AMMONOIDS AND TRILOBITES FROM THE UPPER DEVONIAN AND LOWEST CARBONIFEROUS OF THE LAUNCESTON AREA OF CORNWALL

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ABSTRACT. An ascending sequence of strata, comprising the Petherwin Beds, the Stourscombe Beds, and the Yeolmbridge Beds, is noted at the Devonian–Carboniferous boundary. The ammonoid and trilobite fauna of these beds is described.

The genus *Kenseyoceras* and the contained subgenus *K.* (*Mayneoceras*) are proposed, and *Epiwocklumeria* is redefined. The following species are redescribed or proposed:

Petherwin Beds (*Platyclymenia* and *Clymenia* Zones): *P.* (*Platyclymenia*) *valida* (Phillips), *P.* (*Platyclymenia*) *pattisoni* (M'Coy), *Costaclymenia muensteri* (Ansted). Stourscombe Beds (*Wocklumeria* Zone); *Wocklumeria sphaeroides* (Rh. Richter), *Epiwocklumeria dunhevedensis* sp. nov., *Kosmoclymenia pattisoni* sp. nov., *Cymaclymenia constricta* sp. nov., *C. constricta* var. *globosa* nov., *Parawocklumeria laevigata* sp. nov., *P. laevigata* var. *obesa* nov., *Parawocklumeria sp.*, *K.* (*Kenseyoceras*) *rostrata* gen. and sp. nov., *K.* (*Mayneoceras*) *sinuconstricta* subgen. and sp. nov., *Discoclymenia cornwallensis* sp. nov., *D.* aff. *cornwallensis* sp. nov. Yeolmbridge Beds (*Gattendorfia* Zone): *C.* (*Macrobole*) *drewerensis* Rud. & E. Richter sens nov., *C.* (*Macrobole*) *sp.*

FOR many years it was considered that rocks of highest Devonian and lowest Carboniferous age were unrepresented on the southern limb of the great Culm synclinorium of Devon and Cornwall. Recently ammonoids and trilobites, the subject of this paper, have been collected from a series of beds hitherto undifferentiated in the Launceston district of Cornwall; these fossils show that a complete succession of beds is represented between the Devonian and Carboniferous systems at Launceston.

The Petherwin Beds, the Stourscombe Beds, and Yeolmbridge Beds constitute the ascending sequence of strata at the Devonian–Carboniferous boundary. Faunas from the Petherwin Beds have been known since the area was first surveyed by the Geological Survey (de la Beche 1839). The Stourscombe Beds and the Yeolmbridge Beds are newly identified stratigraphical units recognized within the area mapped as Lower Culm by the Geological Survey (Tavistock and Launceston Sheet—No. 337).

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Specimens which have been described and figured in the palaeontological part of this paper are placed in museums which have been abbreviated in the descriptions as follows: GSM, Geological Survey Museum, London. BM, British Museum (Nat. Hist.), London. SMC, Sedgwick Museum, Cambridge. BU, Geology Museum, University of Bristol. PMC, Penzance Museum, Cornwall.

All localities mentioned in the text are to be found on the Ordnance Survey One Inch Sheet No. 186, and are referred to by their O.S. National Grid Reference.

The terminology used in the descriptions of the ammonoids is similar to that employed in the *Treatise on Invertebrate Paleontology* (*Part L. Mollusca*); foreign specimens, included in tables for comparative purposes, are referred to by the date of the

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paper from which the information was taken. Abbreviations are to be interpreted as follows: W. T.—whorl thickness, W. H.—whorl height, D.—diameter, U.—umbilicus. The trilobite terminology is that of Goldring (1955).

STRATIGRAPHY

The Petherwin Beds

The Geological Survey (Reid *et al.* 1911) applied the name Petherwin Beds to a thick succession of slates containing thin calcareous bands with brachiopods, and also to thicker limestones with abundant ammonoids which are associated with the slates. The stratigraphical relationships of these two lithologies cannot be determined in the field. However, it appears highly probable that the ammonoid-bearing limestones, which represent a very different sedimentary facies from the main bulk of the slates, are not interbedded with them, but constitute an underlying group of strata. The brachiopod slates are here referred to the Upper Petherwin Beds and the ammonoid bearing limestones and associated strata, which include a sandstone, to the Lower Petherwin Beds.

The Lower Petherwin Beds. Only two exposures yield fossils of the Lower Petherwin Beds at the present time. The more complete section is at the locality described (Reid *et al.* 1911) as the Gatepost Quarry (SX 326 821). The fauna, which is largely confined to a rottenstone horizon, includes:

Gonioclymenia (*Kalloclymenia*) *biimpressa* (von Buch 1839)—BU 12876.
Clymenia hoevelensis (Wedekind 1914)—BU 12864.
Kosmoclymenia undulata (Münster 1832)—BU 12868–70.
K. bisulcata (Münster 1840)—BU 12867.
K. sedgwicki (Münster 1840)—BU 12871.
Cymaclymenia striata (Münster 1832)—BU 12872, 12873.
C. camerata Schindewolf 1923—BU 12874, 12875.
Imitoceras cf. *lineare* (Münster 1832)—BU 12878.
Phacops (*Phacops*) *granulatus* (Münster 1840)—BU 12917, 12918.
P. (*Phacops*) *accipitrinus accipitrinus* (Phillips 1841)—BU 12926, 12927.

The second locality is at a neighbouring road section, by Oldwit Farm (SX 319 819), where the following have been identified:

Gonioclymenia (*Kalloclymenia*) *sp.*
Clymenia hoevelensis (Wedekind 1914)—BU 12865, 12866.
Kosmoclymenia sp.
Cymaclymenia sp.

The ammonoids obtained from these two localities show that the fauna of the Lower Petherwin Beds is closely comparable to that of the lower (*Clymenia hoevelensis*) subzone of the German *Clymenia* Zone.

An examination of the available specimens from the Launceston district in the Geological Survey Museum, the British Museum (Nat. Hist.), the Sedgwick Museum, and the Museum at Penzance reveals that a number of species formerly collected from the beds is not present in the fauna from the two localities mentioned above. The species in question are characteristic of the *Platyclymenia* Zone of the continental succession. It thus appears that the strata referable to this zone were formerly exposed in the district. Many of the specimens in the old collections are not properly localized, but most of them certainly come from the old limestone quarry at Landlake (SX 328 823) now com-

pletely filled with refuse. Enough specimens are clearly labelled as coming from this quarry to make it certain that the *Platyclymenia* Zone was exposed there. In addition, specimens of the same species as those occurring in the Gatepost Quarry have also been recorded from this quarry; it is thus evident that the lower *Clymenia* Zone was also once exposed. The fauna, with revised identifications, of the Landlake Limestone Quarry is as follows:

Costaclymenia muensteri (Ansted 1838)—SMC H4010.
Gonioclymenia (*Kalloclymenia*) *biimpressa* (von Buch 1839)—GSM 7083.
Platyclymenia (*Platyclymenia*) *walcotti* Wedekind 1914—GSM 57322.
P. (*Platyclymenia*) *richteri* Wedekind 1914—GSM 57323, 57327.
P. (*Platyclymenia*) *annulata* (Münster 1832)—?GSM 57328.
P. (*Platyclymenia*) *valida* (Phillips 1841)—GSM 7176.
P. (*Platyclymenia*) *bicostata* Wedekind 1914—SMC H992.
P. (*Platyclymenia*) *pattisoni* (M'Coy 1851)—SMC H990.
Clymenia hoevelensis (Wedekind 1914)—GSM 57314, 57315, 57324; SMC H989, H4012.
Kosmoclymenia undulata (Münster 1832)—GSM 57317, 57318, 7176; BM 37955; SMC H4011, H4013, H1488; PMC 152.
K. bisulcata (Münster 1840)—SMC H988.
K. sedgwicki (Münster 1840)—GSM 57325, 57326; SMC H1487; BM C51014.
K. linearis (Münster 1832)—?GSM 57316.
Cyrtoclymenia plicata (Münster 1839)—GSM 7174, ?7172.
C. angustiseptata (Münster 1832)—BM 37827.
Imitoceras cf. *disciforme* Schindewolf 1923—GSM 57300.
I. cf. *quadripartitum* (Münster 1839)—GSM 57303.
Sporadoceras rotundum Wedekind 1908—GSM 57301.
Phacops (*Phacops*) *granulatus* (Münster 1840)—PMC 113.
Cyrtosymbole) (?*Waribole*) *dunhevedensis* (Thomas 1909).

The Upper Petherwin Beds. Ammonoids and trilobites are particularly rare in the Upper Petherwin Beds. A single distorted specimen of the genus *Kosmoclymenia*, together with a trilobite cranidium referable to the subgenus *C.* (*Waribole*), has been discovered in the brachiopod slates of the Lower Landlake Slate Quarry (SX 328 824).

The Stourscombe Beds

The name Stourscombe Beds has been used for a group of nodular and thin-bedded cherts and slates which have yielded a rich fauna of ammonoids and trilobites. The ammonoid fauna has largely been collected from the nodular development of the Stourscombe Beds seen in two disused quarries near Stourscombe (SX 344 839). In the westerly quarry it has been possible to divide the beds into two faunal divisions; an upper division characterized by the genus *Wocklumeria* and a lower division in which *Parawocklumeria* is abundant and *Wocklumeria* absent. This faunal division may be compared closely to the subzone of *P. paradoxa* (Wedekind) which forms the upper part of the *Wocklumeria* Zone in Germany. The fauna from Stourscombe includes:

**Gonioclymenia* (*Kalloclymenia*) *frechi* Lange 1929—GSM 87075; BU 12802, 12803.
G. (*Kalloclymenia*) *wocklumensis* Lange 1929—GSM 87076, 87077; BU 12799–801.
†*Wocklumeria sphaeroides* (Rh. Richter 1848)—GSM 87033–7; BU 12824–8.
†*Epiwocklumeria dunhevedensis* sp. nov.—GSM 87038.
Postglatziella carinata Schindewolf 1937—GSM 87039, 87040; BU 12815, 12816.
Kosmoclymenia undulata (Münster 1832)—GSM 87097; BU 12808, 12809.
K. bisulcata (Münster 1840)—GSM 87041; BU 12810, 12811.
K. linearis (Münster 1832)—GSM 87042; BU 12806, 12807.

K. wocklumeri (Wedekind 1914)—GSM 87078; BU 12805.
**K. serpentina* (Münster 1832)—BU 12804.
**K. pattisoni* sp. nov.—GSM 87043.
Cyrtoclymenia plicata (Münster 1839)—GSM 87080.
C. angustiseptata (Münster 1832)—BU 12813, 12814.
**C. tetragona* Schmidt 1924—GSM 87044; BU 12812.
Cymaclymenia striata (Münster 1832)—BU 12836.
**C. striata* var. nov.—GSM 87045, 87046.
**C. cordata* Wedekind 1914—GSM 87047.
C. camerata Schindewolf 1923—GSM 87048; BU 12843, 12853.
C. constricta sp. nov.—GSM 87049, 87050; BU 12837, 12839–42.
C. constricta sp. nov. var. A nov.—GSM 87052.
**C. constricta* sp. nov. var. *globosa* nov.—GSM 87051.
**Parawocklumeria laevigata* sp. nov.—GSM 87053–6; BU 12829–34.
**P. laevigata* sp. nov. var. *obesa* nov.—GSM 87088.
**Parawocklumeria sp.*—GSM 87057.
Kenseyoceras (*Kenseyoceras*) *rostrata* subgen. et sp. nov.—GSM 87058–63; BU 12844–7.
K. (*Mayneoceras*) *sinuconstricta* subgen. et sp. nov. GSM 87069; BU 12835.
K. (*Mayneoceras*) *nucleus* (Schmidt 1924)—GSM 87064–8; BU 12848–9.
Imitoceras lineare (Münster 1832)—GSM 87083; BU 12819, 12820.
I. substriatum (Münster 1840)—GSM 87084; BU 12882.
I. intermedium Schindewolf 1923—GSM 87085; BU 12821.
I. varicosum Schindewolf 1923—GSM 87086.
**I. subbilobatum* (Münster 1839)—GSM 87087.
**Discoclymenia cucullata* (von Buch 1839)—GSM 87070.
**D. cornwallensis* sp. nov.—GSM 87071, 87072.
**D.* aff. *cornwallensis* sp. nov.—GSM 87073.
**Sporadoceras orbiculare* (Münster 1832)—BU 12817, 12818.
**S. orbiculare* var.—GSM 87074.
Phacops (*Phacops*) *granulatus* (Münster 1840)—BU 12920, 12921.
P. (*Phacops*) *accipitrinus accipitrinus* (Phillips 1841)—BU 12928.
P. (*Phacops*) *wedekindi* Rud. & E. Richter 1926—BU 12930–2.
P. (*Phacops*) *ensae* Rud. & E. Richter 1926—BU 12935–8.
P. (*Cryphops*?) *wocklumeriae* Rud. & E. Richter 1926—BU 12943–4.
**P.* (*Dianops*) *sp.*—GSM 87091.
**Chaunoproetus* aff. *carnicus* (Rud. Richter 1913)—GSM 87092.

* Lower faunal division only.
† Upper faunal division only.

A few ammonoids have been collected from Overwood Farm (SX 303 873). At this locality there are relatively few siliceous nodules, and the majority of these are unfossiliferous. The slates, on the other hand, have yielded a large number of trilobites. The fauna from this locality includes:

G. (*Kalloclymenia*) *sp.*
Wocklumeria sp.
Cyrtoclymenia angustiseptata (Münster 1832)—GSM 87081.
Parawocklumeria sp.
Phacops (*Phacops*) *granulatus* (Münster 1840)—BU 12923–5.
P. (*Phacops*) *accipitrinus accipitrinus* (Phillips 1841)—BU 12929; PMC 100 (labelled 'Near Yeolmbridge').
P. (*Cryphops*?) *ensae* Rud. & E. Richter 1926—BU 12940–2.
Cyrtosymbole (*Waribole*) cf. *warsteinensis* Rud. & E. Richter 1926—BU 12945–7.
C. (*Waribole*) aff. *conifera* Rud. & E. Richter 1926—GSM 87093; BU 12951.
C. (*Waribole*) aff. *italica* (Gortani 1907)—GSM 87094–5; BU 12956, 12957.
C. (*Macrobole*?) aff. *bergica* Rud. Richter 1913—GSM 87096; BU 12962, 12963.
C. cf. *nepia* Rud. & E. Richter 1926—BU 12958–60.

Similar trilobite-bearing slates occur at three localities in the Devonian inlier at Lifton; Heale Farm (SX 362 862), Smallacombe Farm (SX 375 860), and Coombe Farm (SX 386 858).

The slates with thin cherts, which form the more extensive development of the Stourscombe Beds, are generally unfossiliferous. Formerly these beds were included in the

Lower Carboniferous, but the discovery of a single specimen (GSM 87082) of *Parawocklumeria distorta* (Tietze 1870) from a locality north-north-west of Oldtree Lodge (SX 306 846) and other ammonoids from widely separated localities now enables these slates to be correlated with the upper part of the *Wocklumeria* Zone.

The Yeolmbridge Beds

The name Yeolmbridge Beds has been applied to a series of slates, sandstones, and limestones which conformably succeed the Stourscombe Beds.

The fauna from these beds is largely restricted to two localities; at Penfoot (SX 302 833) and Yeolmbridge (SX 322 875). At Penfoot the bulk of the fauna has been obtained from a nodular limestone and includes:

Gattendorfia subinvoluta (Münster 1839)—BU 12886–90.
G. crassa Schmidt 1924—BU 12882–3.
G. tenuis Schindewolf 1952—BU 12885.
G. occlusa Librovitch 1940—BU 12884, 12915.
Imitoceras lineare (Münster 1832)—BU 12893.
I. cf. *intermedium* Schindewolf 1923—BU 12894, 12895.
I. cf. *substriatum* (Münster 1840)—BU 12896.
C. (*Macrobole*) *drewerensis* Rud. & E. Richter 1951—BU 12904–8.
C. (*Macrobole*) *duodecimae* Rud. & E. Richter 1951—BU 12911, 12912.

At Yeolmbridge the fauna has been obtained from two exposures in the disused Yeolmbridge Slate Quarry; one consisting of a fresh limestone on the north side of the quarry, and the other of decalcified lenticles occurring in a sandy slate on the south side of the quarry. The fauna includes:

Gattendorfia sp.—BU 12892.
Imitoceras sp.
Cyrtosymbole (*Macrobole*) *drewerensis* Rud. & E. Richter 1951—GSM 87098, 87099; BU 12901–3.
C. (*Macrobole*) *duodecimae* Rud. & E. Richter 1951—GSM 87100; BU 12913, 12914.
C. (*Macrobole*) aff. *blax* Rud. & E. Richter 1951—GSM 87101; BU 12910.
C. (*Macrobole*) *sp.*—GSM 87097; BU 12909.

The fauna obtained from these localities in the Yeolmbridge Beds is very similar to that obtained from the *Gattendorfia* Zone of the Continent.

SYSTEMATIC DESCRIPTIONS

Ammonoids

Family GONIOCLYMENIIDAE Hyatt 1884
Genus COSTACLYMENIA Schindewolf 1920
Costaclymenia muensteri (Ansted 1838)

Plate 26, fig. 1

1838 *Endosiphonites münsteri* Ansted, p. 419, pl. 8, fig. 1.
1852 *Clymenia muensteri* M'Coy, p. 402, pl. 2A, fig. 12.
1950 *Costaclymenia binodosa* G. & H. Termier, p. 77, pl. 160, figs. 28–30.

Holotype (by monotypy). SMC H4010. Pl. 26, fig. 1.

Type locality. Landlake Limestone Quarry, nr. Launceston.

Horizon. Lower Petherwin Beds.

Remarks. Gümbel (1863) states that *C. muensteri* is identical to *Clymenia binodosa* which was figured by Münster in 1839 (pl. 2, figs. 3*a–c*). On this contention Ansted's name

should have had priority, but it was not used because Münster's species was allegedly conspecific with *Goniatites binodosus* Münster 1832 (pl. 6, figs. 5*a*, *b*). However, the two specimens figured by Münster are not obviously conspecific, and since *C. muensteri* is quite distinct from Münster's earlier figures Ansted's species is still valid.

Only a single specimen has been recorded, and although this specimen closely resembles *C. binodosa* (Münster 1839) it is not considered to be identical to it, for the ribs and tubercles are more numerous and less prominent. In addition the whorl flanks in *C. muensteri* converge slightly towards the venter, whereas the whorl cross-section of *C. binodosa* is rectangular.

The whorl cross-section and the rather weak ornament make the specimens figured by G. & H. Termier (1950) closer to *C. muensteri* than to *C. binodosus*.

Mr. A. G. Brighton has drawn the author's attention to a manuscript note with the specimen which reads: 'It appears to have been subsequently to the drawing of Ansted's figure broken, and in that state was refigured by M'Coy. . . . Since then the greater part of the missing piece has been restored.'

Measurements of holotype (in mm.). D. 97, W.H. 36, W.T. 18, U. 41.

Genus GONIOCLYMENIA Hyatt 1884
Subgenus GONIOCLYMENIA (KALLOCLYMENIA) Wedekind 1914

Remarks. The genus *Kalloclymenia* was erected by Wedekind in 1914, and distinguished from *Gonioclymenia* with which its species had previously been included by the following characters: (*a*) the absence of a spiral groove on the venter, (*b*) the nature of the ribs, and (*c*) the lower rectangular whorl cross-section. The suture-line is, by diagnosis, indistinguishable from that of *Gonioclymenia*. Lange (1929) observed that only the first criterion is valid for generic diagnostic purposes and suggested that the name *Kalloclymenia* be reduced to subgeneric status.

In the *Treatise on Invertebrate Paleontology* (1957) the generic status of *Kalloclymenia* is reaffirmed with a note that the ventral sinus and the low rectangular whorl cross-section are diagnostic. The author does not agree with the latter contention, for G. (*K.*) *wocklumensis* Lange 1929 in particular has a whorl section in which the whorl height is considerably in excess of the whorl thickness. It is therefore proposed to continue the usage of Lange, for the important stratigraphical position which has been ascribed to *Kalloclymenia* on the Continent, which might conceivably warrant generic status, is not valid in Cornwall.

On the Continent the incoming of *Kalloclymenia* has proved a useful datum to mark the lower limit of the *Wocklumeria* Zone. In Cornwall, however, *Kalloclymenia* occurs earlier, for it has been found associated with the index fossil of the lower *Clymenia* Zone in the Petherwin Beds. It thus appears that the lower limit of the *Wocklumeria* Zone needs redefinition. This problem will be discussed in a later paper on the stratigraphy of the area.

The reduction of *Kalloclymenia* to a subgenus of *Gonioclymenia* raises the question of the status of *Otoclymenia* Schindewolf 1923, for this genus was reduced (Schindewolf 1937) to a subgenus of *Kalloclymenia*. The distinctive ornament of parabolic ribs and nodes undoubtedly means that it should be distinguished from *Kalloclymenia*; it is suggested that *Otoclymenia* be referred to a new subgenus of *Gonioclymenia*.

Gonioclymenia (*Kalloclymenia*) *biimpressa* (von Buch 1839)

Plate 26, fig. 2

1841 *Goniatites insignis* Phillips, p. 119, pl. 49, fig. 228.
1929 *Gonioclymenia* (*Kalloclymenia*) *biimpressa* Lange, p. 80, pl. 2, fig. 20, text-figs. 16, 17.
1950 *Gonioclymenia insignis* G. & H. Termier, p. 77, pl. 160, figs. 20–22.

Remarks. Goniatites insignis was referred by Gümbel (1863) to *Gonioclymenia subarmata* (Münster), but the specimen figured by Phillips lacks the characteristic, rather noded ornament of Münster's species (1832, pl. 6, fig. 2). The ornament is much closer to that of *G.* (*Kalloclymenia*) *biimpressa* (von Buch), the holotype of which was refigured by Lange (1929). It does seem, however, that the ornament persists in the British specimens on to more mature whorls than on the holotype.
Measurements of figured specimen (GSM 7083) (in mm.). D. 61, W.H. 15·5, U. 34.

Gonioclymenia (*Kalloclymenia*) *frechi* Lange 1929

1929 *Gonioclymenia* (*Kalloclymenia*) *frechi* Lange, p. 81.

Remarks. The specimens occurring in Cornwall are very close to the described species but show a relatively greater whorl height.

Gonioclymenia (*Kalloclymenia*) *wocklumensis* Lange 1929

1929 *Gonioclymenia* (*Kalloclymenia*) *wocklumensis* Lange, p. 79, pl. 2, figs. 18, 18*a*, text-figs. 14, 15.

Remarks. In the Cornish specimens the whorl height is relatively greater, and the convergence of the flattened flanks at the venter is less than that indicated in Lange's original description. It has been observed that the mature suture line does not develop until approximately the fifth or sixth whorl; i.e. a diameter of some 15 mm. The adventitious lobe does not make its appearance until the fourth whorl. The whorl cross-section in the young stages is much squarer than that exhibited in the mature form.

Family WOCKLUMERIIDAE Schindewolf 1937
Genus WOCKLUMERIA Wedekind 1918
Wocklumeria sphaeroides (Rh. Richter 1848)

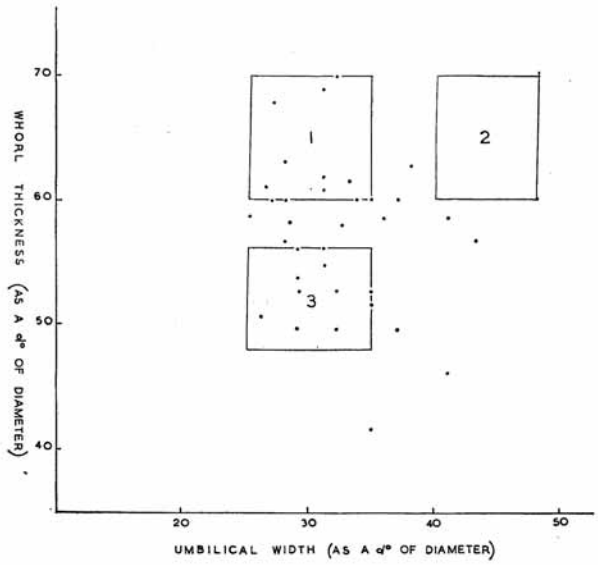
Plate 26, figs. 3–5; text-fig. 1

1937 *Wocklumeria sphaeroides* Schindewolf, p. 69, pl. 1, figs. 12–15; pl. 2, figs. 1–3, text-fig. 12 (with previous synonymy).
1937 *Wocklumeria plana* Schindewolf, p. 70, pl. 2, figs. 4–6.
1937 *Wocklumeria aperta* Schindewolf, p. 71, pl. 2, figs. 7–9, text-fig. 14.
1954 *Wocklumeria sphaeroides* Pfeiffer, p. 58, pl. 8, figs. 5, 6.
1954 *Wocklumeria plana* Pfeiffer, p. 58, pl. 8, fig. 7.

Remarks. The genus *Wocklumeria*, monospecific when erected by Wedekind (1918), was reinvestigated by Schindewolf (1937) who, after a study of many specimens, recognized two additional species *W. plana* and *W. aperta*, closely related to the genotype.

A study of a number of specimens from Cornwall has revealed a much greater variability than was noticed by Schindewolf in his material. A number of gradational forms have been found between *W. plana* and *W. sphaeroides*, and between *W. aperta* and *W.*

sphaeroides. The scatter diagram (text-fig. 1) shows that there is a complete gradation existing between the extreme globose and extreme discoidal forms. The suture-lines of the two species recognized by Schindewolf in this range are, by diagnosis, identical; thus the remaining distinguishing feature is the height of the aperture. Since '*sphaeroides*' forms have been seen with '*plana*' apertures and vice versa there appears no reason to separate the two.



TEXT-FIG. 1. Scatter diagram of specimens of *Wocklumeria* from the Stourscombe Beds. The limits of species defined by Schindewolf are indicated thus: (1) *W. sphaeroides*, (2) *W. aperta*, (3) *W. plana*.

In both German and British specimens there is a preponderance of specimens within the limits formerly defining *W. sphaeroides* and *W. plana*. No Cornish specimen falls within the limits of *W. aperta* as defined by Schindewolf, though several specimens are very close to it. Since Schindewolf defined *W. aperta* on only six specimens there is probably no significance in this fact and nothing to indicate an interruption in the continuous variation of *W. sphaeroides*.

In the light of this evidence, there appears little basis for the division of the range of forms of *W. sphaeroides*; *W. plana* and *W. aperta* are consequently here considered to be synonyms of Richter's species. It has thus become necessary to redefine *W. sphaeroides* in more general terms.

Diagnosis. *Wocklumeria* with discoidal to globose shell, moderately wide umbilicus and low aperture. Young forms triangular in outline impressed by three deep constrictions; adult stage rounded, normally lacking constrictions. Ventral lobe deep, pointed, first lateral saddle rounded passing into a moderately wide and pointed first lateral lobe; this

lobe is as deep or deeper than the ventral lobe. Second lateral saddle rounded, umbilical lobe broad, divided at the umbilical seam by a strong saddle; prongs of umbilical lobe pointed. Dorsal lobe pointed, with almost parallel sides. First and second dorso-lateral saddles rounded, separated by pointed dorso-lateral lobe.

Description. Shell discoidal to globose, involute, greatest thickness at the umbilicus. Five to six whorls, involution considerable, umbilicus moderately large to small, deep; revealing the triangular shape of the earlier whorls. Laterally whorls slightly to moderately compressed, strongly rounded ventrally, flanks deeply impressed by the preceding whorl, aperture small. Body chamber one whorl, anterior portion deviating from the normal whorl spiral, thus considerably increasing the size of the umbilicus at this point. Aperture marked posteriorly by a constriction. Suture-line, see Schindewolf (1937, text-figs. 12*a*, *b*). Chamber posterior to body chamber small in mature specimens. Siphuncle dorsal, septal necks retrochoanitic extending to almost half a chamber in length.

Young stages impressed by three deep constrictions, these occupy the same relative positions on each whorl so that a pronounced triangular shape is produced. With age the constrictions weaken and finally disappear.

Ornament has not been seen on the Cornish specimens, but Schindewolf records occasional intensified growth lines which follow a straight course over the flanks and venter. In addition, a slight spiral ornament has been recorded.

Genus EPIWOCKLUMERIA Schindewolf 1937 emend.

1937 *Epiwocklumeria* Schindewolf, p. 72.

Remarks. Epiwocklumeria was erected by Schindewolf using *Wocklumeria paradoxa* var. *applanata* Wedekind 1918 as the monogenotype. The affinities of *Epiwocklumeria* to the Gonioclymeniaceae were demonstrated; in the same work *Wocklumeria paradoxa* Wedekind, which was referred to the genus *Parawocklumeria* Schindewolf (1926), was placed in the Parawocklumeriaceae.

On the basis of the suture-line a new Cornish species belongs to the genus *Epiwocklumeria*, but it has several characters of *Parawocklumeria*, including a subglobose shape and straight constrictions; features thought by Schindewolf to be of generic importance. The addition of the new species requires modification of the generic diagnosis.

Emended diagnosis. A genus of the Wocklumeriidae with discoidal to globose form, shell broadly triangular in outline, the sides and venter impressed by three strong constrictions. Umbilicus almost closed. Ventral lobe of suture line deep, pointed; first lateral saddle rounded passing into an open V-shaped first lateral lobe. Second lateral saddle gently rounded, umbilical lobe shallow, divided at the umbilical seam by a small saddle. Dorsal lobe broad, V-shaped. First and second dorso-lateral saddles rounded, separated by a rounded dorso-lateral lobe.

Comparison with other genera. This genus resembles *Wocklumeria* on the basis of the suture-line, but differs in the very small size of the umbilicus, the more compressed form, and the absence of several contrasting stages during development. *Epiwocklumeria* shows a marked superficial similarity to *Parawocklumeria* but it has a fundamentally different suture-line.

Epiwocklumeria dunhevedensis sp. nov.

Plate 26, figs. 6, 7; text-fig. 2

Derivation of name. After Dunheved, the ancient name of Launceston.

Holotype. GSM 87038, Pl. 26, figs. 6, 7, text-fig. 2.

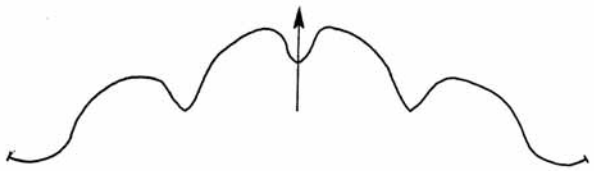
Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds (Upper faunal division).

Material. Only a single internal mould known.

Diagnosis. Shell subglobose, triangular in outline, the sides and venter impressed by three pronounced constrictions. Umbilicus almost closed. Suture-line typical of the genus, the ventral lobe being shallow and rounded.

Description. Species of *Epiwocklumeria* with subglobose shell, involute, greatest thickness at the umbilicus; involution almost entire, umbilicus minute, deep, and triangular



TEXT-FIG. 2. *Epiwocklumeria dunhevedensis* sp. nov.; holotype, GSM 87038, suture-line at 16 mm. diameter.

in outline. Laterally whorls moderately compressed, strongly rounded ventrally; greatly impressed by the preceding whorl. Flanks marked by three constrictions following a straight course from the umbilicus to the periphery, being gently arched forwards over the venter. Body chamber approaches one whorl in length. External suture (text-fig. 2) typical of the genus; ventral lobe small, rounded. First lateral saddle pronounced, passing into a pointed, deep first lateral lobe. Second lateral lobe broadly rounded, passing into rounded umbilical lobe. No ornament has been observed.

Measurements of holotype (in mm.). D. 17, W.H. 8, W.T. 11, U. 1.

Comparisons. This species differs from *Epiwocklumeria applanata* in the greater whorl thickness, the straight course of the constrictions over the whorl sides, and the size of the ventral lobe. Were it not for the characteristic suture line it would be difficult to distinguish this species from *Parawocklumeria laevigata* sp. nov.

Family GLATZIELLIDAE Schindewolf 1928

Genus POSTGLATZIELLA Schindewolf 1937

Postglatziella carinata Schindewolf 1937

Plate 26, figs. 8, 9

1937 *Postglatziella carinata* Schindewolf, p. 82, pl. 3, figs. 4–7, text-figs. 19*a*, *b*.

Remarks. The few specimens from Stourscombe referable to this species differ from Schindewolf's specimens only in having the ribs more widely spaced.

Family CLYMENIIDAE Edwards 1849
Genus PLATYCLYMENIA Hyatt 1884

Platyclymenia (*Platyclymenia*) *valida* (Phillips 1841)

Plate 26, fig. 10

1841 *Clymenia valida* Phillips, p. 126, pl. 54, fig. 245.
non 1914 *Platyclymenia valida* Wedekind, p. 37, pl. 3, figs. 3, 4.
non 1956 *Platyclymenia* (*Platyclymenia*) *valida* Müller, p. 70, pl. 2, fig. 10.

Holotype (by monotypy). GSM 7176. Pl. 26, fig. 10.

Type locality. Landlake Limestone Quarry, nr. Launceston.

Horizon. Lower Petherwin Beds.

Diagnosis. *Platyclymenia* with wide umbilicus and strong, closely spaced ribs on the young whorls. Ribs on the later whorls weaken in intensity, broaden, and become widely spaced at the umbilicus; towards the venter these give rise to three to four weak secondary and intercalatory ribs. Whorl cross-section rectangular.

Description. Shell evolute, with only very slightly embracing whorls. Umbilicus large, moderately deep, in complete specimens probably exposing all of the inner whorls. Whorl flanks flattened, particularly in the mature shell; venter broadly rounded to flattened. Whorl cross-section rectangular, considerably higher than wide.

Ornament on the inner whorls comprises distinct, irregularly spaced concave ribs. Frequently two or three ribs apparently arise from an almost common origin, this gives an irregular, noded appearance to the umbilical rim. On the succeeding whorls the ribs weaken and become more regular and closely spaced. On the final part of the last whorl the ribs at the umbilicus become quite widely spaced and broadly rounded. Towards the venter these divide into three to four fine, but weak, sigmoidal ribs. The fine ribs, some of which appear to be intercalatory, arise from a slightly raised area at approximately the mid-point of the flanks; as a result a weak spiral line is produced. Suture-line (Phillips 1841, p. 126, pl. 54, fig. 245*b*) typical of the genus.

Measurements of holotype (in mm.). D. 40, W.H. 13, W.T. 6, U. 18.

Remarks. The specimens figured and described by Wedekind (1914, p. 37, pl. 3, figs. 3, 4) as *Platyclymenia valida* (Phillips) lack the characteristic bifurcating ribs of the holotype, and appear to represent a new species not recorded from the Petherwin Beds. There are other records of the occurrence of the species in Germany which are unaccompanied by figures (Schindewolf 1923, Lange 1929, Matern 1931, Freyer 1957); it seems probable from the descriptions that reference was being made to the descriptions and figures of Wedekind rather than to those of Phillips.

Platyclymenia (*Platyclymenia*) *bicostata* Wedekind 1914

1914 *Platyclymenia bicostata* Wedekind, p. 36, pl. 3, figs. 16–18.
1923 *Platyclymenia bicostata* Schindewolf, p. 450.
1927 *Platyclymenia bicostata* Schlosser, p. 5, fig. 21.
1931 *Platyclymenia bicostata* Matern, p. 100.
1957 *Platyclymenia bicostata* Freyer, p. 56.

Remarks. A single specimen of this species is recorded from the Landlake Limestone Quarry. This specimen shows the characteristic paired ribs of the species. The posterior member of each pair of ribs is normally more strongly developed than the anterior. In the mature whorls the intensity of the ribbing decreases; a fragment of the latest whorl preserved appears to be almost smooth.

Platyclymenia (*Platyclymenia*) *pattisoni* (M'Coy 1851)

Plate 26, fig. 11

1851 *Clymenia pattisoni* M'Coy, p. 488.
1852 *Clymenia pattisoni* M'Coy, p. 403, pl. 2A, fig. 11.
1854 *Clymenia pattisoni* M'Coy, p. 293.
1855 *Clymenia subnautilina* Sandberger, p. 5, pl. 1, figs. 1*a–f*.
1910 *Clymenia pseudoflexuosa* Rzehak, p. 181, pl. 1, fig. 1, pl. 2, figs. 8, 9.
1914 *Platyclymenia quenstedi* Wedekind, p. 45, pl. 3, fig. 10, pl. 2, fig. 5.
1922 *Platyclymenia subnautilina* (= *Platyclymenia quenstedi*) H. Schmidt in Kegel, p. 39.
1923 *Platyclymenia quenstedi* Schindewolf, p. 457, text-fig. 19*a*.
1929 *Platyclymenia* (*Varioclymenia*) *subnautilina* Lange, p. 102.
1931 *Platyclymenia quenstedi quenstedi* Matern, p. 102.
1950 *Platyclymenia quenstedi* G. & H. Termier, p. 74, pl. 154, figs. 8–11; pl. 157, figs. 31–33; pl. 161, figs. 18–20.
1956 *Platyclymenia* (*Platyclymenia*) *subnautilina* Müller, p. 73.

Holotype (by monotypy). SMC H990. Pl. 26, fig. 11.

Type locality. Landlake Limestone Quarry, nr. Launceston.

Horizon. Lower Petherwin Beds.

Remarks. Clymenia pattisoni M'Coy was referred by Gümbel (1863, p. 126) to *Clymenia flexuosa* Münster (1840). However, it is quite distinct from this species, for *C. pattisoni* has a suture-line characteristic of the genus *Platyclymenia*, whereas *C. flexuosa* has a suture-line typical of the genus *Kosmoclymenia*.

M'Coy's species is identical to *P.* (*Platyclymenia*) *subnautilina* (Sandberger) and its junior synonyms *P.* (*Platyclymenia*) *quenstedi* Wedekind, and *Clymenia pseudoflexuosa* Rzehak. Sandberger's original figures are good and Schmidt's synonymy appears quite

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EXPLANATION OF PLATE 26

Fig. 1. *Costaclymenia muensteri* (Ansted), Landlake Limestone Quarry. Holotype, SMC H4010, ×1.
Fig. 2. *Gonioclymenia* (*Kalloclymenia*) *biimpressa* (von Buch), Landlake Limestone Quarry. GSM 7083, ×1.
Figs. 3–5. *Wocklumeria sphaeroides* (Rh. Richter), Stourscombe. 3, 4, Lateral and ventral view of mature individual showing the change in spiral angle of the anterior part of the body chamber and the apertural constriction, GSM 87033, ×1. 5, Young specimen showing constrictions and triangular-shaped umbilicus, GSM 87037, ×2.
Figs. 6, 7. *Epiwocklumeria dunhevedensis* sp. nov., Stourscombe. Holotype, GSM 87038. 6, Lateral view showing straight constrictions, ×2. 7, Ventral view showing suture-line, ×1½.
Figs. 8, 9. *Postglatziella carinata* Schindewolf, Stourscombe. 8, GSM 87040, ×2. 9, GSM 87039, ×3.
Fig. 10. *Platyclymenia* (*Platyclymenia*) *valida* (Phillips), Landlake Limestone Quarry. Holotype, GSM 7176, ×1.
Fig. 11. *Platyclymenia* (*Platyclymenia*) *pattisoni* (M'Coy), Landlake Limestone Quarry. Holotype, SMC H990, ×2.
Fig. 12. *Kosmoclymenia linearis* (Münster), Stourscombe. GSM 87042, ×1.

valid and was confirmed by Lange (1929) and by Müller (1956). The identity of *Platyclymenia pattisoni* with these species means that *Platyclymenia subnautilina* must now be reduced to a synonym of the Cornish species; the name of which has a priority of several years.

Measurements of holotype (in mm.). D. 20, W.H. 7, W.T. 5, U. 9·5.

Genus KOSMOCLYMENIA Schindewolf 1949

Kosmoclymenia pattisoni sp. nov.

Plate 27, fig. 1

Derivation of name. After Mr. S. R. Pattison, an early pioneer in Launceston geology.

Holotype. GSM 87043. Pl. 27, fig. 1.

Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds (Lower faunal division).

Material. A single specimen showing both suture- and growth-lines.

Diagnosis. Kosmoclymenia with disk-shaped shell, umbilicus wide, deep for genus. Initially the whorls increase slowly in size, but the last 1½ whorls increase rapidly. Whorl height exceeds whorl thickness. Ornament consists of pronounced, raised growth lines.

Description. Shell evolute, planorbiform, with seven to eight very slightly embracing whorls. Umbilicus large, relatively deep, exposing all of the inner whorls. Up to a diameter of 2–3 mm. whorl thickness may equal whorl height, thereafter whorl height always exceeds whorl thickness. Venter broadly rounded. Initial increase in whorl size slight; last 1½ whorls increasing very rapidly, almost doubling in height in the last whorl. In young stages whorl sides rounded, later whorls broadly rounded to flattened. The rapid increase in size of the final whorl creates a rather deeper umbilicus than is normal for the genus. Ornament composed of biconvex growth lines. Suture-line typical of the genus.

Comparisons. The general appearance of the shell is similar to *K. wocklumeri*, but the flanks are not so flattened and they do not converge to a flattened venter. The ornament is also much stronger than in this species. *K. linearis* is characterized by a slow increase in the size of the whorl, and in consequence the umbilicus is very shallow. *K. sedgwicki* is more compressed and involuted than this species.

Measurements of holotype (in mm.). D. 50, W.H. 18, W.T. 14, U. 22.

Family CYRTOCLYMENIIDAE Hyatt 1884

Genus CYRTOCLYMENIA Hyatt 1884

Cyrtoclymenia tetragona Schmidt 1924

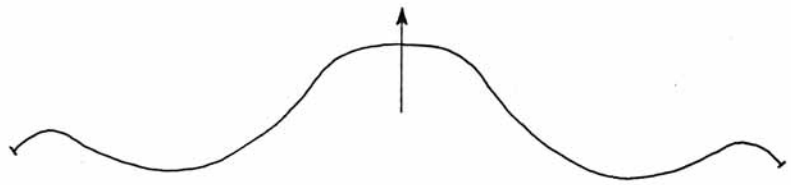
Plate 27, fig. 11; text-fig. 3

1924 *Cyrtoclymenia tetragona* Schmidt, p. 127, pl. 6, figs. 22, 23.

Remarks. Specimens from Cornwall agree closely with the original description, and exhibit details of the suture-line not previously recorded. Just posterior to the body

chamber the septa are crowded, but they become more widely spaced posteriorly. The suture-line consists of a pronounced, rather flattened, ventral saddle which passes into a broad, shallow lateral lobe. A weak lobe is developed at the umbilicus. A geniculate constriction mid-way along the body chamber is present on one specimen. The specimen figured is less globose than that illustrated by Schmidt.

Measurements of figured specimen (GSM 87044) (in mm.). D. 27·5, W.H. 13·5, W.T. 10·5, U. 4·5.



TEXT-FIG. 3. *Cyrtoclymenia tetragona* Schmidt; GSM 87044, suture-line at 26 mm. diameter.

Genus CYMACLYMENIA Hyatt 1884

Cymaclymenia striata var.

Plate 27, figs. 3, 4

Remarks. A number of specimens differ from *C. striata* (Münster 1832). The whorl thickness of these specimens is greater and the involution is considerable; the umbilicus only amounts to one-seventh of the shell diameter. This variety has only been found in the lower faunal division at Stourscombe.

Cymaclymenia constricta sp. nov.

Plate 27, figs. 8–10

Derivation of name. After the constrictions on the venter.

Holotype. GSM 87050. Pl. 27, figs. 8, 9.

Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds.

Material. Internal and external moulds.

Diagnosis. Discoidal *Cymaclymenia* with narrow umbilicus. Flanks and venter rather flattened; venter shows pronounced sinuate constrictions.

Description. Shell discoidal, involute, umbilicus narrow and deep but exposing all of the inner whorls. Whorl section rather compressed, whorl height just exceeding whorl thickness. Venter broadly rounded, becoming flattened in mature specimens; clearly marked by periodic sinuate constrictions which do not continue on to the flanks. Constrictions closely spaced in young specimens but more widely spaced in adult forms. Whorl flanks flattened at maturity, though broadly rounded in youth; tending to converge towards the venter. Final whorl increases rapidly in size, involution of this whorl

two-thirds to four-fifths. Suture-line typical of the genus, though the ventral saddle is not well developed; eight to nine chambers per whorl. Preservation of the material is not delicate enough for growth lines to be preserved.

Measurements of holotype (in mm.). D. 17, W.H. 10, W.T. 7·5, U. 4.

Comparisons. The presence of constrictions is not a particularly common feature of this genus. *Clymenia semistriata* Münster (1832) exhibits constrictions over the flanks, but these are absent over the venter. The specimen figured by Münster (1840) as *Clymenia dorsocostata* appears to show constrictions over the venter, but these are much more closely spaced, and weaker, than those shown by the Cornish specimens, and appear to be produced by raised growth-lines.

Cymaclymenia constricta sp. nov. var. A

Plate 27, figs. 12, 13

Holotype. GSM 87052. Pl. 27, figs. 12, 13.

Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds (Lower faunal division).

Remarks. This variety shows more widely spaced and decidedly weaker constrictions on the venter at all growth stages. In addition the increase in the size of the final whorl, and the amount of involution is not so great.

Measurements of holotype (in mm.). D. 32, W.H. 16, W.T. 12·5, U. 6·5.

Cymaclymenia constricta sp. nov. var. *globosa* nov.

Plate 27, figs. 14, 15

Holotype. GSM 87051. Pl. 27, figs. 14, 15.

Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds (Lower faunal division).

Remarks. This variety, represented by a single specimen, shows a whorl thickness in excess of the whorl height; thus the shell is more globose than is normal for the species. The venter is strongly rounded and the first constrictions do not develop until a diameter of 13·5 mm. is reached.

Measurements of holotype (in mm.). D. 16·5, W.H. 8, W.T. 8·5, U. 4.

Family PARAWOCKLUMERIIDAE Schindewolf 1937

Genus PARAWOCKLUMERIA Schindewolf 1926

Parawocklumeria laevigata sp. nov.

Plate 27, figs. 16–20; text-fig. 4A

Derivation of name. After the smooth shell.

Holotype. GSM 87053. Pl. 27, figs. 18, 19.

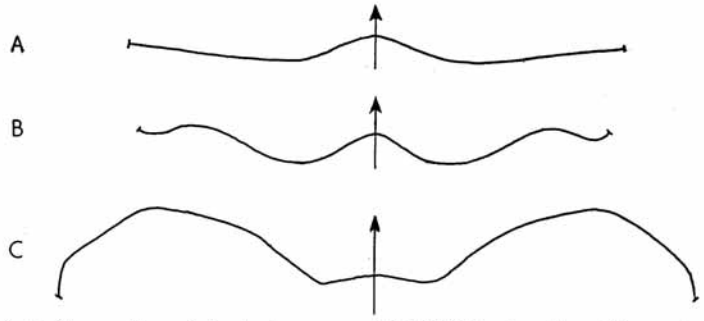
Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds (Lower faunal division).

Material. Internal and external moulds.

Diagnosis. *Parawocklumeria* with discoidal to subglobose shell; umbilicus narrow, of triangular shape. Three strong constrictions give a pronounced trilobation to the shell. Ornament absent. Suture-line variable.

Description. Shell discoidal to subglobose, involute, greatest thickness at the umbilicus. Five to six whorls, involution almost complete. Umbilicus minute, deep, and triangular



TEXT-FIG. 4. A, *Parawocklumeria laevigata* sp. nov.; GSM 87054, suture-line at 9 mm. diameter. B, *Parawocklumeria laevigata* sp. nov. var. *obesa* nov.; holotype, GSM 87088, suture-line at 6·5 mm. diameter. C, *Parawocklumeria sp.*; GSM 87057, suture-line at 10 mm. diameter.

in shape. Whorls laterally compressed, strongly rounded ventrally, greatly impressed by the preceding whorl. Flanks marked by three deep constrictions, occupying the same relative position on each successive whorl. Constriction straight and radial on the flanks, swinging weakly forward over the venter. Shallow secondary constrictions, broader than the main constrictions and present only over the venter, occur anterior to

EXPLANATION OF PLATE 27

Fig. 1. *Kosmoclymenia pattisoni* sp. nov., Stourscombe. Holotype, GSM 87043, ×1.

Fig. 2. *Kosmoclymenia bisulcata* (Münster), Stourscombe. GSM 87041, ×2.

Figs. 3, 4. *Cymaclymenia striata* var., Stourscombe. 3, specimen showing growth-lines, GSM 87046, ×1. 4, GSM 87045, ×½.

Fig. 5. *Cymaclymenia cordata* Wedekind, Stourscombe. GSM 87047, ×1.

Figs. 6, 7. *Cymaclymenia camerata* Schindewolf, Stourscombe. Ventral and lateral view, GSM 87048, ×1.

Figs. 8–10. *Cymaclymenia constricta* sp. nov., Stourscombe. 8, Lateral view of holotype, GSM 87050, ×1. 9, Ventral view of holotype showing constrictions on the venter, GSM 87050, ×1. 10, Ventral view of specimen with rather flattened venter, GSM 87049, ×1.

Fig. 11. *Cyrtoclymenia tetragona* Schmidt, Stourscombe, GSM 87044, ×1.

Figs. 12, 13. *Cymaclymenia constricta* var. A, Stourscombe. Ventral and lateral view, GSM 87052, ×1.

Figs. 14, 15. *Cymaclymenia constricta* var. *globosa* var. nov., Stourscombe. Lateral and ventral view, GSM 87051, ×2. The final part of the last whorl has been removed in fig. 14 to show the characteristic whorl cross-section.

Figs. 16–20. *Parawocklumeria laevigata* sp. nov., Stourscombe. 16, Ventral view showing secondary constriction lying just anterior to the main constriction on the venter, GSM 87055, ×2. 17, Ventral view of mature individual showing closely spaced suture-lines just posterior to the body chamber, GSM 87054, ×2. 18, 19, Lateral and ventral view of holotype, GSM 87053, ×2. 20, Specimen showing asymmetrical suture-lines, GSM 87056, ×3.

the main constrictions in some internal moulds. A median furrow is occasionally preserved extending between the constrictions on the internal mouls of some specimens (Pl. 27, fig. 19). Body chamber 1–1½ whorls. In mature specimens the final suture-lines become progressively more closely spaced. Siphuncle dorsal, septal necks retrochoanitic. External suture-line (text-fig. 4A) variable; ventral saddle broadly rounded passing into a very shallow lateral lobe and saddle. Umbilical lobe frequently not developed. Suture-line often asymmetrical in form (Pl. 27, fig. 20).

Measurements of holotype (in mm.). D. 16, W.H. 7, W.T. 10, U. 2.

Comparisons. Only *P. paradoxa* (Wedekind) bears comparison with the species. The marked ornament on the German species is absent in *P. laevigata*, and in addition the umbilicus of the Cornish species is wider and the ventral saddle of the suture line is less pronounced. Secondary constrictions are not present in *P. paradoxa*.

Parawocklumeria laevigata sp. nov. var. *obesa* nov.

Plate 28, figs. 1, 2; text-fig. 4B

Derivation of name. After globose shell.

Holotype. GSM 87088. Pl. 28, figs. 1, 2.

Type locality and horizon. As for *P. laevigata.*

Material. Internal and external moulds.

Diagnosis. Globose variety of the species possessing a suture-line closely resembling *P. paradoxa* (Wedekind).

Measurements of holotype (in mm.). D. 8, W.H. 4, W.T. 7·5, U. 0·75.

Comparisons. P. laevigata var. *obesa* is very similar to *P. laevigata*, and though it is somewhat more globose, the essential difference lies in the nature of the suture-line (text-fig. 4B) which is much more elaborated both in young and adult forms.

Parawocklumeria sp.

Plate 28, fig. 3; text-fig. 4C

Description. A single specimen of *Parawocklumeria* from the lower faunal horizon in the West Quarry at Stourscombe has a subglobose shell of similar form to *P. laevigata.* The suture-line is, however, distinctive, being characterized by an exceedingly small ventral saddle which follows the anterior arching of the constriction over the venter. The lateral lobe is shallow and passes into a pronounced lateral saddle. The umbilical lobe lies at the umbilical seam. Umbilicus deep, moderately small, and of triangular shape. No ornament has been observed.

Measurements. D. 10·5, W.H. 4·5, W.T. 7, U. 1·5.

Family CHEILOCERATIDAE Frech 1897

Genus KENSEYOCERAS gen. nov.

Derivation of name. After the River Kensey.

Type species. Kenseyoceras (Kenseyoceras) rostrata sp. nov.

Range. Upper Devonian. *Wocklumeria* Zone (V1).

Diagnosis. Shell discoidal to subglobose, completely involute. Flanks marked by deep radial constrictions which swing forwards at the venter to form grooves bounding a median keel. Suture-line consists of a ventral saddle divided by a deep parallel-sided lobe, lateral lobe bell shaped passing into a gently arched lateral saddle.

Comparisons. Two species *K.* (*Kenseyoceras*) *biforme* (Schindewolf 1937) and *K.* (*Mayneoceras*) *nucleus* (Schmidt 1924), now placed in this genus, were referred to the genus *Prionoceras* by Schindewolf (1937). *Prionoceras* is alleged to show a suture-line with a prolobitid development; a feature which would place the above species in the Prolobitidae. However, it has never been conclusively demonstrated that *Prionoceras* has a prolobitid suture-line, and *P. biforme* and *P. nucleus* were referred to the genus without reference to the development of their suture-lines. If *Prionoceras* is found to lack the prolobitid suture then it almost certainly becomes a member of the Cheiloceratidae and indistinguishable from *Imitoceras* (*Treatise on Invertebrate Paleontology*, p. L50). It has not been possible to break the shells of species of *Kenseyoceras* completely down to the protoconchs, but the earliest sutures examined have given no indication of a prolobited suture-line development. The form of the suture-line makes closer reference to the Cheiloceratidae and to the subfamily Imitoceratinae in particular. Of the genera composing the Imitoceratinae *Kenseyoceras* is most closely related to *Imitoceras*, but is distinguished from it by the presence of a raised keel bounded by spiral grooves.

Remarks. Schmidt (1924) figured two new species, *Glatziella nucleus* (p. 119, pl. 6, figs. 10, 10*a*, 11) and *Gattendorfia globularis* (p. 120, pl. 6, figs. 12, 12*a*, 13, 13*a*), from rocks at the Devonian–Carboniferous boundary in the Sauerland. In this work he failed to designate the holotypes of his new species. Lange (1929) observed that, apart from the suture-line, *Gattendorfia globularis* was quite distinct from other species of *Gattendorfia* and included it in a new subgenus, *Gattendorfia* (*Balvia*). No lectotype was designated.

Schindewolf (1937, p. 15, footnote 1) noted that Schmidt had confused three species in the descriptions of *Gattendorfia globularis* and *Glatziella nucleus*, and reinterpreted Schmidt's figures thus:

> *Glatziella nucleus* Schmidt (p. 119, pl. 6, figs. 10, 10*a*).
> *Gattendorfia globularis* Schmidt (p. 120, pl. 6, figs. 13, 13*a*).
> *Prionoceras biforme* n. sp. (pl. 6, figs. 11, 12, 12*a*; holotype figs. 12, 12*a*).

Schindewolf also (1937, p. 24, footnote 3) referred the revised species *Glatziella nucleus* to *Prionoceras*. The revised species *Gattendorfia globularis* becomes, on this new interpretation, a characteristic member of the genus *Gattendorfia*. Since there is no doubt that *G. globularis* represented the subgenotype of *G.* (*Balvia*) Lange, *Balvia* is reduced to a subjective synonym of *Gattendorfia* (not *Imitoceras* as is suggested in the *Treatise of Invertebrate Paleontology*, p. L49). A new genus is therefore proposed to include *P. biforme* and *P. nucleus*.

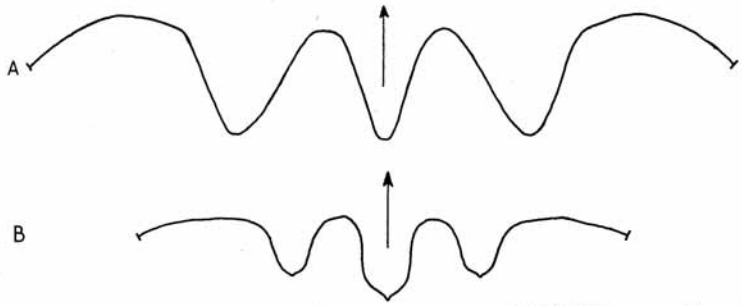
KENSEYOCERAS (KENSEYOCERAS) subgen. nov.

Diagnosis. Discoidal to subglobose. Final third of body chamber characterized by a median keel bounded by furrows. Keel carried forwards to form a pronounced rostrum. Apertural modification terminated posteriorly by constrictions which cross the flanks and reach to the umbilicus.

KENSEYOCERAS (MAYNEOCERAS) subgen. nov.

Derivation of name. After Cuthbert Mayne, a Launceston martyr.

Diagnosis. Discoidal *Kenseyoceras* with pronounced constrictions over the flanks which cross the venter in youth, but later pass into sulci bordering a median keel.



TEXT-FIG. 5. A, *Kenseyoceras* (*Kenseyoceras*) *rostrata* sp. nov.; GSM 87059, suture-line at 9 mm. diameter. B, *Kenseyoceras* (*Mayneoceras*) *nucleus* (Schmidt); GSM 87068, suture-line at 7 mm. diameter.

Kenseyoceras (*Kenseyoceras*) *rostrata* sp. nov.

Plate 28, figs. 4–10; text-fig. 5A

Derivation of name. After the pronounced rostrum.

Holotype. GSM 87058. Pl. 28, fig. 4.

Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds.

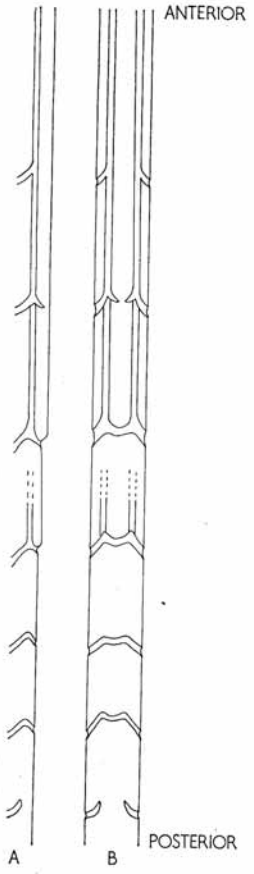
Material. Internal and external moulds.

Diagnosis. Shell discoidal to subglobose, anterior portion of body chamber with a pronounced keel, terminated posteriorly by a tubercle, and bounded by grooves which posteriorly cross the flanks as constrictions reaching to the umbilicus. Keel and sulci produced anteriorly to form a broad rostrum.

Description. Shell discoidal to subglobose, involute, greatest thickness at the umbilicus. Five to six whorls, inclusion complete; umbilicus closed and depressed. Whorls slightly compressed laterally, strongly rounded ventrally, flanks moderately convex; whorls deeply impressed by the preceding whorl, aperture height small. Body chamber just exceeds one volution. Suture-lines closely spaced just posterior to the body chamber (Pl. 28, fig. 8). External suture-line consisting of deep and pointed ventral lobe. First lateral saddle acutely rounded, passing into a broad V-shaped first lateral lobe; second lateral saddle broadly arched, passing into moderately deep umbilical lobe.

On the last third of the body chamber a pair of constrictions, deeply concave to the anterior, extend from the umbilicus towards the periphery attaining maximum concavity one-third of the distance from the venter. From this point each is carried forward,

just off the venter, forming two deep sulci separated by a raised, slightly corded keel. The sulci are continued into a rostrum where the free end of the keel is terminated in a small, hyponomic sinus; the proximal end of the keel is marked by a tubercle. A second less prominent pair of constrictions, similar to, but less concave than the former, occupy a position just posterior to the aperture. Fine ornament is seldom preserved.



TEXT-FIG. 6. *Kenseyoceras* (*Mayneoceras*) *nucleus* Schmidt. Diagrams illustrating the successive stages in the development of the keel. A, Lateral view. B, Ventral view. The diagrams represent the appearance of rather more than two whorls if they were to be uncoiled.

Measurements of holotype (in mm.). D. 10·5, W.H. 4·5, W.T. 6·5, U. closed.

Comparisons. This species is comparable to *Prionoceras biforme* Schindewolf (see above); although no description of the species is given, Schindewolf does select a holotype from Schmidt's figures. In the English species the rostrum maintains the whorl spiral, and the keel is more pronounced and terminated posteriorly by a tubercle. In addition, the pattern formed by the sulci at the posterior termination of the apertural modification is not so highly elaborated over the keel as that figured by Schmidt (1924, pl. 6, fig. 12).

Remarks. There appears to be a good deal of variation in the shape of the shell of this species which covers all gradations from discoidal to subglobose. In addition the tubercle at the posterior end of the keel is frequently not fully developed.

Kenseyoceras (*Mayneoceras*) *nucleus* (Schmidt 1924)

Plate 28, figs. 11–17; text-figs. 5B, 6

1924 *Glatziella nucleus* Schmidt, p. 119, pl. 6, figs. 10, 10*a* (*non* 11).
1929 ? *Prionoceras* or ? *Gattendorfia* (*Balvia*) *nucleus* Lange, p. 61, pars.
1937 *Prionoceras nucleus* Schindewolf, p. 24, footnote 3.

Diagnosis. Shell discoidal. Flanks impressed by three constrictions in youth, increasing to four or rarely five with age. Mature shell bears pronounced keel bounded by spiral grooves.

Description. Shell compressed, discoidal in shape, involute. Seven to eight whorls, inclusion complete; umbilicus closed. Whorls considerably compressed laterally, strongly rounded ventrally; whorls deeply impressed by the preceding volutions. Twelve to thirteen suture-lines per whorl, these are closely spaced anteriorly. External suture-line (text-fig. 5B); ventral lobe deep, parallel sided, first lateral saddle rounded, passing into moderately deep first lateral lobe.

Second lateral saddle gently arched, passing into shallow umbilical lobe. Dorsal lobe deep and narrow.

In young forms whorl sides deeply impressed by three straight constrictions reaching from the umbilicus to the periphery. Initially the constrictions do not unite over the venter but are carried forwards, forming two short spiral grooves. In older specimens these grooves become united through the formation of a posteriorly arched furrow. Subsequently two spiral grooves, separated by a slightly raised keel, develop anteriorly to the constrictions. At first the keel and grooves fail to persist from one constriction to the next, but later become continuous. When this condition is established the constriction pattern over the venter weakens and finally disappears; the lateral constrictions merging into the spiral grooves. No fine ornament has been observed on the Cornish specimens.

In the early stages a suture-line often coincides with a constriction; the ventral lobe of the suture is then much deeper than the constriction sinus.

The adult shell bears four or rarely five constrictions.

Kenseyoceras (*Mayneoceras*) *sinuconstricta* sp. nov.

Plate 28, figs. 18–20

Derivation of name. After the sigmoidally curved constrictions.

Holotype. GSM 87069. Pl. 28, figs. 18–20.

Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds.

Material. Internal and external moulds.

Diagnosis. Discoidal to subglobose *K.* (*Mayneoceras*) with flattened venter and parallel-sided flanks. Flanks impressed by three sigmoidally curved constrictions.

Description. Shell discoidal to subglobose, involute; greatest thickness at the umbilicus. Six to seven whorls, inclusion complete; umbilicus closed. Shell considerably compressed laterally, flattened ventrally, flanks parallel-sided. Each whorl considerably impressed by the preceding whorl. Body chamber just exceeds one whorl. Suture-line typical of the genus.

Flanks deeply impressed by three sigmoidally curved constrictions; the intensity of the constrictions increasing towards the venter. Over the venter constrictions show a well-developed median sulcus separating two equally developed lobes. In mature specimens a median keel develops anterior to the last constriction, this keel is bounded by grooves.

Measurements of holotype (in mm.). D. 11, W.H. 6, W.T. 6·5, U. closed.

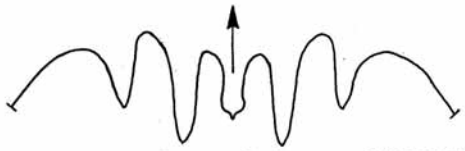
Comparisons. This species may be distinguished from *K.* (*Mayneoceras*) *nucleus* by its thicker whorl cross-section, flattened venter, and by the sinuous pattern of the constrictions over the flanks.

Genus SPORADOCERAS Hyatt 1884

Sporadoceras orbiculare var.

Plate 29, figs. 1, 2; text-fig. 7

Remarks. The suture-line of this variety (text-fig. 7) differs from that described for the species. The lobes are narrow and of unusual depth for the species.



TEXT-FIG. 7. *Sporadoceras orbiculare* var.; GSM 87074, suture-line at 47 mm. diameter.

Genus DISCOCLYMENIA Hyatt 1884

Discoclymenia cornwallensis sp. nov.

Plate 28, figs. 22, 23; text-fig. 8

Derivation of name. After the county of Cornwall.

Holotype. GSM 87071. Pl. 28, fig. 22; text-fig. 8.

Type locality. Stourscombe (West Quarry), nr. Launceston.

Horizon. Stourscombe Beds.

Material. Internal and external moulds.

EXPLANATION OF PLATE 28

Figs. 1, 2. *Parawocklumeria laevigata* sp. nov. var. *obesa* nov. Stourscombe. Ventral and lateral view of holotype, GSM 87088, ×3.

Fig. 3. *Parawocklumeria sp.* Stourscombe. GSM 87057, ×3.

Figs. 4–10. *Kenseyoceras* (*Kenseyoceras*) *rostrata* gen. and sp. nov., Stourscombe. 4, Lateral view of holotype showing apertural modification, GSM 87058, ×3. 5, GSM 87061, ×2, and 6, GSM 87062, ×3, ventral views showing variation in whorl thickness. 7, 8, Specimen viewed from above showing posterior termination of the apertural modification and suture-line, GSM 87059, ×3. 9, Specimen showing tubercle at posterior termination of keel, GSM 87063, ×2. 10, Fragment showing corded keel, GSM 87060, ×2.

Figs. 11–17. *Kenseyoceras* (*Mayneoceras*) *nucleus* Schmidt, Stourscombe. 11, 12, Lateral and ventral view of young specimen showing suture-line and three constrictions which do not unite over the venter, GSM 87068, ×3. 13, 14, Lateral and ventral view of slightly older specimen showing four constrictions almost uniting over the venter, GSM 87065, ×3. 15, 16, Lateral and ventral view showing the keel developing between two spiral grooves, GSM 87064, ×3. 17, Ventral view showing almost continuous spiral grooves between the constrictions and weakening of the constriction over the venter, GSM 87066, ×3.

Figs. 18–20. *Kenseyoceras* (*Mayneoceras*) *sinuconstricta* sp. nov. Stourscombe. Ventral and lateral view of holotype, GSM 87069, ×3.

Fig. 21. *Discoclymenia cucullata* (von Buch) Stourscombe. GSM 87070, ×2.

Figs. 22, 23. *Discoclymenia cornwallensis* sp. nov. Stourscombe. 22, Lateral view of holotype, showing suture-lines in contact, GSM 87071, ×1. 23, Specimen showing growth-lines, GSM 87072, ×2.

Diagnosis. Thickly discoidal *Discoclymenia* with convex growth-lines. The suture-line has a broad V-shaped ventral lobe, and a pointed first lateral saddle bearing on its dorsal side a very flat adventitious lobe.

Description. Shell thickly discoidal; involute with closed umbilicus. Greatest thickness at the umbilicus. Whorl subquadrate in section, whorl height exceeding whorl thickness. Venter broadly convex, flanks flattened, converging slightly towards the venter. Growth-lines convex, fine and closely spaced. Constrictions not seen.

TEXT-FIG. 8. *Discoclymenia cornwallensis* sp. nov.; holotype, GSM 87071, suture-line at a whorl height of 36 mm.

Suture-line (text-fig. 8). Ventral lobe of broad V shape. First lateral saddle pointed, bearing on its dorsal side a very flat, adventitious lobe. First lateral lobe asymmetrical, deep, and pointed. Second lateral saddle rounded, directed upwards towards the venter. Second lateral lobe asymmetrical, broad, and pointed, with almost straight ventral surface; dorsal surface undulatory, passing into a gently arched umbilical saddle.

Measurements of holotype (in mm.). W.H. 36, W.T. 28.

Remarks. A feature of the figured specimen is the closely spaced nature of the suture-lines, and the manner in which the first lateral saddles of each suture are in contact. In one instance the first lateral lobe seems to have been interrupted by the first lateral saddle of the preceding suture.

Comparisons. The suture-line of this species is comparable to *Discoclymenia sp.* of Müller (1956, p. 62), differing only in the size of the ventral lobe; in Müller's species this is narrow and parallel sided. The adventitious lobe in *D. cucullata* (von Buch 1839) is more strongly developed than in *D. cornwallensis.*

Discoclymenia aff. *cornwallensis* sp. nov.

Plate 29, fig. 3

Remarks. This form is similar to *D. cornwallensis,* but it shows a slightly different suture-line. This is not so elaborated and shows the smoother form more generally associated with *Sporadoceras*; in addition the ventral lobe is deep and parallel sided.

Genus GATTENDORFIA Schindewolf 1920

Gattendorfia crassa H. Schmidt 1924

1940 *Gattendorfia crassa* Librovitch, p. 45, pl. 4, figs. 1–4 (with full synonymy).
1952 *Gattendorfia crassa* Schindewolf, p. 296, text-figs. 16, 17.
1954 *Gattendorfia crassa* Pfeiffer, p. 57, pl. 7, fig. 3.
1955 *Gattendorfia crassa* Goldring, p. 48.

Comparison with described forms (measurements in mm.)

Specimen	*D.*	*W.T.*	*W.T. %D.*	*W.H.*	*W.H. %D.*	*U.*	*U. %D.*
1952	46·0	37·0	60	22·0	47	10·5	22
BU 12883	10·0	7·0	70	5·0	50	2·5	25

Gattendorfia occlusa Librovitch 1940

1940 *Gattendorfia occlusa* Librovitch, p. 237, pl. 6, figs. 5, 6, text-figs. 16, 17.

Comparison with described forms (measurements in mm.)

Specimen	*D.*	*W.T.*	*W.T. %D.*	*W.H.*	*W.H. %D.*	*U.*	*U. %D.*
1940 (holotype)	31·0	15·0	46	18·0	58	3·0	9
Range	..	..	41–62	..	46–58	..	9–17
BU 12884	12·5	5·5	44	6·0	48	2·0	16
BU 12915	8·5	3·0	35	3·5	41	1·0	11

Remarks. Two specimens from Penfoot show remarkably small umbilici. The proportions of these specimens are very close to those of *G. occlusa* from Kazakhstan; the specimens are referred to this species in preference to the involute European species *G. involuta* Schindewolf which is inadequately described.

Gattendorfia tenuis Schindewolf 1952

1952 *Gattendorfia tenuis* Schindewolf, p. 298, pl. 3, fig. 1, text-fig. 18.

Comparison with the holotype (measurements in mm.)

Specimen	*D.*	*W.T.*	*W.T. %D.*	*W.H.*	*W.H. %D.*	*U.*	*U. %D.*
BU 12885	19	7	37	8	42	5	26
1952 (holotype)	73	23	31	33	44	18	24

Remarks. The proportions of the Cornish specimen are close to those of the holotype, but the shell has a slightly greater whorl thickness.

Gattendorfia subinvoluta (Münster 1839)

1940 *Gattendorfia* cf. *subinvoluta* Librovitch, p. 40, pl. 3, figs. 6*a*, *b* (with full synonymy).
1952 *Gattendorfia subinvoluta* Schindewolf, p. 295, text-fig. 15.

Comparison with described forms (measurements in mm.)

Specimen	*D.*	*W.T.*	*W.T. %D.*	*W.H.*	*W.H. %D.*	*U.*	*U. %D.*
1940	14·5	6·5	45	4·7	32	7·5	51
1952	52·0	24·0	46	19·0	37	16·0	30
BU 12886 . . .	18·0	6·0	33	6·5	36	7·0	39
BU 12887 . . .	20·5	8·5	41	7·0	33	9·0	43
BU 12888 . . .	13·0	6·5	50	4·5	34	6·0	46
BU 12889 . . .	19·0	6·0	31	5·5	29	7·5	39
BU 12890 . . .	18·0	6·0	33	6·0	33	8·0	44

Remarks. G. subinvoluta is the most commonly occurring Cornish species of this genus. Specimens collected show that the species is variable, particularly in whorl thickness. The Cornish specimens tend to be more evolute than forms described from Germany, for the umbilicus has a size range most comparable to *G.* cf. *subinvoluta* Librovitch, in which the umbilicus is 51–52 per cent. of the diameter.

Trilobites

Family PHACOPIDAE Hawle & Corda 1847

Genus PHACOPS Emmrich 1839

Phacops (*Phacops*) *accipitrinus accipitrinus* (Phillips 1841)

1955 *Phacops* (*Phacops*) *accipitrinus accipitrinus* Goldring, p. 46 (with previous synonymy).

Remarks. P. (*Phacops*) *accipitrinus accipitrinus* occurs commonly in the lower part of the Pilton Beds of north Devon, but it is uncommon in beds of equivalent age in Cornwall.

Although phacopid trilobites occur quite commonly with the rich ammonoid fauna to be found in the siliceous nodules of the Stourscombe Beds, only a single pygidium referable to this species has been recorded. Rare specimens have also been found in the more slaty developments, where they are associated with a rich benthonic fauna. The species has also been collected from the cephalopod limestones of the Lower Petherwin Beds. This represents the oldest horizon from which the fossils have been recorded in this country. However, a comparable range has been observed on the Continent.

Phacops (*Phacops*) *wedekindi* Rud. & E. Richter 1926

1926 *Phacops* (*Phacops*) *wedekindi* Rud. & E. Richter, p. 145, pl. 8, figs. 40–43, text-figs. 17*c*, *d*.
1937 *Phacops* (*Phacops*) *wedekindi* Rud. Richter in Schindewolf, p. 39.

Remarks. Specimens referred to this species are identical to those described from Germany but the eyes have fewer (20–25) facets.

Phacops (*Cryphops*?) *ensae* Rud. & E. Richter 1926

1926 *Phacops* (*Cryphops* ?) *ensae* Rud. & E. Richter, p. 164, pl. 9, figs. 61–64.
1954 *Phacops* (*Cryphops* ?) *ensae* Pfeiffer, p. 40, pl. 2, fig. 4.

Remarks. The granulation of the cephalon of specimens from Cornwall is frequently coarser than that described for the species. This is particularly true of the central part of the glabella; towards the periphery, however, the ornament becomes finer and more

closely spaced. In most of the material collected the lateral border of the cephalon is only very weakly ornamented, and in some cases the posterior border appears quite smooth.

Phacops (*Cryphops*?) *wocklumeriae* Rud. & E. Richter 1926

1926 *Phacops* (*Cryphops* ?) *wocklumeriae* Rud. & E. Richter, p. 167, pl. 9, figs. 65–67.
1937 *Phacops* (*Cryphops* ?) *wocklumeriae* Rud. Richter in Schindewolf, p. 39.
1954 *Phacops* (*Cryphops* ?) *wocklumeriae* Pfeiffer, p. 41, pl. 2, figs. 5–8.

Remarks. This species, which seems to be limited to the upper part of the Stourscombe Beds, occurs less frequently than *P.* (*Cryphops* ?) *ensae*. The tubercles on the test, particularly on the cheek areas, are more widely spaced and rather coarser than described by Rud. & E. Richter. Whilst the length of the glabella is normally much less than its maximum breadth, one specimen shows a glabella with a length almost equal to its maximum breadth.

Phacops (*Dianops*) *sp.*

Plate 29, fig. 4

Remarks. Only a single specimen of a species of the subgenus *P.* (*Dianops*) has been discovered in Cornwall. The broad outline of the specimen is similar to *P.* (*Dianops*) *bartzschi* Pfeiffer (1954, p. 46, pl. 2, figs. 6, 7), but it lacks the diagnostic ornament of this species. In addition to the lack of ornament the specimen can be distinguished from *P.* (*Dianops*) *griffithides* (Rud. & E. Richter 1919) by the greater breadth of the cephalon and by the more rounded anterior margin of the glabella.

Family PROETIDAE Salter 1864

Genus CHAUNOPROETUS Rud. Richter 1919

Chaunoproetus aff. *carnicus* (Rud. Richter 1913)

Plate 29, figs. 8, 9

1913 *Drevermannia*? *carnica* Rud. Richter, p. 379, pl. 22, fig. 16.
1926 *Drevermannia*? *carnica* Rud. & E. Richter, p. 85, pl. 6, figs. ?74, ?75, ?76.
1937 *Drevermannia*? (*Carnica*) *carnica* Rud. Richter in Schindewolf, p. 39.
1955 *Drevermannia*? (*Carnica*) *carnica* Maksimova, p. 124, pl. 9, figs. ?7, ?8.

Remarks. A single ill-preserved cranidium has been found in the Stourscombe Beds which appears to be reasonably close to the holotype of the species. However, the anterior border is less strongly incurved and the anterior branch of the facial suture diverges more strongly than is normal for the species; the suture is placed closer to the glabella. The occipital ring does not show the large median measurement described by Richter. Glabellar furrow 1p only has been detected.

Specimens figured later by Rud. & E. Richter (1926) show variation particularly in the shape of the glabella and the distance of the facial suture from the glabella. The figures suggest that several species may be involved.

Genus cyrtosymbole Rud. Richter 1913

Cyrtosymbole (*Waribole*) aff. *conifera* Rud. & E. Richter 1926

Plate 29, fig. 7

1926 *Cyrtosymbole* (*Waribole*) *conifera* Rud. & E. Richter, p. 53, pl. 3, figs. 37, 38, 40.

Remarks. Several specimens, including an almost complete exoskeleton, from the Stourscombe Beds appear to be very close to this species apart from certain differences in the facial suture. In particular the anterior branch of the suture is more strongly rounded, and cuts the anterior border closer to the median line than in the specimens figured by Rud. & E. Richter. The palpebral lobes are of comparable size to the holotype but are placed a little more anteriorly; γ, and in some cases δ, are farther from the glabella than is usual in the species. The glabella is irregularly, and slightly more strongly, granulated than in the German specimens. No granulation has been observed on the free cheek or pygidium.

Cyrtosymbole (*Waribole*) aff. *italica* (Gortani 1907)

Plate 29, fig. 6

1907 *Dechenella italica* Gortani, p. 39, pl. 1, fig. 27; pl. 2, fig. 32.
1912 *Cyrtosymbole* (?) *italica* Rud. Richter, pp. 259, 337.
1913 *Cyrtosymbole* (?) *italica* Rud. Richter, p. 398, pl. 23, fig. 2.
1913 *Proetus* (*Cyrtosymbole*) *italicus* Gortani, p. 265, text-fig. 1.
1926 *Cyrtosymbole* (*Waribole*) *italica* Rud. & E. Richter, p. 51.

Remarks. Several Cornish specimens, although not perfectly preserved, are similar to the species described by Gortani from the Carnic Alps. This species has not been recorded elsewhere, though the closely related *Cyrtosymbole* (*Waribole*) *octofera* Rud. & E. Richter occurs in the *Wocklumeria* Zone in Germany.

The posterior branch of the facial suture, hitherto incompletely figured, diverges moderately strongly from the glabella, reaching the posterior margin a distance from the axial furrow almost equal to half the breadth of the occipital ring. The palpebral lobes are not quite as broad as those figured by Gortani.

A single free cheek has been found which is similar to the incomplete specimen figured by Gortani, but on the cheek area it shows a raised line passing around the anterior part of the eye. This is a similar line to that seen in *C.* (*Waribole*) *octofera*, but weaker.

Ornament is not characteristic of the species, but the free cheek described shows a fine granulation and the axial part of the glabella of one cranidium is also granulated.

In the Carnic Alps the species is alleged to occur in the *Clymenia* Zone; however, the clymenid *Postglatziella* is also recorded from the same beds. This is a species generally supposed to be of *Wocklumeria* Zone age. It is thus possible that the Carnic specimens, like those from Cornwall, come from this zone.

Cyrtosymbole (? *Waribole*) *dunhevedensis* Thomas 1909 nom. correct.

1909 *Proetus dunhevidensis* Thomas, p. 197, pl. 7, fig. 6.
1926 *Cyrtosymbole* (? *Waribole*) *dunhevidensis* Rud. & E. Richter, p. 53.

Remarks. The single specimen of this species located, according to Thomas, in the Southgate Museum, Launceston, has not been found. No further specimens have been found during the present investigation. The spelling of the specific name which, due to a slip in the original description, read *dunhevidensis*, is corrected.

Cyrtosymbole (? *Calybole*) cf. *nepia* Rud. & E. Richter 1926

1926 *Cyrtosymbole nepia* Rud. & E. Richter, p. 61, pl. 4, fig. 50.
1954 *Cyrtosymbole nepia* Pfeiffer, p. 35.
1955 *Cyrtosymbole* (? *Calybole*) *nepia* Maksimova, p. 103, pl. 6, fig. 4.

Remarks. Several minute pygidia have been collected. Although not perfectly preserved these specimens appear to be similar to *C. nepia*, a possible larval form.

Cyrtosymbole (? *Macrobole*) aff. *bergica* Rud. Richter 1913

Plate 29, fig. 5

1913 *Cyrtosymbole bergica* Rud. Richter, p. 387, pl. 22, figs. 22, 23.
1926 *Cyrtosymbole bergica* Rud. Richter, p. 59.

Remarks. An almost complete cephalon, from the Stourscombe Beds, shows close affinities to the specimen figured by Rud. Richter (1913). However, the exoskeleton where it still remains has a fine granulation which is particularly evident on the free cheeks. Ornament has not previously been described in the species.

The facial suture of the figured specimen, although comparable to the holotype, shows certain differences from it. In particular the posterior branch of the suture which runs parallel, and rather nearer, to the axial furrow than in the German species, cuts the posterior border at a slightly greater distance from the genal angle. γ on the anterior branch is slightly farther from the glabella.

The occipital ring, which is not preserved in the holotype, is comparable to that of *Cyrtosymbole* sp. cf. *bergica* (Rud. & E. Richter 1926, p. 60, pl. 4, figs. 48, 49).

The preservation is such that only the glabellar furrow 1p can be detected.

Pygidia referred to the species show nine clear rings on the axis and three (+1) ribs on the flanks.

This species has not previously been ascribed to any subgenus of *Cyrtosymbole*. The long posterior branch of the facial suture running parallel to the axial furrow suggests that a tentative reference can be made to *C.* (*Macrobole*).

Cyrtosymbole (*Macrobole*) *drewerensis* Rud. & E. Richter 1951, sens nov.

Plate 29, figs. 14–16

1951 *Cyrtosymbole* (*Macrobole*) *drewerensis drewerensis* Rud. & E. Richter, p. 235, pl. 1, figs. 7–11; pl. 5, figs. 47, 48, text-figs. 1M and 3.
1951 *Cyrtosymbole* (*Macrobole*) *drewerensis longisuta* Rud. & E. Richter, p. 238, pl. 1, figs. 12, 13; pl. 5, fig. 48.
1954 *Cyrtosymbole* (*Macrobole*) *drewerensis longisuta* Pfeiffer, p. 51.

Remarks. This species is the most commonly occurring trilobite in the Yeolmbridge Beds. Variation within the species was noted by Rud. & E. Richter, but it has been

found difficult to refer many of the Cornish specimens to either of the subspecies recognized by them due to the occurrence of intermediate forms and the variation in other characters.

On the whole the palpebral lobes, which are elongate, are broader and the maximum breadth occurs just anterior to glabellar furrow 1p; this is slightly more posterior than is usual in the species. Glabellar furrow 4p is normally developed.

Granulation is varyingly developed and does not appear to be necessarily limited to specimens with *longisuta* type glabellae. For instance, the specimen figured in Pl. 29, figs. 14, 15, is very close in its general form to *C.* (*Macrobole*) *drewerensis drewerensis*, but it shows a slight tuberculation at the posterior margin of the glabella. The anterior border of the glabella of this specimen is wider than that figured by Rud. & E. Richter.

Another cranidium (Pl. 29, fig. 16) is very close to *C.* (*Macrobole*) *drewerensis longisuta*; the glabella is covered by a fine granulation, but the anterior end of the glabella does not taper so sharply. The palpebral lobes are slightly longer than is usual in the species.

Pygidia referable to this species are not common in the Yeolmbridge Beds. The length of the axis tends to be rather shorter than in the German specimens; in other respects they are closely comparable.

The variation noted in Cornwall in this species with regard to the shape and granulation of the glabella, and in the facial suture, suggests that *C.* (*Macrobole*) *drewerensis longisuta* has no taxonomic significance.

Measurements (in mm.)

Specimen	GSM 87099 Pl. 29, figs. 14, 15	GSM 87098 Pl. 29, fig. 16	BU 12897
Length of cranidium	6·5	4·75	5·5
Breadth of cranidium	5·0	2·25	2·75
Length of glabella	5·0	3·25	4·0
Breadth of glabella	4·0	3·0	3·0

Specimen	BU 12905	BU 12904	BU 12902	BU 12901
Length of pygidium	4·0	3·0	6·5	5·5
Breadth of pygidium	7·5	5·5	11·0	10·0
Length of axis	3·0	2·25	5·0	4·5
Breadth of axis	1·75	1·5	2·5	2·75

Cyrtosymbole (*Macrobole*) *duodecimae* Rud. & E. Richter 1951

Plate 29, fig. 17

1951 *Cyrtosymbole* (*Macrobole*) *duodecimae* Rud. & E. Richter, p. 238, pl. 12, figs. 18–21; pl. 5, fig. 49, text-fig. 4.
1954 *Cyrtosymbole* (*Macrobole*) *duodecimae* Pfeiffer, p. 51, pl. 4, fig. 5.
1955 *Cyrtosymbole* (*Macrobole*) *duodecimae* Goldring, p. 32, pl. 1, fig. 2, text-figs. 5*a*, *b*.

Remarks. Only a few specimens from the Yeolmbridge Beds can be referred to this species and these are very close to the holotype. In the single cranidium the divergence of the facial suture near the posterior border furrow is such that the suture cuts the

posterior margin at a distance from the axial furrow equal to half the breadth of the occipital ring. This distance is greater than that noted by Rud. & E. Richter. The glabella of the Cornish specimen is very slightly more slender than in the holotype. Glabellar furrow 4p has not been observed.

Pygidia are fairly common and agree closely with the described form, but as in the specimens from the Pilton Beds (Goldring 1955) a few show a length of pygidium rather greater than half the breadth.

Measurements (in mm.). GSM 87100 (Pl. 29, fig. 17), length of cranidium 4·5; breadth of cranidium 3·0; length of glabella 3·25; breadth of glabella 2·7.

Specimen	BU 12911	BU 12912	BU 12913	BU 12914
Length of pygidium . .	6·0	2·0	3·25	4·0
Breadth of pygidium . .	10·5	4·0	7·5	9·0
Length of axis . . .	5·0	2·0	2·5	3·0
Breadth of axis . . .	3·5	1·5	2·25	2·5

Cyrtosymbole (*Macrobole*) aff. *blax* Rud. & E. Richter 1951

Plate 29, figs. 12, 13

1951 *Cyrtosymbole* (*Macrobole*) *blax* Rud. & E. Richter, p. 240, pl. 2, figs. 14–16, ?17; pl. 5, fig. 50, text-fig. 5.

Remarks. A single cranidium from the Yeolmbridge Beds is very close to *C.* (*Macrobole*) *blax* but shows certain differences from it. The palpebral lobes are broader and placed slightly more posteriorly, the anterior border of the cranidium is situated very slightly farther from the glabella, and the granulation of the glabella is only very sparsely distributed.

EXPLANATION OF PLATE 29

Figs. 1, 2. *Sporadoceras orbiculare* var.; Stourscombe. Lateral and ventral view showing suture-line, GSM 87074, ×1.

Fig. 3. *Discoclymenia* aff. *cornwallensis* sp. nov. Stourscombe. GSM 87073, ×1.

Fig. 4. *Phacops* (*Dianops*) *sp.*; Stourscombe. Plan view, GSM 87091, × 2.

Fig. 5. *Cyrtosymbole* (? *Macrobole*) *bergica* Rud. Richter, Overwood Farm, nr. Yeolmbridge. Plan view, GSM 87096, ×4.

Fig. 6. *Cyrtosymbole* (*Waribole*) aff. *italica* (Gortani), Overwood Farm, nr. Yeolmbridge. Plan view, GSM 87094, ×4.

Fig. 7. *Cyrtosymbole* (*Waribole*) aff. *conifera* Rud. & E. Richter, Overwood Farm, nr. Yeolmbridge. Plan view, GSM 87093, ×4.

Figs. 8, 9. *Chaunoproetus* aff. *carnicus* (Rud. Richter) Stourscombe. Side and plan view, GSM 87092, ×4.

Figs. 10, 11. *Cyrtosymbole* (*Macrobole*) *sp.* Yeolmbridge Slate Quarry. Plan and side view, note elongate glabella, GSM 87097, ×4.

Figs. 12, 13. *Cyrtosymbole* (*Macrobole*) aff. *blax* Rud. & E. Richter, Yeolmbridge Slate Quarry. Plan and side view, GSM 87091, ×4.

Figs. 14–16. *Cyrtosymbole* (*Macrobole*) *drewerensis* Rud. & E. Richter, Yeolmbridge Slate Quarry. 14, 15, Plan and side view of cranidium, GSM 87099, ×4. 16, Plan view of cranidium, GSM 87098, ×4.

Fig. 17. *Cyrtosymbole* (*Macrobole*) *duodecimae* Rud. & E. Richter, Yeolmbridge Slate Quarry. Plan view, GSM 87100, ×4.

The palpebral lobes are not as large, and the anterior branch of the facial suture diverges more strongly from the glabella at γ, than in the closely related species *C.* (*Macrobole*) *mulesi* Goldring (1955).

An incomplete pygidium can probably also be referred to this species. No fine granulation has been detected, and, unlike the pygidium described by Rud. & E. Richter, the anterior portions of the ribs are larger than the posterior. Four ribs can be detected, but only the first two are distinct.

Measurements (in mm.). GSM 87101 (Pl. 29, figs. 12, 13), length of cranidium 6·0; breadth of cranidium 4·5; length of glabella 4·5; breadth of glabella 4·0. BU 12910, length of pygidium 4·0; breadth of pygidium 6·0; length of axis 3·0; breadth of axis 2·0.

Cyrtosymbole (*Macrobole*) *sp.*

Plate 29, figs. 10, 11

Description. A species has been noted in the Yeolmbridge Beds which is characterized by a particularly slender cranidium. The glabella is elongate and tapers sharply to the anterior; its length is just over twice its breadth. The preglabellar field is small and the anterior border curved. The occipital furrow is broad and deep, rising posteriorly into the occipital ring which continues the outline of the glabella. At the median line the occipital ring widens slightly and is marked by a mesial tubercle. Four glabellar furrows are present; 1p is a shallow groove curving slightly posteriorly and extending almost to the occipital furrow, 4p is short and indistinct.

The anterior branch of the facial suture diverges moderately from the glabella. β is rounded and lies on a line just posterior to the anterior end of the glabella. The palpebral lobe is small and elongate with γ lying farther from the glabella than δ; γ is placed between 2p and 3p, δ lies one-third of the distance from 1p to the occipital furrow. The posterior branch of the suture is long and straight and runs parallel to the axial furrow. Near the posterior border it diverges strongly to reach the posterior margin at a distance from the axial furrow equal to half the breadth of the axial ring. The posterior border of the cranidium is much narrower than the occipital ring and only very weakly arched.

Measurements (in mm.). GSM 87097 (Pl. 29, figs. 10, 11), length of cranidium 8·5; breadth of cranidium 4·0; length of glabella 6·25; breadth of glabella 3·0.

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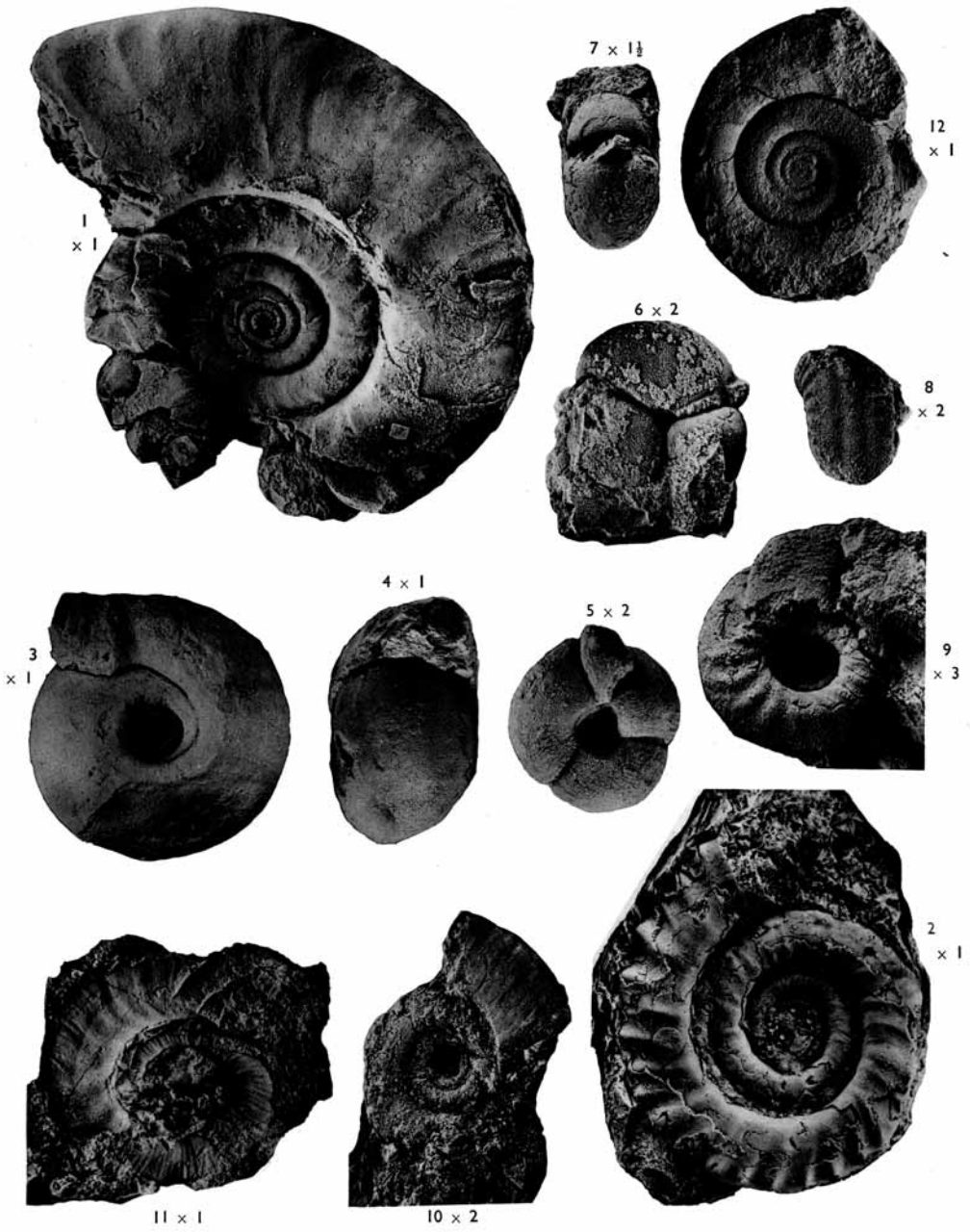

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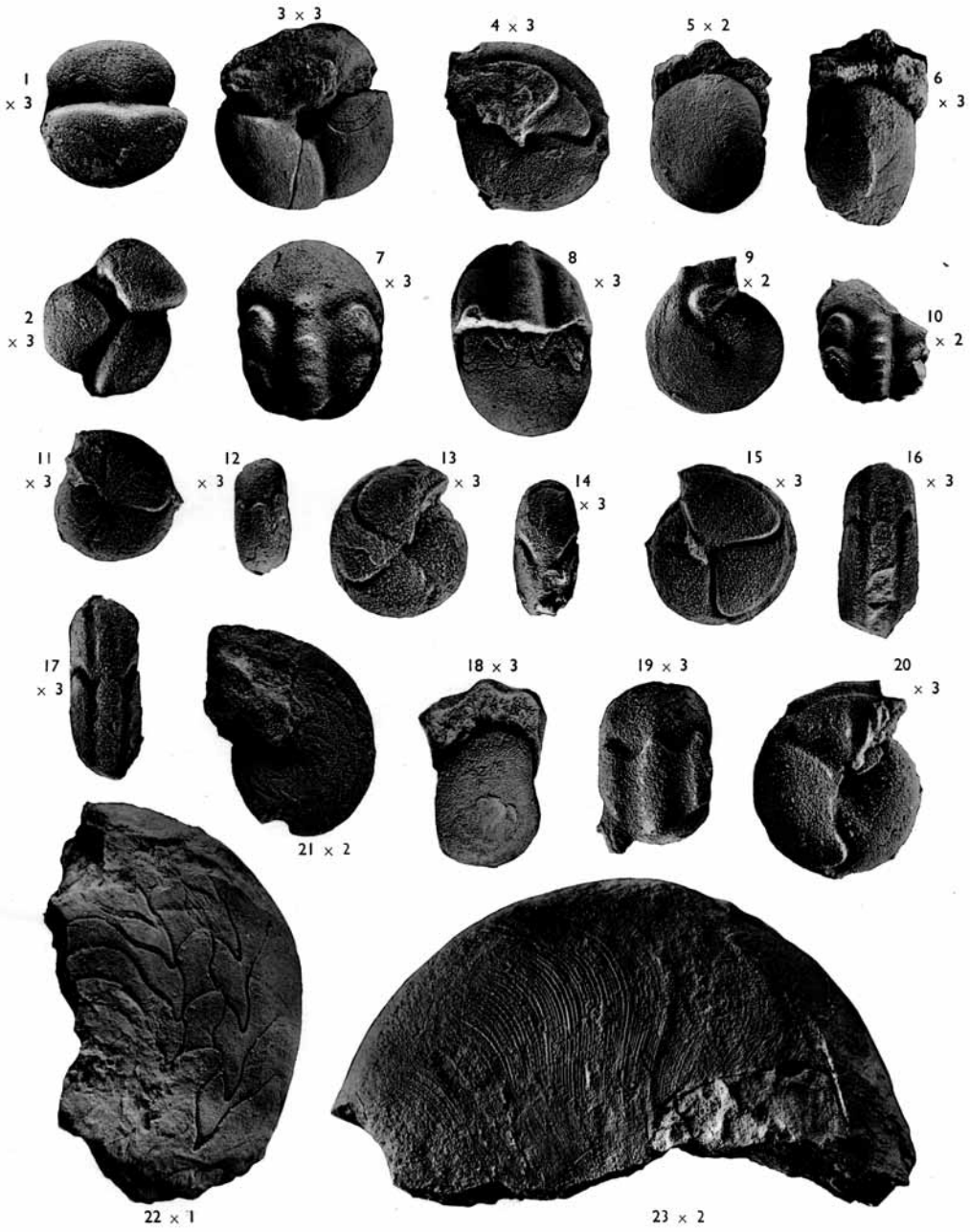

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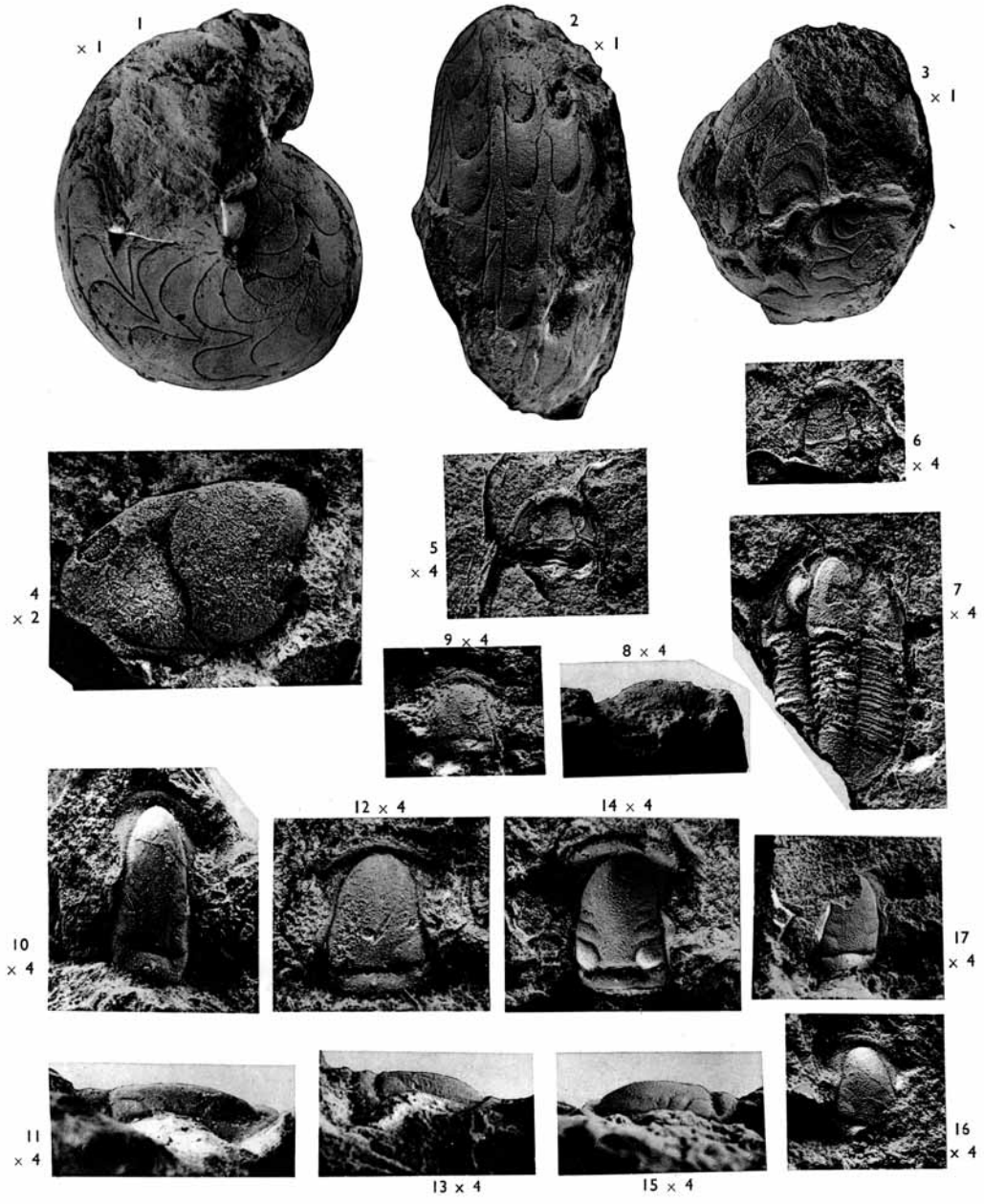

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