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Art VI.—*Chonetidae from the Palaeozoic Rocks of Victoria and their Stratigraphical Significance.*

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Summary.

A survey is made of all the known Chonetidae from the Palaeozoic rocks of Victoria. Comments are made on species of *Chonetes* and *Anoplia* already described, and the following new species are erected—*Chonetes bowieae C. productoida, C. killarensis, C. psiloplia, C. ruddockensis, C. taggertyensis, and C. gaskini.* The affinities of these forms with those found elsewhere are given, and their stratigraphical significance commented upon. A subdivision of the Yeringian Series is proposed.

Introduction.

Fossils of the brachiopod family Chonetidae (the classification of the *Fossilium Catalogus* is adopted) are known in Victoria only from Silurian and Devonian rocks, and they belong to the two genera *Chonetes* (*sensu stricto*) and *Anoplia*. The following table summarizes our knowledge of the occurrence of this group:—

Series.	Age.	Genus and Species.
Buchan Beds ..	Middle Devonian ..	*Chonetes australis* McCoy
Bindi Beds	Middle Devonian ..	*C. australis* McCoy *C. gaskini*, sp nov.
Yeringian	Lower Devonian (in part at least)	*C. bowieae*, sp. nov. *C. cresswelli* Chapman *C. killarensis*, sp. nov. *C. productoida*, sp nov. *C. psiloplia* sp. nov. *C. robusta* Chapman *C. ruddockensis*, sp. nov. *C. taggertyensis*, sp. nov. *Anoplia australis* Gill *A. withersi* Gill
Melbournian ..	Lower Ludlow (in part at least)	*Chonetes melbournensis* Chapman

The Devonian genera *Eodevonaria* and *Chonostrophia* have not been found in Victoria. Fig. 1 attempts to represent diagrammatically the relationships of the various genera of the family Chonetidae, and of that family to the closely-related family Productidae.

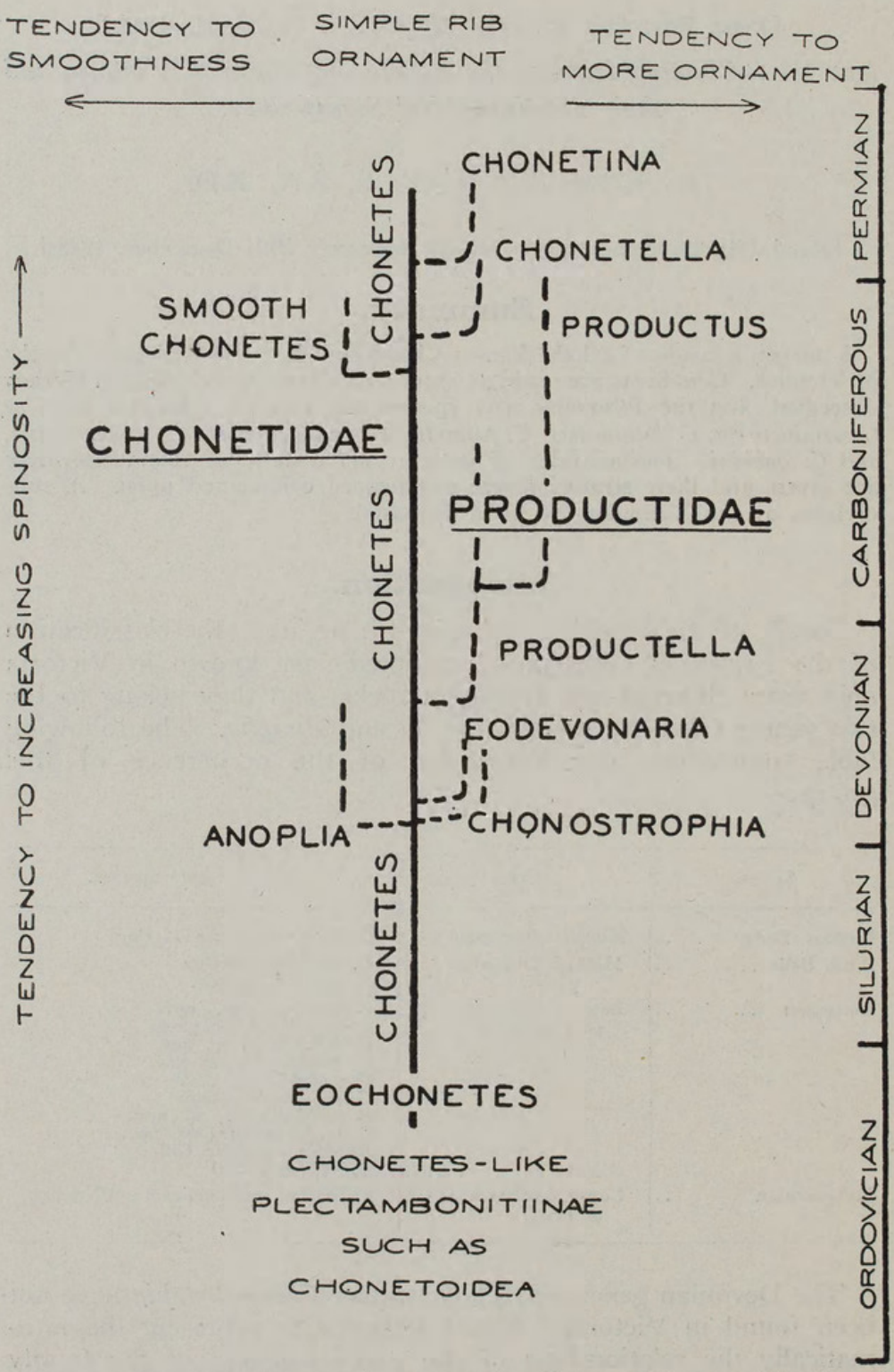

FIG. 1.—Generalized diagrammatic representation of the evolutionary relationships of genera of the Chonetidae and Productidae. The remarkable persistence of *Chonetes* as a genus should be noted.

Discussion of the Genus Chonetes.

Class BRACHIOPODA Dumeril.

Family CHONETIDAE Hall and Clarke, 1895.

Genus **Chonetes** Fischer de Waldheim, 1837.

GENOLECTOTYPE *Chonetes* sp. Fischer = *C. variolata* D'Orbigny, 1842, as interpreted by De Koninck, 1847 (quoted from *Fossilium Catalogus*).

ETYMOLOGY OF GENERIC NAME.—The name of the genus is derived from the feminine Greek noun "chone," a funnel, but the form "chonetes" is masculine, and so strictly speaking all the trivial names should be masculine in agreement. Such they were made by many early writers, but feminine forms have been established by consistent recent usage, and it would be confusing now to change all the names.

DIAGNOSIS OF THE GENUS.

Inequivalve, equilateral chonetids, with a straight hinge-line, and a row of hollow spines along the ventral cardinal margin. Ventral valve convex; dorsal valve flat to concave. Interior ventral valve with two small teeth, unsupported by dental lamellae. Cardinal area narrow and smooth. Pedicle obsolescent as shown by closure of pedicle opening by a pseudo-deltidium. Muscle impressions non-dendritic. Surface usually covered with radiating striae or ribs; rarely smooth. Interior of shells commonly papillose in the pallial region.

PHYLOGENETICS.

The genus *Chonetes* is a simple expression of the forms previously grouped in the large family Productidae. It is the stock from which the Upper Palaeozoic productids were evolved. *Chonetes* appeared in the late Ordovician whereas *Productella* did not appear till the Devonian. The genera *Chonetes, Productella,* and *Productus* are very similar, differing characteristically in their degree of spinosity. The spines were probably a means of attachment compensating for a deficient or obsolescent pedicle (Beecher, 1898, p. 351). They may be regarded as a mark of group gerontism. In his diagnosis of the genus *Chonetes,* Schuchert writes of the spines (1913, p. 389), "These are prolongations of tubes which penetrate obliquely the substance of the shell along the hinge-line." Practically all the Victorian species have their spines at right angles to the hinge-line, and in a number of cases it is known definitely that the tubes penetrated the shell substance at right angles and not obliquely. A number of species have been noted both in European (e.g., *C. margaritacea*) and American (e.g., *C. setigera*) deposits which have their spines set at right angles to the hinge-line.

One visualizes the Chonetidae arising from Strophomenids of the type of *Chonetoidea* and *Sowerbyella,* which are quite chonetoid in structure but lack spines. *Eochonetes* (Reed, 1917) is a plectambonitin with spines. Breger (1906) erected the sub-genus *Eodevonaria* to accommodate the denticulate forms of *Chonetes.* Denticulation is so important a feature phylogenetically that Schuchert and Le Vene (1929) justifiably accorded *Eodevonaria* generic status.

Spines are the principal generic feature of *Chonetes,* and are also of considerable value for specific determination. Hall (1892) writes, "Their comparative strength or direction often furnishes means for specific determination, but I have not been able to satisfy myself that the number of spines on the hinge-line is of specific importance." The investigation of the Victorian forms suggests that the number of spines is constant in a species. As Hall says, the nature of the spines is of specific importance. For instance *C. robusta* and *C. killarensis* have a somewhat similar outline and ornament, and both possess a median sulcus, but the spines of each species are very different. In *C. robusta* they are long, thick, and straight, whereas in *C. killarensis* they are short, thin, and sinuous. Evidently there was rapid variation in this specialization of the genus.

CLASSIFICATION.

De Koninck (1847) classified *Chonetes* in his monograph according to the surface ornament, as follows:—

A surface ornée de plis concentriques .	1. Concentricae.
plus de 100 côtes lisses	2. Comatae.
moins de 100 mais plus de 30 côtes lisses	3. Striatae.
de moins de 30 côtes lisses .. .	4. Plicosae.
de côtes rugueuses	5. Rugosae.

In the light of later studies such a classification appears rather arbitrary and not based on genetic relationships, but Paeckelmann (1930) has created sub-genera based on these divisions. All the Victorian forms come within the class Striatae of De Koninck, i.e., the *Chonetes sensu stricto* of Paeckelmann.

Grabau and Shimer (1909) have classified *Chonetes* according to the presence or absence of ornament, and the presence or absence of a sulcus, as follows:—

A. *Chonetes* with radiating striae.
  (*a*) Ventral valve with a median sulcus.
  (*b*) Ventral valve without a median sulcus.
B. Smooth *Chonetes.*

Group A is further sub-divided by Grabau and Shimer according to the number of spines carried on the ventral cardinal margin. All the species described in this paper come within Group A. *C. cresswelli, C. robusta,* and *C. killarensis* come within the sub-section "a," and the rest of the species in sub-section "b."

Prendergast (1944) has recently dismissed Schuchert's 1913 classification of productids based on means of attachment as "purely arbitrary," arguing that it "makes no allowance for a similarity of external form due to growth under similar environmental conditions" (p. 10). This view is expressed more specifically in the statement that "Given the condition necessary for spine development, that is, a plentiful supply of $CaCO_3$, any species will probably develop spines in the same position in all its members. The inclination of the spines to the body surface will depend upon the hardness of the sea-floor, arising at a high angle where the substratum is soft and being adherent where it is hard. In modern lamellibranchs the temperature of the water has a marked effect on the thickness of the shell, the Arctic forms having a thick shell and the warm water forms of the same species a shell thin almost to fragility. The difference between the Irwin forms, thin with short spines of small bore and those from Mt. Marmion, thick-shelled with heavy spines, of *Taeniothaerus subquadratus* (Morris) is possibly due to the difference in temperature of the sea at the two localities."

From a consideration of Prendergast's statements, the following points emerge:—

(1) Schuchert's 1913 classification is challenged but no mention made of his 1929 revised classification in the *Fossilium Catalogus*.

(2) Phenotypes result from interaction between genetic constitution and environment. Imagine, for instance, a *Chonetes* individual with genes for spines of a certain size and shape, orientated to the shell in a certain way. That such genes existed may be justly inferred from the fact that spines of a certain character are always found on individuals of the same species. If the optimum amount of calcium salts (or the ability to assimilate them) for building such spines in such a way is not present, then spines will develop, but not of the strength that would otherwise be attained. The whole exoskeleton will show signs of calcium starvation. Paucity or plenty of calcium salts will not determine the absence or the presence of spines, but their degree of development. If calcium salts were absent altogether, there would be no exoskeleton and no shellfish. If the calcium supply is low, then the whole exoskeleton will suffer by the shell being thin and the spines weak. This is where Prendergast's argument breaks down. However abnormal the conditions be, the means of attachment of the shell, viz., the spines, will be present, and so available as an objective means for the classification of species, genera, &c.

(3) The means of attachment represent a line of rapid evolution for the group under discussion. *A priori,* such lines of rapid evolution should constitute good bases for classification. The wide variety in the nature of the spines in the numerous

species of *Chonetes* indicates that there must have been a high mutation rate operating. The spines on the exoskeletons of some modern shells seem to have no biological significance. They may be mutations which remain because they are neither an advantage nor a disadvantage to the animal. However, the spines of the *Chonetes-Productus* series appear to have played an important part by keeping the animal above the muddy sea-floor where the water would be clearer and the supply of food more certain. The group was a very successful one, maintaining itself over a vast stretch of time, and existing in prolific numbers. The spinosity of these forms was apparently an important biological feature. The series ended up with the Richthofeniidae, which lost the power to elevate themselves by spines and elevated themselves above the sea-floor by thickening the ventral valve until they looked like cyathophylloid corals.

(4) Prendergast's reference to forms lacking calcium because in warm tropical seas is not easy to follow. Coral reefs are tremendous accretions of calcium, and such shells as the big clams indicate the withdrawal from tropical and sub-tropical seas of very large amounts of lime. The biggest and most extravagantly ornamented shells come from tropical seas. Many extensive beds of limestone have been laid down in tropical waters. These facts do not suggest paucity of calcium in tropical waters, or lack of ability on the part of marine organisms in those areas to assimilate calcium.

(5) Schuchert's 1929 classification separates off the Chonetidae as a distinct family from the Productidae. The difficulty in taxonomy is that no systematic classification fits perfectly the complex variations of nature itself. The systematist's task is to devise a classification which represents as closely as possible the known facts. The early chonetids are closely allied to the Plectambonitiinae, being distinguished from them chiefly by the presence of cardinal spines. Similarly, the later chonetids are very closely allied to the productids, which are distinguished by their increased spinosity and dendritic muscle impressions. The productids constitute a clearly-defined group of an increasing number of genera, very widely distributed, and most prolific. "They produced the most numerous, the most varied, the most widespread and the largest brachiopods in the late Palaeozoic" (Raymond, 1939). The chonetids likewise form a biologically distinct, numerically large, and racially prolific group surviving in strength through the major part of the Palaeozoic (*vide* fig. 1), and still maintaining its strength after giving rise to the productids. In my opinion, furthermore, the early chonetids are quite as closely allied to the Strophomenidae as the later chonetids are to the Productidae, and therefore there are as adequate grounds for separating the chonetids from the productids as there are for separating the chonetids from the strophomenids. I

therefore agree with Schuchert's suggestion that they be represented as two separate families—the Chonetidae and the Productidae.

ADAPTATIONS.

Most of the species of *Chonetes* from Victoria are fairly thin-shelled forms, and usually there is a direct correlation between the weight of the shell and the strength of the spines. For example, *C. melbournensis* is a light form with fine spines, whereas *C. robusta* has heavier valves and stronger spines. The mechanics of these shells are very interesting. The spines are hollow, which affords strength with the lightness needed for a semi-floating organism; likewise corrugations of the shell give strength with lightness. The shells are usually flattish or concave, and so adapted to the semi-floating (i.e., not rigidly fixed) condition of an organism attached to a sub-stratum. The small space between the two valves indicates that the animal was slender, and so again adapted by its lightness to the particular place this genus had in the marine ecology of Palaeozoic times.

SOME CHARACTERISTICS OF THE VICTORIAN FORMS.

Reference has already been made to the setting of the spines on our forms at right angles to the hinge-line. *Chonetes maoria* Allan from the Reefton (Lower Devonian) Beds of New Zealand also has its spines inserted at right angles as is to be seen on a specimen in the National Museum, Melbourne.

Three species described in this paper (*C. robusta, C. cresswelli,* and *C. killarensis*) have a well-defined mesial sulcus in the ventral valve. The biological advantage of this would be the increased area for muscle attachment; perhaps also the sulcus would have a similar action to a keel and help to keep the animal floating evenly. The same feature has been noted in *C. variolata, C. verneuiliana, C. mesoloba, C. coronata, C. lepida, C. arcuata, C. mansuyi,* and *C. ningpoensis.* Reed (1921) describes this feature in a variety of *C. sarcinulata.* In the Victorian forms the sinus is a constant character of the species named, whereas it is claimed to be present in *C. acutiradiata* only sometimes, and it is not found in all the specimens named *C. maoria.* A mesial sinus is common in the Productidae.

Another feature of interest is the differentiated margin, such as found in *C. taggertyensis,* a similar phenomenon to which has been described in *C. sarcinulata, C. maoria, C. coronata,* and *C. syrtalis.* The structure is interesting phylogenetically in view of various modifications of the margin of the shell found in other Strophomenaceae, such as the deflected margin in *Leptaena* and *Strophonella,* variation in papillosity around the margin of the interior surface in *Chonetes,* variation in the external ornament around the margin of some species of *Productus,* and so on.

Notes on Species Previously Described.

CHONETES (CHONETES) MELBOURNENSIS Chapman.

Chonetes melbournensis Chapman, 1903, pp. 74-76, pl. XI., figs. 2-4.

TYPE MATERIAL.—Two syntypes. National Museum, Reg. No. 636, is the internal cast of a ventral valve in micaceous, bluish-grey, very fine-grained sandstone from "South Yarra Improvement Works." N.M., Reg No. 1419, is the internal cast of a dorsal valve in hard, greyish-brown, very fine-grained sandstone from "Sewerage tunnel near old Fishmarket."

DESCRIPTION OF VENTRAL VALVE (No. 636).—This is a decorticated shell, small, slightly convex, flat on cardinal margins, measuring 5 mm. long and 8·5 mm. wide. The profile rises about ·75 mm. above the plane joining the anterior and posterior margins. Surface with about 80 fine, radiating striae with some six more or less evenly-spaced, slightly stronger radii. The preservation does not allow of detailed examination of the fine striae, but where clearly discernible, increase is by bifurcation. Cardinal area narrow; cardinal angles a little more than right angles. Beak distinct, but not large, projecting just beyond the hinge-line. Elongate papillae present, orientated to the striae. (Not realizing that he was dealing with a decorticated specimen, Chapman described these impressions of papillae as pittings in the outer surface of the shell.) Muscle scars indistinguishable. No spines preserved.

DESCRIPTION OF DORSAL VALVE (No. 1419).—Small shell, very slightly concave, measuring 3·5 mm. long, and 6·5 mm. wide. Surface covered with numerous poorly preserved fine radiating striae, some few being a little more pronounced than the rest; a clearly defined linear depression runs down the whole length of the centre of the shell. Five long, very fine spines preserved from the ventral valve (two on one side of the umbo and three on the other), the longest being 2·5 mm

COMMENT.—Examination of specimens other than the syntypes shows that *C. melbournensis* carries ten long, pointed spines, five on each side of the umbo; the spines are set at right angles to the hinge-line or curved outwards slightly. Examination of a number of specimens also shows that the interiors of both valves are covered with fine papillae, which are elongate, set in the interstriate spaces, and orientated to the direction of the striae. The external ornament appears also on the interiors of the valves, but less distinctly, and is absent where the muscle scars are well developed.

In *C. melbournensis* there is a stronger rib down the middle of the ventral valve and a corresponding linear depression on the dorsal valve. This bipartition may be compared with the mesial

sinus found in a number of species of *Chonetes* (*vide* p. 131). Similar bipartition has been described in *C. novascotica* (McLearn, 1924) and *C. aroostookensis* (Clarke, 1907).

C. melbournensis is a valuable index fossil, but some care is necessary to ensure that specimens really do belong to this species. The author has noted a variety of forms which have been referred in collections to this species, but which do not conform to the type. Extensive collecting and intensive study will have to be undertaken to separate out these various forms and accord them their proper status. Sherrard and Keble (1937) recorded *C. melbournensis* from New South Wales. Mrs Sherrard kindly allowed me to examine these specimens. However, they are possibly small stropheodontids and certainly not *Chonetes*. Many stropheodontids simulate *Chonetes*, e.g., *Stropheodonta bipartita* (Chapman) from the Yeringian rocks of Victoria. Thomas (1937) has used *C. melbournensis* as a zone fossil in the series of sediments at Heathcote, but this form is not *Chonetes* either, if the specimens collected by Professor Hills from this horizon are the form to which Thomas refers. Like the New South Wales fossil, it is devoid of spines and only simulates *Chonetes* in its general form and ornament. The record of *C. melbournensis* from "Auburn" and "Balwyn, near Templestowe" (Chapman, 1914, p. 215) is also incorrect.

Affinities.—*C. melbournensis* is comparable with *C. novascotica* of the North American succession and *C. striatella* of the European succession. *C. novascotica* occurs in the Moydart (Lower Ludlow age) and the Stonehouse (Upper Ludlow age) of Arisaig, Nova Scotia (McLearn, 1924), and has also been recorded from the Missenden Bore in England (Straw, 1932). McLearn says (p. 65) that *C. novascotica* differs from *C. striatella* in the development of a stronger median stria on the ventral valve, which feature is also found in *C. melbournensis*. *C. novascotica* has the same number of spines as *C. melbournensis*, but they are minute, whereas those of the latter species are as long as three-quarters of the length of the shell. The surface of *C. novascotica* has more numerous striae, but forms with coarser ornament are known (McLearn, 1924, p. 66). The striae are flexuous in *C. novascotica* but straight in *C. melbournensis*. These two species are distinct, but closely approximate one another, and provide another interesting connecting link between the faunas of this age in North America and Australia. The spines of *C. striatella* are heavy and short and set at an angle of about 45° to the hinge-line, whereas those of *C. melbournensis* are long and slender and set at right angles to the hinge-line. The dorsal valve is definitely concave in *C. striatella*, whereas it is flat or almost so in *C. melbournensis*. *C. striatella* is characteristically larger and more transverse than the Victorian species. However, the obvious similarity is striking.

Chonetes (Chonetes) robusta Chapman.

(Pl. VIII., fig. 5.)

Chonetes robusta Chapman, 1903, pp. 76-77, pl. XII., fig. 8.

Type Material.—Two valves *in situ* (holotype), National Museum, Reg. No. 1417; about half of ventral valve, and most of dorsal valve, in indurated fine-grained sandstone from "North of Lilydale" (loc. 3, *vide* Gill, 1940, p. 258).

Description.—Concave-convex dorso-ventrally, 19 mm. wide (but this not full width as one cardinal angle broken), and 12 mm. long. Outline sub-semicircular. Shell tumid with mesial sinus and a slight flattening on the cardinal angles; longitudinal profile rises about 6 mm. above the plane joining the anterior and posterior margins of the shell. Hinge-line mostly absent, but little less than greatest width of shell owing to slightly obtuse cardinal angles. About thirty-six fairly sharp, high ribs (counted in middle of shell) some bifurcating anteriorly. Other specimens suggest that four strong spines on each side of the umbo (eight in all) is the normal number. The outer spine in the type specimen has a slight inclination outwards. The dorsal valve of the type specimen follows fairly closely the contours of the ventral valve, the greatest distance of separation being 1·5 mm. Similar ornamentation to that on the ventral valve is preserved. The ornamentation continues through to the interior of both valves. As is the case with practically all fossils from the Lilydale district, only casts and moulds are preserved, the original shell material having been leached away.

Comment.—The study of specimens other than the type shows that the beak is inconspicuous, scarcely projecting beyond the hinge-line; the cardinal area is flat and well-developed; median septum short and narrow; teeth and muscle scars not observed. The number of ribs has been noted to vary from 24 to 36. *C. robusta* is closely allied to *C. killarensis* sp. nov., and *C. cresswelli* Chapman.

Occurrence.—Besides the localities mentioned above, *C. robusta* is known from "Wilson's" (loc. 2), Hull-road, Mooroolbark (loc. 13), and Syme's Tunnel, Killara (loc. 34).

Chonetes (Chonetes) cresswelli Chapman.

Chonetes cresswelli Chapman, 1903, pp. 77-78, pl. XII., fig. 7.

Type Material.—Internal cast of ventral valve (holotype) in indurated mudstone from "North of Lilydale" (National Museum, Reg. No. 652).

Description.—Shell approximately semi-circular in outline, being 7·5 mm. long and 13 mm. wide. Ventral valve convex rising about 3 mm. above the plane joining the anterior and

posterior margins. Beak inconspicuous, scarcely projecting beyond hinge-line. Hinge-line straight and nearly equal to greatest width of shell. Cardinal angles approximately right angles. Teeth fine. Short, fine median septum 1·5 mm. long. Very narrow cardinal area. Some 40 fine, rounded ribs radiate from umbo, bifurcations increasing number of ribs at margin to about 54. Other specimens show spines at right angles to the hinge-line; they are finer than those on *C. robusta.* Conspicuous mesial sinus present. Faint traces of concentric lines of growth observed. Spines on a specimen from Hull-road, Lilydale (loc. 1) are figured (Pl. VIII., fig. 5).

Horizon.—Yeringian (Lower Devonian).

Comment.—This species is very closely related to *C. robusta,* the chief differences being (as Chapman remarked) in the altogether stouter build and fewer radii in *C. robusta.* The ribs are fine and rounded in *C. cresswelli* but high and sharp in *C. robusta.* Chapman also drew attention to the similarity between *C. cresswelli* and *C. australis* McCoy from the Middle Devonian rocks of Victoria. This is the more significant now in view of the much more closely approximated ages attributed to the Lilydale and Buchan Beds. *C. australis* occurs in great numbers in the Buchan and similar limestones, but no *Chonetes* has been found in the Cave Hill limestone beds at Lilydale. Brachiopods, except for *Atrypa reticularis,* are very rare at Cave Hill.

There is a close similarity between the chonetids of Victoria and those of the Devonian rocks of French Indochina. The Devonian of New Zealand, Eastern Australia, and Indochina appear to constitute a well-defined zone. Attention has already been directed to the similarity between certain trilobites in this zone (Gill, 1944). *Chonetes nongpoensis* (Mansuy, 1919, pp. 26-27, Plate V., fig. 4*a*, *b*) is very much like *C. cresswelli* Chapman. The general proportions of the shell are the same, the number of ornamenting ribs is about the same, and both have a well-marked mesial sinus, and short fine median septum. However, the ribs are rounded in *C. cresswelli* and raised and sharp in *C. nongpoensis,* as they are also in *C. robusta* which is a close variant of *C. cresswelli.* Unfortunately, the spines of *C. nongpoensis* are not known. As our knowledge stands at present, there is very little to separate *C. cresswelli* and *C. nongpoensis.* The specimens figured as *C. hardrensis* (Mansuy, 1921, Plate II., figs. 5*a-c*), *C.* cf. *margaritacea* (Mansuy, 1916*a*, Plate I., fig. 11), *C. indosinensis, C. lacroixi, C. lantenoisi,* and *C.* cf. *striatella* (Mansuy, 1916*b*, Plate VII., figs. 5-8), *C. zeili,* and *C. mansuyi* (Patte, 1926) are comparable with our Victorian types. It is interesting to note the presence of a mesial sinus on some of these forms, and the orientation of the spines at right angles to the hinge-line, as in our species. *C. lantenoisi* and *C. lacroixi* have the long median septum noted in *C. taggertyensis.*

CHONETES (CHONETES) AUSTRALIS McCoy.

Chonetes australis McCoy, 1876, p. 17, pl. XXXV., figs. 3-5.

Unfortunately, the National Museum is unable at present to locate the type specimen of *C. australis*. Further description of this form, and comment, are therefore withheld in the hope that the type may be found. As the specimen concerned is probably only misplaced and not really lost, it is not proposed to choose a lectotype.

Descriptions of New Species.

CHONETES (CHONETES) BOWIEAE, sp. nov.

(Pl. VIII., figs. 1 and 2.)

TYPE MATERIAL.—External cast and internal mould (syntypes) of a ventral valve in indurated fawn shale from Syme's Quarry, Killara, presented to the University of Melbourne, Geology Department Museum (counterparts, Reg. Nos. 1908-9). Collected by Mrs. R. Bowie, after whom the species is named.

DESCRIPTION.—Shell 17 mm. long (measured in one plane) and 19 mm. wide at the widest part; middle of the shell very tumid, but practically flat on the cardinal extremities. Cardinal angles obtuse. Hinge-line straight and less than greatest width of shell. Cardinal area flat, full width of hinge-line, parallel to plane of shell, and about 1 mm. wide. Eight long, evenly-spaced spines, fairly slender, project from the cardinal margin at right angles to the hinge-line; longest spine preserved is 7 mm. Beak projects a little beyond the hinge-line. Thin median septum about 4 mm. long, which is low at its anterior end where it rises from the floor of the shell, and becomes higher towards its posterior end. Interior of valve finely papillose around cardinal extremities; there are traces of papillosity elsewhere on the internal cast, which suggests that the whole interior of the valve was papillose. The type specimen is crushed slightly by lateral pressure. Teeth small and supported by dental lamellae almost parallel with the hinge-line. Between 50 and 60 fine rounded ribs (counted at the anterior margin) radiate from the umbo; increases by bifurcation.

HORIZON.—Yeringian (Lower Devonian).

COMMENT.—This species shares with *C. productoida* and *C. taggertyensis* general productid proportions. It provides a further link between the faunules of Lilydale and Killara. On the piece of rock containing the internal cast there is also a specimen of *Pleurodictyum megastomum* Dun, and on the piece containing the external mould a pygidium of *Lichas* (*Euarges*) *australis* McCoy, and *Beyrichia* sp. can be seen.

OCCURRENCE.—Syme's Quarry (loc. 35), Seville Quarry (loc. 37), Melbourne Hill, Lilydale (loc. 7), and doubtfully at Hull-road, Lilydale (loc. 1).

CHONETES (CHONETES) TAGGERTYENSIS, sp. nov.

(Pl. VIII., figs. 6 and 8.)

TYPE MATERIAL.—External cast and internal mould (syntypes) of a ventral valve in highly indurated fine-grained grey sandstone from Blue Hills, Taggerty, collected by Professor E. S. Hills and preserved in the University of Melbourne Geology Department Museum (counterparts, Reg. Nos. 1910, 1911).

DESCRIPTION.—Shell 22 to 24 mm. wide (one cardinal extremity is damaged and so an accurate measurement is not possible), 16 mm. long; profile rises 6 mm. above the plane joining the anterior and posterior margins. Valve very convex and flattened on the cardinal extremities ("oreillettes" of de Koninck). External mould shows 70 to 80 fine ribs at the anterior margin; increases by bifurcation. The ribs scarcely show on the internal cast except for a strip 3 to 4 mm. wide round the anterior perimeter of the shell. This is an area outside the phenomenally large muscle scars, and is finely papillate; slightly heavier papillae occur on the oreillettes. Large, flabellate, incised (i.e., raised in the mould) diductors extend three-quarters length of shell, enclosing incised adductors 4·5 mm. long. Beak inconspicuous, projecting just beyond the cardinal line. Cardinal area low at the extremities but rising to about 2 mm. in the centre—very high for *Chonetes*. Teeth very strong. Shell thick. Median septum strong and high at the cardinal end; at least 6·5 mm. long (between the cast and mould a little material has infiltrated and the septum may be longer than stated). There is the suggestion of a septum down almost the entire length of the shell. In the other specimen figured (Reg. No. 1912, paratype, Plate VIII., fig. 6), the septum is seen to run practically the whole length of the big adductor scars. No spines or spine bases can be distinguished on the type specimen, but in the associated specimen spine bases are present. The only difference between the type specimen and the other is that the latter is a little more transverse in proportions, and the muscle scars are a little more deeply incised. Both these variations are known to occur with increasing age in *Chonetes*.

HORIZON.—Probably Yeringian (Lower Devonian).

OCCURRENCE.—Blue Hills, Taggerty, Victoria. Professor Hills (1929) mentions the collection of *Chonetes* sp. from Taggerty, but the specimens figured herein were collected subsequently by him.

COMMENT.—*Chonetes taggertyensis* has a number of affinities with *C. sarcinulata* (Schlotheim) as figured by de Koninck (1847) in Pl. XX., fig. 15E. There the same flabellate, incised muscle

scars are seen with but faint trace of the ribs of the external ornament, a punctate margin is present showing more clearly the external ornament, and a very long median septum. The size of the muscles, the length of the septum, and the height of the ventral cardinal area are all phenomenal, and thus give more point to the comparison. However, the external ornament as described by de Koninck is quite different from that of our species, the ribs being many fewer in *C. sarcinulata,* practically all bifurcating, and doing so at about the same distance from the umbo. *C. sarcinulata* is one of the most characteristic fossils of the European Lower Devonian assemblage. *C. maoria* and *C. nigricans* (Allan, 1935; Shirley, 1938), from the New Zealand Lower Devonian, are of this same type, but the muscle area is smaller and the median septum shorter. However, a specimen of *C. maoria* in the National Museum, Melbourne, has a longer septum than that figured for the holotype. Allan says, "The general appearance of this species suggests such genera as *Plectambonites* Pander, but it probably belongs to *Chonetes.*" The generic position of *C. maoria* is confirmed by the presence of one spine base and probably a second on the specimen in the National Museum, Melbourne. Like *C. sarcinulata,* the New Zealand species is highly papillose on the interior surface except on the muscle scars. From Allan's figure, it appears that *C. maoria* has a mesial sinus like *C. cresswelli* and *C. robusta.* However, this is not present in the Melbourne specimen, nor is the "anterior margin somewhat sharply bent to produce a Leptaenid-like appearance." The latter may be due to pressure in the rock matrix.

C. taggertyensis is also like *C. unkelensis* (Dahmer, 1936, 1937), which is from the Siegenian of Unkel, and belongs to the *C. sarcinulata* gens.

Chonetes (Chonetes) psiloplia, sp. nov.

(Pl. VIII., fig. 15.)

Type Material.—Holotype consisting of a ventral valve in bluish-grey mudstone from Killara collected by Mr. F. Chapman, and lodged in the National Museum, Melbourne (Reg. No. 14519). The fossil is probably from loc. 34 (Gill, 1944).

Description.—Valve 13 mm. wide, 6·5 mm. long, and height (distance profile rises above plane joining anterior and posterior margins) about 1·5 mm. The cardinal angles are approximately right angles so that the outline of the valve is not exactly semi-circular, but tends towards the sub-rectangular; the radius of the valve is 7·5 mm. half way between the cardinal angle and the centre of the posterior edge of the shell. Valve somewhat flattened on the cardinal extremities and round the perimeter, forming a marginal

flange comparable with that in *C. taggertyensis*. The muscle scars are not distinct, but inside the flange referred to there is a raised area on the cast where the ornament is less distinct and this may well be interpreted as incised muscle scars on the original shell. The external ornament consists of between 70 and 80 fine, somewhat sinuous, rounded ribs, increasing in number by bifurcation. Interior of valve finely papillate. Beak insignificant, not projecting beyond the hinge-line. Cardinal area about ·5 mm. wide, smooth, and fairly regular in width. Two spines set at right angles to the hinge-line are preserved, but neither is complete; one fragment is ·75 mm. long and the other 4 mm. These spines are very slender for a shell of this size—hence the trivial name. Impression of one tooth only (the other side is slightly broken away), and that is minute. Fine median septum 1·75 mm. long.

Horizon.—Yeringian (Lower Devonian).

Comment.—This species is of the *C. sarcinulata* type with large incised muscle scars giving a differentiated margin to the interior of the ventral valve. The shell is of altogether lighter construction than *C. taggertyensis* (with which it may be compared), and the median septum is proportionately very much shorter. The spines are notable.

Chonetes (Chonetes) ruddockensis, sp. nov.

(Pl. VIII., fig. 10.)

Type Material.—Holotype, consisting of an internal cast of a ventral valve in indurated olive-grey mudstone from Ruddock's Quarry (loc. 20), presented to the University of Melbourne Geology Department Museum (Reg. No. 1914).

Description.—Shell 7 mm. wide and 5·5 mm. long; longitudinal profile rises about 2 mm. above a line joining the anterior and posterior margins of the valve. Cardinal angles approximately right angles. Valve less convex on cardinal extremities. Beak insignificant. The two halves of the cardinal area form an angle of about 170°.

Ribs as seen in internal cast linear and of rounded cross-section; fine pitting between ribs, i.e., interior of valve finely papillose; about 40 ribs half way between anterior and posterior margins, and about 50 at the anterior margin; increase by bifurcation. What appears to be a linear median septum stretches nearly half way down the middle of the valve from the umbo. Cardinal area very narrow, and teeth not seen. Parts of two spines preserved on each side of the umbo; spines long and thin, set more or less at right angles to the hinge-line; longest spine present 3·5 mm.

Horizon.—Yeringian (Lower Devonian).

Occurrence.—In the Lilydale District the new species is known from Ruddock's Quarry (loc. 29, and from here the trivial name), Ruddock's Corner (loc. 21), Edward-road Hill (loc. 22), West of Lilydale Cemetery (loc. 23), Victoria-road cutting (loc. 24), "Devon Park" West (loc. 25), "Devon Park" North (loc. 26), North of Ruddock's (loc. 39), Manchester-road, Mooroolbark (large cutting north of station—a new locality), Smale's Farm (on the west side of Edward-road, north of Ruddock's—a new locality). It has also been collected from the Kinglake District from "near Strath Creek" by Professor E. S. Hills (Univ. Geol. Dept., Mus., Reg. No. 1916); a small *Pleurodictyum megastomum* is present on the same piece of rock.

Comment.—There is a good deal of variation in the group of shells at present included under *C. ruddockensis*. The type specimen is sub-quadrate in outline with 40 to 50 straight linear ribs. Another specimen noted is transverse in outline, with 30 to 40 stronger ribs which are somewhat sinuous. Intermediate stages between the type and this latter specimen have been observed. It is not clear yet how (if at all) this compact group should be subdivided, but a detailed study of a large collection will no doubt solve the problem. *Chonetes ruddockensis* has affinities with *C. setigera* Hall, which has similar proportions, ornament, and orientation of spines (at right angles to the hinge-line). Our species has fewer and different spines. Those of our species are remarkably long and slender, so much so that it is surprising that so many have been preserved. The waters in which the enclosing sediments were laid down must have been fairly quiet, an inference which may also be made from the fineness of those sediments. One shell from Ruddock's Quarry, 4·5 mm. long, has preserved a spine 8 mm. long, and it ends abruptly suggesting that it was even longer originally. In the European facies, *C. ruddockensis* seems to find its affinities with *C. soror* Barrande.

Chonetes (Chonetes) killarensis, sp. nov.

(Pl. VIII., fig.14.)

Type Material.—Internal cast of a ventral valve (holotype) in bluish-grey indurated mudstone from Syme's Tunnel, Killara (loc. 34), presented to the University of Melbourne Geology Department Museum (Reg. No. 1915).

Description.—Shell 20 mm. wide and 17 mm. long; evenly tumid except for mesial sinus and a slight flattening on the cardinal angles; longitudinal profile rises 5 mm. above the line joining the anterior and posterior margins of the shell. Mesial sulcus about 1 mm. deep, and about the width of five ribs. Cardinal angles approximately 115°. Cardinal area nearly straight, but the two halves of the line form a vertex at the umbo. Ribs

(on the internal cast) sharp and high, with bifurcations but no intercalations; number 34 half way between the anterior and the posterior margins, and 37 at the anterior margin; slight punctation between the ribs right in the cardinal angles. Probably ten very short, fine, somewhat sinuous spines ranged along the cardinal margin, perpendicular to the hinge-line; most complete spine present 1·5 mm. long. Cardinal area very narrow. Beak small, distinct, projecting slightly beyond the hinge-line. Median septum about 3 mm. long, not ending abruptly but tapering away on to the floor of the shell; septum about 1/6th mm. wide. Teeth strong.

Horizon.—Yeringian (Lower Devonian).

Comment.—This new species is comparable with *C. robusta* which occurs in the same beds. The spines are long, straight, and strong in *C. robusta,* but short, fine, and sinuous in *C. killarensis.*

Occurrence.—A form very similar to *C. killarensis* occurs in the soft fawn mudstones of Melbourne Hill, Lilydale (loc. 7). The spines are of the same kind, but the ribs are more numerous, and the mesial sinus very shallow. However, for the time being it is included in this species. In any case, the fossil constitutes another interesting link between the beds at Killara and those at Lilydale.

Chonetes (Chonetes) productoida, sp. nov.

(Pl. VIII., figs. 7 and 12.)

Type Material.—Internal cast of a ventral valve (holotype) in indurated, fine-grained, fawn sandstone from Lilydale, Victoria. Collected by Reverend A. W. Cresswell, M.A., from "North of Lilydale" (loc. 3), and presented to the National Museum, Melbourne (Reg. No. 14520).

Description.—Length of shell (measured in one plane and not following obesity of shell) 17 mm., and width 21 mm.; longitudinal profile rises about 7 mm. above a line joining the anterior and posterior margins of the shell. Shell very tumid, but fairly flat on the cardinal margins, simulating productoid proportions—hence the trivial name. Cardinal angles damaged, but probably slightly obtuse. Hinge-line straight. Ribs (on internal cast) sharp and high, but have the appearance of being worn off on the anterior part of the type specimen (compare other figured specimen, National Museum, Reg. No. 14521—hypotype), number 31 half way between the anterior and posterior margins; increases by bifurcation. Umbonal area highly arched and overhangs hinge-line productid-fashion. The spine bases present indicate eight strong spines along the cardinal margin, probably

at right angles to the hinge-line. Cardinal area narrow. Median septum 3 mm. long, ending fairly abruptly; high, and about ¼ mm. wide. Teeth strong.

Horizon.—Yeringian (Lower Devonian).

Comment.—This new species is very similar in external appearance to *C. hemispherica* Hall of the Upper Helderberg in North America, from which it can be distinguished readily by its fewer ribs. *C. productoida* is not merely the gerontic stage of *C. robusta* which also it closely resembles. Gerontic specimens of the latter are equally obese but do not have the high umbonal area and recurved beak of *C. productoida.* Moreover, *C. robusta* has a mesial sinus at all stages in its development, and the shell is not so flattened on the cardinal angles. It is interesting to note in this species (as also to certain extent in *C. bowieae*) the attainment of a *Productus*-like form.

Chonetes (Chonetes) gaskini, sp. nov.

(Pl. VIII., fig. 9.)

Type Material.—A ventral valve preserved in hard, bluish limestone from the scarp along Old Hut Creek, Bindi District, Gippsland (see map, Gaskin, 1943). The species is named after Mr. A. J. Gaskin, who collected the type specimen, which is now in the University of Melbourne Geology Department Museum (Reg. No. 1913).

Description.—Ventral valve 4 cm. wide; greatest length preserved in type specimen (which is incomplete) 2 cm.; but a complete valve would be longer; height (distance profile rises above plane joining anterior and posterior margins) about 1·25 cm. Cardinal margin rises slightly at umbo, which is not prominent. One spine only preserved on the cardinal margin. It is ½ cm. long, straight, slightly turned outwards, and possessing fine annulations (see photomicrograph, Pl. VIII., fig. 11). The valve is flattened on the cardinal extremities. The external ornament consists of 40 ribs which are much stronger in the centre of the shell than they are on the cardinal margins. The ribs do not all commence at the umbo, some beginning at locations along the cardinal margin, the furthest out starting at a point 13 mm. from the umbo. The ribs in cross-section form low arches, and the interspaces are about equal in width to the ribs.

Horizon.—Bindi Limestone (Middle Devonian).

Comment.—This large new species is phenomenal for its possession of an annulated spine. It is clearly not an artefact, nor is it a small annulated shell like *Tentaculites* resting against the cardinal margin of the *Chonetes.* As far as the author is aware, an annulated spine on a *Chonetes* has not been described before.

Discussion of the Genus Anoplia.

Family CHONETIDAE Hall and Clarke, 1895.

Genus **Anoplia** Hall and Clarke, 1892.

Genoholotype 2· *Leptaena nucleata Hall*, 1857, 10th Rept. New York State Cabinet, p. 47 (quoted from *Fossilium Catalogus*).

ETYMOLOGY OF GENERIC NAME.—Greek anoplos = unarmed.

DIAGNOSIS OF GENUS.—Small chonetoids possessing a smooth or almost smooth surface, but without spines on the ventral cardinal margin. Ventral median septum, terminating abruptly.

COMMENT.—As far as the author is aware, only four species have been referred to this genus, viz.:—

Anoplia nucleata (Hall) Lower and Middle Devonian—Oriskany of Ontario and New York. Amazon. Onodaga and Grand Grève (Caley, 1940). Middle Devonian of Maryland. Lower Devonian of Moselle (Dahmer, 1928, 1930).

Anoplia helderbergiae Schuchert. Lower Devonian—Helderberg Formation.

Anoplia australis Gill. Lower Devonian of Victoria—Yeringian Series.

Anoplia withersi Gill. Ditto.

When Hall and Clarke erected the genus, the absence of spines was regarded as its chief feature—hence the name meaning "unarmed." However, *A. helderbergiae* was found to possess spines like *Chonetes,* but Schuchert (1913) has argued that the genus is a good one to embrace "the early smooth or slightly lamellose, highly convex, small chonetoids with a ventral median septum." The ventral median septum is a common feature of *Chonetes,* and the Victorian forms of *Anoplia* at least are not highly convex. Smooth *Chonetes* are also known. Thus, none of the features named by Schuchert can now be said to be characteristic of *Anoplia* alone. There seems to be no course left but to keep to the original definition of the genus as small, smooth chonetoids without spines, and refer *A. helderbergiae* to *Chonetes.* It is interesting to note that smooth forms have arisen twice in the *Chonetes* line of evolution, viz., *Anoplia* in the Lower Devonian, and smooth *Chonetes* (*C. glaber*) in the Upper Carboniferous.

Anoplia possesses reversionary characters. The term "reversion" is here used in distinction from the term "atavism," and as defined by Crew (1925, p. 3). It may be assumed that the genus *Chonetes* "degenerated" in one direction to *Anoplia,* just as in another it "advanced" to *Productella* and *Productus.* The reversionary characters are:—

(1) Loss of ornament.—The surface of the shells is smooth in *Anoplia,* or almost so. Schuchert writes, "The smooth forms of *Chonetes* are not descendants of *Anoplia,* but are derived from

associated finely striated forms of the former genus." Apparently both the smooth *Chonetes* and *Anoplia* arose from finely striated *Chonetes* but at different times. Hall (1892, Plate 15*a*, fig. 18) figures a specimen of *A. nucleata* with faint ribbing which may be regarded as an indication of the ornament carried by its ancestors. An example of similar genetic interest is a specimen of *A. australis* collected by Mr. R. B. Withers in the Kinglake District (Plate VIII., fig. 4).

(2) Loss of Spines.—Hall and Clarke made this the chief diagnostic character of their genus, and it is indeed notable among a whole series of spinose forms which were an important element in marine faunas for over 150 million years. It is notable also for the reason that the general tendency with the effluxion of time was for the increase and not decrease of spinosity.

Notes on Species Previously Described.

Anoplia australis Gill.

Anoplia australis Gill, 1942, pp. 38-39, Pl. IV., fig. 8.

This species is very characteristic of the Ruddock's Quarry horizon of the type Yeringian Beds at Lilydale. It occurs in great numbers at Ruddock's Quarry along with equally great numbers of *Chonetes ruddockensis,* sp. nov., and *Stropheodonta bipartita* (Chapman). On the other hand, it is very rare in the highest beds of the series, only one specimen having been collected, for instance, from Hull-road, Mooroolbark. The Ruddock's Quarry horizon has been traced south to Mooroolbark, where *A. australis* has been collected from a large cutting on Manchester-road north of the railway station.

The two subsidiary ridges in addition to the median septum are of interest in this species. Certain parallels to these can be found in other genera. For example, *Sowerbyella gracilis* Jones (1928, p. 473, Plate XXIV., fig. 22) possesses a similar complement of ridges; also *Chonetes cumbrensis* Garwood (1931, p. 148).

Further Occurrences.—In addition to localities previously named, *A. australis* has been collected from the quarry north of Syme's Homestead, Killara (loc. 32), and from Jerusalem Creek (Geol. Surv. Vic., Reg. No. 18218).

Anoplia withersi Gill.

Anoplia withersi Gill, 1942, p. 39, Pl. IV., fig. 7.

Usually *A. australis* is the dominant form where both the Victorian species are present together. An exception to this has been noted at Jerusalem Creek, east of Eildon Weir. The

numbers given with the following new records of occurrence are registered numbers of the Geological Survey of Victoria:—

Nos. 18222 and 18223—light fawny-grey sandstone from 70 chains S.E. of the junction of Jerusalem and Barnwell's Creeks, Jamieson, Q.S.

Nos. 18218 and 18227, from spur between Wilson's and Barnwell's Creeks.

Variations have been noticed in *A. withersi* in the length of the septa, in the prominence of the beak, and in the general outline of the shell.

Stratigraphical Considerations.

The earliest reference to chonetids in Victoria is probably that made by Blandowski in 1855 when he figured some undescribed fossils from the McIvor Goldfield. His plate opposite page 223, fig. 359, is evidently a *Chonetes*.

The named species of Victorian *Chonetes* were described by McCoy (1876) and Chapman (1903). To these the present writer has added two species of *Anoplia* (1942), and the new species of *Chonetes* described in this paper. These amount to fourteen chonetid species in all. Material has been collected which indicates the presence of a number of further new species, but the specimens are not good enough on which to found new species. The Silurian and Devonian rocks of Victoria are rich in chonetids. Some occur in gargantuan numbers, e.g., *Chonetes ruddockensis, C. australis,* and *Anoplia australis*; also to a less extent, *C. melbournensis, C. cresswelli,* and *A. withersi.*

Subdivision of the Yeringian Series in the Type Area.

The Victorian chonetids are good index fossils. *C. melbournensis* is strictly Melbournian, *C. australis* and *C. gaskini* strictly limited to the Buchan and Bindi Beds, and the rest strictly Yeringian (Lower Devonian). Divisions within the Yeringian Series can be satisfactorily made on the basis of these fossils, and the following subdivision is proposed (for structure, *vide* Gill, 1942):—

1. Lower Yeringian—to be recognized by the presence of *Chonetes ruddockensis, Anoplia australis,* and *Stropheodonta bipartita.* (It has been noted that there is a *Stropheodonta bipartita* in the Devonian beds of North America (Swartz, 1941), but it belongs to *Leptostrophia,* which sub-genus is now accorded generic rank. As our *S. bipartita* belongs to *Stropheodonta sensu stricto* there is no need to change the name). These are all prolific forms, and their occurrence in strength may be always taken as an indication of the presence of this sub-division.

2. Upper Yeringian—to be recognized by the presence of *Chonetes cresswelli, C. robusta,* and *C. killarensis.*

These subdivisions are in keeping with what we know of the Yeringian faunules as a whole. Of course, such subdivisions must be regarded as tentative in that further subdivisions will probably become possible as our knowledge of these beds and their faunules increases. However, this distinction between Upper and Lower Yeringian will help considerably in the classification of strata elsewhere in relation to the type Lilydale beds. For instance, the grey mudstone beds north of Tommy's Hut with plentiful *S. bipartita,* and the bluish indurated mudstones of West Kinglake with *A. australis,* the reddish mudstones of Yellingbo with *S. bipartita* and *C.* cf. *ruddockensis,* the grey mudstones at Christmas Hills with *S. bipartita,* and similar beds at " Two miles below Simmond's Bridge Hut on the Yarra," may all be classified as Lower Yeringian; the bluish-grey mudstones at Killara (locs. 34 and 35) may be classified as Upper Yeringian. The strong affinities between *C. taggertyensis* and the Upper Yeringian form *C. psiloplia* suggests an Upper Yeringian classification for the beds in the Blue Hills in which *C. taggertyensis* occurs. No *Chonetes* have yet been described from the Heathcote Beds, but the collections made by Dr. Thomas have not yet been studied.

Chonetes ruddockensis and *Stropheodonta bipartita* are entirely absent from the Upper Yeringian beds of the Lilydale District. One specimen only of *Anoplia australis* has been found at Hull-road, Mooroolbark (loc. 13), and one only at North of Lilydale (loc. 3), whereas both species are prolific in the Lower Yeringian. As far as our knowledge goes, any of the three forms named as characteristic of the Lower Yeringian, if present in strength, may be taken as indicative of a Lower Yeringian horizon. The three forms given as characteristic of the Upper Yeringian have not been found outside those beds, so apparently any of the three species, if present at all, is an indication of that horizon.

Ruddock's Quarry (loc. 20) is named as the type locality for the Lower Yeringian. The olive-grey indurated mudstones (with occasional still harder sandstone bands) found there can be traced from Mooroolbark through the Ruddock's Quarry area (where pitch affects the strike), and north towards Yarra Glen. Hull-road, Lilydale (loc. 1), is named as the type locality for the Upper Yeringian. There, in whitish and reddish soft mudstones, *C. robusta* and *C. cresswelli* have been collected, and *C. killarensis* occurs in the adjacent locality of Melbourne Hill, Lilydale (loc. 7).

The Jordanian Series.—The next question is the relation of these forms to the Jordanian Series (Gill, 1941). Except for a few ubiquitous forms, the faunas of the Melbournian and

Yeringian are mutually exclusive, although they are both of littoral facies. There would not be this faunal break if the two series constituted a continuum in time. There must be a time-break between the two series, and this is occupied by the Jordanian Series. This series (as known at present) is pelagic, but not just the pelagic facies of a part of the Melbournian or Yeringian. Littoral forms are rare in the Jordanian, and so chonetids are not to be expected. A brachial valve which may be a *Chonetes* (collected by Dr. I. Cookson at McMahon's Creek) is the only chonetid found so far in the series.

The Melbournian beds contain graptolites of Lower Ludlow age (Jones, 1927). The Yeringian beds are Lower Devonian (Gill, 1942), and may even extend up into the Middle Devonian (Ripper, 1938, Hill, 1939, 1943). Thus there is a lacuna of Upper Ludlow age, which must be the age of the Jordanian beds. A *Posidonomya* common at McMahon's Creek (east of Warburton) is very similar to *P. eugyra* from étage E. of Bohemia, which is equivalent to the Upper Ludlow.

Correlation with Overseas Deposits.—There are interesting parallels between the Victorian chonetids and forms described from the classic series of Europe and North America; also from beds in Indochina. These may be summarized as follows:—

Stratigraphical position in Victoria.	Victorian Species.	Overseas Species.	Stratigraphical position Overseas.
Melbournian ..	*Chonetes melbournensis*	*C. novascotica* of Nth. America and Europe	Ludlow.
Yeringian ..	*C. productoida* ..	*C. hemispherica* of Nth. America. *C. verneuli* of Europe	Upper Helderberg, etc.
Yeringian ..	*C. cresswelli* ..	*C. nongpoensis* of Indochina	(Lower) Devonian
Yeringian ..	*C. ruddockensis* ..	*C. setigera* of Nth. America *C. soror* and *C. C. embryo* of Europe	Marcellus-Waverley
Yeringian ..	*C. taggertyensis* ..	*C. sarcinulata* ..	Lower Devonian, "most abundant in the Upper Siegenian."
		C. unkelensis ..	Uppermost L. Dev.
		C. maoria ..	Lower Devonian of N.Z., "Siegenian or Lower Coblenzian."
Yeringian ..	*Anoplia australis* ..	*A. nucleata* ..	L. Dev. of Moselle; Oriskany and Onondaga of Nth. America.

It should be noted that the above comparisons are not all of equal value. *C. melbournensis* and *C. novascotica* are very similar; so also are *C. taggertyensis, C. maoria,* and *C. sarcinulata.* On the other hand, the comparisons between *C. ruddockensis* and *C. setigera,* and between *C. productoida* and *C. hemispherica,* are based on striking likenesses in external form. In both the cases quoted the important internal characters are not known.

Further, there is no great likeness between our species of *Anoplia* and *A. nucleata,* but as the genus is so rare in number of species, there is no doubt significance in its presence.

The Lilydale Beds, which constitute the type beds of the Yeringian Series, are very thick. Although the thickness already given on the evidence available (Gill, 1942) will very likely be reduced as our knowledge of the structure is increased, there nevertheless is certainly a great thickness of beds involved. It is possible that the mudstones and sandstones of the Yeringian Series cover the whole of Lower Devonian time, but a great thickness of beds below the Ruddock's Quarry horizon is apparently quite unfossiliferous, and the limits of the series have not yet been precisely defined. The writer prefers to wait till the faunules of the Yeringian type area have been further worked out, before drawing any close correlations with the classic overseas series.

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Description of Plate.

PLATE VIII.

(No photographs are retouched.)

FIG. 1.—*Chonetes bowieae,* sp. nov., internal cast of ventral valve (syntype) × 2 approx.

FIG. 2.—*Chonetes bowieae,* sp. nov., external mould of ventral valve (syntype) same size approx.

FIG. 3.—*Chonetes productoida,* sp. nov., internal cast of ventral valve (hypotype) × 1.5 approx.

FIG. 4.—*Anoplia australis* Gill. Specimen from Kinglake showing ribbing (enlarged).

FIG. 5.—Spines of *Chonetes cresswelli* Chapman. Specimen from Hull-road, Lilydale.

FIG. 6.—*Chonetes taggertyensis,* sp. nov., internal cast of ventral valve (paratype) × 2 approx.

FIG. 7.—*Chonetes productoida,* sp. nov., internal cast of ventral valve (holotype) × 1·5 approx.

FIG. 8.—*Chonetes taggertyensis,* sp. nov., internal cast of ventral valve (syntype) × 2 approx.

FIG. 9.—*Chonetes gaskini,* sp. nov., ventral valve (holotype), same size. Note spine.

FIG. 10.—*Chonetes ruddockensis,* sp. nov., internal cast of ventral valve (holotype) × 4 approx. Note long spine.

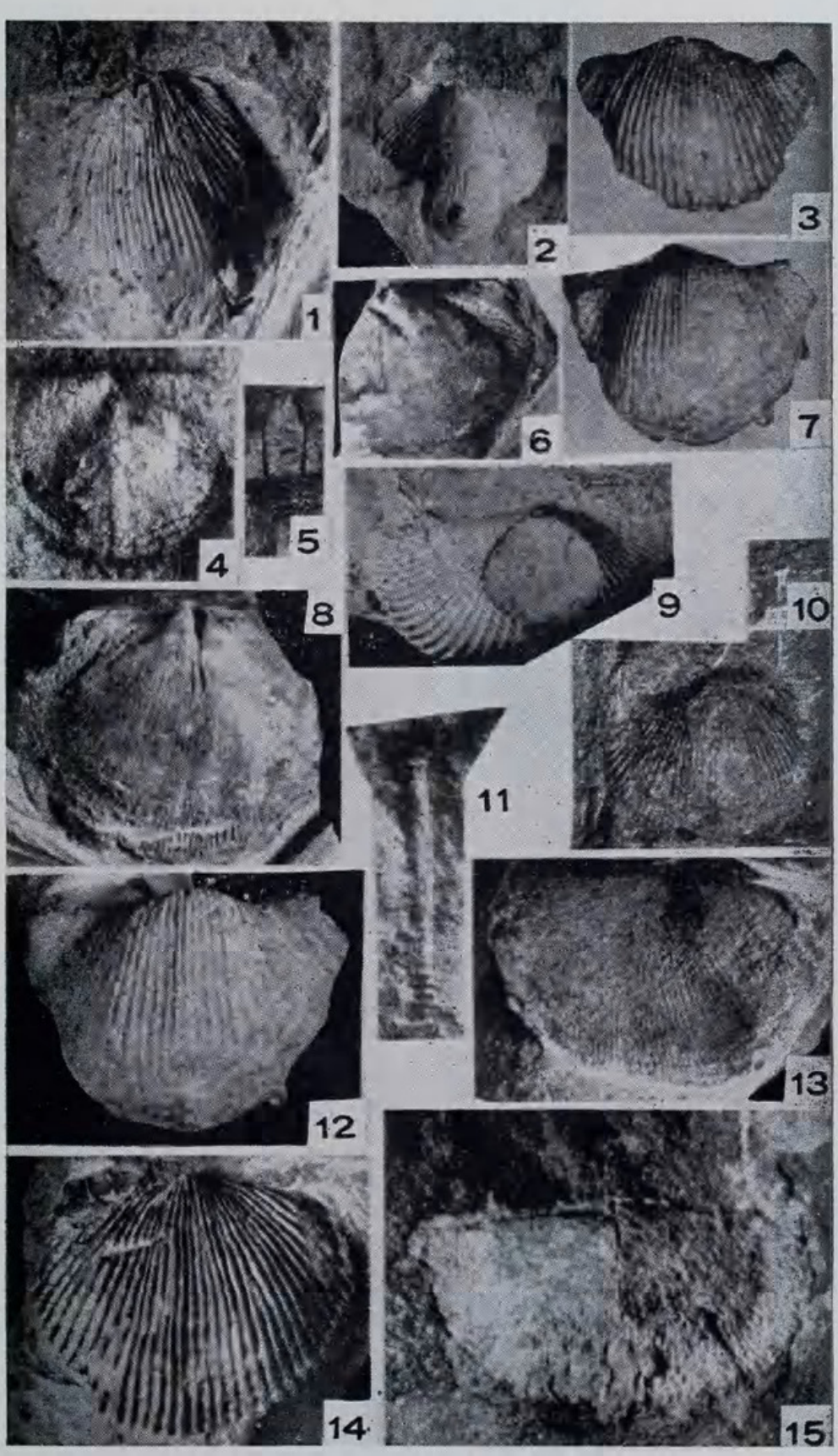
FIG. 11.—Photomicrograph of spine of *Chonetes gaskini,* sp. nov. (*vide* fig. 9). Note annulation where spine joints shell, and a series of annulations at the outer end.

FIG. 12.—*Chonetes productoida,* sp. nov., internal cast of ventral valve (holotype) showing spine bases and medium septum.

FIG. 13.—*Chonetes taggertyensis,* sp. nov., external mould (syntype) showing external ornament, × 2 approx.

FIG. 14.—*Chonetes killarensis,* sp. nov., internal cast of ventral valve (holotype) × 2 approx.

FIG. 15.—*Chonetes psiloplia,* sp. nov., internal cast of ventral valve (holotype) × 4 approx.



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