metabolism is a function of the air temperature, and comes almost to a standstill in the winter of certain climates. A poikilothermal man could not make definite plans or enter into definite contracts for the performance of work except in the tropics as the ability to labour would rise and fall as the air was warm or cold. Now the temperature of a bird or mammal is not absolutely constant. Vigorous muscular movement, as is well known, may, even in an English winter, drive the temperature up to fever pitch; normality is resumed quickly if the air is cold, slowly if the air is hot and humid. The temperature chart of a healthy human being is by no means a straight line. Even when metabolism is kept fairly constant, as when the subject of the experiment remains fasting in bed, a marked diurnal oscillation is apparent, which may have an amplitude of as much as 0.8°C.[1] Whether this oscillation is that due to self-regulation or is more properly a periodicity effect, is, however, not very clear. Much more likely to be the oscillations in question are those small irregular waves displayed when thermo-electric records are graphically taken. Again, we find that a deranged mechanism will produce an exaggerated amplitude of rhythm. In convalescence from an illness, particularly an illness accompanied by fever, exertion that would not in health affect the adjustment, is sufficient to provoke a decided elevation of temperature, and lead to copious sweating, which, in its turn, can very easily produce subnormality when the exercise ceases.

III. The Muscular System.—It will be evident that if the position assumed by a limb is one extreme of movement, if, for instance, extension be carried as far as the ligaments on the flexor side will allow, the fixation here is mechanical, and no oscillation need be expected. In reflex postural contraction it is also probable that an arhythmical fixation is present for the tension may here be purely elastic, the contractile substance being fixed by a hook mechanism (Grützner)[2], or through gel formation (Sherrington)[3].

1 See article Die Wärmeökonomie des Körpers, by R. Tigerstedt in Nagel's Handbuch.

2 See Bayliss, Principles of General Physiology, 1915, p. 534.

3 Postural Activity of Muscle and Nerve. Brain, 1915, vol. 37, p. 191.

But when a limb assumes a special directive position through voluntary muscular action there is no rigid attachment, and the constancy of the direction must of necessity be adjusted by the proprioceptive system reinforced by vision or touch, or occasionally by the proprioceptive system alone. Here it is impossible that oscillation could be avoided, and oscillation is assuredly found. Moreover the better the mechanisms involved—the steadier the nerves in popular parlance—the smaller and more uniform are the oscillations. This is well displayed in rifle shooting, particularly when the barrel is unsupported. A good shot is aware of the tremor but he is able to keep it regular and of small dimensions. Similarly in all skilled actions, and skill will always mean precision of spatial and temporal relations, a high degree of efficiency is only possible if the oscillations arising from the adjusting mechanism remain small. Equilibrists and wire-walkers are definitely aware of the oscillatory effect, and consciously resort to fine rhythmic movement to keep the centre of gravity not statically above the small base of support but moving to and fro on either side. Excitement, self-consciousness, lack of experience, strain, fatigue, etc., may in the healthy body produce an extensive increase in the range of oscillation, whilst that exaggeration due to alcoholism, cerebellar disease, senility, neurasthenia, etc., is well known. A small amount of swaying of the upright body when the eyes are shut has often been observed in health, but a marked oscillatory movement has a high diagnostic value. The position of the eyeball is maintained by muscular contraction, guided by macular vision and the proprioceptive information sent up from the eyes muscles. But when a static object is regarded steadily the visual axis is not immobile; there is a slight range of tremor. That this delicate oscillation plays some part in art, especially pointilistic art, has been suggested by H. G. Keller and J. J. R. Macleod[1]. Again, it is possible that in nystagmus we may find the pathological amplification of a normal rhythm[2]. That a voluntary fixation of a limb (using the term limb in its widest sense) must of necessity be oscillatory is not usually assumed in physiological literature, yet a little consideration will show that this must exist. In dealing, therefore, with the rhythm of neural discharge from the central nervous system to the muscles, two possible causes must be borne in mind. There may be an intrinsic periodicity in the nerve cell or nerve cell complex—*i.e.*, rhythmic discharge of each nerve cell or rhythm due to sequence of

1 Popular Science Monthly. November, 1913.

2 This has been stated precisely by Coppez. Archives d'Ophthalmologie, vol. 33, p. 545.

one nerve cell discharging after the other. This is the causative factor usually assumed. But the rhythm due to absence of mechanical fixation and absolutely necessitated by the adjustments based on sensory impressions is left out of count.

IV. The Blood Constants.—The blood of the higher animals displays remarkable constancy in a number of its characters. Determinations of hydrogen ion concentration have shown that the range of reaction, despite almost gross variations in the reaction of food and of metabolites, is exceedingly small. Here the kidney and lungs are the organs entrusted with the standardisation, or, at least, with the fine adjustment of the standardisation. There is similarly a constancy with respect to osmotic pressure, metallic balance and water content, and again the kidney is the regulating organ. If an oscillation in any of these properties were sought for it would be in the blood from the renal vein, but one might well expect the oscillations to be so small and so damped that they would escape detection. Yet it is surely possible that pathological conditions might exist which would magnify such oscillations and make them detectable and of import to the functioning of the tissues of the body generally.

Arteriolar vaso-constriction is a local variable adjusted to the varying action of gravity on each part of the body and to the varying call for blood from the organs as they are severally excited. Yet there is a mean blood pressure and self-regulating devices, such as the depressor nerve or the direct action of high pressure on the medulla, have been proved to exist. Though once more the oscillations produced may be too small and too damped to be made manifest, it is again possible to assume that they may be greatly exaggerated in pathological states.

What determines the total quantity of blood in the body, the concentration of plasma proteins, and the number of formed elements, physiology as yet has not determined, but if self-regulating mechanisms are at work, the same argument applies.

The above are a few only of the self-adjusting processes in the body. There are many others not touched upon. One has only to think of the reflex excitation of the lachrymal gland, which is so finely adjusted that both dryness and excessive moisture of the cornea are avoided, of the secretion of mucous surfaces, of the growth of the skin *pari-passu* with frictional loss and such like, to realise that self-adjustment is the rule and not the exception. And in all self-adjusting systems, we may venture to state, rhythm, if not apparent, is latent, and can be brought into prominence by pathological changes.

[Proc. Roy. Soc. Victoria 29 (N.S.), Part II., 1916].

Art. IX.—*The Wet-Bulb and Kata Thermometers.*

By W. A. OSBORNE, M.B., D.Sc.
(Professor of Physiology in Melbourne University).

[Read 22nd September, 1916.]

The ordinary thermometer which records the temperature of its immediate environment, is, as is now well known, an unreliable guide to those air conditions that influence the animal body. "It affords no measure of the rate of cooling of the human body, and is, therefore, a very indifferent instrument for indicating atmospheric conditions which are comfortable and healthy to man."[1] Of the three air factors for which the body has to make adjustments in order to keep thermostatic—namely, the temperature, water content and velocity, the thermometer records one only. The great superiority of the wet-bulb reading over the dry-bulb reading consists in this that the wet-bulb does respond to all these three variables. Though Harrington pointed out the importance of wet-bulb records, naming their indications "sensible temperatures," and actually mapped out the United States of America in wet-bulb isotherms for the month of July,[2] yet it is to Haldane[3] that we are chiefly indebted for pointing out the importance of this instrument. Haldane made some interesting recommendations concerning wet-bulb standards of temperature in mines and factories. He also pointed out that there is for the human being a critical wet-bulb temperature where the conditions are such that the body, even at rest, cannot lose its heat quick enough, and cumulative fever results. This has been confirmed by other investigators, and I may add that I have had opportunity to put the matter to the test with results that agree with Haldane's conclusions. The first great extension of the use of the wet-bulb in climatology occurred here in Australia when the Commonwealth Bureau of Meteorology, under Mr. H. A. Hunt, published maps giving wet-bulb isotherms in Australia for each month of the year 1910. After this a systematised series of wet-bulb observations was undertaken giving records of temperature in homes, offices, etc., as well as outside shade in Northern Territory, and the tropical parts of Queensland. I have had access to these records

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1 Leonard Hill, O. W. Griffith and Martin Flack, The Measurement of the Rate of Heat Loss, etc. Phil. Trans. B, vol. 207, p. 184.

2 Quoted in Hann's Handbuch der Klimatologie, 1908, vol. i., p. 57.

3 J. S. Haldane. Journal of Hygiene, 1905, vol. 5, p. 494.

through the courtesy of Mr. Hunt, and find most interesting material contained in them, though to make adequate use of such data would demand more time than I am able to bestow.

The estimation of one's state of discomfort in hot weather is obviously impossible to carry out with any approach to exactness. I have tried various expedients but without result. The amount of sweat absorbed by the clothes is no guide at all, for, in this climate in summer, we have days when the human body may lose over 400 grammes[1] water per hour by evaporation and yet the skin and clothes remain dry and comfort is not greatly disturbed. A rough and ready indication which I have come to regard as the most useful is simply the clothing that is chosen as the most comfortable when the body lies in an open-meshed hammock in a good shade and at perfect rest. If such a hammock is not at hand, the upright position is, I think, best, and much preferable to resting in, say, a deck chair.[2] Judged roughly in this way, and by general feeling, I have placed wet-bulb 73° F. as an empiric standard above which truly tropical conditions arise. This wet-bulb temperature is seldom attained in the Victorian climate. A typical instance of the effect of dryness in keeping the wet-bulb down is shown in the following :—

Place.	Time.	Dry-Bulb F.	Wet-Bulb F.
Mildura	Dec. 30, 1908, 3 p.m.	110	69

contrast this with

Place.	Time.	Dry-Bulb F.	Wet-Bulb F.
Nottingham	July 29, 1911, 1 p.m.	82	73.6
Kew, London	July 29, 1911, 3 p.m.	87.7	71.3

The last-mentioned high temperature I experienced personally and can truthfully say that it exceeded in unpleasantness anything that I have felt in Melbourne or its environs.

. The wet-bulb isotherms drawn by Mr. Hunt show very clearly that of all portions of Australia the worst from the climatic standpoint is the pearling coast in the north-west. In December, January and February this district is included within the 80° W.B. isotherm. I find that on December 24th, 1909, the shade wet-bulb temperature at Wyndham on this coast was 85° F. at 9 a.m. !

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1 W. A. Osborne. Contributions to Physiological Climatology, Part II. J. Physiol., vol. 49, p. 133.

2 I have made some measurements of the water loss of the body in two almost successive hours in practically the same meteorological conditions, the first hour in a hammock, the second in a deck chair, and found that in the latter case the water loss was considerably increased in each instance owing to the impeded evaporation—the water given off by the skin was of course to be found in the fabric of the deck chair and in the clothing with which it was in contact.

In the course of observations, I began to detect some discrepancies between the wet-bulb reading and the state of discomfort of the body. The most striking of these occurs when a hot day with strong north wind and clear sky undergoes a "change." The sky becomes overcast and the wind drops. There may or may not be electrical disturbance. At this time the air conditions may become most oppressive, and sweating may be very copious on exertion. Now, in all the observations I have made in five summers, I have only noted two occasions in which the wet-bulb rose with the overcasting of the sky and the drop in the wind. In all other cases the wet-bulb, like the dry-bulb, fell. I, therefore, came to the conclusion that the wet-bulb is not sufficiently sensitive to air currents. Experiments on the evaporation from the skin and from an evaporimeter confirmed me in this view.[1] I, therefore, devised a wet-bulb thermometer, having its bulb within a cylindrical gauze cage open at the bottom but otherwise covered with cloth. At the suggestion of Professor Roaf bolting cloth of standard mesh was used for this latter purpose. These "jacketed wet-bulb thermometers" manifested a much better response to air movement, and when tested in a "change," usually gave a rise in temperature. Further experience, however, brought to the light new difficulties. The cloth was apt to get greasy, and to shrink, so I fell back on various porous substances. The same trouble with grease still pursued me, and, most annoying of all, I found that the slightest shift in the position of the bulb made a change in the height of the column, and that it was practically impossible to obtain two jacketed thermometers that gave the same reading. This particular effort, then, which has cost me some considerable time I have been compelled to give up, as I do not see how standardisation can be effected.

The Kata-thermometer of Leonard Hill works on a different principle. Here the time of cooling of a large wet-bulb through a range of 10° F. (from 100° F. to 90° F.) is taken, and the cooling power of the air calculated in terms of millicalories per cm^2 per second. I have had just one summer's experience with three of these instruments, one of them having been kindly sent to me by Professor Leonard Hill who had worked out its special factor.[2] The Kata-thermometer certainly indicates well the onset of oppressive thunder weather and therein manifests its superiority to the wet-bulb. But I soon discovered that in its present form it is somewhat too sensitive to air currents, at any rate in hot, dry weather. The following

1 W. A. Osborne. Contributions to Physiological Climatology, loc. cit.

2 A kerosene tin can be employed with very fair results for obtaining the reading in still air.

data, expressed in seconds, for the cooling of a wet Kata from 100° F. to 90° F., may be taken as illustrating this. Date—Dec. 28th, 1915.

Time.	Dry-Bulb F.	Wet-Bulb F.	Kata Time.	Wind.
0–20 p.m.	94.3	68.7	38″	slight
0–30 p.m.	94.3	68.7	41″	slight
0–35 p.m.	94.5	68.8	43″	very slight
1–45 p.m.	98.7	70	34″	gust

I found, indeed, that it was easy to obtain, especially, as I have said, in hot, dry weather with unsteady wind, greater variations in the wet Kata reading than it was possible that the state of the body could parallel. In fact, theory would suggest that the bulb of the Kata should approximate in size, shape and water equivalent to the human body if correct values are to be obtained. Of course, a series of readings in fairly quick succession could be taken with the present Kata, and the average computed, but this would be tedious. On the other hand, in calm weather, also when the wind was moderately steady, I obtained consistent readings.

More experience is necessary before I can venture to come to a conclusion. Yet, so far as my observations go, I feel that for estimating air conditions in mines and buildings, and possibly sheltered outside places where variations in air velocity are not of much magnitude, the Kata-thermometer is the better instrument. Very probably, too, it could be used profitably in those tropic areas where calm weather is the rule. But for ordinary climatological purposes I still feel that the wet-bulb record is of high value.

[Proc. Roy. Soc. Victoria, 29 (N.S.), Part II., 1917].

Art. X.—*On the Probable Environment of the Palaeozoic Genus Hercynella in Victoria.*

By FREDERICK CHAPMAN, A.L.S., &c.
(Palaeontologist to the National Museum, Melbourne).

[Read November 9th, 1916].

The recent discovery[1] of the interesting gasteropod *Hercynella*, a supposed pulmonate or air-breathing mollusc, in the newer Silurian or Yeringian of the Upper Yarra district in Victoria, leads one to enquire into its mode of living. This enquiry may be conducted on two lines—viz., that of the nature of the sediment in which it occurs, and the other, regarding the fauna with which it is associated.

Before entering upon these questions, it will be well to consider the views of Marjorie O'Connell on this subject[2] in regard to the species of *Hercynella* occurring in the Waterlime Group (=Upper Ludlow) of North Buffalo, U.S.A., at what seems to be an identical horizon as the Victorian, so far as one can judge by associated faunas. Miss O'Connell's note on the "Habitat of Hercynella" (loc. cit. p. 100) is here given in full:—

"The horizon in Bohemia in which the largest number of Hercynellas has been found is F or Upper Monroan [Lower Devonian]. Here they are associated with vast numbers of graptolites, and also with sponges, trilobites and tentaculites. The fauna is undoubtedly marine, and since it is well-preserved, and the Hercynellas are also numerous and in good condition, there is no reason for questioning the marine habitat of the species of Bohemia. Furthermore, the shells are comparatively thick, showing no lack of carbonate of lime for impregnation. The one specimen from the Monroe limestone of Michigan likewise has good marine associates, though its macerated condition and the fact that no other specimens have been found would leave it an open question whether it was a true marine form or merely one swept out to sea by land waters. The Hercynellas which have been found in the Bertie waterlime, seem to indicate conditions other than marine, for their shells are exceedingly thin, as though available lime were not abundant in the water in which they lived, and, moreover, their faunal associates are not typical marine forms, there being only eurypterids, ceratiocarids and the

1 Proc. Roy. Soc. Victoria, vol. xxix., (n.s.), pt. i., 1916, p. 99, pl. v., figs. 47, 48.

2 Bull. Buffalo Soc. Nat. Sci., vol. xi., No. 1, 1914. Description of some New Siluric Gasteropods, pp. 93-101, 1 plate.

plant *Bythotrephis lesquereuxi*, together with a few water-worn specimens of *Orthoceras*. The writer has elsewhere[1] discussed at length the significance of this unique fauna and bionomic conditions which it indicates. The very thin shell of these pulmonate gastropods may be taken as a slight bit of additional evidence to that given in the paper above referred to in support of the view that the Bertie waterlime was deposited not in marine water, but in brackish or fresh water, and that the Hercynellas, as well as eurypterids, were carried into the Bertie muds by the rivers. If, on the other hand, *Hercynella* is to be regarded as a marine genus, then we have here another case of intermingling of marine and fluviatile species in the region of deposition at their junction."

The sediments in which the Yeringian (newer Silurian) fossils are found in the Upper Yarra district are mudstones. This fossil collection was made prior to 1856 by the Geological Survey of Victoria, the locality number being B 23, and the exact position, near Stewart's station, at the junction of the Woori Yallock Creek and the Yarra River. These mudstones are olive-brown in colour, varied with dark grey streaks, and distinctly micaceous. The structure appears to indicate that the rock was either deposited in shallow water or in areas subjected to currents. From the occurrence of corals and gasteropods in this fauna one is inclined to infer that the water was not very shallow, but that periodic incursions of mud took place. That there may also have been a fair amount of decaying matter brought down to this area by streams is evident from the abundance of ostracods (*Beyrichia*), for these little crustaceans probably fed on the drifted weed and similar pabulum.

The following is a list of fossils associated with *Hercynella victoriae* in the mudstone at the junction of the Woori Yallock and the Yarra :—

Coral—

Lindstroemia, sp.

Worm—

Trachyderma cf. *squamosa*, Phillips.

Polyzoan—

Fenestella margaritifera, Chapm.

Brachiopods—

Camarotoechia, sp.

Nucleospira australis, McCoy.

Orthis actoniae, Sow.

1 Bull. Geol. Soc. America, vol. xxiv., 1913, pp. 499-515.

Strophomena ?antiquata, Sow. sp.
Stropheodonta (*Leptostrophia*) *alata*, Chapm.

Bivalves—
Conocardium bellulum, Cresswell sp.
Mytilarca acutirostris, Chapm.
Nuculites maccoyianus, Chapm.
Palaeoneilo raricostae, Chapm.

Gasteropods—
Bellerophon fasciatus, Lindström.
Pleurotomaria maccoyi, Chapm.
Conularia sowerbii, Defr.

Cephalopod—
Orthoceras lineare, Münster sp.

Trilobites—
Lichas australis, McCoy.
Odontopleura jenkinsi, Eth. fil. and Mitch.
Odontopleura rattei, Eth. fil. and Mitch.
Phacops sweeti, Eth. fil. and Mitch.

Ostracods—
Beyrichia kloedeni, McCoy.
Beyrichia kloedeni, var. *granulata*, Jones.
Beyrichia wooriyallockensis, Chapm.
Beyrichia ligatura, Chapm.
Beyrichia maccoyianus, Jones, var. *australiae*, Chapm.

Cirripede—
Turrilepas cf. *yeringiae*, Chapm.

It has been suggested by Miss O'Connell, in the case of the Waterlime Hercynellas that being thin-shelled they probably lived under fresh or brackish-water conditions, and were subsequently swept by rivers into the sea. Our Victorian species is, like the Waterlime fossils, apparently thin in texture, but the perfect condition of the cast of the figured type is so striking as to preclude the idea of its having drifted into the marine mud.

The absence of eurypterids from the Yeringian, and, with one exception, all ceratiocarids, both groups of which are so common in the Waterlime series of North Buffalo, is additional evidence in favour of a marine origin for the Victorian Yeringian deposits. The same cannot be said, however, of the Melbournian sediments, whose fauna contains a *Pterygotus* and numerous ceratiocarids.

That the mudstone of locality B 23 is of marine origin is evident from the fairly large assemblage of brachiopods, bivalves and gasteropods which it contains. The thin-shelled condition, not only of

Hercynella, but of the molluscs and brachiopods occurring in the Victorian Yeringian, seems, therefore, entirely due to the fact that the waters were frequently rendered turbid by the periodic discharge of terrigenous material by rivers, and possibly also by coast erosion, a condition which acts severely on lime-secreting organisms, a fact that can be proved by examining the shore-faunas of land-locked and mud-swept bays at the present time.

The conclusions drawn from the above data are:—

1.—That the Hercynellas of the Victorian Yeringian were of marine habits, as proved by the associated fauna.

2.—That the sediments of locality B 23, in which Hercynella occurs, were laid down under fairly deep-water marine conditions, but the areas of sedimentation may have been periodically subjected to invasions of mud brought down by rivers.

3.—That the lime-secreting fauna of the Yeringian mudstones tends to prove, by the thin shells, that the terrigenous element in the Yeringian sea was so marked as to considerably lower the amount of carbonate of lime available to those organisms.

[Proc. Roy. Soc. Victoria, 29 (N.S.), Part II., 1917].

Art. XI.—*Reptilian Notes:*
Megalania prisca, Owen, and Notiosaurus dentatus, Owen; Lacertilian dermal armour; Opalized remains from Lightning Ridge.

By R. ETHERIDGE, Junr.

(Curator of the Australian Museum, Sydney).

(With Plate VIII.).

[Read November 9th, 1916].

1.—The Identity of Megalania (vel. Varanus) prisca, Owen, with Notiosaurus dentatus, Owen. (Pl. 8, Figs. 1-4).

The late Mr. Richard Lydekker remarked :—" Sir R. Owen has described two peculiar blunt and pleurodont teeth of a large lizard from the Pleistocene of Queensland under the name of *Notiosaurus*, which is, however, preoccupied by the genus *Notosaurus*. . . . It is just possible that the teeth may be referable to *Varanus priscus*, in which event the generic name *Megalania* would have to be retained for that form."[1]

I am now in a position to materially confirm Mr. Lydekker's astute conjecture. The Australian Museum has long been in possession of numerous vertebrae, undoubtedly those of Owen's *Megalania prisca* from fluviatile deposits near Clifton Station, King Creek, Condamine River.

Associated with these, like in appearance, colour, and condition of petrifaction, are a few limb bones, and the larger portion of a right dentary, with part of a tooth *in situ;* there can be no reasonable doubt that these remains all belonged to one and the same species of reptile.

This dentary portion (Pl. 8, figs. 1 and 2) is fractured in front at about the premaxillary suture, and as preserved measures six and a-half inches in length. Posteriorly it is also fractured contiguous to the prefrontal-lachrymal sutures, so that nearly the whole of the bone is preserved. On the external surface (Pl. 8, fig. 1) are visible six large foramina of the maxillary artery branches (anterior branch of external carotid). On the anterior aspect along the alveolar

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1 Lydekker. Nicholson's Man. Pal., 3rd Edit., ii., 1889, p. 1142. A suspicion of this appears to have occurred to the late Mr. C. W. de Vis (Proc. Roy. Soc. Queensland, vi., 1890, p. 97).

channel are the concave surfaces of attachment of seven pleurodont teeth (Pl. 8, fig. 2), another with the dental tissue remaining on it, and the base of a ninth, the tooth fractured transversely, and displaying the pulp cavity. At the base of the tooth represented by dental tissue may be seen the foramen leading into the space in which a new successional tooth would be developed.[1]

The dental impressions (Pl. 8, fig. 2) along the alveolar channel average one and three-eighth inches vertically by five-eighths of an inch transversely, but the immediate surface of tooth attachment averages six-eighths by five-eighths. The base of the remaining tooth is longitudinally grooved as in the better of the two figured by Owen as *Notiosaurus dentatus*,[2] indicating the inflected folds of the external cement.

There are six foramina on the exterior of the dentary of the maxillary artery branches, the second in retiring order double, the sixth and last again double, but the two meati are united whilst still exhibiting evidence of a former separation. This posterior "dumb-bell"-shaped foramen enlarges inwards and upwards immediately beneath the lachrymal bone (Pl. 8, fig. 1).

In the Water Monitor (*Varanus salvator*) these foramina are nine in number. The posterior terminal is simply transversely elongated instead of dumb-bell shaped, and it is the most anterior, instead of the second anterior as in *Megalania*, that is double. In the Australian *V. varius*, Shaw, there are again nine foramina, all single, and the posterior opening as in *V. salvator*.

Notiosaurus dentatus, from Cuddie Springs, New South Wales, it is true, was established[3] by Owen on a mere fragment of the dentary element of a mandibular ramus with portions of two teeth, but the form of these teeth, method of implantation against the alveolar wall, and nature of the cement infoldings are so essentially those of the dentary portion accompanying the *Megalania* vertebrae, that I have no doubt of their identity. I very much doubt if the tooth figured by Mr. de Vis as *Notiosaurus dentatus*[4] is in any way related to Owen's fossil of the same name.

The words of Owen, in describing the dentition of the Crocodilian Monitor (*V. crocodilinus*) apply so well to the present specimen, that I cannot refrain from quoting them. The teeth "are anchylosed by the whole of their base, and by an oblique surface leading up-

1 Tims. Tomes' Man. Dental Anatomy, 7th Edit., 1914, p. 310.
2 Owen. Phil. Trans., 175, pt. i., pl. 12, fig. 2*b*.
3 Owen. Ibid., p. 249.
4 De Vis. Proc. Roy. Soc. Queensland, ii., 1886, pl. iii., fig. 2.

wards on the outer side of the tooth to a slight depression on the oblique alveolar surface as in *Var. striatus.* . . . The alveolar channel or groove has scarcely any depth; but the anchylosed base of the tooth is applied to an oblique surface, terminating in a sharp edge, from which the outer side of the free crown of the tooth is directly continued."[1]

2.—Megalania prisca, a Cave Fossil. (Pl. 8, Figs. 3 and 4).

A few months ago I received a small consignment of bones from the ossiferous deposit at the Wellington Caves Reserve. For some time past a commercial venture, known as the "New South Wales Phosphate Co. Ltd.," has operated on a portion of the area in question. From vugs, vertical crevices, the latter possibly leading to unexplored cave-chambers, and shaft exploration, a large quantity of ossiferous material in red cave-earth has been extracted.[2] To the courtesy of Mr. George Dixon, of the above company, the Trustees are indebted for a small collection of bones from one or other of these openings.

Amongst the specimens my attention was at once attracted by a large vertebra more or less enclosed in red earth. On being freed from the latter, it was found to correspond in every detail with the dorsal vertebrae forming a portion of the series already referred to from near Clifton Station.

The neural spine (Pl. 8, fig. 3) is broken off immediately above the level of the post-zygopophyses, only the right hand one of which approaches entirety. The pre-zygopophyses are also fractured, the left being the more complete. As compared with Owen's dorsal figure,[3] the pre-zygopophyses are relatively lower in position, and nearly on a level with the upper margin of the ball articular surface of the centrum. Again, the posterior zygopophyses appear to have a more solid base than those in the figure quoted. On the right side of the bone the transverse process is practically complete, and would seem to be constructed on somewhat more solid lines than in the type examples.

The articular ball of the centrum is very convex and projecting (Pl. 8, fig. 4). The neural canal is distinctly broad-oval at the posterior end, as usual in this reptile, and at the opposite or

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1 Owen. Odontography, pt. ii., 1841, p. 265.

2 Carne: "Phosphate Deposits in Limestone Caverns in New South Wales." Ann. Rept. Dept. Mines N.S. Wales for 1914 (1915). p. 191, plan, etc.

3 Owen. Phil. Trans., 171, pt. iii., pl. 34.

anterior end is wide transversely. The following are the principal measurements :—

	inches.
Length of centrum	3
Breadth of the same behind the ball	$1\frac{3}{4}$
Vertical, or longitudinal, diameter of ball	$1\frac{1}{2}$
Transverse ditto	$1\frac{5}{8}$
Vertical, or longitudinal, diameter of centrum	$1\frac{3}{8}$
Fore and aft diameter of cup	$1\frac{1}{8}$
Transverse diameter of cup	$1\frac{7}{8}$
Transverse diameter of anterior outlet of neural canal	$\frac{5}{8}$
Transverse diameter of posterior ditto	$\frac{4}{8}$

The remains of *Megalania prisca*, inclusive of *Notiosaurus dentatus*, have now been found in fluviatile, mound spring and cave deposit, as follows :—

Fluviatile deposits	Condamine River and its branches (King Creek, &c.), Queensland; "Near Melbourne,"[1] Victoria; South Australia; Castlereagh River, N. S. Wales.
Mound Spring deposit	Cuddie Springs, East of Gulgongong, N. S. Wales.
Cave deposits	Wellington Caves Reserve, N. S. Wales.

3.—Lacertilian Dermal Armour. (Pl. 8, Figs. 6-9).

For two very interesting fragments from the Opal beds of Lightning Ridge, near Walgett, New South Wales, I am indebted to Mr. T. Wollaston, of Adelaide. Both are formed of roughly hexagonal bony pieces (Pl. 8, figs. 6-8), firmly united by their margins in alternate series. Each component plate is limpet-shell-shaped, more or less, obliquely and unequally conical fore and aft, with a backwardly projecting obtuse apex, with a tendency to overlap in a similar direction. One specimen (Pl. 8, figs. 6, 7) is composed of six larger plates, with three smaller along one of its margins forming, as it were, a border. The second specimen (Pl. 8, fig. 8) comprises five plates of a like nature, and again with three smaller marginal pieces.

These plates are thick, of a compact and bony tissue, the structure of the latter displayed on the inner surface; externally they are highly rugose, the rugosities papilla-like, and usually separate from one another, but here and there becoming semi-confluent, with the narrow interspaces between the papilla often pitted. When

1 It would be interesting to know the exact locality.

examined externally, they appear to be separate from one another, but on the inner surface (Pl. 8, fig. 7) all are anchylosed into a solidity. In one instance at least, some of the papillae have run together, forming three radiating lines from the apex to points on the circumference.

When these fragments first came under my notice, I was struck with a general resemblance to the scale armour of some lizards, and as one naturally turns first to the native fauna for comparisons and affinity, the " Shingle-back " or " Stump-tail " (*Trachysaurus rugosus*) claimed attention. This remarkable species is " clothed with an armour of rough, thick, brown scales (Pl. 8. fig. 9), which give it very much the appearance of a living pine cone." In the Shingleback the dermal armour is osseous, with a horny epidermal covering, as usual, but in the present instance the osseous plates only are presented to us.

The living *Trachysaurus* measures some fourteen inches in length, and if these consolidated scutes represent a reptile allied to the Shingle-back, and are to be accepted as a guide to its relative size, it may not have greatly exceeded the latter in dimensions, the largest scutes on the tail of the Shingle-back measure on an average 9×11 m.m., whilst the cross diameters of the fossil plates are 12×13 m.m.

There is agreement between the recent species and the petrified plates in the general outline of the latter, and the granular sculpture, or ornament. On the tail plates there is a tendency to a posterior pointed apex as in the Lightning Ridge fragments, but the markedly conical elevation of the latter is not seen in the scales of *T. rugosus*.

I have already spoken of the smaller plates at the sides of the fossil fragments, and if an examination be made of the creases between the hind limbs and tail of *T. rugosus*, similar small scales will be found bordering the larger lateral ones. From this, I venture to suggest that the Lightning Ridge fragments are from an approximately similar position in the extinct form.

I am unable to compare my specimens with the few Lacertilian dermal scutes known from the Cretaceous elsewhere, both from the absence of comparative material and literature. In the meantime I ask those who may have reptilian material from the Upper Cretaceous of either Lightning Ridge or White Cliffs, to carefully examine it, with the view of throwing further light on a very interesting subject.

4.—Opalised Reptilian Dentary from Lightning Ridge.
(Pl. 8, figs. 10 and 11).

To Colonel R. E. Roth, D.S.O., M.R.C.S.E., the Australian Museum is indebted for sundry reptilian and molluscan remains from the above locality. The most attractive of these is a small dentary (Pl. 8. figs. 9 and 10), posteriorly broken just at the symphasis, and incomplete forward. There are six teeth set in sockets in an alveolar groove, and supported by the outer alveolar wall, in other words, a pleurodont dentition; the entire specimen is one and three-quarter inches long, the bony tissue being wholly converted into ordinary blue-black opal.

The most complete tooth measures five millimetres from the bottom of the alveolar groove to the tooth apex, but at what I take to be the posterior end of the specimen, the socket visible there is quite ten millimetres deep, and as the slightly curved teeth extend to the bottom, it follows that some of them, at least, attained a length of fifteen millimetres; at the anterior end the alveolar groove is shallower, about six millimetres, the bone itself has a maximum width of fifteen millimetres. The teeth are faintly striate to about the middle of their exposed length, and opalisation has removed all trace of osseous structure throughout the specimen.

Our present knowledge of the Australian Cretaceous reptilian fauna is a very limited one. A few Ichthyopterygian and Sauropterygian remains, a Chelonian or two, a Saurischian (*Agrosaurus macgillivray*), Crocodilian scutes, and other dermal scutes of an unknown reptile,[1] possibly Stegosaurian, about complete the list.

In looking round for relatives of this very beautiful little fossil, I was at first led towards the Ichthyopterygians, but being unsuccessful in this direction, I took the precaution of consulting my former colleague, Dr. Smith Woodward, who suggested a provisional reference to the American Cretaceous and imperfectly known genus *Botosaurus*, L. Agassiz. There is certainly a resemblance to Leidy's figures, but there are also discrepancies in the form of the teeth which it will be well to point out.

In *Botosaurus harlani*, Leidy said that one of the teeth had a mammiliform crown and a gibbous fang; another, the penultimate or last tooth possessed a laterally compressed mammiliform crown,

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1 Etheridge. Rec. Austr. Mus., v., No. 2, 1904.

2 Leidy : "Cretaceous Reptiles of the United States." Smithsonian Contrib. Knowledge, 192, 1865, p. 12.

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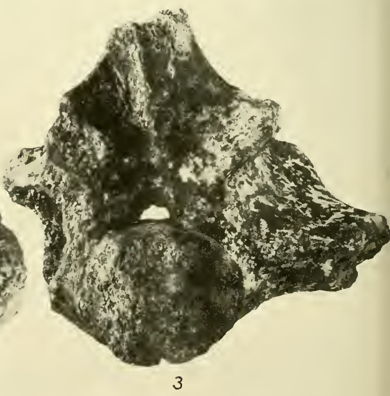
4



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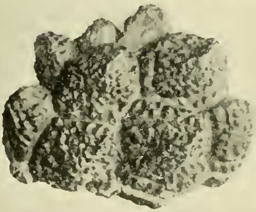

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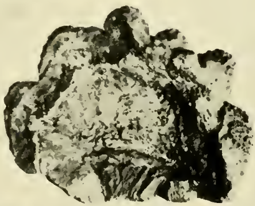

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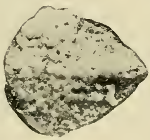

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with its outer and inner surfaces separated by a prominent ridge, and its enamel strongly corrugate.[1]

The teeth of the Lightning Ridge reptile, on the other hand, are, so far as at present known, alike, sharply conical above the alveolar border, with a slight inward curvature, and barely any difference in size amongst the six. By their regularity of disposition and similarity of form, these teeth partake far more of the Gavilian than the Crocodilian type, with the exception of those of *Crocodilus johnstoni*, Krefft, inhabiting the upland waters of North Australia. In this comparatively small species the forward teeth are of the same type as those of our fossil, within certain limits of the same size, and inwardly curved.

This remarkable fossil is certainly worthy of a name, and for it I propose that of *Crocodilus* (? *Botosaurus*) *selaslophensis*[2]

EXPLANATION OF PLATE VIII.

Fig. 1. Exterior view of right dentary, with six arterial foramina, the terminal posterior dumb-bell-shaped, of *Megalania prisca*, Owen.

Fig. 2. Interior view of the subject of Fig. 1 with impressions of seven teeth along the alveolar border, one nearly entire tooth and a partially decayed one, nine in all.

Fig. 3. Posterior view of the dorsal vertebra from the Wellington Cave Reserve, with the transverse process on the right hand side of the figure nearly complete.

Fig. 4. Side view of the subject of Fig. 3, exhibiting the rotundity and convexity of the articular ball of the centrum.

Fig. 5. Palate of the Water Monitor (*Varanus salvator*) for comparison of the right and left dentaries with Fig. 2.

Fig. 6. Six large and three small dermal scutes of a Lacertilian, exterior view.

Fig. 7. The same specimen, inner view.

Fig. 8. Another example with five large and three small dermal scutes.

Fig. 9. Osseous dermal scute of the Shingle-back (*Trachysaurus rugosus*) – × 11 diam.

Fig. 10. *Crocodilus* (? *Botosaurus*) *selaslophensis*, Eth-fil. Portion of ramus with six teeth seen from the side—nat.

Fig. 11. The same specimen seen from above—nat.

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1 Leidy. *Loc. cit.*, p. 13.

2 σελας = lightning; λοφος = ridge; and *ensis*.

[Proc. Roy. Soc. Victoria, **29** (N.S.), Part II., 1917].

Art. XII.—*New or Little-known Victorian Fossils in the National Museum.*

Part XX.—Some Tertiary Fish-teeth.

By FREDERICK CHAPMAN, A.L.S., &c.
(Palaeontologist to the National Museum, Melbourne).

(With Plate IX.).

(Read December 14th, 1916),

Introduction and Summary.

The series of fossil remains now described, although small, is especially noteworthy on account of the rarity of the specimens. The following genera are represented:—

CARCHAROIDES.—Instituted in 1901 by Ameghino for selachian teeth from the Patagonian Tertiary, having the dual characters of *Lamna* and *Carcharodon*. They have now been found at two Janjukian localities in Victoria, thus affording an additional link in the evidence of the contemporaneity of the South American and Victorian strata.

ODONTASPIS.—One of the largest Tertiary species of the type of the living Bull-shark is *O. elegans*, here noted in detail, and first recorded, but without locality, from Victoria by McCoy.

PRISTIOPHORUS.—The side-gilled saw-fish is almost unique amongst fossils. Its rostral teeth are here shown to occur in the Tertiaries of Victoria and New Zealand.

PRISTIS.—The teeth of this sawfish were unknown in the Southern Hemisphere, although several species have been recorded from Tertiary deposits in England and North America. The Victorian fossils appear to be most nearly allied to the Mediterranean species, Pristis antiquorum, and not to the Indian and Australian form.

MYLIOBATIS.—This is the first recorded occurrence of the genus in undoubted Victorian Miocene beds; the oldest example hitherto known occurring in the Mallee at about the junction of the Miocene and Lower Pliocene (Janjukian and Kalimnan).

SARGUS.—A representative of this genus is common in the Miocene of New Zealand, but this is its first occurrence in Victoria, in beds of similar age.

Description of Specimens.

PISCES.

Fam. CARCHARIIDAE.

Genus **Carcharoides,** Ameghino.

Carcharoides totuserratus, Ameghino. (Plate IX., Figs. 1 and 2.)

Carcharoides totuserratus, Ameghino, 1901, Bol. Acad. Nac. Cienc. Cordoba, vol. XVI., p. 102. Idem, 1906, "Les Formations Sedimentaires du Crétacé Supérieur et du Tertiaire de Patagonie." Anales del Museo Nacional de Buenos Aires, ser. III., vol. VIII., p. 183 (footnote), and woodcut, fig. 50. Chapman, 1913, Vict. Naturalist, vol. XXX., pp. 142, 143.

Description.—The teeth of the Victorian specimens are, like those from Patagonia (of Patagonian age), of moderate size. The base is strong, but not so stout or heavy in proportion as in a tooth of the genus *Carcharodon*, but more akin to that of *Lamna*, and angularly inarched. The crown is strong and slightly and obliquely curved; apex sharp. External face depressed-convex, with a weak median sulcus extending for about 3 mm. from the junction of the base upwards. Internal face depressed-convex. Lateral cusps blunt in Ameghino's type, but acute in well-preserved specimens, as that from Torquay. Edges of crown and lateral denticles compressed, thin and bluntly serrate, the serrations varying from mere crenulae to stout serrations. Edge view of crown shows a slight flexure.

Dimensions.—Ameghino's type. Total length, 26 mm. (crown, 18 mm.; base, 8 mm.). Width of crown at base, not including cusps, 10 mm.; thickness, 4 mm.

Specimen from Torquay. Total length, 24 mm. Width at base, 15.25 mm. Length of crown, 17 mm. Width of crown, 9 mm. Thickness of crown, 3 mm. Height of lateral denticles, 4.25 mm.; width, 3.25 mm.

Specimen from Waurn Ponds. Total length, 22 mm. Length of crown, 19 mm. (base imperfect). Width of crown at base, 9.75 mm. Thickness, 3.5 mm.

Observations.—When complete, this type of tooth is seen to be distinct from *Lamna*, *Carcharias* (*Prionodon*) or *Carcharodon*. From the former it differs in its serrated edges, and from the two latter genera in the shape of the base and the presence of lateral denticles.

Occurrence.—Tertiary (Janjukian). Waurn Ponds, near Geelong; pres. by Mr. S. R. Mitchell (tooth consisting of crown and part of base), W. of Rocky Point, Torquay. (A nearly perfect specimen in excellent preservation, showing the crown and two lateral denticles, with a part of the base.) From the collection of the late Dr. T. S. Hall, M.A.

Carcharoides tenuidens, Chapman. (Plate IX., Fig. 3.)

cf. *Carcharias* (*Prionodon*) *acutus*. non Agassiz, Chapman and Pritchard, 1904, Proc. Roy. Soc. Vict., vol. XVII. (N.S.), pt. I., p. 274.

Carcharoides tenuidens, Chapman, 1913, Victorian Naturalist, vol. XXX., pp. 142, 143, and woodcut. Idem, 1914, Australasian Fossils, p. 270, fig. 131A.

Description.—Holotype. Tooth of slender habit. Root slightly arched and moderately stout. Crown acutely triangular, flattened on the outer face near the junction with the root, and otherwise depressed convex; inner face roundly convex; edge view showing a wide recurvation of the lateral line, as in *Odontaspis*. Edge crenulate, with blunt serrae. Lateral denticles well developed, sharp, and turned towards the crown.

Dimensions.—Total length from base to apex, 20.25 mm. Extreme width at base of root, 12 mm.; thickness, 4.5 mm.; width of crown at junction with root, 7.25 mm.; thickness, 3.75 mm. Length of lateral denticle, 3.75 mm.

Observations.—The serrated crown from Waurn Ponds described by Dr. Pritchard and myself in 1904, and doubtfully referred to *Carcharias* (*Prionodon*) *acutus*, Ag. appears to belong to the above species, with which it agrees in its narrow crown and acute apex, as distinguished from that of the preceding species, *C. totuserratus*, which has a broader crown.

Occurrence.—Tertiary (Janjukian). Waurn Ponds Quarry. Type specimen collected and presented by Mr. J. F. Mulder. An imperfect tooth (crown only), from J. F. Bailey coll.; same locality.

Fam. LIMNIDAE.

Genus **Odontaspis**, Agassiz.

Odontaspis elegans, Agassiz sp. (Plate IX., Fig. 4.)

Lamna elegans, Agassiz, 1843, Poissons fossiles, vol. III., p. 289, pl. XXXV., figs. 1-5 (non figs. 6, 7); pl. XXXVIIa., fig. 59 (non 58). R. W. Gibbes, 1849, Journ. Acad. Nat. Sci. Philad., ser. 2, vol. I., p. 196, pl. XXV., figs. 98-102 (? figs. 96, 97). Dixon, 1850, Foss. Sussex, p. 203, pl. X., figs. 28-31. McCoy, 1867, Ann. Mag. Nat. Hist., ser. 3, vol. XX., p. 192. Id., 1874, in Brough Smyth's Prog. Rep. No. I., p. 35. Johnston, 1877, Proc. R. Soc., Tas., for 1876, p. 86.

Lamna huttoni, Davis, 1888, Trans. Roy. Dubl. Soc., ser. 2, vol. IV., p. 15, pl. III., fig. 1.

Odontaspis elegans, Ag. sp., Smith Woodward, 1889, Cat. Foss Fishes, Brit. Mus. (Nat. Hist.), pt. I., p. 361.

This species of *Odontaspis* is perhaps the rarest of the genus in Victoria. It did not occur in the series of Australian Tertiary fish-teeth examined by Dr. G. B. Pritchard and myself in 1904, but was recorded by McCoy in 1867 under the name of *Lamna elegans* from Victorian Miocene beds, and was also noted by R. M. Johnston from Tasmania in his "Notes on the Tertiary Beds of Table Cape."

It is readily distinguished from the other Australian species of *Odontaspis* by its stouter build and strong divergent roots. There is little doubt that this world-wide species is also represented in New Zealand by Davis' *Lamna huttoni*, the type of which has a rather long crown, gently but sinuously reflexed. The Victorian specimens are destitute of lateral denticles, owing to attrition or partial decay of the base.

Occurrence.—Tertiary (Janjukian). Waurn Ponds, near Geelong. Fyansford Hill, near Geelong. Presented by Miss Lenna Bryan.

Fam. PRISTIOPHORIDAE.

Genus **Pristiophorus**, Müller and Henle.

Pristiophorus lanceolatus, Davis sp. (Plate IX., Fig. 5.)

Lamna lanceolata, Davis, 1888, Trans. R. Dubl. Soc., ser. 2, vol. IV., p. 20, pl. III., figs. 12*a-d*.

Observations.—The fossil fish-tooth figured by J. W. Davis as cited above has long been a puzzle as to its real relationship. That author himself was dubious about referring it to *Lamna.* Dr. A. S. Woodward, in his "Catalogue of Fossil Fishes,"[1] remarks upon it as follows :—

"The so-called *Lamna lanceolata*, J. W. Davis (Trans. Roy. Dublin Soc., 2 vol. IV., 1888, p. 20, pl. III., fig. 12), from New Zealand, is founded upon a tooth evidently not Selachian."

Whilst studying the structure of the rostral teeth in the living *Pristis* and allied genera, I was struck with the resemblance of Davis's fossil with the teeth of the Hobson's Bay Saw-shark, *Pristiophorus.* Their generic identity was confirmed from the following features common to both. The flattened crown of the tooth is equally, slightly convex on both surfaces. The base of the tooth is not furnished with a definite semi-calcified root as in *Lamna*, but appears to be torn from its base, suggesting a cartilaginous attachment. The tooth curves gently backwards, and at its junction with the basal cartilage the osteodentine is clearly marked off from the base. This line of attachment bends down to the anterior margin in both living and fossil species. The hollow root of the fossil teeth further indicates a hollow or membranous base seen on the rostral margin of the living *Pristiophorus.*[2]

The teeth of *Pristiophorus lanceolatus* are closely comparable to those of *P. nudipinnis*, Günther,[3] (Pl. IX., fig. 6), a saw-fish found in Hobson's Bay, Port Phillip, with these differences :—

The fossil specimens are larger, stouter and more strongly curved. The size of the Victorian specimen indicates a fish of about four and a-half feet long, whilst that from New Zealand would have been about six feet or more.

The genus *Pristiophorus* is rare in the fossil condition, being only represented by some detached vertebrae from the Molasse of Baltringen, Würtemberg,[4] and by an undescribed form from the Upper Cretaceous of Mount Lebanon (Smith Woodward).

J. W. Davis's specimen came from the Oamaru series at Castle Hill Station, Canterbury, N.Z.

Occurrence.—Tertiary (Kalimnan). Beaumaris. Pres. by Mr. F. A. Cudmore.

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1 Part i., 1889, p. 410.

2 In working out the relationships of this and other fossil specimens I have been kindly assisted by Mr. J. A. Kershaw, F.E.S., Curator of the Museum, who has given facilities for examining recent specimens.

3 Günther. Cat. Foss. Fishes, Brit. Mus., vol. viii., 1864, p. 432. McCoy, Prod. Zool. Vict., vol. i., 1885, pl. lvi., fig. 2.

4 Hasse, C. "Das natürl. Syst. Elasm., Besond. Theil," p. 103, pl. xiii., figs. 6, 7.

Fam. PRISTIDAE.

Genus **Pristis**, Latham.

Pristis cudmorei, sp. nov. (Plate IX., Fig. 7).

Description.—Dermal teeth of rostrum, flattened-conical and curved; bluntly pointed. Inner, concave edge rounded; the convex margin cultrate. Base nearly straight across, but slightly hollowed below, the surface in contact with the cartilaginous socket of the rostrum being roughened for attachment. Surface of tooth even but for a few longitudinal grooves around the base. The surface of the tooth when magnified shows numerous longitudinal striae, very fine and distinct.

Dimensions of Holotype.—Length of tooth, 17.5 mm.; width at base, 7.5 mm.; greatest thickness, 4 mm. The smaller specimen has a length of 15 mm.

Observations.—None of the fossil forms about which I have been able to gather details show any decided resemblance in shape to the above specimens, excepting *Pristis ensidens*, Leidy,[1] from the Miocene phosphate beds of South Carolina, but this form has a straight-sided tooth which is broader at the base. Undoubtedly the nearest representative is the living *Pristis antiquorum*, Latham, found in the Mediterranean and the warmer parts of the Atlantic. The teeth of the rostrum in this species are almost identical in shape, especially the anterior teeth, the only difference being the coarser striae on the teeth of the living species. Strangely enough, the Indian and Australian species (*P. zysron*, Bleek) has dermal teeth of a very different type, they being thick, long and straight, and with a coarse, fibrous structure near the base.

Occurrence.—Tertiary (Kalimnan). Beaumaris, Port Phillip. Two teeth referred to the above species were found by Mr. F. A. Cudmore, after whom the species is named, in recognition of his many interesting palaeontological discoveries.

Fam. MYLIOBATIDAE.

Genus **Myliobatis**, Cuvier.

Myliobatis moorabbinensis, Chapman and Pritchard. (Plate IX., Fig. 8.)

Myliobatis moorabbinensis, Chapman and Pritchard, 1907, Proc. R. Soc., Vict., vol. XX. (N.S.), pt. I., p. 60, pl. V., figs. 1-3.

1 Journ. Acad. Nat. Sci. Philad., ser. 2, vol. viii., 1877, p. 252, pl. xxxiv., figs. 31, 32.

Chapman, 1914, ibid., vol XXVII. (N.S.), pt. I., p. 57, pl. X., fig. 57.

Observations.—The median palatal teeth referred to under the above name all differ in being more depressed, and having more closely set denticles than those of the living *Myliobatis australis*, Macleay.

M. moorabbinensis has been previously found in the Kalimnan of Beaumaris; and in the borings in the Mallee ranging from Janjukian to Kalimnan.

The tooth from Torquay is even more slender and depressed than the Beaumaris specimens, but evidently belongs to the same species. This is the earliest appearance of the genus in our Tertiary beds.

Occurrence.—One example from the Tertiary (Janjukian). Bird Rock Cliffs, Torquay, near Geelong. Pres. by Mr. W. J. Parr.

Fam. Sparidae.

Genus **Sargus**, Cuvier.

Sargus laticonus, Davis. (Plate IX., Fig. 9.)

Sargus laticonus, Davis, 1888, Trans. R. Dubl. Soc., Ser. 2, vol. IV., p. 43, pl. VII., figs. 3-8.

Observations.—This genus and species has not been recorded previously from the Australian Tertiary strata, although it is a well-known fossil in the New Zealand Oamaru system. It is there found with some frequency in the limestone beds of Coleridge Gully, Broken River, Castle Hill, Trelissic and Canterbury. It is especially interesting to find this fossil in our Batesford fauna, since the writer has more than once referred this series to a similar period as the Oamaruian.

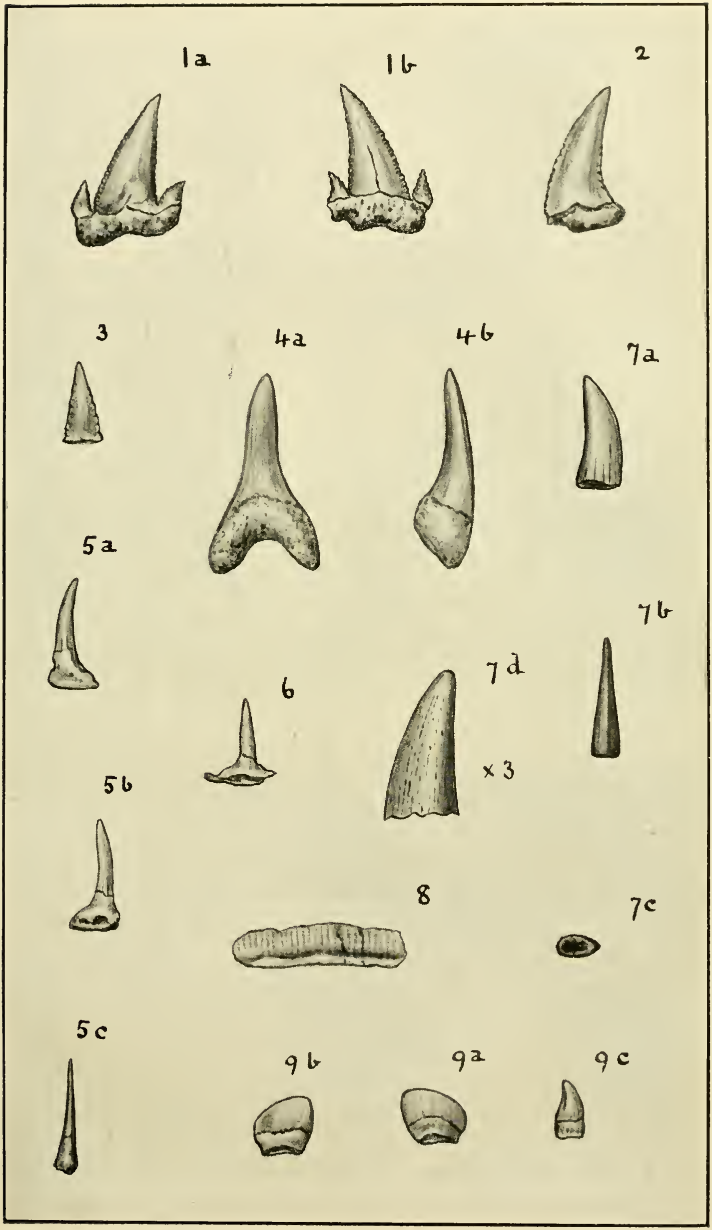
The specimen here figured is one of the anterior cutting teeth, and is exceptionally broad, but not unlike Davis's figure 7 on pl. VII. of his paper.

Occurrence.—Tertiary (Janjukian). Limestone quarries, Batesford, near Geelong. Pres. by Mr. D. Culliney.

EXPLANATION OF PLATE IX.

Fig. 1.—*Carcharoides totuserratus*, Ameghino. 1*a*, external face; 1*b*, internal face. Tertiary (Janjukian). Torquay. T. S. Hall coll.

,, 2.—*Carcharoides totuserratus*, Amegh. Internal surface of tooth. Tertiary (Janjukian). Waurn Ponds, near Geelong. Pres. S. R. Mitchell.



F.C. ad nat. del.

Tertiary Fish-Remains from Victoria.

,, 3.—*Carcharoides tenuidens*, Chapman. External face. Tertiary (Janjukian). Waurn Ponds, near Geelong. Pres. by J. F. Mulder.

,, 4.—*Odontaspis elegans*, Agassiz sp. 4*a*, internal face; 4*b*, edge view. Tertiary (Janjukian). Fyansford, near Geelong. Pres. by Miss L. Bryan.

,, 5.—*Pristiophorus lanceolatus*, Davis sp. 5*a*, upper surface of tooth; 5*b*, lower surface; 5*c*, edge view.

,, 6.—*Pristiophorus nudipinnis*, Günther. A rostral tooth, from the lower side. Living, Hobson's Bay, Port Phillip.

,, 7.—*Pristis cudmorei*, sp. nov. 7*a*, lateral face of dermal tooth; 7*b*, edge view, anterior; 7*c*, basal aspect; 7*d*, apex of tooth magnified 3 diameters. Tertiary (Kalimnan). Beaumaris, Port Phillip. Pres. by F. A. Cudmore.

,, 8.—*Myliobatis moorabbinensis*, Chapman and Pritchard. Lower or articulated surface of median tooth. Tertiary (Janjukian). Bird Rock Cliffs, Torquay, Vict. Pres. by W. J. Parr.

,, 9.—*Sargus laticonus*, Davis. 9*a*, anterior face of tooth; 9*b*, posterior face; 9*c*, lateral view. Tertiary (Janjukian). Batesford, near Geelong. Pres. by D. Culliney.

N.B.—All figures of natural size, excepting fig. 7*d*, which is magnified 3 diameters.

CORRIGENDA.

In Part XIX. of this series, vol. XXIX., pt. I., 1916, p. 90, line 2 from top, for "Holotype" read "Paratype"; line 4 from top, for "Paratype" read "Holotype."

[Proc. Roy. Soc. Victoria, 29 (N.S.), Part II., 1917].

Art. XIII.—*Contributions to the Flora of Australia, No. 25.*[1]

BY

ALFRED J. EWART, D.Sc., Ph.D., &c.

(Government Botanist of Victoria and Professor of Botany and Plant Physiology in the Melbourne University).

(Read December 14th, 1916).

Ailanthus glandulosa, Desf. "Chinese Tree of Heaven." (Simarubaceae).

Bacchus Marsh, J. W. Audas, October, 1916.

This tree, a native of China, is frequently grown in gardens or planted in reserves, etc.

In the Bacchus Marsh district it appears to spread on each side of a 300 yards length of road to a depth of 10 to 15 yards, possibly partly by sucker growth from planted trees. The plant also occurs along the Lerderderg River. When fully grown it forms a large tree, but the timber does not appear to have a great economic value. The plant may ultimately become naturalised, but the evidence for this is as yet insufficient.

Allium sphaerocephalum, L. "Round Headed Allium." (Liliaceae).

Warrnambool, L. Crawley, August, 1914.

A native of Europe, apparently not yet sufficiently established to be considered naturalised.

Amsinckia lycopsoides, Lehm. "Loose Amsinckia." (Boraginaceae).

Buninyong, Victoria, H. B. Williamson, November, 1915.

A native of California, U.S., America. This is a new locality in Victoria for this introduced plant, as it has previously been recorded from the North-Eastern district only. It may now be considered to be a definitely naturalised alien. It is apt to become a troublesome pest in arable land, and should be suppressed.

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1 No. 24 in the Proc. Roy. Soc. Victoria, vol. xxviii. (n.s.), p. 230, 1916.

Bellis perennis, L. "Perennial Daisy." (Compositae).

Fish Creek and Foster, C. French, jnr., September, 1916.

This naturalised alien is now spreading in pastures in South Gippsland.

Brachypodium distachyum, Beauv. (Gramineae.)

Dooen, Victoria, A. Dreverman, November, 1915.

It is a native of the Mediterranean regions and the Orient, and has not been previously recorded as growing wild in Victoria. It may be regarded as an exotic not yet sufficiently established to be considered naturalised.

Mr. Dreverman states that "the grass is very abundant in the immediate district, but for how long I do not know, since this is the first season I have noticed it. It is rather a coarse grower, possessing little value as a stock food."

Brassica nigra, Koch. "Black Mustard." (Cruciferae).

Shire of Dimboola, Mr. St. Eloy D'Alton, October and November, 1915.

This plant, a native of Southern Europe and temperate Asia, has apparently been introduced with impure seed, and is apt to become as troublesome as the Charlock in cornfields, if allowed to spread. It may be considered as an exotic not yet sufficiently established to be considered naturalised.

Calycotome spinosa, Link. "Spiny Broom." (Leguminosae).

Koo-wee-rup Swamp, J. W. Audas, 27/10/15.

A new locality for this introduced plant. It is a native of North America.

Cassia tomentosa, Lam. "Woolly Senna" (Leguminosae).

Portland, J. W. Audas, September, 1916.

It is a native of tropical America, and has not been previously recorded as growing wild in Victoria. It may be regarded as an exotic not yet sufficiently established to be considered naturalised.

Ceratogyne obionoides, Turcz. "Wing Fruit." (Compositae).

Underbool (H. B. Williamson, No. 1560), J. Malone, August, 1915.

In this curious little composite the young head externally closely resembles a single flower, and the few outer florets develop curious winged fruits. It is recorded from isolated localities in West Australia, South Australia, New South Wales, and Queensland, and is a new addition to the Flora of Victoria. It has no economic value.

COLLOMIA LINEARIS, Nutt. (Polemoniaceae).

Beaconsfield, Victoria, J. R. Tovey, March, 1916.

Previously recorded as a garden escape from Romsey, and possibly in the process of naturalisation. It is a garden plant, native of North-West America, and appears to have no injurious properties, nor to be of any economic value.

COLOBANTHUS BILLARDIERI, Fenzl. "Coast Colobanth." (Caryophyllaceae).

Mt. Hotham, A. H. Taylor, December, 1915.

This mountain locality is a new record, since the plant is only recorded previously from the south-west coast of Victoria, and from Wilson's Promontory. It grows on Mt. Hotham in very wet places, in association with Oreomyrrhis pulvinifica.

DIGITALIS PURPUREA, L. "Common Foxglove." (Scrophulariaceae.)

McCrae Creek, J. W. Audas, 30/10/1915.

Spreading in the Gembrook district. Apparently in process of naturalisation. It is a native of Europe.

EREMOPHILA CRASSIFOLIA, F. v. M. (Myoporaceae).

Ngallo, near South Australian border, N.W. Victoria, C. F. Hawkins, October, 1916. (Williamson, No. 1589.)

Only previously recorded from South Australia; a new addition to the Flora of Victoria.

A specimen from Eucla, J. D. Batt, 1886, appears to belong to the same species, but has the leaves narrower and spathulate. It may be distinguished as a Western Australian form or variety (var. spathulata).

EREMOPHILA STURTII, R. Br. (Myoporaceae).

Mirbein, Victoria, D. B. Halked, 27/10/1915.

This species is given in Mueller's Census of Australian Plants as occurring in South Australia, New South Wales and Queensland, but not from Victoria. This was evidently an oversight, as there is a Victorian specimen from the Murray River, collected by Dallachy half-a-century ago, in the National Herbarium. A second specimen from the same locality was seen by Bentham, but is not mentioned in the Flora Australiensis.

ERICA ARBOREA, L. "Tree Heath." (Ericaceae).

Wheeler's Hill, J. W. Audas, 11/8/16; Beaconsfield, Victoria, Mrs. L. R. Dancocks, December, 1916.

This shrub is now probably in the process of establishing itself as a naturalised alien in Victoria. The specimens collected at Wheeler's Hill were growing among thick scrub, and fully two miles from the nearest homestead. It is a native of South Europe.

GALEGA OFFICINALIS, L. (Leguminosae).

Ruffy, near Gobur, Victoria, William Noye, January and February, 1915.

A native of Southern Europe and South-Western Asia. It is a perennial herb, which stands drought well, and will grow on poor soil provided such is porous. It is an exotic not sufficiently established to be considered naturalised.

GNAPHALIUM CANDIDISSIMUM, Lam. "White Cudweed." (Compositae).

Tynong, J. W. Audas, 22/11/1915.

This introduced plant is already widely spread, and now appears to be extending deeply into Gippsland. It is a native of South Africa.

HIBISCUS DRUMMONDII, Turcz. (Malvaceae).

Minnipa, Eyre's Peninsula, South Australia, 11/11/1915.

A West Australian plant not previously recorded from South Australia.

HYPERICUM PERFORATUM, L. "St. John's Wort" (Guttiferae). (Hypericineae).

Majorca, near Maryborough, Victoria, F. Outtrim, January 1916. Muckleford, D. James, December, 1916.

This introduced pest, which is proclaimed under the Thistle Act for the whole State, has now made its appearance in these districts. This weed is (November, 1916) spreading from Rutherglen township, and has already reached the banks of the Murray River. It will be likely to appear at various points of the lower reaches of the river after floods.

LAMARCKIA AUREA, Moench. "Golden Lamarckia." (Gramineae).

Moodemere, North Rutherglen, Murray River. It is growing in unusual abundance owing to the moist season, G. H. Adcock. November, 1916.

The grass is a native of Europe, Asia and Africa, and was first recorded in 1878. It has only a very slight pasture value.

LATHYRUS ANGULATUS, L. "Angular Pea." (Leguminosae).

Harcourt, C. French, jnr., November, 1916.

This plant, a native of Europe, is abundant at Harcourt, and has probably existed as a naturalised alien in Victoria for some time, but has been overlooked on account of its inconspicuous character and resemblance to a Vetch. It is now growing in all cultivated land in the district; stock do not seem to eat it readily. It is not recorded as a poisonous plant, but is worthy of investigation.

LAVATERA ARBOREA, L. "Common Tree Mallow." (Malvaceae).

Iona and railway enclosure, Garfield, J. W. Audas, 22/11/1915.

A new locality for this introduced plant. It is a native of Europe.

LEPIDIUM RUDERALE, L., var SPINESCENS. (Cruciferae).

Camperdown, Victoria, per G. H. Sinclair, March, 1916.

This spiny form of L. ruderale has the smaller branches developed into thorns, more irregular branching, the leaves reduced in size and the pods with hardly any notch on top. It was queried by Bentham as a variety spinescens of L. ruderale, and was recorded from South Australia. It is questionable, however, to what extent the two forms are related, as the spiny habit of the variety is very different from that of typical forms of L. ruderale.

LEPIDIUM VIRGINICUM, L. "Virginian or Wild Peppercress." (Cruciferae).

Ashburton, Victoria, W. B. Wilson, June, 1915.

A native of North America. This species is very close to L. ruderale, and cannot be distinguished from it unless both the flower and fruit are available. The petals are present, and the seeds are minutely margined in L. virginicum.

Linaria versicolor, Moench. (Scrophulariaceae).

Red Jacket Creek, Victorian Alps, Mr. Gargeuvich, 1873; Newstead, F. M. Reader, 1910; St. Arnaud, T. O. Murphy, October, 1916.

This plant, a native of Europe, is now evidently establishing itself as a naturalised alien in Victoria. Some species of Linaria are poisonous, but the present species has not been tested. The plant, having rather handsome flowers, might be of some use for decorative purposes, but otherwise it has no known economic value.

Orthocarpus purpurascens, Benth. "Purple Orthocarpus." (Scrophulariaceae).

Maryborough, Miss Lydiard, 4/11/1915; Balmattum, Victoria, B. S. Budds, 26/11/15; Casterton, per J. Harris (Aust.), 30/11/15; Port Fairy, per W. S. MacPherson, 30/11/15; Casterton, November, 1915; Mokoan, J. B. Higgins, November, 1916.

This plant, a native of California, is injurious in pastures on account of its roots being parasitic on the roots of grasses. It is a freely seeding annual, introduced with fodder imported from North America.

The plant was previously recorded in Victoria from Euroa as an exotic not sufficiently established to be considered naturalised. In view of the wide distribution of the plant and its freely seeding habit is has now evidently definitely established itself as a naturalised alien.

Pinus Pinaster, Ait. "Star or Cluster Pine." (Coniferae).

Beaconsfield, 9/10/13, and Nar-Nar-Goon North, 25/10/1915, J. W. Audas.

This tree is now probably in the process of establishing itself as a naturalised alien in Victoria. The specimens collected were found growing among thick scrub, and were fully a mile away from the nearest planted trees.

Plantago Bellardi, All. "Hairy Plantain." (Plantaginaceae).

Ararat, E. J. Summers, November, 1914; H. B. Williamson, November, 1915.

The plant is a native of the Mediterranean regions and of Asia Minor, and has possibly been introduced into Victoria through the medium of bird seed. It differs widely from the ordinary plantains in appearance owing to its hairiness, and to the relatively large and prominent bracts between the flowers in the spike. The present specimens are somewhat dwarfed, being only 2-4 inches in height, but agree in general characters with the above species. The plant has no economic value, and shows no signs of being a more troublesome weed than the ordinary plantains.

Plantago Psyllium, L. "Fleawort Plantain." (Plantaginaceae).

Nantawarra, 15 miles N.N.E. Pt. Wakefield, at the head St. Vincent's Gulf, S.A., Prof. T. G. B. Osborn, November, 1916.

This plant is a native of the Mediterranean regions, South-West India, and the Orient, and has not previously been recorded as a naturalised alien for Australia. Professor Osborn reports it to be spreading rapidly, and that it may become another Stinkwort, as it has an unpleasant smell. The seeds appear in the Pharmacopoeia as Semen Psyllii. These, from their resemblance to fleas, give the plant the name of "Fleawort." Their mucilaginous outer coat gives them the same properties as flax seed, viz., demulcent and emollient, and they can be used internally or externally.

Stylidium. (Stylidiaceae).

Maiden, in his Census of New South Wales plants (1916) follows F. v. Mueller in reversing the nomenclature adopted by Bentham and by R. Brown, and using the name Candollea (Candolleaceae) for this genus and order. Schönland, in Englers Pflanzenfamilien, also followed the advice of F. v. Mueller on this matter without giving any other reasons. Mr. Maiden, however, gives definite reasons as follows :—"The genus Candollea (Candolleaceae or Stylidiaceae) was founded by Labillardiere in 1805. One year later the same author applied the name Candollea, apparently by an oversight, to another genus (Dilleniaceae). As both genera could not stand, Swartz changed Candollea (Candolleaceae) in 1807 into Stylidium, and consequently the order into Stylideae, but in doing so he made the twofold mistake of changing the name of the plant that had undoubtedly the claim to priority, and of selecting a name, Stylidium, already applied by Loureiro in 1790 to a genus of Cornaceae. There can be no doubt that F. v. Mueller was right in restoring the name Candollea to the genus first named so by Labillardiere (Candolleaceae). Labillardiere's second genus, Candollea (Dilleniaceae), of course, had to go, and is now united with Hibbertia."

In regard to Swartz's supposed errors, the genus of Cornaceae referred to is the Marlea of Roxburgh, which is now Alangium, Lam. The "Stylidium chinense" of Loureiro, Fl. Cochinch, ed.

Willdenow, 1793, p. 273, is usually referred to as a synonym to Marlea begoniifolia, Roxb., but since Loureiro describes it as having the corolla inferior and the drupe superior, it cannot belong to this genus at all, and has become a lost name without an owner. It is not advisable to use lost names of this kind in founding new genera, but it is quite another matter to suppress a generic name attached to well-defined species because 12 years earlier the name was applied to a species of plant which cannot now be identified.

The true history of the names of Stylidium and Candollea appears to be the reverse of that given. Swartz published the name of Stylidium in 1805 (Willdenow spec., Pl. IV. (1805), 146), and at a later date, 1807, repeats it (Magaz. Ges. Naturf. Fr. Berlin. I., 1807, p. 48).

In the same year (1805) Labillardiere published the names Candollea (Candolleaceae) for the same genus and order. Finding that Swartz's name had priority, Labillardiere then used the name Candollea in the following year for a genus of Dilleniaceae, now submerged in Hibbertia.

Apart from the fact that nearly all the species of the genus have been described under the name of Stylidium, namely, 90, as compared with 9, there are no valid reasons for changing the name adopted by Bentham and by R. Brown. I have gone fully into this matter because of the confusion likely to occur, if the plants known as Stylidium in Victoria are to be named Candollea in New South Wales.

Tricholaena Teneriffae, Parl. "Red Natal Grass." (Gramineae).

This South African grass was introduced into Queensland many years ago, and has there become fully naturalised. It has since been carried to Victoria, and grows well at Mortlake and in the Western District, where it is now naturalised. It is of some value as a pasture grass, particularly in dry soils, being somewhat drought resistant, but is by no means in the first rank as a pasture grass, and is apt to become a troublesome weed in gardens and cultivated ground. It is not suitable for a pasture grass in a rotation series, where pasture follows cultivation.

Zygophyllum ovatum, Ewart and White. (Zygophyllaceae).

Alawoona (Trans-Murray Scrub), October, 1915, and Poochera, Eyre's Peninsula, South Australia, J. M. Black, November, 1915.

This species was first described from West Australian specimens, then afterwards found in Victoria, and now in South Australia, thus bridging the geographical gap in distribution.

[Proc. Roy. Soc. Victoria, 29 (N S.), Part II., 1917].

Art. XIV.—*A Disease or Teratological Malformation of Lucerne.*

By ELLINOR ARCHER, B.Sc.

(With Plate X.).

(Read December 14th, 1916).

Description of Abnormality.

The curious malformation about to be described was found on two specimens of lucerne received from different parts of Victoria, one being from the Werribee Irrigation Settlement, and the other from Echuca. They had both been collected in February, 1916, which was an exceptionally dry month.

The only parts to be affected by the deformity are the flower heads. The main stalks and the leaves are all normal, except a few small leaves at the termination of the main stalk, which show the terminal leaflet very much elongated in proportion to the lateral leaflets. The lower leaves and stem show symptoms of rust, caused by Uromyces striatus, but this is hardly likely to have any connection with the malformation.

The place of true flowers has been taken by clusters of small, indefinite heads, which show no special structure until they are examination microscopically.

These heads, as far as could be judged from the dried specimen, were dull grey in colour, with a faint suggestion of the purple characteristic of normal flowers.

If each head is taken to represent a flower, the inflorescence will be found to have increased in complexity from a simple raceme to a raceme of racemes which may be several times compound.

The main axies are normal, but the secondary are somewhat elongated, and bear still smaller axies instead of forming the peduncles of the flowers. The bracts to the main and secondary axies are normal.

Microscopic examination of the heads shows these axies to be terminated by masses of rounded growing points, which are enveloped by what may be described as small, narrow, simple bracteate leaves. Apparently all the growing points ultimately develop into these abnormal leaves, there being no true flowers or rudiments of parts of flowers to be found on either specimen.

The actual growing points show no special feature, being simply rounded masses of meristematic cells, with large granular nuclei. Careful examination of the bracteate leaves shows them to be small structures not more than two or three layers of cells thick, and varying very much in length, those placed lowest on the axis being the longest.

A rudimentary vascular strand can be found in all, and in the largest a few spiral and annular vessels are developed. Transverse section shows no distinction into palisade parenchyma and spongy mesophyll, but the internal cells are differentiated from the epidermal by being smaller and having thinner walls. A few of them terminate in a curious unicellular, hair-like projection. The larger bracts show a few stomata, but the most noticeable feature is the extensive deposit of calcium oxalate crystals along the vascular strand. These crystals occur in the same form along the mid-rib of normal foliage leaves, but as the bracts are so much smaller the crystals appear to be more prominent.

It would be impossible to say whether these bracts represent abortive foliage or floral organs. From their position and suggestion of colour they seem to represent the floral whorls. They are indefinite in size, number and position, but they appear to wrap round and protect the young growing points.

Normal hairs occur at the base of a cluster of heads and bracts. These hairs have not suffered in the general abortion, and consequently appear rather large in comparison with the rest of the heads.

Sections.

Microtome sections of the material were made, and carefully stained and examined. Some of the stains used were methyl, blue, fuschin, safranin and gentian violet.

A careful examination made for any sign of parasitic fungi gave a negative result. If there had been any hypha present these should have been clearly stained by the methyl blue or safranin. No hypha could be seen, and the cells showed no sign of disintegration. Staining with concentrated alcoholic solution of Fuschin revealed numerous granules, varying very much in size. These were embedded in the cell walls or lining layers of protoplasm. They were most numerous in sections passing through the phloem of vascular bundle of the stems; very few could be distinguished in the very young growing points or the younger bracts.

High-power examination with an oil immersion lens did not reveal any structure in these granules. The sections were tested with iodine for starch, but the granules gave a negative reaction. They were probably proteid in character, as similar granules which have been proved to be proteid have been found in other plants. Further investigation is needed to make sure of this.

Sections of normal lucerne, which were subjected to the same embedding and staining processes, showed no trace of the granules, but here again more work must be done before the evidence is entirely satisfactory.

Staining with gentian-violet showed the cortical cells, abnormal stem and bracteate leaves to be densely packed with small, rod-like structures. These did not stain themselves, but showed clearly in the coloured protoplasm. They could be seen to be actually embedded in the protoplasm of the cell, and were not in the cell sap.

These gave a good positive reaction with chlorozine iodine, and a faint blue with strong solution of iodine in potassium iodide, which proves them to be an unusual form of young starch grains, or ones in which the cellulosic basis is more prominent than the granulose. They were especially numerous in sections of leaves from the abnormal plant.

Gram's special staining method to indicate the presence of bacteria in cells gave a negative result.

Culture Solutions.

The only growth which could be definitely traced as originating from the lucerne was the fungus Macrosporium, and this was found to develop from both specimens.

Very careful examination of the dried material showed the presence of macrosporium hyphae on the bracts themselves.

As macrosporium is usually a superficial fungus, and as it has been proved that there is no endophytic fungus present, it is very unlikely that it is the primary cause of the malformation.

Cause of Malformation.

As far as the investigation has gone at present it would be impossible to state definitely the cause of the abnormality, but it is possible to exclude some factors which might have affected the plant.

1. The malformation does not appear due to parasitic fungi.
2. There is no indication of the presence of destructive


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insects, the bites of which might very easily have caused the proliferation of growing points.

3. The tissues do not seem to be infected with bacteria, and the cells do not show abnormality of size or shape, which is usually the case in the presence of bacteria.

The abnormal starch grains and proteid granules point to abnormal nutrition, and the fact that both specimens came from dry country, and were produced during a drought period, may possibly have something to do with the cause.

DESCRIPTION OF PLATE X.

Fig. 1.—Stem leaf and infloresence of abnormal plant.
,, 2.—Inflorescence of normal lucerne (Medicago sativa).
,, 3.—Head of abnormal material, showing growing points and bracteate leaves (magnified low power).
,, 4.—Section of growing points and bracteate leaves (magnified low power).
,, 5.—Single bracteate leaves (magnified high power).
,, 6.—Section showing proteid granules (magnified high power).
,, 7.—Section showing starch grains (magnified high power).

[Proc. Roy. Soc. Victoria. 29 (N.S.), Part II., 1917].

Art. XV.—*On the Age of the Alkali Rocks of Port Cygnet and the D'Entrecasteaux Channel in S.E. Tasmania.*

By PROFESSOR ERNEST W. SKEATS, D.Sc., A.R.C.S., F.G.S.

[Read 14th December, 1916].

Introduction.

The remarkable series of alkali rocks at Port Cygnet, Woodbridge, and other localities on the D'Entrecasteaux Channel, present many features of mineralogical and petrographic interest. They have been made known principally by the researches of Mr. W. H. Twelvetrees, F.G.S., Government Geologist of Tasmania, in a series of papers in which he has described their mineralogical and petrographic characters as shown in the field and under the microscope. He has also discussed the difficult and vexed question of their age. Other geologists and petrologists who have contributed to our knowledge of these rocks include the late Mr. Petterd, the late Professor Rosenbusch, and Dr. F. P. Paul. During a visit to South-East Tasmania in January, 1916, I examined this district. Mr. Twelvetrees was good enough to show me the chief outcrops, and to discuss the problems with me in the field, while Dr. W. N. Benson, of Sydney University, was with us in the earlier part of our stay at Port Cygnet.

This brief paper results from the discovery at Little Oyster Cove, Kettering, of evidence bearing on the vexed question of the age of the alkali series in this part of Tasmania.

Previous Literature.

(1) The earliest reference to the alkali rocks of this area, apart from their approximate distribution as shown on the Geological map in Johnston's Geology of Tasmania, 1888, appears to be a paper by Twelvetrees and Petterd, entitled "On Havyne Trachyte and allied rocks in the districts of Port Cygnet and Oyster Cove. (Proc. Roy. Soc., Tas., 1898-9.)

(2) In the handbook for the Aust. Assoc. for Advancement of Science, Hobart, 1902, Mr. Twelvetrees gave a sketch of the Geology of Tasmania, in which he referred to the elaeolite syenites,

phonolites and trachytes at Port Cygnet (pp. 24, 26 and 27), and tentatively referred them to the top of the Permo-Carboniferous series.

(3) Mr. Twelvetrees, in a paper, entitled "A Geological Excursion to Port Cygnet," in connection with the Australasian Association for the Advancement of Science, 1902, published by Roy. Soc., Tasmania, 1902, in the course of a report on the excursion described the modes of occurrence and petrological characters of the chief rock types then known, including in his report petrographic determinations by Professor Rosenbusch.

(4) Mr. Twelvetrees contributed a "Note on Jacupirangite in Tasmania," to the Roy. Soc., Tasmania, 1902, in which he described the occurrence of this rock among the alkali intrusions of Port Cygnet.

(5) Mr. Twelvetrees, in a paper, entitled "On the Nomenclature and Classification of Igneous Rocks in Tasmania," published by the Aust. Assoc. for Adv. of Science, New Zealand, 1904, pp. 264-305, discussed the position of the alkali series in a review of the classification of the igneous rocks of the State.

(6) Dr. F. P. Paul published a paper, entitled "Foyaitisch-Theralitische Gesteine aus Tasmania," in Min. Petr. Mitt., Vienna, 1906, pp. 269-318, in which he recorded detailed chemical and petrological work among the alkali series.

(7) Mr. Twelvetrees made a "Report on Gold at Port Cygnet and Wheatley's Bay, Huon River," published in Report of Secy. of Mines, Tasmania, 1907, in which he associates the gold occurence with quartz veins developed in the metamorphosed sediments of Lower Permo-Carboniferous age at the contact with the alkali intrusive rocks.

(8) Mr. Twelvetrees, in his "Outlines of the Geology of Tasmania," published in the Report of the Secretary for Mines for 1908-1909, pp. 133, 141 and 142, regarded as unsettled the precise age of the elaeolite and alkali syenites, with various alkaline porphyries at Port Cygnet and along D'Entrecasteaux Channel, but placed them at the top of the Permo-Carboniferous series in Tasmania, above the horizons of the Southport sandstones and shales, and the Mt. Cygnet and Adventure Bay sandstones and shales, of which the latter is correlated with the Newcastle series of New South Wales. On pp. 141, 142 it is stated that the alkaline rocks which form a S.W., N.E. belt running from the Huon River through Port Cygnet to Woodbridge and Kettering, are referred provision-

ally to the close of this period (Permo-Carboniferous). It is definitely known that they are intrusive into the Lower Marine sandstones and mudstones, and they appear to be cut through by the diabase which is considered to date from the close of the Mesozoic. The belt comprises the following rock varieties:—

Alkali Syenites.—Quartz augite syenite, Aegirine augite syenite, Alkali syenite porphyry.

Elaeolite Syenites.—Pyroxene foyaite, Mica foyaite, Jacupirangite, Amphibole foyaite porphyry, Sölvsbergite porphyry, Mica sölvsbergite, Tinguaite porphyry, Monchiquite nephelinite.

Essexite.—Essexite.

Auriferous quartz and pyrites have been developed near the line of contact of these igneous rocks with the Permo-Carboniferous sediments, and a good deal of alluvial gold has been recovered from the creeks and flats.

(9) Dr. H. I. Jensen, in Proc. Linn. Soc., N.S.W., 1908, pp. 557-558, referring to the rocks of the Port Cygnet group, remarked on their general close resemblance to Australian alkaline rocks, and stated that they were considered without very much evidence to be of Lower Mesozoic age. They are known to be later than the Permo-Carboniferous, and to antedate the Pliocene, but direct evidence to fix their age more closely appears to be wanting.

(10) Professor David and the writer wrote a chapter on the igneous rocks in the Geology of the Commonwealth in the Federal Handbook on Australia for the British Association meeting of 1914. On p. 309, under the heading, Jurassic (?) (possibly Triassic), they refer to the foyaitic rocks of the Port Cygnet series. These rocks are considered to be perhaps of Lower Mesozoic age. They are all strongly intrusive into the Permo-Carboniferous series, but their relations to the Jurassic sedimentary rocks and to the diabase have not yet been clearly demonstrated.

Distribution of the Alkali Rocks.

Two groups of outcrops of alkali rocks occur in this district,[1] one in the S.W. of the area on the shores of the Huon River and of Port Cygnet, the other in the N.E. part of the area, on the shores of Peppermint Bay and Little Oyster Cove on D'Entrecasteaux Channel. The exposures of alkali rocks in the first group in the S.W. of the area include the following:—An outcrop in Petchey's Bay on the Huon River, dykes of porphyry at Lymington, a quarter

1 See locality map.

of a mile south of Shag Point on Port Cygnet. N.W. of this is the akerite or quartz augite syenite outcrop, $1\frac{1}{2}$ miles up Forester's

SKETCH MAP OF PORT CYGNET AND KETTERING
S. E. TASMANIA

Alkali Rocks in Black. Scale of Miles 0 1 2 3

Rivulet on the back road to Mt. Mary. North of this is the plexus of alkali rocks composing Mt. Mary. East of this on the shores of Port Cygnet are the main outcrops of the much-differentiated alkali-rich rocks of Regatta Point, and various other localities along the coast southwards for $1\frac{1}{2}$ miles. Stretching inland from the opposite or N.E. shores of Port Cygnet another outcrop of alkali rocks occurs along the Peppermint Bay Road. One mile N.E. of the town of Lovett are the alkali rocks of Livingstone Hill. The second group of alkali rocks occurring in the N.E. of the area consists of the alkali porphyry of Woodbridge towards the northern extremity of Peppermint Bay. Two outcrops occur here, intruding the Permo-Carboniferous sediments. Permo-Carboniferous glacial beds outcrop in Little Peppermint Bay. Further north, on the south side of Little Oyster Cove, diabase, Permo-Caboniferous sediments and alkali porphyry are all represented.

Between these two groups of outcrops in the S.W. and N.E. of the area a gap of 8 or 9 miles occurs, consisting mostly of hilly country, in which up to the present the only rocks known are diabase and Permo-Carboniferous sediments.

I visited all the localities mentioned above under Mr. Twelvetrees' guidance, with the exception of the outcrop in Petchey's Bay, which I have not seen. I am indebted to one of my students, Mr E. O. Cudmore, for specimens of the alkali rock from this locality.

Field Occurrence of the Alkali Rocks.

In all the localities examined the alkali rocks present the characters of intrusive rocks. The petrographic descriptions by Mr. Twelvetrees and by Professor Rosenbusch indicate that so far as textural characters go some of the porphyries, with fine-grained ground-mass, show fluidal and other characters, which occur in lava flows, but since these textures are also represented in dyke rocks and the field relations are generally clear, their intrusive character is practically placed beyond question. Some of the coarser-grained varieties near Regatta Point and the akerite mass on the back road from Lymington to Mt. Mary are described as syenites of various kinds, but they occur as relatively small intrusions, intimately associated with the smaller dykes, and are best regarded as hypabyssal in origin, and described as larger dyke-like masses. In every case except the one presently to be described these rocks have penetrated the Lower Marine series of the Permo-Carboniferous sediments. Junction specimens were obtained from south of Regatta Point, and from Mt. Mary and at the latter place especially the Permo-Carboniferous rocks near the contact are considerably altered. They have been converted into indurated and silicified rocks, more or less pyritized, and have been penetrated by small quartz veins, which, as Mr. Twelvetrees has described, have shed a fair quantity of gold, since recovered in alluvial workings near by.

The Porphyry Dyke Cutting the Diabase at Kettering.

While the age of the alkali series is thus proved to be post Lower Permo-Carboniferous, its relations to the only other rock of the district, the diabase, have hitherto remained obscure. A ridge of diabase runs down the eastern side of the peninsula formed between the D'Entrecasteaux Channel, Port Cygnet and the Huon River, and on the western part of the peninsula Permo-Carboniferous rocks outcrop at the surface. Although Mr. Twelvetrees and other geologists have made several traverses across this ridge separating the S.W. and the N.E. occurrences of alkali rocks, no members of the alkali series have yet been found in any part of this intervening ridge. Impressed by this negative observation Mr. Twelvetrees has explained it on the supposition that the alkali rocks are older than the diabase.

In the latter part of our visit Mr. Twelvetrees and I worked northwards from the alkali outcrops at Woodbridge on the north edge of Peppermint Bay, past the Permo-Carboniferous glacial deposits of Little Peppermint Bay to Little Oyster Cove at Kettering.

On the south side of Little Oyster Cove, going east for about 150 yards beyond the jetty, we found the diabase came down to the shore. At this point a low outcrop, a few feet in height, occurs, and an abrupt change from diabase to alkali porphyry was observed. The porphyry extends for 15 to 20 feet, and then just as abruptly diabase comes in again, and remains nearly to the east extremity of the bay, which is occupied by Permo-Carboniferous sediments, while on rounding the point to the south diabase comes in again.

There is no doubt in my mind that the occurrence of Porphyry with parallel walls and in abrupt contact with the diabase represents an intrusion of porphyry into the diabase. The only alternative explanation of the relations of the two rocks that occurs to me is that of a large mass of porphyry detached by and included in the diabase. I reject the latter explanation, and adhere to the view that the porphyry is part of a dyke for two reasons. The first is that although the exposure is limited, one can see that the walls in contact with the diabase are parallel as one would expect to find in a dyke. The second reason is that at the contact with the diabase the porphyry for about half-an-inch in width is quite different in texture from the central part of the mass. The small porphyritic crystals are set in an exceedingly fine-grained paste or ground-mass, much finer in texture than the normal ground-mass, away from the contact. This feature I regard as a selvage to the dyke produced by the rapid chilling of the intrusive mass against the cold diabase walls.

Kainozoic Age of the Porphyry Dyke at Kettering.

The above evidence, I think, establishes the conclusion that the prophyry at Kettering is a dyke, intrusive into the diabase, and therefore younger than it. The age of the diabase sills in Tasmania has been demonstrated to be post Upper Jurassic, since in several places an intrusive contact with these sediments has been established. It is generally believed to be probably Cretaceous in age, and to have been intruded during the earth movements, which led to the breaking up of the Gondwanaland continental mass or masses.

If this view is correct the porphyry dyke at Kettering is probably post-Cretaceous in age, and in that case belongs to some part of the Kainozoic period.

Relations of the Kettering Dyke to the other Alkali Rocks of the District.

While the field evidence as described above defines the age of the Kettering dyke as post-Diabase, and therefore almost certainly Kainozoic, the field relations of the other alkali occurrences in the district only enable one to assert definitely that they are post-Lower Permo-Carboniferous.

We must turn to petrographic evidence to see whether or no there are sufficient petrographical and mineralogical resemblances between the various members of the suite of rocks to make it probable that they were all intruded during the same period.

For this purpose I have had a number of sections cut of rocks from the various localities mentioned above. This paper is not concerned with the detailed microscopic characters of the rocks, and my examination of the sections has simply been for the purpose of correlation of the various dyke occurrences.

Examination in the field or by hand specimens suggested that as far as naked eye examination goes the rocks which most closely resembled the Kettering dyke occur at Woodbridge and at Petchey's

Bay, the latter being the outcrop furthest to the S.W., the Kettering dyke the outcrop furthest to the N.E. in the area examined.

Microscopic Characters of the Alkali Porphyries.

A section kindly lent me by Mr. Twelvetrees, labelled Foyaite porphyry, Little Oyster Cove, contains as phenocrysts, dark-green pleochroic hornblende, pale-green augite in smaller prismatic crystals, plagioclase and small crystals of sphene. The ground-mass consists of small rectangular crystals of alkali felspar.

A section from the central part of the dyke at Kettering, Little Oyster Cove, shows that the rock has been considerably altered by weathering. The phenocrysts consist of Hornblende, more or less completely altered to aggregates of micaceous and chloritic material, altered plagioclase, with a ground-mass of small rectangular crystals of alkali felspar. Another section of the same rock at the contact with the diabase shows a definite, fine-grained selvage, consisting of a dense felspathic ground-mass, in which are set fairly fresh phenocrysts of plagioclase, and somewhat altered green hornblende. The hornblende in this rock is probably a soda hornblende, and the abundance of felspar, particularly of the alkali felspar of the ground-mass, shows that it is an alkali porphyry of intermediate composition. Somewhat noteworthy is the abundance of plagioclase phenocrysts.

With this rock may be compared those from Woodbridge and from Petchey's Bay. The Woodbridge rock in section shows as phenocrysts dark-green hornblende, pale-green alkali-augite, abundant plagioclase, and small sphenes set in a ground-mass of rectangular alkali felspars.

The Petchey's Bay porphyry in section has large phenocrysts of plagioclase, some of which may be anorthoclase, green aegirine-augite, and small sphenes in a ground-mass of rectangular alkali felspars.

There can be no doubt of the great general similarity of these three rocks. In each, the same ground-mass of alkali felspar is present, and the plagioclase phenocrysts predominate. Probably the Petchey's Bay rock, owing to the abundance of aegirine-augite is the most highly alkalic, the Woodbridge rock intermediate in alkali content, and the Kettering dyke somewhat less alkalic. Among the Port Cygnet rocks occur many whose texture and composition differs considerably from these three described above, but in the series near Port Cygnet various alkali porphyries are present in such close field relations to the other types as to suggest strongly a genetic resemblance and reference to the same period of igneous activity.

One of the Port Cygnet porphyries in section shows as phenocrysts big crystals of orthoclase or sanidiare, green aegirine-augite, a little green hornblende, and small sphenes. In the ground-mass occur needles of pale augite, and the rest consists of lath-shaped and irregular alkali felspars, and probably some nepheline, and a very little plagioclase. This rock is distinctly more alkalic than the Kettering dyke or the Woodbridge and Petchey's Bay rocks, and yet in its texture and mineral content, allowing for greater alkali content, family resemblances are to be traced.

It would appear that all the rocks of the district are consanguineous and members of one petrographic province. But it is equally clear that differentiation was developed further in the Port Cygnet and Regatta Point areas than in the more outlying districts of Petchey's Bay in the S.W., and Woodbridge and Kettering in the N.E. This is evident from the fact that while some of the porphyries of the Port Cygnet area are in many respects allied to the Kettering, Woodbridge and Petchey's Bay rocks, there are also present in the central area, as Mr. Twelvetrees has described, adjoining and related rocks in which the mutually incompatible minerals, quartz and nepheline, are separately developed. This close association in the field of quartz-bearing augite syenites and related quartz-bearing rocks with others containing the felspathoids, nepheline and nosean or havyn, provides an interesting example of what are probably nearly extreme types of differentiation in a magma of moderately alkalic character. The rocks of Kettering, Woodbridge and Petchey's Bay probably represent products intruded in a less differentiated form, and may quite possibly approximate in composition to the parent magma.

Comparison of the Alkali Rocks of S.E. Tasmania with other Australasian Types.

Hitherto the question of the age of these alkali rocks has been discussed, firstly, in the light of field evidence, particularly the evidence of the dyke at Kettering, and, secondly, on the evidence submitted that all the rocks of the area are consanguineous, and belong to one petrographic province, and, therefore, probably to one period of igneous activity. A third method of enquiry turns on the evidence of age and of character of the principal alkali rocks of Australasia generally. Dr. Jensen,[1] among others, has discussed this problem. The age of some of the alkali rocks of Australasia is not yet susceptible of exact determination, since they only come into relation with and intrude rocks of high antiquity. Many were referred by Dr. Jensen to the Eocene period in New South Wales and Queensland, on somewhat slender evidence. The alkali rocks of New Zealand, described by Professor Marshall and others, are referred generally to the middle or upper part of the Kainozoic, and those of Victoria so far as known appear to belong to the period immediately preceding the newer basalts; that is, to the Mid-Kainozoic or the lower part of the Upper Kainozoic.

Some years ago, in a paper on the Volcanic Rocks of Victoria,[2] I tentatively included among Palaeozoic volcanic rocks certain alkali rocks in Eastern Victoria. This reference was based on Dr. Howitt's observations. Since then I have visited some of these districts in the field, and have been impressed by their recent looking characters, and now believe that they are probably of Middle to Upper Kainozoic age. The Mittagong-Bowral series of alkali rocks in New South Wales intrudes the Triassic sediments, and may well be Kainozoic in age. They are interesting in this connection, since they probably come nearest in chemical and mineralogical characters to the rocks of Port Cygnet, as they include syenites allied to bostonite, and aegirine-arfvedsonite-quartz-trachytes. The only alkali rocks in Australia definitely proved to be Palaeozoic in age are the series of alkaline eruptive rocks of the Cambewarra-Kiama districts, south of Sydney. These rocks consist mainly of lavas and tuffs, partly contemporaneous with the Upper Marine series of the Permo-Carboniferous, and partly with the Bulli coal measures. Their petrographic and chemical characters are, however, quite distinct from other alkali rocks in Australia, so far as known, and from the rocks of Port Cygnet, as they contain generally a good deal of potash, and are described as Orthoclase-basalts.

Apart from these Orthoclase-basalts of exceptional characters, it will be noted that other occurrences of alkali rocks intrude various members of the mesozoic, and may, therefore, be of Kainozoic age, while a considerable number are definitely known, not only to be of Kainozoic age, but to be not older than the Mid-Kainozoic. So far as analogy with other Australasian occurrences go it is in favour

1 Proc. Linn. Soc. N.S.W., 1908.

2 Aust. Assoc. Adv. of Sc., Brisbane, 1909. Pres. Add. to Sect. C.

of the view that the alkali rocks of the Port Cygnet and associated areas belong to the Kainozoic period. Objection may be raised that some of the Port Cygnet rocks are very decomposed, and a claim to greater age for them may be made on that account. While, however, some of the rocks are considerably altered so far as the surface outcrops are concerned, which alone are available for examination, fresh material from some of the rock types clearly related to the decomposed rocks can be obtained, and in any case arguments based on relative surface decomposition carry little weight when it is remembered that highly alkalic rocks are more susceptible generally of ready decomposition, and it is usually types richest in the alkalies which show the greatest change.

Conclusions.

The evidence presented in this paper warrants, in my belief, a revision of the previous view that the alkali rocks of the Port Cygnet district are of pre-diabase age, and probably belong to the top of the Permo-Carboniferous series, and it is here considered to be highly probable, if not definitely proved, that the alkali rocks are of Kainozoic age. The most powerful argument adduced is the field evidence of the intrusion of a dyke of alkali porphyry into the diabase (probably Cretaceous in age) at Little Oyster Cove, Kettering. Secondly, the close similarity of the Kettering rock with those of Woodbridge and Petchey's Bay is advanced, and the general similarity with some of the Port Cygnet rocks is pointed out. This leads to the second and more general conclusion, that between all the alkali rocks of the area consanguinity exists, arguing intrusion during a single period of igneous activity. A subsidiary argument, to reinforce the view of the Kainozoic age of the series, consists in a consideration of the age and nature of the alkali rocks of Australasia generally, wherein it is shown that such rocks as are fairly comparable in composition with the Port Cygnet series, and whose age is susceptible of anything approaching precise determination, have been shown to belong to the Kainozoic period. On these three grounds it is claimed that the alkali-porphyry of Kettering in particular and the alkali rocks of the district in general can be referred to the Kainozoic period with a high degree of probability.

[Proc. Roy. Soc. Victoria, 29 (N.S.), Part II., 1917].

Art. XVI.—*Teratological Notes: Part 2.*

By A. D. HARDY, F.L.S.
(State Forests Department, Melbourne).

(With Plates XI., XII., XIII.).

[Read 14th December, 1916].

The first part of this series was devoted to seedlings. The present contribution is intended to record some instances of aberration of stem, branch, and fruit. For part 3 is reserved a number of cases of foliar abnormality.

Root.

One abnormal root arrangement was near Heidelberg, on the Yarra, where erosion of the river bank caused an exposure of the roots of two small red-gum trees (*Eucalyptus rostrata*). The trees, nearly equal in size, stood 8 feet apart, and were connected by a simple cable root. The cable was dead and much waterworn, its thickness varying irregularly between 2 and 3 inches. Seen from a canoe in a swift current by Mr. R. A. Keble and myself, it was not conveniently situated for photography or for further investigation than to note that there was no suture indicative of fusion. It is possible that one of the two trees was originally a sucker of the other, but of faster subsequent development, and that the continuation of the supporting root had disappeared without leaving superficial evidence of its having existed. The specimen was carried away during further erosion, but there is another—though not so good—at a bend of the river just above Heidelberg.

Stem.

Malposition.—Peculiarities in form and posture of the stem may be seen where, on the northern edge of the plains to the north and north-west of Melbourne, the eucalypts (*E. rostrata*) have yielded to the pressure of the prevailing winds of their youth. The southward leaning of about 60 per cent. of these large trees can be seen from the Whittlesea railway. They are bent from the vertical, near the base, through angles varying up to 65 degrees, and at times are so much curved and arched that the large branches have fractured in contact with the ground, and occasionally from this semi-recumbent position send up shoots, or adjust existing shoots, the inclination of which does not suggest that the winds prevail now in the same force.

Adhesion.—Near Turritable Creek, Macedon, there is a composite growth, comprising two species—*Eucalyptus obliqua* and *E. viminalis*—which by mutual pressure are fused at the base, but have the remainder of their stems and their branches free. In stem and canopy the small Messmate (*E. obliqua*) is dominant, its partner being dwarfed, low-branched, and distorted. The presence of two species would have escaped notice but for the cortical distinction.

Torsion.—Spiral growth, betrayed by the bark, affects many forest trees. When present in species of the cortical group Rhytophloiae, it is conspicuous at all seasons, but, in those of the Leiophloiae, more conspicuous during certain stages of decortication. In the messmates, stringybarks, and silvertop-ironbark, the spiralling of the bark is frequently noticeable, and often, in a mixed forest, *E. sieberiana* may be singled out from amongst others of somewhat similar appearance, because of this spiral tendency. Of the Leiophloiae there is a tree between Lara and the You Yangs, which, when alive, had dark and light slashes of colour markings, irregular in detail, but of general spiral trend. The picture shown is from a photograph taken after the death of the tree, when ringbarked, the conspicuous, irregularly sinuous and spiral lines indicating the openings in the bark due to shrinkage.

Bifurcation.—Early forking of lowland trees is not uncommon. The tendency of trees (of lofty habit in the highland glens) to dwarf, and approach the shrub form in exposed lowland situations may be seen in *Eucalyptus viminalis* and *E. obliqua*, while in the silurian hills of Kerry, *E. obliqua* and *E. amygdalina* have many stems arising from near the ground, and resembling "mallee" or shrubby Eucalypts. There is a young *E. rostrata*, symmetrically bifurcated, in Richmond Park, Melbourne. The giant Eucalypt *E. regnans*, occasionally forks early in sheltered localities.

Fasciation.—This phenomenon is, according to Blaringhem and Worsdell, the result not of the union of younger organs which remain coherent for a longer or shorter period, but from the absence of individualization of the cells or tissue into independent buds. Worsdell attributes fasciation to congenital impulse, and not to post-genital union of parts, as supposed by Masters and others, and regards it as the first sign of partition of a single shoot.

In the practically aphyllous Exocarpi and Casuarinae fasciation may be found. *E. cupressiformis* exhibits the formation frequently in the terminal branches. I have seen it in *E. spartea* only once, and the specimen of *E. gracilis* (exhibited) is the only case of fasciation of this sub-desert species known to me or to the many travellers in the Mallee region, whom I consulted. The specimen was sent by Mr. Poole, Staff Surveyor, as a novelty from North-West Victoria. The shrub is affected from within a few inches of the ground upwards, until, towards the summit, multiple forking takes place, and this is accompanied by curling, an almost regular concomitant of fasciation. Small branches arising from any part of this fasciated axis are normal in character.

A fasciated branch of *Casuarina stricta* was exhibited[1] at a meeting of the Field Naturalists' Club by the Assistant Director of the Botanic Gardens, Melbourne.

The great length to which fasciation may affect an axis is seen in the specimen of Tecoma (exhibited), which is flattened through four feet of its length.

Branch.

Cohesion of Branches.—Cohesion of contemporary or other branches of one plant occurs in *Eucalyptus rostrata*, the crooked branching of which affords more opportunities than are obtained in any other species. The tree figured (Plate XI.) is growing in the Kiewa Valley, near Tanganbalanga. There is fusion of branches in several places, the primary cause being the premature forking of the stem at 4 feet from the ground. This early bifurcation of the axis allowed insufficient room for subsequent branching of the great divisions, which are 2 feet thick; so the secondary branches came into contact, and, by mutual pressure, have fused. At one place the smaller branch became so overgrown by the bark of the larger as to produce the appearance of penetration. Another example of branch fusion was described by a member of the National Herbarium staff, and figured in the "Victorian Naturalist."[2]

Torsion of Branches.—This is a rare occurrence where uncultivated plants are concerned. Plate XI., fig. 2, shows two of the many affected twigs of one tree—*Casuarina stricta*—near Melbourne. In general appearance the tree was as healthy as its neighbours, none of which was similarly torsive, but it and others succumbed to the ravages of borers. Both vegetative and reproductive twigs were affected, the spiral being short in proportion to the total

1 Pitcher, Vict. Nat., xxix., Jan., 1913.
2 Audas, Vict. Nat., xxvii. (1911) p. 207.

length—from a tenth to a twentieth part. In many twigs the spiral growth was at or near the base, in some others about midway, and in a few the terminal node was the abnormal one. In Casuarina the staminiferous twigs have the stamens at the nodes of the apical end only, but in the abnormal twigs a spiral staminiferous node was in one case succeeded by several nodes of purely vegetative character. Staminiferous spirals were usually terminal, and the anthers and their pollen grains were morphologically good; so, too, were the stamens borne at terminal nodes of twigs affected by torsion nearer the base. The method of growth of these spirals appears to be as follows:—Instead of the usual production of whorls of leaves, which in the matured branchlets might reach an inch or more in length—laterally connate and decurrent except for the scale-like free end which forms the cup whence springs the succeeding shoot—there is, usually, in the abnormal branchlets a bursting of the cup-like circlet of scales, and an oblique emergence of a laterally-developing spiral band, forming a tortuous structure with laterally connate members, each of which is terminated by a pointed, scale-like leaf-end, similar to those of a normal whorl. The leaves laterally connate in such a laterally winding spiral are one-fourth the length of normal branchlets, and in number may be regarded as indefinite, there being 45, 51, and 59 respectively in three of the longer spirals which I closely examined; and other spirals were longer. The spirals wound indifferently to the right or to the left in respective twigs. The stamens in the case of a staminiferous spiral appeared as a continuous fringe at the overlapping edge of the imbricated tunic so formed. The number of leaf-ends in a whorl in *C. stricta* is not constant, but is from 9 to 12.

In many aquatic or marsh plants torsion of vegetative shoots which are normally cylindrical and hollow is a not uncommon occurrence. *Heleocharis sphacelata* is one that I have frequently noticed, and in this case the discoid septae become ellipsoid. The cylindrical shoot becomes flattened, and twists in a more or less easy torsion while keeping perfectly straight (the twist being that of an auger rather than that of a corkscrew), while, in other plants, solid, angular shoots may twist through an inch or two of the apical end, the twist being a compromise between a zig-zag (in one plane) and a corkscrew spiral. This is exemplified by the shoots of *Xanthorrhoea minor* (Plate XIII., fig. 5), the leaves, straight for about 12 inches, having the terminal inch torsive.

Heterotropy (reversed direction of growth of a branch and branchlets of a hybrid eucalypt. Plate XII.).

On the way from Stawell to the Grampians, and near Brigg's Creek, on Rose's Gap road, there is, in a paddock lately occupied by Mr. Wills as a bee farm and range, a tree which seemed to be a hybrid (*Eucalyptus hemiphloia* × *E. melliodora*), with foliage, fruit and bark satisfying the requirements of the former, and with buds distinctly nearer the latter species. Both species grew in the district, but with no *E. melliodora* lately in the immediate neighbourhood. *E. melliodora* (Yellow Box) sometimes—frequently in the silurian country near Alexandra, etc.—assumes a drooping habit like *Salix babylonica*, or the Weeping Elm; many trees may be found aggregated in a locality or scattered amongst those of more or less erect habit, but *E. hemiphloia* avoids this weeping habit entirely, so far as my experience goes. In the particular tree under notice, there is a fork in the stem at only a few feet from the ground, and at a height at about 30 feet an offshoot from the main limb bears a branch which terminates abruptly, but sends back at an angle of 40 degrees or so a smaller branch, which, by reason of its slenderness and the weight of foliage subsequently produced below, hangs vertically. After 10 feet of growth earthwards, during which there were several abortive attempts to retain downward-growing twigs, one lateral branch at an acute angle grew downwards until at about 6 feet it sent a branchlet upwards at an acute angle, and this persisted, and bore good foliage, and the downward growth ceased and withered back to an abrupt end, where the dead portion snapped off. Meanwhile the leader pursued its downward course, the stumps of dead and missing twigs indicating the production of several downward branches—leaving a space of about 16 feet of denuded axis below, while three branches have persisted, and from these latter I collected the bloom, buds and fruit by which I recognized the probability of the parentage being as above mentioned. At the abrupt, broken, and dead termination of this 30-feet-long pendent leader a final branch, directed upwards at an acute angle, bore abundant foliage. The whole, swinging from 30 feet above, swayed and gently gyrated in the light breeze, but during a gale must be badly used at times. The drooping habit of one branch and some offshoots reminded me of weeping forms of *E. melliodora*, and if the tree is, as I believe, a hybrid, it may be that the tendencies to an erect—and also to a drooping—habit were present at the same time during growth, with the heterotropic result shown in the drawing. The leader, instead of tapering downwards, thickens considerably before—or because of—upward branching. Evidence of many attempts to produce persistent geotropic offshoots is seen in the numerous "die-backs," some of which are shown in the plate (XII., figs. 1-7).

Adventitious Shoots.—These are commonly seen in many species of eucalypts, but they are generally vegetative growths caused by injury to the old stem or branch. In those species, which have juvenile and adult foliage distinct, e.g., *globulus*, *goniocalyx*, *elaeophora*, *viminalis*, *rubida*, *stuartiana*, and many others, the adventitious shoots exhibit the characteristic phyllotaxis and axial nature of juvenile shoots, but the case now brought under notice (Pl. XIII., 4) is of unusual interest in that these shoots, taken from the fork of a cultivated Blue Gum (*E. globulus*) at Stawell, has an abundance of buds, flowers, and fruit in the axils of the opposite, sessile, dorsiventral leaves. Springing from the same affected spot, and well shaded by the canopy of mature foliage, were several other similar shoots. The tree was generally in bloom or bearing young buds or fruits, but in no case did any of the normal branches carry more fruit than these "reversionary" shoots. In the Stawell district, I found trees of *E. elaeophora* in which there were buds, flowers, or fruit in the axils of dorsiventral, opposite, sessile leaves, and also where the leaves were opposite, but petiolate, and mostly on drooping branches at a height of 12 feet or so. (Pl. XIII., 1.)

Eucalyptus dives[1] is known to bloom while in the sucker stage, and it is not uncommon to find, in the axils of both opposite, sessile leaves of the lower branches and petiolate alternate leaves higher on the sapling, flowers or fruit in various stages of development; but the limit of precocity seems to have been approached, if not reached, in a sucker shoot (exhibited) taken from the base, at the ground, of a sapling of *E. dives*, near Healesville. This shoot, with sessile, opposite, dorsiventral leaves has a well-developed umbel in an axil at the second node, six inches from the ground, and again at 12 inches, the total length of the shoot being 18 inches. In *Eucalyptus rostrata*, usually a large tree and one that does not bloom in the sapling stage, we may find in exceptional circumstances a similar precocity. The species grows straight-stemmed and robust on damp flats, subject to periodical inundation, but, as the photograph (exhibited) shows, may also thrive on rocky ground well above

1 At maturity this species is a forest tree in good localities.

the limit of stream influence, while yet obtaining large size, the rooting being good. On the Hawthorn bank of the Barker's Road tram cutting, near the Yarra, there are two shrubby specimens of *E. rostrata*, which bloom generously every year; the leaves, flowers, and fruit are typical, but the buds often bear conical opercula. These lowly specimens, growing as they are on the outcropping silurian strata, which dips at an angle of about 70 degrees, must have their roots confined to the bed planes. Yet on comparatively unfriendly ground, with roots unusually confined, and the general habit altered, they produce abundant fruit, some of which may be on branches only two feet from the ground. One of the plants is 12 feet, and the other 6 feet, high.

Fruit.

Bifurcated Peduncles.—Bifurcated peduncles, or, alternatively, double umbels are rare. The specimens shown (Pl. XIII., 1) is from a branch of *E. elaeophora* collected at Stawell. There were many adventitious shoots on the upper branches of the tree whence the specimen was taken, and it appears to be in transition stage, the phyllotaxis being that of the juvenile plant, near the base, and up to the middle, while towards the apex the leaves become alternate and petiolate, though lacking the length of those of adult foliage. Near the middle of the twig are a pair of opposite leaves, with petioles much longer than even those of the normally petiolate leaves of the species, and in the axil of each there is a double umbel. Although the reduced number of fruits suggests bifurcation of the peduncle of a single umbel, I prefer to regard it as a case of proliferation, as the umbels in normal axils on this tree were in many places sparsely fruited, and in each of the affected axils there was one peduncle longer than the other. Normally there should be in the axils of the alternate petiolate leaves, simple pedunculate umbels, each of which should have six fruits. It will be observed that these two long-petiolate leaves are abnormally narrow; they are narrower than any I have seen on a tree of this species. I have seen double umbels, also in *E. goniocalyx*, *E. elaeophora*, and *E. obliqua*.

Connation.—Lateral connation of fruits or even syncarpy might reasonably be expected in some species of eucalypts, owing to there being many almost stalkless fruits forming the umbel, or where short-stalked fruits are few but large, as in *E. globulus*, etc., but the occurrence is rare. Irregularity of shape through mutual pressure may sometimes be seen. Sustained pressure is at times avoided by the sacrifice of one or more members of the umbel. In a quantity of fruit of *E. cordata*, procured from Tasmania by the Conservator of Forests, Mr. H. Mackay, I found fully 25 per cent. of the umbels—which usually are trimerous in series monoplane or approaching thereto—affected by lateral connation. In these coherent fruits the rims were circular or nearly so. The cohesion was not necessarily due to mutual pressure, but probably congenital, as in some cases there were only two fruits occupying the axial place of three. (Pl. XIII., 3.)

Precocious Fruiting Amongst Resting Buds.—This was observed in two umbels of *Eucalyptus eugenioides.* It is the habit of many eucalypts to rest from flowering during a season, and to bloom in alternate years. In some species the bud-to-seed period is a few months—in others one, two, or (rarely) perhaps three years. *E. rostrata* is prone to biennial fruiting; in some species a season of vigorous reproduction is sometimes followed by two years' rest. This phenomenon (the "on" and the "off" year) is watched carefully by apiarists as of ecomonic importance in their anticipation of, and arrangements for, "honey-flow." Other eucalypts, as the winter-flowering *E. leucoxylon*, *E. sideroxylon*, etc., bloom yearly; and others, climatically affected, are irregular, but in most cases the fruit does not mature until the second year. So that, as a rule, a fruitful eucalypt bears either young fruit which will ripen next year, or old fruit of last year's flowering, or may have the old fruits present during the early development of young fruits of the present season. The habit of *E. eugenioides* is not known to me, but of four twigs collected between Bruthen and Orbost one bore two umbels of abnormal development. Of these one comprised seven young flowers and one old fruit, while the other consisted of six buds, one newly expanded flower, and two fully matured fruits. In view of the resting condition of the contemporary buds at the time when these fruits began to develop in the previous year, this may be regarded as a case of precocity. (Pl. XIII., 2.) Seen also in *E. obliqua.*

Delayed Dehiscence.—Species of both *Callistemon*[1] and *Melaleuca* retain their ripened seeds for years. The specimen of *C. lanceolatus* (exhibited) accounts for six years' fruit, and seeds from the first four of the series germinated when the capsules were opened by artificial heating.

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1 Cf. Ewart, Annals of Botany, vol. xxi., 1907, 135.

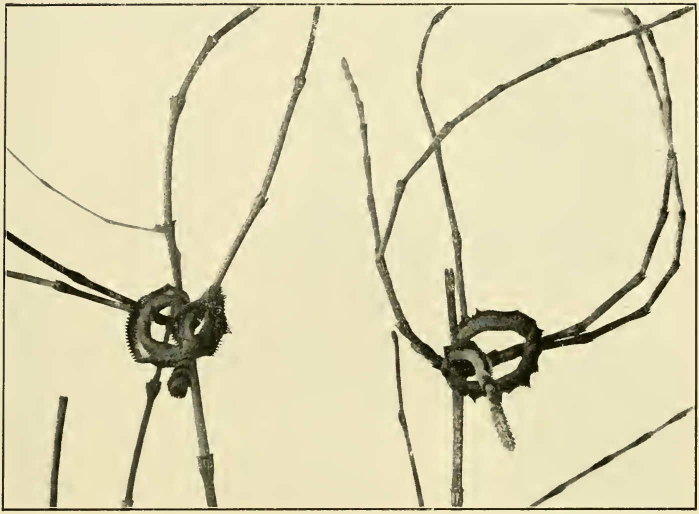
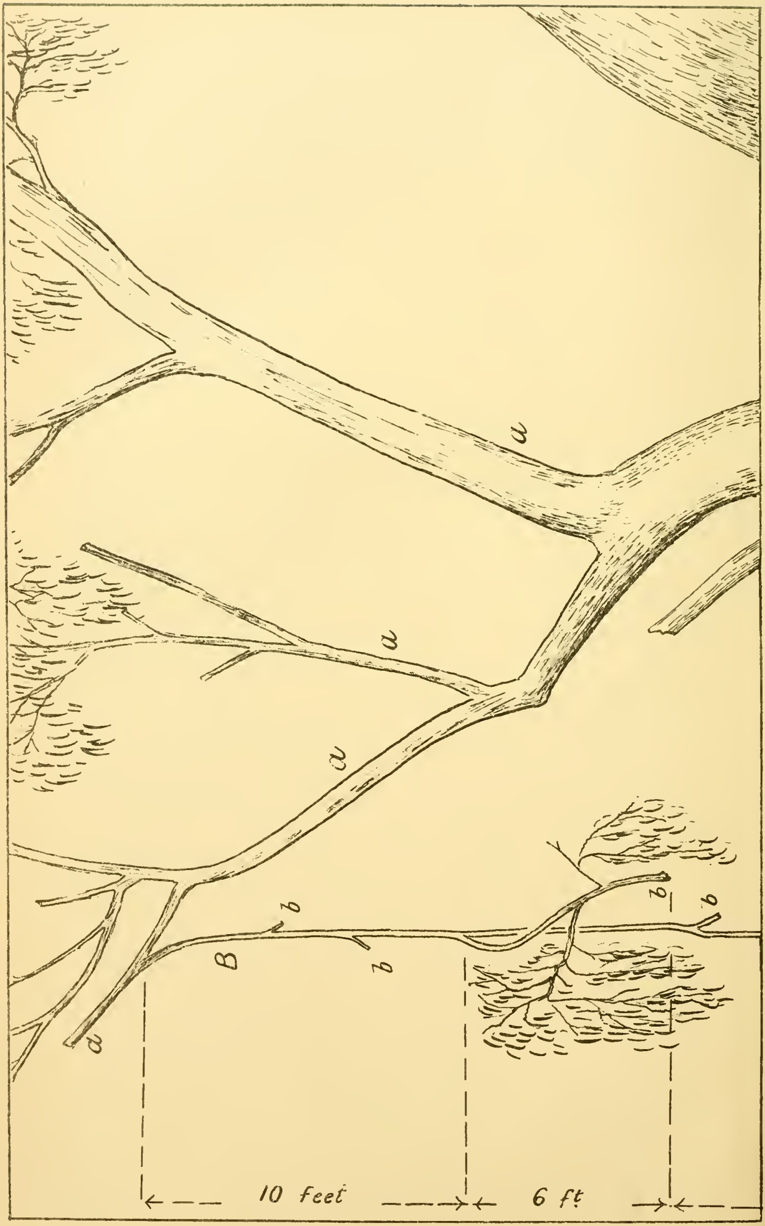


Fig. 2

Fig. 1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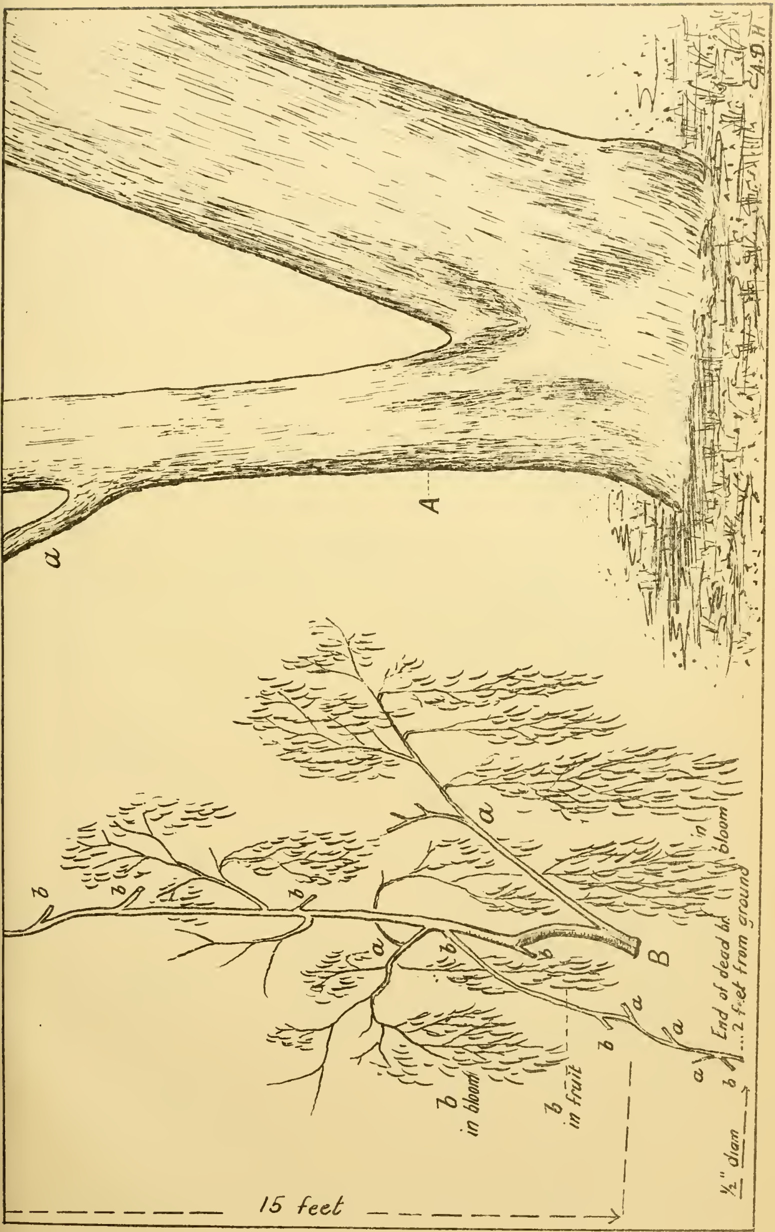
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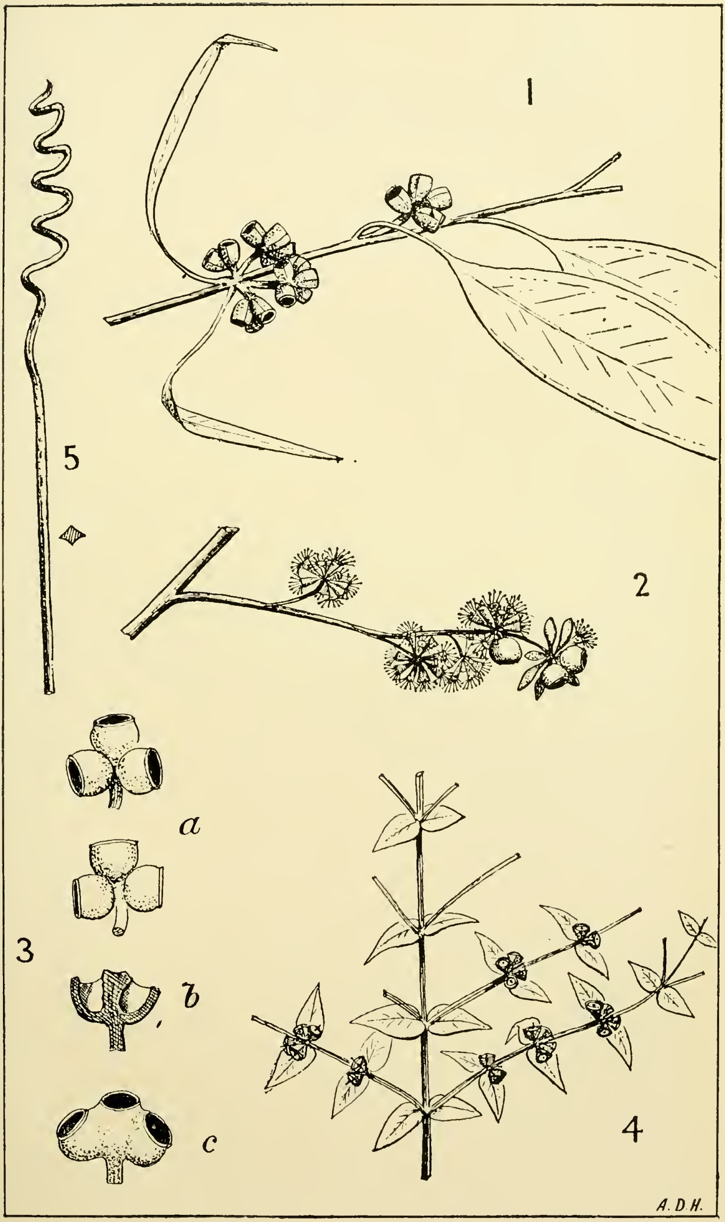
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DESCRIPTION OF PLATES.

Plate XI.

Fig. 1.—*Eucalyptus rostrata*, Schl., showing fusion of branches.

2.—*Casuarina stricta*, Aiton (Syn. C. quadrivalvis, exhibiting spiral torsion).

Plate XII.

Sketch (somewhat diagrammatic) of part of a Eucalypt, probably (*E. hemiphloia*, F.V.M., × *E. melliodora*, Cunn.), the pendant branch 30 feet long, exhibiting heterotropy. Upward growths A, a, a; downward growth, B, b, b, b.

Plate XIII.

Fig. 1.—*Eucalyptus elaeophora*, F.V.M. A twig showing proliferation associated with heterotaxis. ($\frac{1}{2}$.)

2.—*E. eugenioides*, Sieber, with precocious fruits in two umbels, developed a year in advance. ($\frac{3}{4}$.)

3.—*E. cordata.*

(a) Two normal umbels.

(c) One of many umbels with fruits laterally connate.

(b) Section showing two fruits connate. (Nat. size.)

4.—*E. globulus*, Labill. An adventitious shoot, with reversionary foliage, and fructiferous. Rough sketch of part only of one of several shoots. (Photograph exhibited.)

5.—*Xanthorrhoea minor*, R. Br. One of many torsive leaves, the whole plant being affected. (Nat. size.)

INDEX.

The names of new genera and species are printed in italics.

END OF VOLUME XXIX.

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OF THE

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