

EURYDESMA AND PERUVISPIRA FROM THE DWYKA BEDS OF SOUTH AFRICA

by J. M. DICKINS

ABSTRACT. *Eurydesma mytiloides* Reed 1932 and *Peruvispira vipersdorfensis* sp. nov. are described and figured. The distribution and origin of *Eurydesma* are considered. *Eurydesma* has been recorded from South Africa, India, Western and Eastern Australia, and South America: in all areas it is associated with deposits of glacial origin. It may have evolved from early Mytilacean forms and was apparently adapted to cold-water conditions and became extinct when these conditions ended. The characters of *Peruvispira* are discussed. It is separated from *Ptychomphalina* Fischer 1885, to which it is closely related, mainly by the possession of a distinct revolving concave area below the slit-band. *Pleurocinctosa* Fletcher 1958 is regarded as a synonym of *Peruvispira*. The fossils indicate a Lower Permian age, most likely Sakmarian but possibly early Artinskian.

ALTHOUGH the occurrence of *Eurydesma* in association with the Dwyka tillites was first recorded many years ago, up to the present no palaeontological description has been undertaken. As well as *Eurydesma* cf. *globosum* Dana,¹ Range (1912, p. 29–31, pl. 6) recorded conularians, fish, gastropods, and an *Inoceramus*-like pelecypod from beds he considered to be associated with the *Eurydesma* beds. Although the specimens figured by Range were too incomplete to allow definite identification at the species level, the hinge structure shown established the presence of *Eurydesma*.

Reed (1935, p. 161, pl. 5) described *Aphanaia haibensis* from the Upper Dwyka Shales near Haib, South-west Africa.

The present specimens were collected by Dr. H. Martin of the Geological Survey of South Africa and were forwarded for examination to Dr. C. Teichert, then at the Department of Geology, University of Melbourne. By arrangement with Dr. Teichert, Dr. Martin, and the Director of the Geological Survey of South Africa, the specimens were passed to the author for description.

The stratigraphical occurrence of the fossils is described in detail by Martin (1953). The marine invertebrate fossils are found in the Mariental-Keetmanshoop area, in the bottom part of the sequence, which lies discordantly on the Nama Beds. The Nama Beds are of Upper Precambrian to Lower Palaeozoic age (for a recent account see Haughton and Martin 1956). Martin shows that the layers with marine fossils are interbedded with deposits of glacial origin and of the total thickness of 1,400–1,700 feet he considers 800–1,000 feet to be glacial. The beds with marine fossils are separated by several hundred feet of shales from the *Mesosaurus* horizon.

In addition to the *Eurydesma*, which is described as *Eurydesma mytiloides* Reed, the collection contains *Peruvispira vipersdorfensis* sp. nov., an unidentified bryozoan and crinoid plates. Thus the occurrence in South Africa of elements of the '*Eurydesma*-fauna' other than *Eurydesma* (elements which are characteristically developed in India and in Western and Eastern Australia) is of considerable interest.

¹ Etheridge and Dun (1910, p. 72) regard the specimens on which Dana based his description of *Eurydesma globosum* as young of *E. cordatum* and thus *E. globosum* is placed by them in synonymy. There certainly seems ample justification for Etheridge and Dun's conclusion.

WORLD DISTRIBUTION AND ORIGIN OF *EURYDESMA*

Eurydesma is known to occur in South Africa, India, Western and Eastern Australia, and South America. In all these areas it is associated with sediments showing marked signs of glacial influence. The author has recently discussed (1957, p. 18) the association of *Eurydesma* with cold, shallow-water sediments and taking into consideration the recent work on turbidity currents and deep-water deposition, there appears no reason to revise the conclusions made.

The origin of *Eurydesma* remains almost as obscure as when the subject was discussed by Etheridge and Dun in their classic monograph of 1910. Despite a wide search, no close ancestor is apparent in the Carboniferous Period. The relationship of *Eurydesma* to the living pteriids is not as close as was thought by Etheridge and Dun. *Eurydesma* differs especially from all other forms in its marked dental process at the anterior end of the hinge, in the anterior position of a large adductor muscle and in the S-shaped series of muscle pits associated with the umbo. These impressions probably represent the pedal muscles and the pits of the pallial attachment. Waagen (1891, p. 140, pl. 6, figs. 3-6) suggests real cardinal teeth are present but these may represent rather folds of shelly material not analogous with hinge-teeth. Koken (1904, p. 101) says no such teeth are visible in his specimens from the Salt Range and I have never observed them in specimens from Australia. The ligament, which is lodged in a single elongated ligament groove, is of a type common in many groups of Palaeozoic shells, a type which has apparently formed the basis of that found in living mytilids. The ligament, the dental process, and the relatively complex shell structure (see Dickins 1957) would preclude close relationship to the living Pteriidae. The distinctiveness of *Eurydesma* from other late Palaeozoic pelecypods is emphasized by its arrangement in a separate family, Eurydesmidae Reed.

Amongst earlier forms, *Eurydesma* appears to resemble *Shaninopsis* Isberg (1934, p. 336) from the Leptaenakalkes of Dalarna (Ordovician to Silurian). *Shaninopsis* has the same type of ligament, is similar in shape, and has a dental process not unlike that found in *Eurydesma*. It differs, however, in possessing a distinct anterior byssal opening. As such a long period of time separates *Shaninopsis* from *Eurydesma*, an alternative explanation to descent of *Eurydesma* from *Shaninopsis* may be that *Eurydesma* developed rapidly, probably from one of the Mytilacea, in the environment which came into existence towards the end of the Carboniferous Period. *Eurydesma* can be related to the Mytilacea in the following respects:

1. The shell structure, although differing from the Myalinidae, is not very different from that described by Newell (1942, p. 32) in the Mytilidae.
2. The ligament is of the same type as that found in *Atomodesma* which has been placed in the family Myalinidae (Newell 1942, and other authors).
3. The pattern of the pedal muscle scars and the pits of the pallial attachment would require only slight modification from that found in the Myalinidae. A similar muscle pattern, however, also occurs in the Pteriacea.
4. The dental process could be derived from the umbonal septum found in *Atomodesma*, and in other genera of Myalinidae. The Myalinidae, however, appear to lack the distinct byssal notch found in front of the dental process of the right valve of *Eurydesma*. The byssal notch is especially distinct in young *Eurydesma*.

It thus seems possible that *Eurydesma* developed rapidly in cold-water conditions,

either accompanying or immediately after the late Palaeozoic glaciation. Once developed it became stabilized to these conditions and very little evolutionary development is apparent.

Any large collection of specimens made at one locality (collection point) shows considerable variation and some authors (Reed 1936; Harrington 1955; Sahni and Srivastava 1956) have proposed a considerable number of specific names in such cases. In samples I have examined, however, from Western Australia, New South Wales, and Queensland, there have been no sharp morphological differences which could be used for specific differentiation and the whole appeared to be rather a single variable community. This variability has already been noted by a number of previous workers, including Etheridge and Dun (1910, pp. 47, 72), Fossa Mancini (1944, p. 91—*vide* Harrington 1955, p. 122) and Harrington (1955, p. 122). Many of the groups for which specific names have been proposed, therefore, should possibly be regarded rather as varieties. As frequently occurs with variable forms there seems to be considerable stratigraphical and geographical range of species, and the species found in different regions do not differ greatly.

When the conditions to which *Eurydesma* was apparently specially adapted ceased to exist the genus rapidly became extinct. In Western Australia and Salt Range, India, this occurred in late Sakmarian or early Artinskian time, when the Gondwana '*Eurydesma*-fauna' was replaced, in the Lower Productus Limestone and the Callytharra Formation, respectively, by a more temperate Tethyan Fauna (Dickins 1957; Dickins and Thomas 1959). It is possible that in the Agglomeratic Slate of Kashmir *Eurydesma* lingered on slightly longer. In Eastern Australia, which was apparently partly isolated, either by climate or by geography, the earlier fauna persists with considerable diversification until at least late Lower Permian (Kungurian),¹ when earth movements brought marine sedimentation to an end and initiated extensive intra-continental non-marine deposition. *Eurydesma* itself, however, does not appear to persist to the top of the marine sequence.

AGE OF THE DWYKA FAUNA

To the marine forms previously recorded (conulariids, '*Aphanaia*' *haibensis* Reed 1935, unidentified gastropods and pelecypods and fish remains) can be added *Eurydesma mytiloides* Reed 1932 and *Peruvispira vipersdorfensis* sp. nov. which are described in the present paper. Amongst the molluscs *E. mytiloides* and *P. vipersdorfensis* are important with regard to the age of the South African deposits, as pelecypods similar to '*Aphanaia*' *haibensis* are known to occur in the Lower and Upper Permian of both North-eastern Siberia (Popov, 1957) and Western Australia (unpublished work of the author).

Du Toit (1954, p. 356) apparently considered that the horizons with marine fossils lay above the glacial deposits and concluded that the Dwyka ice age must have embraced much, if not the whole, of the Upper Carboniferous, while the Upper Dwyka shales (with *Eurydesma*) were not younger than lowest Permian. Martin's (1953) work, however, indicates that marine horizons are interbedded with the glacial horizons. Martin (written communication) considers it probable also that *Eurydesma* occurs in shales overlying

¹ General although not unanimous current Soviet opinion is followed with regard to the subdivision of the Permian System. The System is regarded as containing two main subdivisions, Lower and Upper, the Lower comprising the Sakmarian, Artinskian, and Kungurian Stages and the Upper, Kazanian and Tatarian (Kulikov, pers. comm.; and Stepanov 1958). The Australian deposits are correlated with the standard subdivisions and the names are used to indicate the age.

the highest glacial bed. The affinities of the marine fossils would suggest they are of a Lower Permian age, mostly likely Sakmarian but possibly early Artinskian.

Some workers have concluded, for example Caster (1953), Beurlen (1953), Maack (1957), and Putzer (1957), that the '*Glossopteris* flora' of South America associated with deposits of glacial origin and marine fossils is of Upper Carboniferous age. To some extent this seems to be based on the assumption that the Australian '*Glossopteris* (and *Gangamopteris*) flora' and the '*Eurydesma* fauna' are of Upper Carboniferous age. Dickins and Thomas (1959) have considered evidence which indicates that in Australia the '*Eurydesma* fauna' with associated glacials is mainly or entirely of Lower Permian age. If the '*Eurydesma* fauna' does begin earlier, which we do not think likely, it could only be in the very uppermost Carboniferous. If our conclusion is correct then it follows also that the '*Glossopteris* flora' first appears in the Lower Permian or less likely in the very uppermost Carboniferous because we do not know of any occurrence of the '*Glossopteris* flora' in Australia significantly earlier than *Eurydesma*.

In New South Wales evidence has been adduced for Carboniferous glaciation earlier than that associated with the '*Eurydesma* fauna' (see David 1950, p. 292). This earlier glaciation appears to be confined to New South Wales and may be associated with Upper Carboniferous orogeny. In India also, some workers, for example Bhatia and Singh (1959), had made a similar assumption that the '*Eurydesma* fauna' is Upper Carboniferous and have used this to support a conclusion that Talchir Series is of Upper Carboniferous age. The evidence from New South Wales for glaciation both in the Carboniferous and in the Lower Permian may have caused confusion with regard to the stratigraphical position and age of the '*Eurydesma* fauna'. Bhatia and Singh have also indicated that the arenaceous forams from the Talchir Series are similar to those of the Pennsylvanian of North America. They are similar also, however, to forms found in the Permian of Western Australia (see Crespin 1958). Although the possibility that the '*Eurydesma* fauna' first appeared in the uppermost Carboniferous cannot be discarded, the close relationship of the South African fossils to forms from Kashmir, Umaria, the Salt Range, and Western Australia indicates a Lower Permian age (Sakmarian or possibly early Artinskian).

E. mytiloides has so far been recorded from the Agglomeratic Slate of Kashmir and the Speckled Sandstone of the Salt Range, from Argentina, and recently by Sahni and Srivastava (1956) from the eastern Himalayas. Harrington, who described the Argentinian species, has also suggested (1955, p. 124) that a specimen from Eastern Australia referred to *Eurydesma cordatum* var. *sacculum* by Etheridge and Dun may belong to *E. mytiloides*. I have recently suggested (Dickins and Thomas 1959) that *E. mytiloides* may be present at Umaria, from where *P. umariensis*, which is closely related to *P. vipersdorfensis*, was first described.

Dickins and Thomas, on the basis of the occurrence of similar productids and spiriferids, the gastropod *P. umariensis*, and a calceolispongiid crinoid, correlate the Umaria Beds with the upper part of the Lyons Group, considering both to be of Sakmarian age. The Speckled Sandstone on the basis of its brachiopods and molluscs is also considered to be of similar age. Both the Umaria Beds and the Speckled Sandstone lie above or at the top of the Talchir Series. The Agglomeratic Slate of Kashmir, on the basis especially of the molluscs, productids, and spiriferids, as well as probably containing sediments of Sakmarian age, may also contain slightly younger sediments as the

sequence contains *Oriocrassatella* and a type of *Deltopecten* which, in Western Australia, appear in formations younger than Lyons Group and which are not recorded from the Umaria Beds and the Speckled Sandstone.

As is considered in more detail later, *P. vipersdorfensis* appears to resemble the older (Sakmarian) species of *Peruvispira* more closely than the younger Artinskian.

The conclusion made about the age of the Dwyka Beds is similar to that of Gürich (1923, p. 73) who described the fish from Ganikobis and considered they were late Carboniferous or early Permian. Recently Leschik has described spores from beds overlying the *Eurydesma* horizon and underlying the *Mesosaurus* horizon; he regards the spore-bearing beds as Lower Permian (1959, p. 52).

SYSTEMATIC DESCRIPTIONS

Class PELECYPODA

Family EURYDESMIDAE Reed 1932

Genus EURYDESMIA Morris 1845

Type species. Eurydesma cordata Morris (1845, p. 276, pl. 12, figs. 1, 2) by monotypy.

Eurydesma mytiloides Reed 1932

Plate 18, figs. 1-6

1932 *Eurydesma cordatum* Morris var. *mytiloides* Reed, p. 50, pl. 11, figs. 1-3b.

1936 *Eurydesma cordatum* Morris var. *mytiloides* Reed 1932; Reed, p. 18, pl. 3, figs. 1, 2.

1955 *Eurydesma mytiloides* Reed 1932; Harrington, p. 124, pl. 25, figs. 5-8.

1956 *Eurydesma cordatum* Morris var. *mytiloides* Reed 1932; Sahni and Srivastava, p. 205, pl. 34, figs. 1-3.

Description. The shells are oval and of moderate size for *Eurydesma*. The ligament is characteristic of *Eurydesma*, lodged in an elongated groove running backwards from the umbo and narrowing toward both front and back. Fine longitudinal growth-lines are visible within the ligament groove. In the right valve the distinct byssal notch runs almost directly downwards, but is inclined slightly towards the back. The details of the dental process in the right valve are obscured by erosion. In the left valve the characteristic smaller process is developed at the anterior end of the hinge-line. When the two valves are in position the process of the left valve overlaps the right valve and covers from view the byssal opening (see Etheridge and Dun 1910, pl. 18, fig. 3; pl. 19, fig. 3;

EXPLANATION OF PLATE 18

Figs. 1-6. *Eurydesma mytiloides* Reed 1932. All specimens figured are from Farm Hardap 110, about 10 miles north-west of Mariental. 1, Hypotype C, left valve, No. 7093, lateral view, $\times 1$. 2, Hypotype C, left valve, No. 7087, internal view showing the hinge, $\times 1$; the hinge is damaged by weathering. 3, Hypotype B, left valve, No. 7094, internal view showing hinge, $\times 1$; the back part of the shell is missing. 4, Hypotype E, right valve, No. 7090, dorsal view, $\times 1$. 5, 6, Hypotype D, bivalved specimen, No. 7086, lateral view of left valve and front view respectively, $\times \frac{1}{2}$; the specimen is crushed and telescoped in a dorso-ventral direction so that the shape is distorted.

Figs. 7-11. *Peruvispira vipersdorfensis* sp. nov. $\times 4$. All specimens figured have the number 7081 and are from Farm Vipersdorf No. 63, Gibeon District. 7, Holotype, external matrix blotted out to show character of slit-band and concave revolving area. 8, Holotype showing shell in matrix. 9, Paratype B. 10, Paratype A. 11, Paratype C.

Dickins 1957, pl. 5, fig. 11). The external surface is ornamented only with concentric growth-lines. A distinct lobe is formed anteriorly and the umbo is developed in a similar manner to described specimens of *E. mytiloides*. The umbo appears to be more distinctly developed than in *E. playfordi* Dickins (1957, p. 33, pl. 5, figs. 1-11). The muscle pattern is not visible in any of the specimens.

Dimensions (in mm.)

	<i>Length</i>	<i>Height</i>	<i>Thickness</i>
Hypotype A (7087): right valve . . .	68	70	..
Hypotype B (7094): left valve . . .	35	36	..
	(approx.)		
Hypotype C (7093): left valve . . .	52	55	16
	(approx.)		
Hypotype D (7086): bivalved specimen .	Crushing does not allow reliable measurement		
Hypotype E (7090): right valve . . .	50	52	15
		(approx.)	

Occurrence. All the specimens come from the lower part of the Dwyka Succession, Farm Hardap 110 about 10 miles north-west of Mariental. The numbers are those of the Geological Survey, Union of South Africa, Pretoria, where the specimens are housed.

Discussion. Taking into consideration the specimens available there does not seem to be any basis for their separation from *A. mytiloides* Reed. Range figured two umbonal fragments similar to the umbonal parts of Martin's specimens, and they seem likely to belong to the same species. The reference of Range's specimens to *E. cf. globosum* Dana by Professor Schröder (Range 1912, p. 29) was reasonable at the time, before Reed's description of the Kashmir fauna became available, but the South African specimens are distinct from those of *E. globosum* (= young specimens of *E. cordatum*). The young specimen figured by Dana (1847, pl. 7, figs. 7; 7a) shows already the very tumid and prominent umbo characteristic of *E. cordatum*.

When proposing the name *E. cordata* Morris (1845, p. 276) figured two shells. Apparently neither has been chosen as a type and if this is the case, the top figure of pl. 12, apparently fig. 1, is here designated as the lectotype. This designation safeguards usage and meets the suggestion of Etheridge and Dun (1910, p. 72): 'The large number of specimens now before us conforming to Morris's upper single figure, compels us to regard this as representing the type form of *E. cordatum*.'

Morris states that his specimens are from Illawarra, New South Wales, but as with his specimens of *Deltopecten illawarrensis* there must be doubt whether this locality is correct (see Etheridge and Dun 1910, p. 69). It seems likely that Morris's specimens came from Harpers Hill where *E. cordatum* is common and from where he also had specimens.

I am grateful for the following comment to Mr. S. Ware of the British Museum (Natural History) where Morris's specimens are housed: 'The two specimens of *E. cordata* in question have a preservation entirely different from the other six specimens from Illawarra. *E. cordata* (pl. 12, fig. 1) is identical with our material from Harpers Hill, and the other (pl. 12, fig. 2) compares most favourably with specimens preserved in a black or greyish black limestone labelled '? W. Maitland' unfortunately, and also *Eurydesma* specimens from Tasmania.'

E. mytiloides is so different from *E. cordatum* especially with respect to the characters

of the umbo that I have no hesitation in agreeing with Harrington's (1955, p. 124) decision to regard Reed's variety as a species.

Class GASTROPODA

Family PLEUROTOMARIIDAE D'Orbigny

Genus PERUVISPIRA Chronic 1949

Type species. *Peruvispira delicata* Chronic (in Newell, Chronic, and Roberts 1949, p. 147; 1953, p. 139, pl. 28, figs. 9-12) by original designation of Chronic.

Synonym. *Pleurocinctosa* Fletcher (1958, p. 139).

Diagnosis. Similar to *Ptychomphalina* Fischer 1885 but characterized by the possession of a distinct revolving concave area about as wide as and below the slit-band. The concave area is bounded below by a ridge which may form a lira or carina. The growth-lines after leaving the base of the slit-band swing forward across the concave area and then back across the revolving ridge and over the base of the whorl.

Family position. Because of the variability of certain important characters and thus the difficulty of choosing distinct groupings, the supra-specific subdivision of the Upper Palaeozoic pleurotomarioids presents considerable difficulties. The taxonomy of the family level is under review (see Batten 1958, p. 184) and in this paper *Peruvispira* is retained in the family Pleurotomariidae. This, however, must be regarded as provisional only.

Discussion. Although all the described species of *Peruvispira* have a higher spire than is found in the type species of *Ptychomphalina* *P. striata* (J. Sowerby) (figured and described in Knight 1941, p. 286, pl. 29, figs. 3a-c), such a difference alone can hardly be regarded as a reliable criterion for generic distinction. The spire will vary in height according to small variations in the whorl profile and the amount of involution, and indeed varies considerably within some ptychomphalinid species that I have examined. In *Peruvispira* the whorl cross-section in a general way is similar to that of the type species of *Ptychomphalina*, and the differences in detail, except for the occurrence of the distinct concave area below the slit-band, would not appear to warrant generic separation.

In proposing the generic name *Peruvispira* Chronic made no comparison of his new genus with *Ptychomphalina*; perhaps he assumed, following Thomas (1940), that it was a synonym of *Mourlonia*. On the other hand *Peruvispira* does not appear to be particularly closely related to *Neilsonia* Thomas (1940). Thomas based her conclusion regarding the synonymy of *Ptychomphalina* not on examination of the type specimens but on Fischer's (1885) description of *Ptychomphalina* where it is stated that *Ptychomphalina* has spiral ornament. However, according to Knight's (1941) description and figures, *Ptychomphalina* can be separated from *Mourlonia* by its lack of spiral ornament. None of the Western Australian Permian species referable to *Ptychomphalina* has any spiral ornament; this character appears to be consistent and of some importance. *Ptychomphalina* also, according to Knight, has a distinct thickening of the columellar lip without an extension of callus outside the aperture and the *Mourlonias* and *Ptychomphalinas* form two distinct lines of development in the Carboniferous and Permian; so that,

although the two lines may be convergent in the Lower Carboniferous, it does not seem justifiable to place *Ptychomphalina* in synonymy with *Mourlonia*.

In *Ptychomphalina striata* (J. Sowerby), as figured in Knight (1941), the growth-lines swing forward only slightly below the slit-band, and a narrow poorly developed concave area is present. Thus although *Peruvispira* is distinguished only by the degree of development of these features, its recognition as a separate taxonomic group appears justifiable because it forms a rather compact group of high-spined forms which has a different stratigraphical distribution from *Ptychomphalina*.

Fletcher (1958, p. 139) has proposed the new generic name *Pleurocinctosa*, with *Pleurotomaria trifilata* Dana (1847, p. 150) as the type species. He distinguishes *Pleurocinctosa* from *Peruvispira* on the possession of a strongly developed columellar lip and other apertural features. However, in the specimens of *Peruvispira* figured by Chronic (in Newell, Chronic, and Roberts 1953, pl. 28, figs. 9–12) the columellar lip seems to be incompletely preserved, so that proposal of a new name on the basis of the apertural features seems hardly justifiable. In other important characters such as whorl height and profile, nature of the slit-band, ornamentation, and the concave revolving area beneath the slit-band *Peruvispira* and *Pleurocinctosa* are similar. It seems unlikely that, when complete specimens of *Peruvispira delicata* are available, the apertural features will differ in any important way from those of *Pleurotomaria trifilata*; so I have no hesitation in regarding *Pleurocinctosa* as a synonym of *Peruvispira*.

Peruvispira vipersdorfensis sp. nov.

Plate 18, figs. 7–11

Diagnosis. Very similar to *Peruvispira trifilata* (Dana)¹ (1847, p. 150; 1849, p. 706, pl. 9, figs. 15, 15a) and *Peruvispira umariensis* (Reed) (1928, p. 389, pl. 34, fig. 12, pl. 35, figs. 11–13). Separated, however, from *P. umariensis* by having a less well-rounded whorl cross-section and having the third lira or ridge situated farther away from the periphery of the shell. From *P. trifilata* it can be separated by the higher spire and the lesser apical angle.

Description. Holotype: a natural vertical cross-section through the columella, slightly etched with acetic acid, shows the essential features of the species. The upper whorl surface is almost straight with the slit-band at the outer edge and approximately vertical. The slit-band is bounded on either side by a distinct ridge. Below the slit-band the outline is concave; the concave part being bounded below by a ridge. The outline then joins the base with an arc of low curvature. The columellar lip is distinctly thickened as in *P. umariensis* and *P. trifilata*. Other specimens: these confirm the characters shown by the holotype. Paratype B shows in addition that the adult was non-umbilicate. Apparently most mature specimens have four whorls, though some have five.

¹ Fletcher (1958, p. 140) sets out reasons for considering that *Pleurotomaria morrisiana* M'Coy (1847, p. 306, pl. 17, fig. 5) should be regarded as a synonym of *Pleurotomaria trifilata*. The choice by Fletcher of the specimen figured by Dana (1849, pl. 9, figs. 15, 15a) as the holotype thus ensures that *P. morrisiana* becomes a synonym of *P. trifilata*. The writer is in full accord with the proposals and conclusions of Fletcher in this regard.

Dimensions (in mm.)

	<i>Height</i>	<i>Width</i>	<i>Apical angle</i>
Holotype . . .	9 (approx.)	6	46°
Paratype A . . .	8 (approx.)	6	45°
Paratype B . . .	8	5.5	38°
Paratype C . . .	9	6	38°

Occurrence. Holotype and Paratypes A, B, and C, No. 7081, Farm Vipersdorf No. 63, Gibeon District, other specimens No. 7082, Tses Native Reserve, near main road about 8 miles north of Tses Siding. The numbers are those of the Geological Survey, Union of South Africa, Pretoria, where the specimens are housed.

Discussion. Although several pieces of rock are crowded with some hundreds of specimens apparently all belonging to this species, only a few specimens show the characters necessary for a generic and specific differentiation. The preservation is not good, but revolving ornament appears to be present only as ridges bounding the slit-band and the ridge at the lower boundary of the revolving concave area.

Whorl cross-section and the height of the spire vary somewhat, so that some specimens approach more closely to *P. trifilata* and others to *P. umariensis*. On the whole, however, the species appears to approach closer to *P. umariensis* than to *P. trifilata* and it is tempting to identify specimens with more rounded whorls with *P. umariensis*. It seems best, for the present at least, to recognize the overall difference of the South African specimens as a specific difference.

P. vipersdorfensis also appears to be closely related to *Peruvispira allandalensis* (Fletcher) (1958, p. 141, pl. 11, figs. 7-9, pl. 12, figs. 2, 3) from the Lochinvar and Allandale 'Formations' of the Lower Marine Beds (= Dalwood Group of Hanlon in Hill 1955) of the Hunter Valley, New South Wales. *P. allandalensis* apparently has a greater number of whorls, a higher spire, and an overall lesser apical angle. *P. vipersdorfensis* appears to be more closely related to the slightly older forms, *P. umariensis* and *P. allandalensis* which occur in rocks of Sakmarian (Lower Permian) age than to the younger *P. trifilata* which occurs in rocks of Artinskian (Lower Permian) age.

Acknowledgements. This work was partly carried out in the Department of Geology of the University of Queensland in partial fulfilment of requirements for a Ph.D. degree. The material has been obtained by arrangement with the Director of the Geological Survey of South Africa, Dr. C. Teichert, and Dr. H. Martin. The co-operation of Dr. F. C. Truter, Director of the Geological Survey of South Africa, is acknowledged and Dr. H. Martin has been most helpful at all stages of this study. The paper is published by permission of the Director of the Bureau of Mineral Resources, Geology and Geophysics, Canberra.

REFERENCES

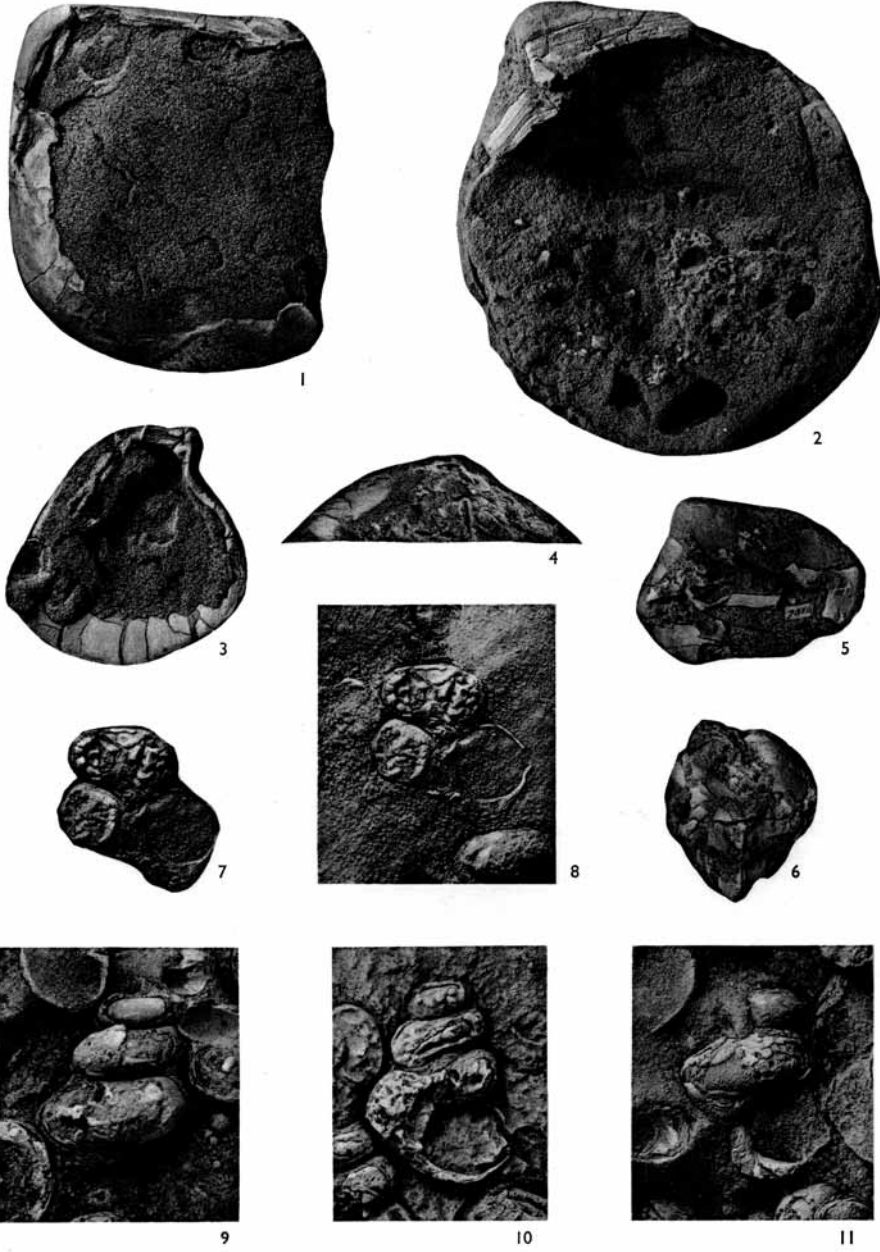
- BATTEN, R. L. 1958. Permian Gastropoda of the South-western United States. 2. Pleurotomariacea: Portlockiellidae, Phymatopleuridae and Eotomariidae. *Bull. Amer. Mus. nat. Hist.* **114** (2).
- BEURLEN, K. 1953. Einige vorläufige Mitteilungen über die Stratigraphie des Gondwana-Systems. *Neues Jb. Geol. Paläont., Abh.* **97** (1/3), 241-56.
- BHATIA, S. B. and SINGH, S. K. 1959. Carboniferous (Uralian) Foraminifera from Manendragarth, Central India. *Micropaleontology*, **5** (1), 127-34.

- CASTER, K. E. 1953. Stratigraphic and palaeontologic data relevant to the problem of Afro-American ligation during the Paleozoic and Mesozoic. *Bull. Amer. Mus. nat. Hist.* **99** (3), 105-52.
- CRESPIN, C. 1958. Permian Foraminifera of Australia. *Bur. Min. Resour. Aust. Bull.* **48**.
- DANA, J. D. 1847. Description of fossils from Australia. *Amer. J. Sci.* **54**, 151-60.
- 1849. In United States Exploring Expedition during the years 1838-42 under the command of Charles Wilkes, U.S.N., 10, Geology, 681-713.
- DAVID, T. W. E. ed. BROWNE, W. R. 1950. *The Geology of the Commonwealth of Australia*, Vol. 1, London.
- DICKINS, J. M. 1957. Lower Permian Pelecypods and Gastropods from the Carnarvon Basin, Western Australia. *Bur. Min. Resour. Aust. Bull.* **41**.
- DICKINS, J. M. and THOMAS, G. A. 1959. The marine fauna of the Lyons Group and the Carrandibby Shale of the Carnarvon Basin, Western Australia. *Bur. Min. Resour. Aust. Rep.* **38**.
- ETHERIDGE, R. jun. and DUN, W. S. 1910. A monograph of the Carboniferous and Permo-carboniferous Invertebrata of N.S.W., Vol. II—Pelecypoda, Part II—*Eurydesma*. *Mem. geol. Surv. N.S.W., Palaeont.* **5**, 41-75.
- FISCHER, P. 1880-7. *Manuel de conchyliologie et de paléontologie conchyliologique*, Paris.
- FLETCHER, H. O. 1958. The Permian Gastropods of New South Wales. *Rec. Aust. Mus.* **24** (10), 115-64.
- FOSSA MANCINI, E. 1944. Las transgresiones marinas del Antracólítico en América del Sur. *Rev. Mus. La Plata, sec. Geol.* **2**, No. 49 [not seen].
- GÜRICH, G. 1923. *Acrolepis Lotzi* und andere Ganoiden aus den Dwyka-Schichten von Ganikobis Südwestafrika. *Beitr. geol. Erforsch. dtsch. SchGeb.* **19** (2), 26-74.
- HARRINGTON, H. J. 1955. The Permian *Eurydesma* Fauna of Eastern Argentina. *J. Paleont.* **29**, 112-28.
- HAUGHTON, S. H. and MARTIN, H. 1956. The Nama System in South and South-West Africa. *Congr. geol. int. xx sess.*, Mexico: Symp. Cambrian, **1**, 323-39.
- HILL, D. 1955. Contributions to the correlation and fauna of the Permian in Australia and New Zealand. *J. geol. Soc. Aust.* **2**, 83-107.
- ISBERG, O. 1934. *Studien über Lamellibranchiaten des Leptaenakalkes in Dalarna. Beitrag zu einer Orientierung über die Muschelfauna im Ordovicium und Silur.* Lund, Hakan Ohlssons Buchdruckerei.
- KNIGHT, J. B. 1941. Paleozoic Gastropod Genotypes. *Spec. Pap. geol. Soc. Amer.* **32**.
- KOKEN, E. 1904. *Eurydesma* und der *Eurydesmen*-Horizont in der Saltrange. *Zbl. Miner. Geol. Paläont.* **5**, 97-107.
- LESCHIK, G. 1959. Sporen aus den 'Karru Sandsteinen' von Norronaub (Südwest-Afrika). *Senck. Leth.* **40** (1/2), 51-95.
- MAACK, R. 1957. Über Vereisungsperioden und Vereisungsspuren in Brasilien. *Geol. Rdsch.* **45** (3), 547-94.
- MCCOY, F. 1847. On the fossil botany and zoology of the rocks associated with coal of Australia. *Ann. Mag. nat. Hist.*, ser. 1, **20**, 145-57, 226-36, 298-312.
- MARTIN, H. 1953. Notes on the Dwyka Succession and on some Pre-Dwyka valleys in South-West Africa. *Trans. geol. Soc. S. Afr.* **56**, 37-41.
- MORRIS, J. 1845. Descriptions of fossils, in STRZELECKI, P. DE, *Physical description of New South Wales and Van Diemen's Land*, London, 270-91.
- NEWELL, N. D. 1942. Late Paleozoic Pelecypods: Mytilacea. *Kansas geol. Surv.* **10** (2), 1-115.
- NEWELL, N. D., CHRONIC, J., and ROBERTS, T. G. 1949. *Upper Paleozoic of Peru*, New York [not seen].
- 1953. Upper Paleozoic of Peru. *Mem. geol. Soc. Amer.* **58**.
- POPOV, U. N. 1957. Some Permian Pelecypods, Gastropods and Ammonites of Verchoyan. *Sci. Inst. Geol. Arctic, Coll. Pap. Palaeont. Biostrat.* **1**, 45-60 (also in *Mater. Geol. Min. Resour. N.E. U.S.S.R.*, 1958 (12)).
- PUTZER, H. 1957. Beziehungen zwischen Inland-Vereisung und Kohlebildung im Oberkarbon von Süd-Brasilien. *Geol. Rdsch.* **45** (3), 599-608.
- RANGE, P. 1912. Geologie des deutschen Namalandes. *Beitr. geol. Erforsch. dtsch. SchGeb.* **2**.
- REED, F. R. C. 1928. A Permo-Carboniferous marine fauna from the Umaria Coal Field. *Rec. geol. Surv. India*, **60**, 367-98.
- 1932. New fossils from the Agglomeratic Slate of Kashmir. *Paleont. Indica*, n.s. **20** (1).

- REED, F. R. C. 1935. A new Lamellibranch from the Upper Dwyka Beds of South-West Africa. *Trans. roy. Soc. S. Afr.* **23**, 161-3.
- 1936. Some fossils from the *Eurydesma* and *Conularia* Beds (Punjabian) of the Salt Range. *Palaeont. Indica*, n.s. **23** (1).
- SAHNI, M. R. and SRIVASTAVA, J. P. 1956. Discovery of *Eurydesma* and *Conularia* in the Eastern Himalaya and description of associated faunas. *J. palaeont. Soc. India*, **1** (1), 202-14.
- STEPANOV, D. L. 1958. The Carboniferous System and its main stratigraphic subdivisions—Report to the Commission on the Stratigraphy of the Carboniferous of the National Committee of Soviet Geologists. Copy distributed at Heerlen conference on Carboniferous stratigraphy, 1958.
- THOMAS, E. G. 1940. Revision of the Scottish Carboniferous Pleurotomariidae. *Trans. geol. Soc. Glasgow*, **20** (1), 30-72.
- TOIT, A. L. DU. 1954. *The Geology of South Africa*. Edinburgh and London.
- WAAGEN, W. 1891. Salt Range fossils. *Palaeont. Indica*, ser. 13, **4** (2), 89-242.

J. M. DICKINS
Geological Section,
Bureau of Mineral Resources,
Geology and Geophysics,
Canberra, A.C.T., Australia

Manuscript received 21 January 1960



DICKINS, *Eurydesma* and *Peruispira*