

FAMENNIAN AMMONOIDS FROM NEW SOUTH WALES

by T. B. H. JENKINS

ABSTRACT. Seven species and two subspecies belonging to four genera of ammonoids (Clymeniina and Goniatitina) are described from a Famennian horizon, *Platyelymenia* Zone, a few hundred feet below the erosive base of the Carboniferous in the vicinity of Keepit Dam, near Tamworth, New South Wales. Three new species of Clymeniina are described: *Genuelymenia keepitensis*, *Platyelymenia (Platyelymenia) teichertii*, and *P. (P.) alterna*.

ONLY in recent years have ammonoid cephalopods been reported in the Upper Devonian strata of eastern Australia. As Teichert remarked in 1948, the earlier records of ammonoids from those strata are probably erroneous. The first acceptable record of such fossils is that of Pickett (1960) who described a new species of clymenid from the Borah Limestone in northern New South Wales. Lately the index goniatite *Cheiloceras* has been recorded by the present writer and reference has been made to the fauna now described, both occurrences being in the same northern New South Wales province.

The stratigraphic horizons of these ammonoids have been previously indicated in a column for the area near Keepit Dam (Jenkins 1966, text-fig. 2), the horizon of the fossils now described being about 3,000 ft. higher, in an expanded, largely clastic succession, than that of the *Cheiloceras* occurrence. The persistent Borah Limestone seems to be absent in the belt of country running meridionally through Keepit Dam which has yielded the later ammonoid finds; its absence there is presumably due to the disconformity between the Devonian and Carboniferous systems. The inferred position of the Borah Limestone is thus an unmeasured distance, possibly as much as a thousand feet, above that of the fauna now described. The general geology of the surrounding country has been described by Voisey and Williams (1964).

All the fossils here described come from a 25 ft. lens of clayey coarse sandstone, containing patches of shale breccia, in the basal portion of the Mandowa Mudstone outcropping in Spring Gully at a point 3.13 miles N. 24° W. of Keepit Dam and 1.0 miles W. 27° S. of Gartmore Homestead. It is 1.5 miles N. of the *Cheiloceras* spot shown in text-fig. 1 of Jenkins (1966), the scale of which locality map should be corrected to 1 in. = 0.7 mile.

Recent discoveries of Late Devonian ammonoids in northern New South Wales provide a few firm correlations with other areas but the sequence of faunas is as yet only very imperfectly known in eastern Australia, in marked contrast to the position in western Australia, where ammonoids are now known from each of the major divisions, *Manticoceras*-Stufe to *Wocklumeria*-Stufe (Glenister and Klapper 1966).

Described specimens are in the fossil collections of The University of Sydney Geological Department and are referred to by USGD catalogue numbers.

SYSTEMATIC DESCRIPTIONS

Suborder CLYMENIINA Hyatt 1884
Superfamily CLYMENIACEAE Edwards 1849

[Palaeontology, Vol. 11, Part 4, 1968, pp. 535-48, pls. 104-5.]

Family CYRTOCLYMENIIDAE Hyatt 1884

Genus GENUCLYMENIA Wedekind 1908

Type species. *Clymenia frechi* Wedekind 1908, p. 617, by subsequent designation of Schindewolf 1957.

In its sutural character this genus is intermediate between the two other genera, *Cyrtoclymenia* and *Cymaclymenia*, included in the Cyrtoclymeniidae by Schindewolf, (in Moore, 1957). *Genuclymenia* is previously recorded from Germany and the Urals (U.S.S.R.).

Genuclymenia keepitensis sp. nov.

Plate 104, figs. 1-4; text-fig. 1 *g, h*

Derivation of name. From Keepit Dam, near Gunnedah, N.S.W.

Holotype. USGD 6827.

Preservation. The holotype is an internal mould in clayey sandstone; three other specimens are similarly preserved.

Dimensions (in mm.)

	D	WW	WH	UW
Holotype USGD 6827	16.8	c. 4.5	6.8	c. 5.5
USGD 6830	16.3	4+	6.9	5.7

Diagnosis. *Genuclymenia* with lateral lobe separated from umbilical seam by short straight radial segment of suture, flatly rounded whorl sides converging from maximum width near mid-flanks to a narrowly rounded venter.

Description. Shell form is subdiscoidal and rather narrowly umbilicate with whorls deeply overlapping; in cross-section the whorls are compressed with flatly rounded sides having maximum width at about mid-height and converging gradually to a narrowly rounded venter. Low ribs on part of one mould and faint growth-lines on its counterpart seem to mark a shallow lateral sinus passing into a broad ventro-lateral salient.

The external suture line runs radially from the umbilical seam and passes abruptly into a semicircular lateral lobe which is separated from the flat ventral saddle by a shallow lobe. The internal suture has not been observed.

EXPLANATION OF PLATE 104

Figs. 1-4. *Genuclymenia keepitensis* sp. nov. 1, internal mould, USGD 6829, $\times 4$; 2, internal mould, holotype, USGD 6827, $\times 3$; 3, a partial internal mould, uncoated, showing suture and low ribs, USGD 6830, $\times 2$; 4, plasticine mould from counterpart of USGD 6830, showing low growth ridges, $\times 2$.

Figs. 5, 6. *P. (Platyclymenia) annulata annulata* (Münster). 5, internal mould, USGD 6834, $\times 1$; 6, fragment of an internal mould, USGD 6836, $\times 2$.

Figs. 7, 8. *P. (Platyclymenia) annulata densicosta* Frech. 7, internal mould, USGD 6837, $\times 2$; 8, external mould, USGD 6880, $\times 2$.

Figs. 9-13. *P. (Platyclymenia) teichertii* sp. nov. 9, crushed specimen preserving fine growth-lines, syntype, USGD 6839, $\times 1$; 10, internal mould, (subsequently sectioned for text-fig. 2*e, f*), syntype, USGD 6891, $\times 2$; 11, internal mould (see also text-fig. 2*a-d*), syntype, USGD 6890, $\times 2$; 12, internal mould showing septal face of body chamber, USGD 6851, $\times 1\frac{1}{2}$; 13, partly crushed internal mould showing portions of three septal faces, USGD 6850, $\times 1\frac{1}{2}$.

Remarks. Previously figured sutures of species assigned to *Genuclymenia* (see text-fig. 1) show an umbilical saddle passing immediately into a rounded lateral lobe. In *G. keepitensis* the lateral lobe is separated from the umbilical seam by a nearly straight radial portion of the suture which could be considered a flat saddle. Wide separation of lateral lobe and umbilical seam characterizes the related *Cymaclymenia* which has a broad saddle in this position. In the character of its dorso-lateral suture, the new species is thus intermediate between *Cymaclymenia* and other species of *Genuclymenia*. Of figured specimens it is closest to *Cymaclymenia pseudogoniatites* (Sandberger 1853, pl. 7, fig. 4 (others excluded)) which shows a slightly asymmetrical and incipiently acuminated lateral lobe (text-fig. 1i herein).

In shell form *G. keepitensis* is distinguished from Wedekind's species *G. frechi* and *G. discoidalis* by the absence of any flattening along its venter and from *G. angelini* by its more compressed whorls. *G. karpinskii* Perna has wider whorls ($WW/WH = 0.81$ at $D = 25$ mm.) and straighter lateral growth-lines meeting the umbilical seam more orthogonally than in *keepitensis*. *G. borni* Schindewolf is closest in shell shape but has maximum whorl width near the umbilical shoulder and lacks even the low ribs seen in some of the Keepit specimens.

Occurrence. According to Schindewolf (in Moore 1957) *Genuclymenia* is confined to the *Platyclymenia* zone of the Famennian, i.e. to Stufen III and IV of Wedekind (1913). *G. frechi* was recorded at Enkeberge by Wedekind (1908, table after p. 634) from beds that were later termed Stufen IV and V. But these tabulated records do not appear in the text, were not repeated by Wedekind (1914) and were not confirmed by Lange's (1929, p. 12 n., p. 88) later work in the same area. Lange's observations agreed with Wedekind's (1914) revision in restricting *Genuclymenia* to III β , wherein it is abundant. Schindewolf's record of *G. frechi* from III α at Gattendorf is the only authentic occurrence of the genus known to the writer outside III β . Schindewolf's (1923, p. 435) record of *G. dunkeri* (Munster) from V α at Gattendorf refers to the type species of *Protoxyclymenia* Schindewolf 1922.

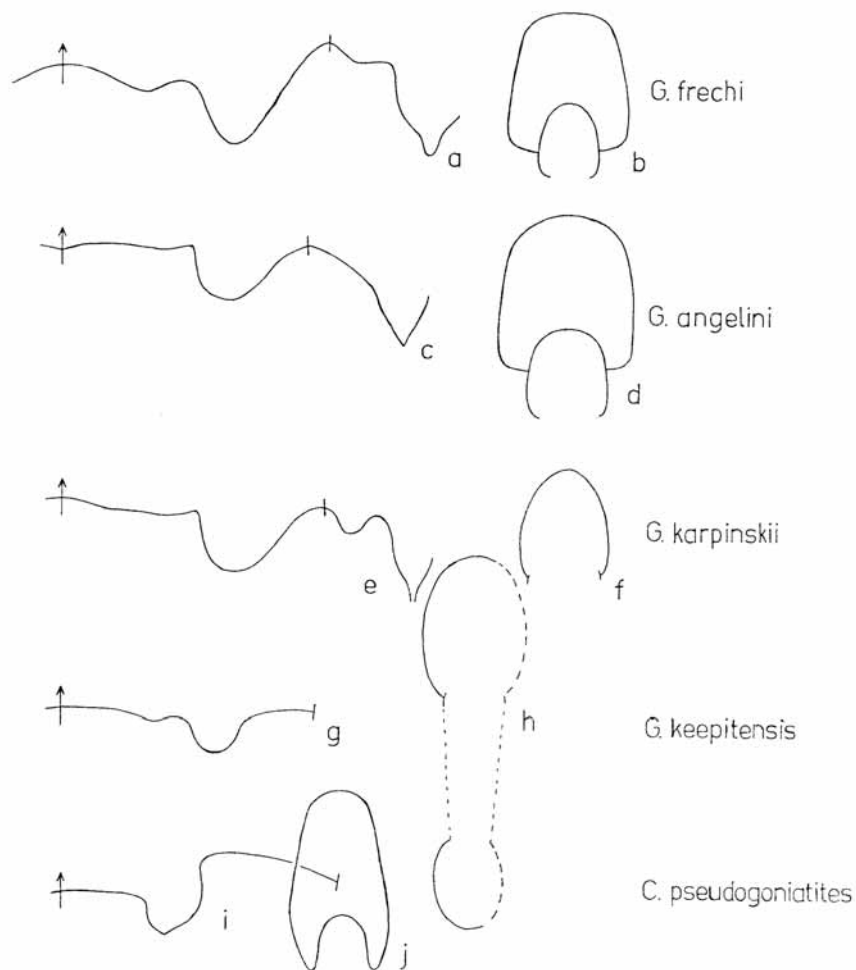
Family CLYMENIIDAE Edwards 1849

Genus PLATYCLYMENIA Hyatt 1884

Type species. By original designation *Goniatites annulatus* Münster 1832.

This genus receives the species of widely umbilicate clymenids having growth-lines which are concave on the lateral areas and simple sutures consisting of a broad ventral saddle passing evenly through a broadly rounded lateral lobe to a sharper, often angular umbilical saddle and a moderately deep, undivided dorsal lobe.

The genus is currently subdivided by Schindewolf (1934, 1957 in Moore) and Bogoslovsky (1962) into four subgenera: *P. (Pleuroclymenia)*, *P. (Trigonoclymenia)*, *P. (Spinoclymenia)*, and *P. (Platyclymenia)*, of which only the last is represented in my material. Species have been defined mainly on whorl section and ornamentation. It is well established that both characters change during the ontogeny of many included species. Specimens which combine the features of several nominal species are common (*vide* Lange 1929, pp. 93-6).



TEXT-FIG 1. Comparison of *G. keepitensis* sp. nov. with other species.

a, b, G. frechi Wedekind, the suture at maturity, from Schindewolf 1957 (text-fig. 40, 3*b*) and whorl section from Wedekind 1914, pl. 1, fig. 76.

c, d, G. angelini Wedekind, the suture from Perna 1914 (text-fig. 81) and whorl section from Wedekind 1914 (pl. 1, fig. 6*b*).

e, f, G. karpinskii (Perna), suture and whorl section from Perna 1914 (text-fig. 86*a*, and pl. 3, fig. 18*a*, respectively).

g, h, G. keepitensis sp. nov., suture $\times 6$, whorl section $\times 4$, based on holotype, USGD 6827.

i, j, C. pseudogoniatites (Sandberger), suture and whorl section from Sandberger (1853, pl. 7, figs. 4*b*, 4*a*, respectively).

Platyclymenia is widespread in the northern hemisphere, being found in North America (U.S.A., Canada?), Europe, North Africa, and Asia (Kazakstan, China). It is also recorded from Western Australia (Teichert 1941) and a doubtful specimen from New South Wales has been figured by Pickett (1960).

Platyclymenia (Platyclymenia) annulata (Münster)

Neotype. By designation of Wedekind 1914: *Clymenia annulata* Münster; Gümbel 1863, pl. 15, fig. 12.

Diagnosis. A species of *Platyclymenia* with strong, sharp, unpaired, and clearly separated ribs on the flat or arched whorl sides; ribs absent or greatly reduced in later growth stages.

Remarks. Interpretation of this, the type species, was stabilized by Wedekind's selection of a neotype and clarified by Schindewolf's (1923) redefinition. Lange has discussed the morphological variation on the basis of material from around Enkeberg, close to the locality of the neotype and has described intergradations with *P. (P.) richteri* Wedekind which seemingly would be better regarded as a subspecies of *annulata*. Frech's (1902) *annulata* var. *densicosta* and Wedekind's (1914) *richteri* var. *densicosta* as well as Petter's (1960) *annulata* var. *semperornata* belong within the redefined species, but Perna's (1914) var. *correcta* and var. *rustica* are excluded.

Occurrence. Oberdevonstufe IV of Wedekind, more usually termed nowadays the *annulata* Zone, which is the uppermost division of the *Platyclymenia*-Stufe.

Platyclymenia (Platyclymenia) annulata annulata (Münster)

Plate 104, figs. 5, 6

- 1832 *Goniatites amulatus* Münster, p. 3, pl. 6, fig. 6 [fide auctt.].
 1834 *Goniatites annulatus* Münster; Münster, p. 95, pl. 6, fig. 6.
 1863 *Clymenia annulata* Münster; Gümbel, p. 130, pl. 15, fig. 12 [non figs. 11, 13].
 1910 *Clymenia annulata* Münster; Rzehak, p. 169, pl. 2, fig. 1 [non figs. 2-5].
 [non] 1914 *Clymenia annulata* Münst.; Perna, p. 75.
 1914 *Platyclymenia annulata* (Münster) Gümbel; Wedekind, p. 35.
 1923 *Platyclymenia annulata* Gümb. red.; Schindewolf, p. 447, pl. 17, figs. 7, 8.
 1929 *Platyclymenia annulata* Gümb. red. Schind.; Lange, p. 107.
 1956 *Platyclymenia (Platyclymenia) annulata* (Münster 1832); Müller, p. 70.
 1960 *Platyclymenia annulata* (Münster) 1832 red. Gümbel; Petter, p. 23, text-fig. 3E, pl. 4, figs. 4, 7, 9, 10.

Diagnosis. A subspecies of *P. (P.) annulata* having 26 or fewer ribs per whorl in the coarsely ribbed portion of the shell and a subrectangular or trapezoidal whorl section.

Material. Two specimens, one a fragment of an internal mould, the other two whorls of an internal mould and its external mould counterpart, preserved in a clayey sandstone.

Dimensions (in mm.)

	D	WW	WH	UW
USGD 6834 (internal mould)	63	—	c15	38

C 5934

N n

Description. The more complete specimen is large (maximum diameter over 88 mm.), widely evolute with a rounded rectangular whorl section in its strongly ribbed stage. The ribs are in the form of sharp ridges, radial to slightly prorsiradiate and weakly concave towards the aperture; they increase in height and width, but maintain their sharpness, towards the ventro-lateral shoulder and there flatten out abruptly, thus seemingly accentuating the sub-rectangular whorl shape. There are 21 ribs in the whorl ending at WH = 9.5 mm. Adjacent ribs are separated by completely smooth sections which are twice to four times the width of a rib. In the next whorl, ending with WH = c. 15 mm., the ribs are much less sharp, about twice as numerous and are highest towards the umbilical shoulder. The flank of the last preserved whorl, on the external mould, is smooth except for low radially elongate swellings which diminish in definition and elevation towards the aperture.

Part of one suture is preserved within the strongly ribbed stage; it shows the shallow, evenly rounded, lateral lobe which is characteristic of the genus.

Remarks. There is close correspondence with *P. annulata* red. Schindewolf and especially with a large specimen carefully described by Lange (1929, p. 111) under the name *Platyclymenia richteri*, but which he regarded as possibly belonging to *P. annulata*, presumably because the whorl section was not clearly observable.

Platyclymenia (Platyclymenia) annulata densicosta Frech

Plate 104, figs. 7, 8

- 1863 *Clymenia annulata* Münt. Gümbel, p. 130, pl. 15, fig. 13, 13a [non figs. 11, 12].
 1902 *Clymenia annulata* var. *densicosta* Frech, p. 31, pl. 1, fig. 7.
 1914 *Platyclymenia annulata* var. *densicosta* Frech emend.; Wedekind, p. 36, pl. 3, fig. 2.
 1914 *Platyclymenia richteri* var. *densicosta* Wedekind, p. 35.
 1923 *Platyclymenia annulata* var. *densicosta* Frech; Schindewolf, p. 449.
 1929 *Platyclymenia annulata* var. *densicosta* Frech; Lange, p. 108.
 1960 *Platyclymenia annulata* var. *densicosta* Frech emend. Wedekind; Petter, p. 24, pl. 4, fig. 5; pl. 5, figs. 13, 23.
 1960 *Platyclymenia richteri* var. *semperornata* Petter, p. 25, pl. 4, figs. 6, 11.

Diagnosis. A subspecies of *P. (P.) annulata* having 27 or more ribs per whorl in the coarsely ribbed portion of the shell.

Material. Two specimens preserved in clayey sandstone, one a fragment of an external mould and the other an internal mould of two inner whorls.

Dimensions (in mm.)

	D	WW	WH	UW
USGD 6837 (internal mould)	21.7	c. 7	6.9	12.6

Description. The more complete specimen is a widely umbilicate small mould of approximately circular whorl section. Fourteen ribs in the last-preserved half whorl are sharp and are highest and broadest towards the venter, but abruptly end in a slightly prorsiradiate attitude to leave the venter unribbed and rounded. The inner of the two preserved whorls has somewhat more numerous but less sharp ribs.

The second specimen (USGD 6880) is a fragment of an external mould showing ten ribs of the *annulata* pattern in about one-third of a whorl.

Remarks. The close similarity of *P. (P.) annulata* and *P. (P.) richteri* in features other than whorl shape, and the existence of specimens of intermediate whorl section has been pointed out by Lange and Petter. Each species has a named variety distinguished from its type by more numerous ribs: *annulata* var. *densicosta* Frech and *richteri* var. *densicosta* Wedekind. In view of their similarity, intergradation, corresponding varieties and ranges I consider that *annulata* and *richteri* belong to one species and, further, that the more closely ribbed nominal varieties constitute a single taxon of subspecific rank which includes also Petter's var. *semperornata*.

In publishing the name var. *densicosta* Frech cited two specimens, one fragmentary (his pl. 1, fig. 7) and the other Gumbel's plate 15, fig. 15 (*sic*), which, as there is no fig. 15 or 14 on Gumbel's plate 15, must be read plate 15, fig. 13, and then corresponds with the text. The latter is a specimen of five whorls ending at WH = 8.5 mm, with 28 ribs in the last preserved whorl. I hereby designate it as lectotype of *P. (P.) annulata densicosta* Frech.

Platyclymenia (Platyclymenia) teichertii sp. nov.

Plate 104, figs. 9-13; Plate 105, figs. 1-4; text-fig. 2a-j

Derivation of name. For Professor Curt Teichert of the University of Kansas Paleontological Institute.

Syntypes. USGD. 6839, 6890, 6891.

Material and preservation. About forty more or less complete shells in clayey sandstone, crushed and decalcified to varying degrees.

Dimensions (in mm.)

	D	WW	WH	UW
USGD 6839	c. 42	(crushed)	13	21
USGD 6890	25	c. 5.5	6.9	13.0
USGD 6891	23	c. 5	5.6	13

Diagnosis. A species of *Platyclymenia* which is unribbed and very widely evolute, with an umbilical diameter equal to or greater than one-half the total diameter, i.e. $UW \times 2 \geq D$.

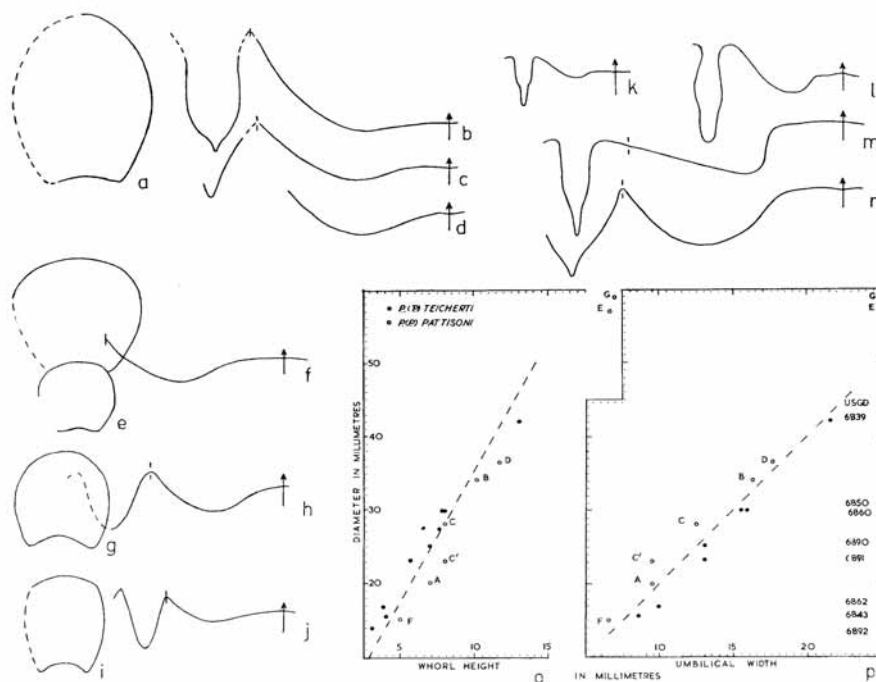
Description. The smooth widely umbilicate shells have whorls which vary in cross-section between sub-circular, oval and sub-rectangular; impressed area is always shallow (text-fig. 2).

Rarely preserved growth-lines are almost rectiradial faint undulations showing a weak lateral sinus (Pl. 104, fig. 9); they have not been observed on the venter.

Suture lines consist of an almost flat ventral saddle, broad, evenly rounded lateral lobes, moderately sharp umbilical saddles, and a widely open dorsal lobe. The umbilical saddle is usually crested forward of the ventral saddle; in several specimens this forward projection of the umbilical saddles is accentuated in late growth stages (text-fig. 2b). One sectioned specimen shows septa near the dorsum to be strongly deflected forward to meet the next succeeding septum, and apparently failing to form complete transverse partitions; this curious configuration may possibly have resulted from distortion. In some specimens (e.g. USGD 6846) the curvature of the lateral lobe is localized on the mid-flank, forming a very broad V.

Septal necks are short.

Late growth stages usually show internal constrictions numbering up to 5 per whorl.



TEXT-FIG. 2. Comparison of *P. (P.) teichertii* sp. nov. with *P. (P.) pattisoni* (M'Coy) and *Clymenia laevigata* (Münster).

a-j, *P. (P.) teichertii* sp. nov. $\times 4$. *a-d*, based on USGD 6890; *a*, whorl section at $D = 24.3$ mm.; *b*, the last suture, at $D = 24$ mm.; last but one suture, at $D = 23.5$ mm.; last but four suture at $D = c. 20.5$ mm.; *e, f*, based on USGD 6891; *e*, whorl section, *f*, external suture, both at $D = c. 19$ mm.; *g, h*, based on USGD 6843; *g*, whorl section, *h*, suture, both at $D = c. 15.5$ mm.; *i, j*, based on USGD 6862; *i*, whorl section, *j*, suture, both at $D = 16.9$ mm.;

k-m, sutures of *C. laevigata*. *k*, copied from Sandberger, 1853, pl. 7, fig. 1*e-f*; *l*, copied from Gumbel, 1863, pl. 16, fig. 5*c*, 'Munster's Original'; *m*, copied from Bogoslovsky *et al.* in Orlov 1962, fig. 187*a*; *n*, suture of *C. placida* Perna, copied from Perna 1914, fig. 79.

o, whorl height plotted against diameter for *P. (P.) teichertii* and *P. (P.) pattisoni*.

p, umbilical width plotted against diameter for the same species. Specimens of *P. (P.) teichertii* represented in these diagrams are indicated by USGD numbers at the left margin. Represented specimens of *P. (P.) pattisoni* are indexed by letters A-G; A, holotype of *pattisoni*, dimensions from Selwood 1960, p. 165; B, C, *P. placida* from Perna 1914, p. 77; C, *P. subnautilina* from Petter 1960, p. 27; C¹ from Petter 1960, pl. 5, fig. 20; D, E, *P. quenstedti*, from Wedekind 1914, p. 45; F, *P. subnautilina schleizi* from Müller, 1956, p. 74; G, *C. subnautilina* from Sandberger 1855, pl. 1, fig. 1*f*.

They are rectiradiate to rursiradiate, straight or with a slight forward concavity, and are formed by wave-like thickenings which may be symmetrical or have crests located forward of their mid-line. Constrictions are not detectable externally.

Remarks. Smooth species of *Platyclymenia* are not always readily distinguished from species of *Clymenia*. Wedekind's criterion of relative straightness of growth-lines in *Clymenia* is unsatisfactory since they are rarely preserved in either group and may be nearly straight in late growth stages of *Platyclymenia* (Schindewolf 1923, p. 462; Müller 1956, p. 74). More practical are the criteria proposed by Schmidt (1924, p. 124) based on sutural and septal form: the wider dorsal lobe and shorter septal necks of *P. subnautilina* in comparison with *C. laevigata*. Suture diagrams showing dorsal lobes which are about as deep as they are wide have been figured also for several other species of *P. (Platyclymenia)*, (e.g. Perna 1914, figs. 71, 72, 77, 79 and Schindewolf 1934, fig. 12); in this characteristic they contrast sharply with the narrow parallel-sided dorsal lobe of *Clymenia laevigata* (e.g. Sandberger 1853, pl. 6, fig. 6; pl. 7, fig. 1; Gümbel 1863, pl. 16, fig. 5c; Frech 1902, text-fig. 4b). The relatively wide dorsal lobes and the short septal necks of the new species therefore assign it to *Platyclymenia*.

Nominal species of *Platyclymenia* having oval or round cross-section and lacking ornamentation have been justifiably synonymized by Selwood (1960) under the name *P. (P.) pattisoni* M'Coy 1851 who also refigured the holotype (pl. 26, fig. 10, not fig. 11 as stated in text). Perna's species *Clymenia placida* also belongs, at least in part, to *P. (P.) pattisoni* (cf. Schindewolf 1922, p. 124). But the new species described above differs from *pattisoni* in being more widely umbilicate and in its slower rate of increase of whorl height (text-fig. 2o and p). In these characters of general form, and in the presence of constrictions, *P. (P.) teichertii* resembles *C. laevigata*, but in the present material it does not reach the size of the latter species. It could be regarded as a possible ancestor of *Clymenia*.

Occurrence. Specimens of *P. (P.) teichertii* outnumber the total of all the other species in the fauna here described.

Platyclymenia (Platyclymenia) alterna sp. nov.

Plate 105, figs. 8-11

Derivation of name. Latin *alternus*, alternating, referring to the ribs.

Holotype. USGD 6838, the only specimen found of this species.

Preservation. Internal mould of segment of one whorl and the more complete external mould of two whorls, preserved in clayey sandstone.

Dimensions (in mm.)

	D	WW	WH	UW
Holotype, USGD 6838	23.5	4.5	c. 7	11

Diagnosis. A species of *Platyclymenia* with intercalated ribs and a subrectangular whorl section.

Description. The holotype is widely umbilicate with a high subrectangular whorl section. It is slightly distorted and WW as measured may be somewhat reduced thereby. Whorls

overlap only slightly, the impressed area being about 1 mm. deep at WH = 7 mm. Whorl sides are parallel and the venter is weakly arched.

Ribs are concave, projected and in two alternating sets, both ending at the ventrolateral shoulder to leave the venter smooth. The ribs of the more prominent set are usually continuous across the flanks; they increase in height and width towards the venter and, to a lesser extent, towards the umbilical seam, so that the ribs are relatively weak in the middle portion of the whorl. Intercalated ribs are usually confined to the outer half of the whorl, but may occasionally appear weakly near the umbilical seam. Crests of adjacent ribs are about 1.5 mm. apart at WH = 7, the accentuated rib terminations being there about 0.5 mm. wide.

Remarks. Two other specimens from the type locality having high subrectangular whorl sections and umbonally accentuated ribs may belong to this species (USGD 6835 and 6881); both represent a growth stage which is later than is preserved in the holotype and so cannot be confidently identified until more complete material becomes available.

In whorl shape the species resembles *P. (P.) sandbergeri* and *P. (P.) walcotti*, but the intercalated ribs of *alterna* are distinctive.

Family RECTOCLYMENIIDAE Schindewolf 1923

Genus RECTOCLYMENIA Wedekind 1908

Type species. *Rectoclymenia roemeri* Wedekind 1908 by subsequent designation of Schindewolf 1957.

Rectoclymenia ? sp.

Plate 105, figs. 15-18

Description and remarks. Together with the other described species occur numerous fragments of a large coiled cephalopod. Its siphuncle has not been observed; the simple partial suture preserved on one fragment, the straightness of the low radial undulations on the whorl flanks and the general form suggest *Rectoclymenia*.

A quite exceptionally large size is indicated. One short portion of a whorl which is incomplete ventrally measures 74 mm. in the radial direction, has a whorl thickness

EXPLANATION OF PLATE 105

Figs. 1-4. *P. (Platyclymenia) teichertii* sp. nov. 1, 2, internal mould, USGD 6862, $\times 2$; 3, 4, internal mould, USGD 6843, $\times 2$. 2, 4 are dorsal views of the detached incomplete body chambers showing septal face and internal suture.

Figs. 5-7. *Sporadoceras* cf. *rotundum* Wedekind. 5, internal mould, USGD 6831, $\times 3$; 6, 7, internal mould, USGD 6832, $\times 3$.

Figs. 8-11. *P. (Platyclymenia) alterna* sp. nov. 8, 9, external and internal moulds of holotype USGD 6832, $\times 2$; 10, 11, the same, $\times 1$.

Figs. 12-14. *Sporadoceras inflexum* Wedekind. 12, part of impressed area of body whorl showing spiral striae, $\times 3$. 13, 14, lateral and ventral views, the latter showing the deformed venter, due to crushing; USGD 6866, $\times 1$.

Figs. 15-18. *Rectoclymenia* ? sp. 15, small internal mould showing several partial sutures, USGD 6853, $\times 2$; 16, part of an external mould of an outer whorl photographed to show low rectiradiate undulations, USGD 6899, $\times \frac{2}{3}$; 17, portion of an outer whorl, USGD 6865, $\times \frac{2}{3}$; 18, USGD 6864, $\times 1$.

(internal mould) of 24 mm. and an impressed area 12.5 mm. deep; its umbilical margin forms an arc which approximately fits a radius of 70 mm. A diameter of about 300 mm. is thus indicated.

Whorl section in late growth stages is compressed high oval, the very gently arched sides converging ventrally from the inner flanks to an evenly rounded unkeeled venter. Sculpture seemingly changes with growth from rectiradiate ribs, evenly rounded in profile and strongest towards the umbilicus, to low dorso-lateral bullae which pass radially into low rectiradiate swellings at a later growth stage. Faint radial growth lines parallel the ribs and also indicate a probable ventral sinus.

Three small unribbed specimens may represent an early growth stage. One shows simple sutures with shallow rounded lateral lobes (Pl. 105, fig. 15), is moderately evolute, and has the following dimensions (in mm.).

	R	WH	WW	UW
USGD 6853	12	6.7	c. 2	10

(WW may be reduced by compressive distortion).

Closest of the described species of *Rectoclymenia* in general form to these small specimens is *R. acuta* (Schmidt), but none is recorded as attaining the exceptionally large size indicated for the material described above.

According to Schindewolf (in Moore 1957) the genus is confined to the *Platyclymenia* Zone. It is previously recorded from Europe, Asia, and North America.

Suborder GONIATITINA Hyatt 1884
Superfamily CHELOCERATACEAE Frech 1897
Family CHELOCERATIDAE Frech 1897
Genus SPORADOCERAS Hyatt 1884

Type species. Goniatites bidens G. and F. Sandberger by original designation.

Sporadoceras inflexum Wedekind

Plate 105, figs. 12–14; text-fig. 3a, b

- 1908 *Sporadoceras inflexum* Wedekind, p. 595, pl. 39, fig. 43; pl. 42, figs. 3, 3a.
[non] 1914 *Sporadoceras inflexum* Wedekind; Perna, p. 36, 98, pl. 1, fig. 14; text-fig. 21 [= *S. muensteri* var *brachyloba* Frech]
1918 *Sporadoceras inflexum* Wedekind; Wedekind, p. 149, text-fig. 47d.
1959 *Sporadoceras inflexum* Wedekind; Petter, p. 274.

Material. One specimen (USGD 6866), an internal mould, somewhat crushed.

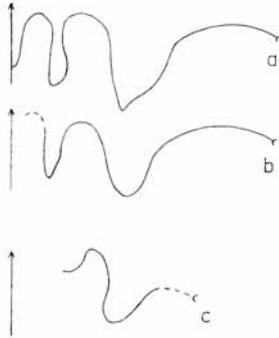
Diagnosis. A species of *Sporadoceras* in which the second lateral lobe is pointed and is two or three times as wide as the first lateral lobe which is shorter and skewed towards the venter.

Dimensions (in mm.)

	D	WW	WH	UW
USGD 6866 (internal mould)	45.8	11+	16	nil

Description. The mould shows a closed umbilicus, the whorls being completely overlapping; the body chamber extends through three-quarters of a whorl. Whorl section is interpreted as having been approximately oval with an evenly rounded venter; crushing has resulted in a narrowed venter but the original rounded venter is preserved at some points.

A detached fragment of the body chamber preserves a sector of its impressed area which clearly shows fine and regular spiral striae (about 30 per cm.).



TEXT-FIG. 3. Sutures of *Sporadoceras*. a, b, *S. inflexum* Wedekind, based on USGD 6866 at D = c. 47; $\times 2$. c, *S. cf. rotundum* Wedekind, based on USGD 6832 at D = c. 9; $\times 4.25$.

The suture is characteristic of the genus (text-fig. 3a, b) with rounded saddles and more or less pointed lobes. The inner lateral saddle is pointed and asymmetrical with a straighter outer limb; the outer lateral saddle is shorter, deep and narrow, parallel sided, ending bluntly or sub-acutely with a slight outward direction.

Remarks. The specimen described resembles *heterolobatum* Lange but its first lateral lobe lacks the consistent sharpness shown in Lange's species, and its first lateral saddle (E/A₁₁) is relatively higher. The ventral deflection of the first lateral lobe in my specimen, is less than in Wedekind's figure of the type of *S. inflexum*, but this is judged to have been possibly diminished by the partial crushing which has converted an originally rounded venter to an acute form.

S. muensteri var. *brachyloba* Frech and *S. pseudocarinatum* Petter are somewhat similar to my specimen in shell-form and suture but have a relatively wider first lateral lobe.

Sporadoceras inflexum, is previously recorded from III β in Germany and from an unrecorded locality and horizon in North Africa (Petter 1959).

Sporadoceras cf. rotundum Wedekind

Plate 105, figs. 5-7; text-fig. 3c

- 1908 *Sporadoceras rotundum* Wedekind, p. 594, pl. 39, fig. 21; pl. 42, fig. 1.
1918 *Sporadoceras rotundum* Wedekind; Wedekind, p. 148, text-fig. 47c.

Two similar small distorted specimens of *Sporadoceras* are comparable with *S. rotundum* in form and suture-line. The widely rounded venter and the dorso-ventral direction of distortion by compaction indicate an originally sub-spherical form. A partial external suture (text-fig. 3c) on the smaller specimen shows a deep and pointed second lateral lobe and a shallow rounded first lateral; the umbilical sector is indistinct but probably as shown by the dashed line, whereas the ventral sector is not observable. Both specimens show three constrictions about 90° apart; they are rectiradiate on the flanks and show a constant shallow rounded ventral sinus. *Sporadoceras biferum* is similar in its suture-line and has a named variety (*sulcifera* Lange) distinguished by

constrictions, but its shell-form is more compressed than that indicated for the specimens here recorded.

S. rotundum is recorded from Zones III α and III β in Germany and the lower *Prolobites* Zone (= III α) in the Urals. *S. biferum* is recorded from Zones II β –III β in Germany and Zones II–IV in the Sahara.

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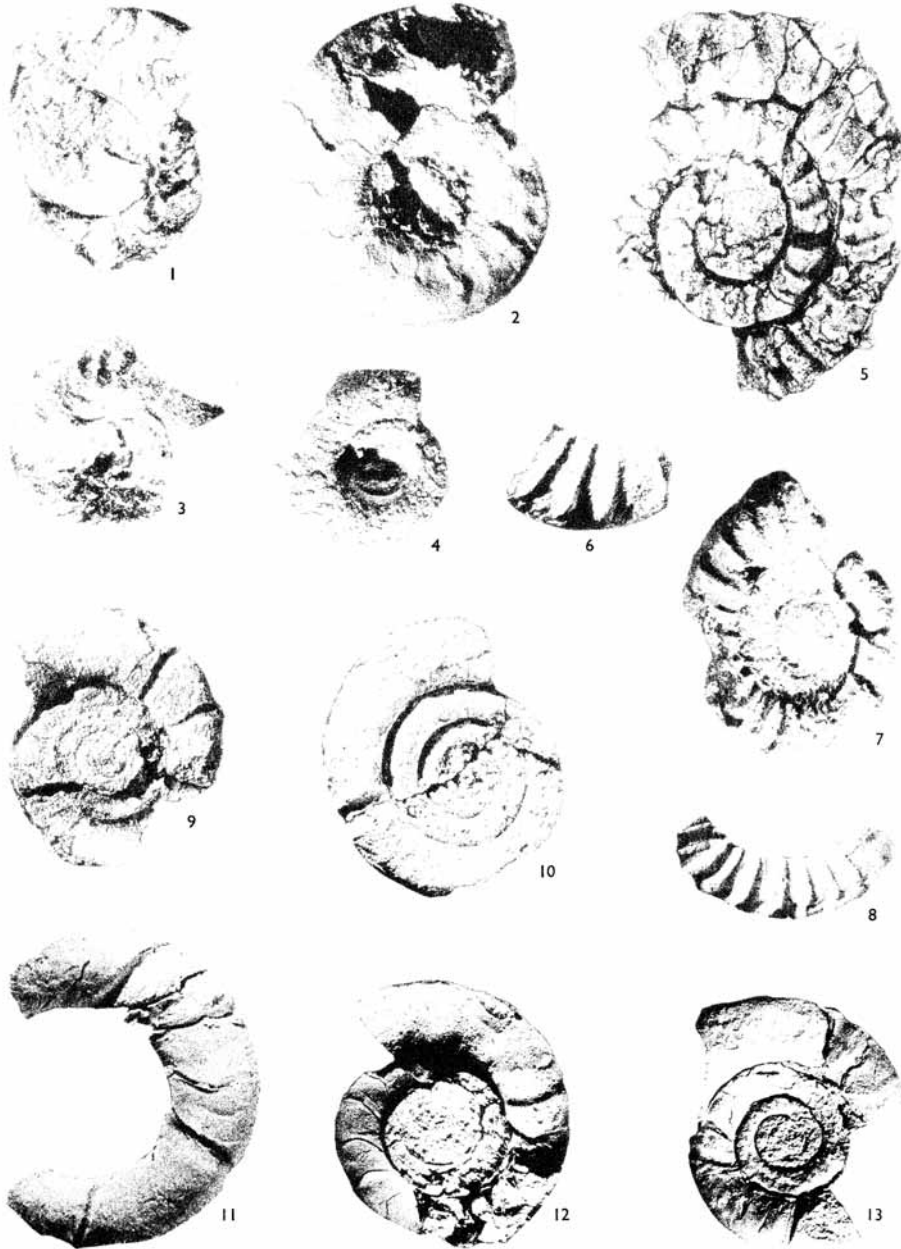
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