

NEW GONIATITE HORIZONS AT THE VISEAN/NAMURIAN BOUNDARY IN SOUTHWEST PORTUGAL

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ABSTRACT

Ammonoids of North American provenance allow the recognition of the basal beds of the Namurian in Southwest Portugal. They contain *Cravenoceras* ? aff. *pisiforme* (Gordon, 1960) and *Fayettevillea paprothae* n. sp. which show a close relationship to forms in the lower part of the Fayetteville formation in Arkansas (USA) considered to be lowermost Namurian (E₁) in age. *Fayettevillea* species of Arnsbergian age (upper part of Namurian A, E₂) are referred to *Parafayettevillea* YANG 1986.

ZUSAMMENFASSUNG

Ammonoideen von nordamerikanischem Gepräge erlauben die Festlegung der Basis-Schichten des Namuriums in Südwest-Portugal. Sie enthalten *Cravenoceras* ? aff. *pisiforme* (Gordon, 1960) und *Fayettevillea paprothae* n. sp., die enge Verwandtschaft zu Formen belegen, die im unteren Teil der Fayetteville-Formation in Arkansas (USA) auftreten; diese Schichten werden als zeitgleich mit dem untersten Namur A (unterer Teil des Pendleium, E₁) angesehen. *Fayettevillea*-Arten von Arnsbergium-Alter (mittlerer Teil von Namur B, E₂) werden in das Genus *Parafayettevillea* Yang 1986 gestellt.

KEY WORDS

Ammonoids, Carboniferous, Namurian A, Pendleian, Southwest Portugal, Arkansas (USA).

SCHLÜSSELWORTER

Ammonoideen, Karbon, Namur A, Pendleium, Südwest-Portugal, Arkansas (USA).

1. INTRODUCTION

In Southwestern Portugal (fig. 1A) a succession of Famennian to Upper Carboniferous terrigenous sediments crops out forming two main antiforms: the Bordeira and Aljezur Antiforms. A nearly complete succession of the upper part of the Carrapateira Group (cp. Oliveira *et al.*, 1985) is well exposed in the north cliff of the Carrapateira Valley at the southern slope of Rocha da Lagoa, about 1.5 km northeast of the Carrapateira village (fig. 1B), in the southern part of the Bordeira Antiform.

2. STRATIGRAPHY

The Rocha da Lagoa section comprises the upper part of the Murração formation and the Quebradas formation ranging from Visean to upper Namurian. The beds are folded and displaced by steeply dipping faults. It can be studied in normal stratigraphic succession about 200 m east of the highway from base to top of the hill and along the ridge to its western slope.

The section (fig. 2) starts within the lower part of the Murração formation, the Pedra das Safias Member. Only the upper 7 m of brownish to red-brown weathered marls are exposed. They yielded only some poorly preserved crinoid ossicles and pelecypods. Further west (Praia das Quebradas), this member provided a fauna of Visean age.

The upper part of the Murração formation, the Vale Figueira Member, consists of 24 m of marls, limestones and dolomites, with interbedded shales. In the lower portion an alternation of slates, laminated marls and dolomitic layers on top of the sequence can be observed. In the upper part of the member limestones and dolomites are more abundant.

In the Vale Figueira Member *Posidonia* is common; in the upper part badly preserved

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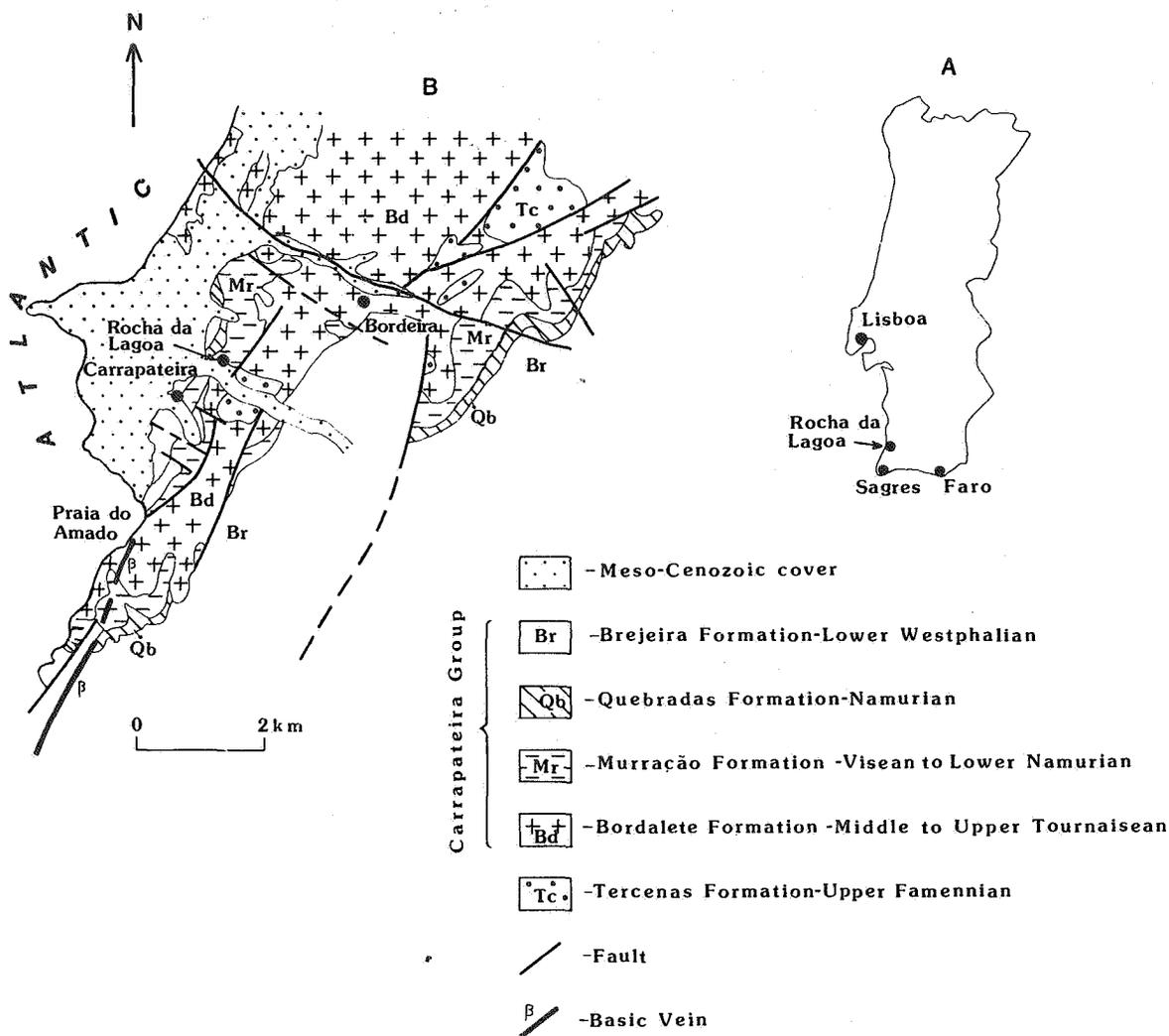


Figure 1. : Situation of the goniatite locality in Southwest Portugal.

goniatites can be found. Only one layer, about 50 cm below the top of the formation, yielded several specimens of determinable goniatites belonging in the genera *Fayettevillea* and *Cravenoceras*.

The Murração formation is overlain by the Quebradas Formation, which indicates a sharp facies change : a sequence of "black shales", strongly weathered and white to light grey, reddish or yellowish, alternates with sideritic limestones.

The Quebradas Formation is about 50 m thick. In its middle and upper part light grey phosphoritic nodules are frequent in shales. The sideritic limestones from lenses and nodular layers of 10-50 cm thickness, their colours being dark grey or brown, sometimes black due to their high content of manganese. In the upper part of the succession chert layers are found.

The Quebradas Formation is rich in macrofossils. *Posidonia* occurs in its lower part, together with crinoids.

Goniatites are common, but mainly poorly preserved. In the basal beds orthoceratids, *Dombarites* and cravenoceratids seem to prevail. About 30 m above the base of the formation *Reticuloceras circumplacitile* has been found, indicating a middle Namurian age (Namurian B). The following se-

quence of about 20 m represents a highly condensed section comprising the whole of middle and upper Namurian ; the uppermost layers yielded *Cancelloceras* sp., indicative of Namurian C.

The overlying Brejeira formation, consisting of greywackes and interbedded shales, represents the youngest part of the Baixo-Alentejo Fiysh Group.

3. GONIATITE FAUNA

Within the South Portuguese Zone, areas of distinct Carboniferous stratigraphical sequences (Oliveira, 1982) can be recognized (fig. 3) : (1) in the south-east part (south of Mértola), already the Lower Carboniferous Visean-Namurian transitional beds (Mira formation) consist of mainly turbiditic sandstones and silts, with inter-turbiditic shale bands (Oliveira & Wagner-Gentis, 1983). The early Namurian goniatite fauna is dominated by the presence of various species of girtyoceratids.

(2) In the Carrapateira region in South-west Portugal (Oliveira *et al.*, 1985) the Carboniferous turbiditic sequences are much younger ; they rest conformably upon the goniatite-bearing strata of uppermost Namurian age. The goniatite fauna of the Visean-Namurian transitional beds differs con-

siderably : it consists of dwarfed goniatites which resemble some members of the peculiar fauna of the lowermost Namurian age (Gordon, 1965).

The lowermost bed of the Namurian *Posidonia*-bearing shales in the Rocha da Lagoa section yielded the following two goniatite taxa, which will be briefly described.⁴

Cravenoceras ? aff. *pisiforme* (Gordon 1965)

(Text-fig. 4A-C ; pl. 1, fig. 1-3).

aff. 1965 *Muensteroceras pisiforme* Gordon, p. 180, text-fig. 40 ; pl. 17, fig. 25-28, 30-33.

aff. 1977 *Cluthoceras pisiforme* - Saunders, Manger & Gordon, p. 120.

Three small narrowly umbilicate specimens (GPIT 1676/1789-91) with a globular or even barrel-shaped conch form and a narrow umbilicus exhibit a *Muensteroceras*-like ventral lobe (fig. 4A, B) with

a low median saddle and subparallel sides. They resemble in its pea-shaped conch form as well as in the outline of its suture *Muensteroceras pisiforme* ; the lateral (adventitious) lobe, however, is somewhat narrower and more acute suggesting a close relationship to cravenoceratids. The test is not preserved ; ribs or constrictions are absent. The dimensions of the Portuguese specimens are shown on Table 1 (compared with the holotype from Arkansas, in mm).

The Portuguese forms do not seem to be identical with the American species. Distinguishing features are the less broadly arched first lateral saddle and the narrow lateral lobe, which is already acute in young stages, giving the suture a cravenoceratid appearance. For this reason the form under consideration as well as the nominal species are here referred to *Cravenoceras*. *Emstiles* Korn 1988 is closely related but has in early stages a wider umbilicus and higher saddle in the ventral lobe.

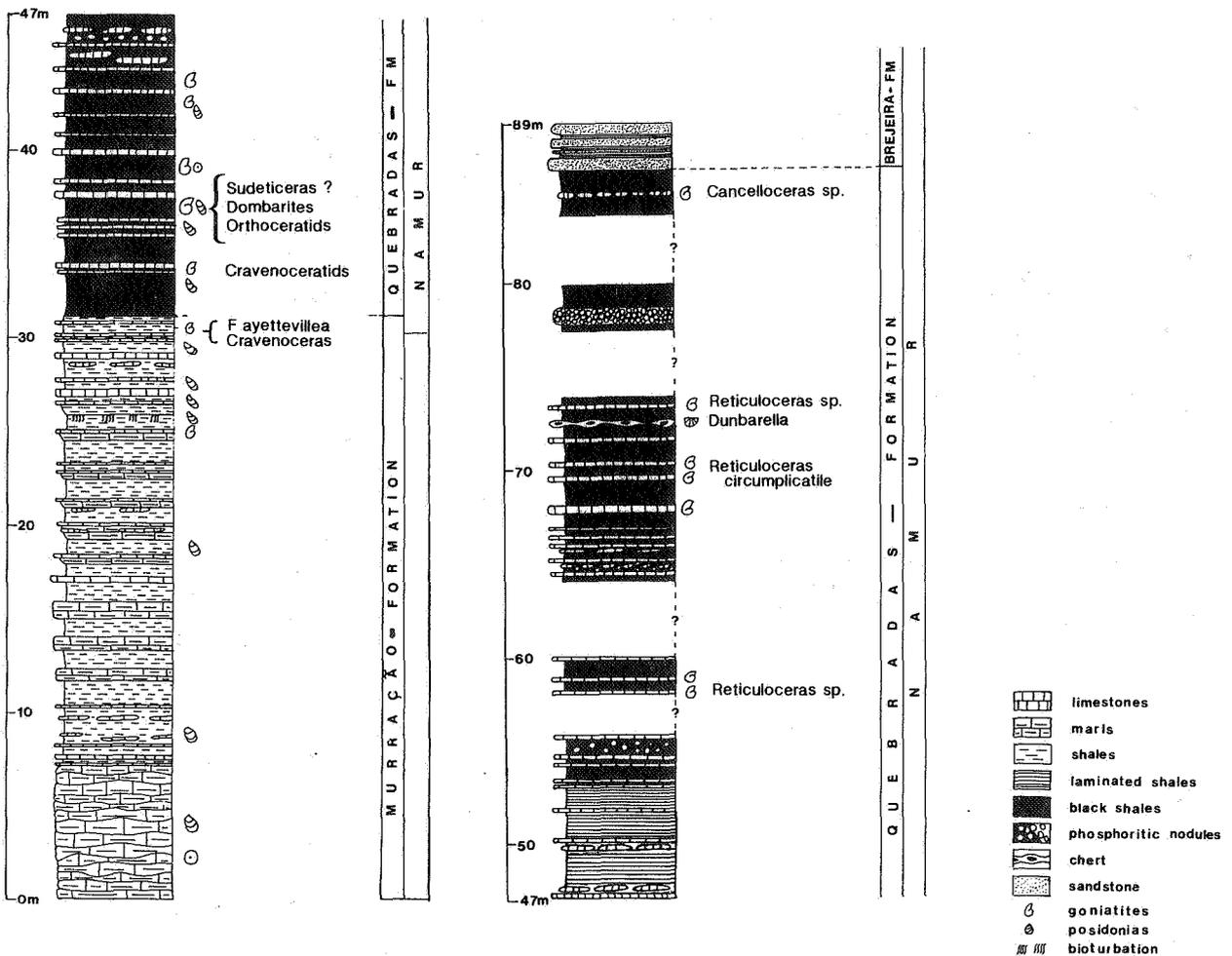


Figure 2. : Stratigraphic log of the Rocha da Lagoa section.

⁴ A more detailed description and discussion will be given in a later publication on the Carboniferous goniatite faunas of Southwest Portugal.

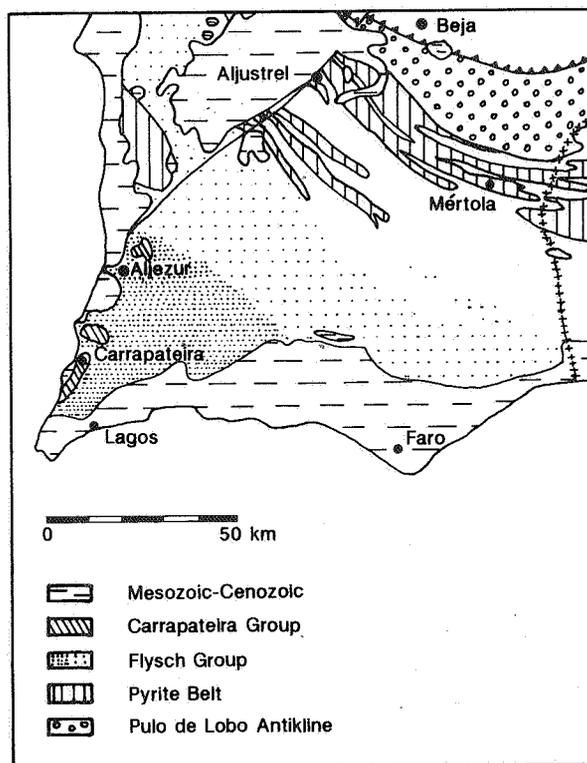


Figure 3. : Major lithostratigraphic units of the South Portuguese Zone.

Ex.# GPIT	D	Wh	Ww	U	Ww/D	U/D
1676/1790	? 7.0	3.8	7.5	? 0.6	? 1	? 0.09
1676/1789	? 4.5	2.2	5.0	0.5	? 1.1	? 0.11
1676/1791	4.4	? 2.0	5.6	0.5	1.3	0.11
HT Gordon 1965	8.1	0.5	7.3	0.7	0.9	0.09

Table 1. : Dimensions of *Cravebicerias* ? aff. *pisiforme*

Ex.# GPIT	D	Wh	Ww	U	Ww/D	U/D
1676/1788	? 16			? 6.0		? 0.38
1676/1659	? 10	3.8		3.8		? 0.38
HT: 1676/1658	4.5	1.0	1.5	2.8	0.33	0.62
	6.5	1.9	? 1.7	3.6	? 0.26	0.55
1676/1661	4.6	1.9	1.7	2.2	0.37	0.48
1676/1660	4.6	1.5		2.3		0.50
HT <i>F. planorbis</i>	7.3	2.0	2.8	4.3	0.38	0.59

Table 2. : Dimensions of *Fayettevillea paprothae* and *F. planorbis*.

Fayettevillea GORDON 1960

1960 *Fayettevillea*, p. 146 ; 1965 - Gordon - p. 225

pars ! 1971 *Fayettevillea* - Ruzhentsev & Bogoslovskaya, p. 341

non ! 1977 *Fayettevillea* - Saunders, Manger & Gordon, p. 120

non ! 1986 *Fayettevillea* - Yang, p. 267.

pars ! 1987 *Fayettevillea* - Riley, p. 27.

Type species : *Fayettevillea planorbis* Gordon 1960, p. 147.

According to the original diagnosis the conch form is planorbiforme, with a large umbilicus ; the suture exhibits a rounded spatulate first lateral saddle and a rounded first lateral lobe. Later, Ruzhentsev & Bogoslovskaya (1971) added species of Arnsbergian age (E2), which are considerably larger and have a higher width/umbilicus ratio on the adult stages (at $D > 10$ mm : 0.5-0.6) being pachycone. Yang (1986) erected *Parafayettevillea* (as subgenus of *Fayettevillea*, type *P. serpentina* YANG 1986) to accommodate pachycone *Fayettevillea* species with a low median saddle ("short acuminate prongs") which, however, seems to be a general character in *Fayettevillea*. On the basis of suture development, the older species *F. planorbis* and *F. paprothae* n.

sp. show on all two rounded lateral lobes, the first one about as deep as the ventral lobe, the second one shallow.

The younger (Arnsbergian) species usually possess acute lateral lobes. Therefore these species are referred herein to *Parafayettevillea* Yang 1986.

Fayettevillea paprothae Kullmann n.sp.⁵

(Text-fig. 4D, E ; pl. 1, fig. 4-8)

Holotype : GPIT 1676/1658, pl. 1, fig. 4 ;

Loc.typ./Strat. typ. : Rocha de Lagoa, 1 km sw Carrapateira, uppermost Murração formation.

Paratypes : 4 specimens, GPIT 1676/1659-1661, 1788.

Diagnosis : A species of *Fayettevillea* with adult whorl section higher than wide ; suture with widely divergent flanks of the ventral lobe. Constrictions may be present.

The conch form is lenticular (whorl width/diameter between 0.3 and 0.4), in young stages serpenticone. The dimensions are as shown on table 2 (compared with the holotype of the type species, in mm [GPIT 1676/1788 and 1659 are distorted]).

Up to the fourth volution the whorls are wider than high, but on later stages this ratio is inverse. There is no test preserved, but weak nodelike swellings as described by GORDON can be observed on the internal mold. Constrictions are rare.

The ventral lobe has a relatively low median saddle ; the first lateral saddle is broadly rounded on young stages (up to D = 10 mm), becoming subacute later (text-fig. 4D, E).

Parafayettevillea has pointed lateral lobes. *Fayettevillea planorbis* is similar up to the fourth whorl ; in the fifth volution, its whorl section is wider than high.

4. CONCLUSIONS

(1) A dwarfed goniatite fauna in *Posidonia*-bearing shales in the uppermost part of the Murração formation in South-west Portugal contains *Cravenoceras* ? aff. *pisiforme* and *Fayettevillea paprothae* n. sp. Because of its close relationship to a similar fauna in the lower part of the Fayetteville Shale in Arkansas considered to be lowermost Namurian in age the Portuguese horizons are regarded to be coeval with the *Fayettevillea planorbis* beds in Arkansas.

(2) The lowermost Namurian goniatite faunas of the South Portuguese Zone differ in their composition : in the eastern part, they contain girtyoceratids, in the southeast *Cravenoceras* and *Fayettevillea* are present.

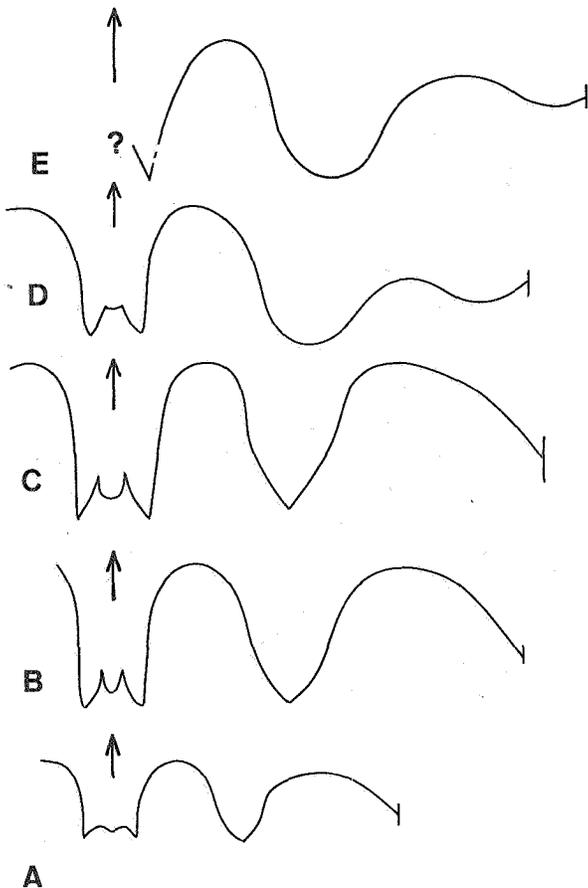


Figure 4. : Sutures of *Cravenoceras* ? aff. *pisiforme* and *Fayettevillea paprothae* n. sp. A-C: *Cravenoceras* ? aff. *pisiforme* (Gordon 1965), x 6. A: GPIT 1676/1791 - B: GPIT 1676/1789 - C: GPIT 1676/1790 - D-E: *Fayettevillea paprothae* Kullmann n.sp. D: GPIT 1676/1761, appr. x 30 - E: GPIT 1676/1759, appr. x 10.

(3) Because of its sutures which are of cravenoceratid appearance "*pisiforme* GORDON 1960" seems to belong in *Cravenoceras* rather than *Muensteroceras*. The genus *Fayettevillea* should be confined to small Fayettevilleinae with rounded lateral lobes. Later forms with acute lateral lobes are referred herein to *Parafayettevillea*.

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⁵ This species is named for Eva Paproth, in recognition of her numerous contributions to knowledge of the European Lower Carboniferous biostratigraphy.

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PLATE I

Fig. 1-3. *Cravenoceras* ? aff. *pisiforme* (GORDON, 1965)

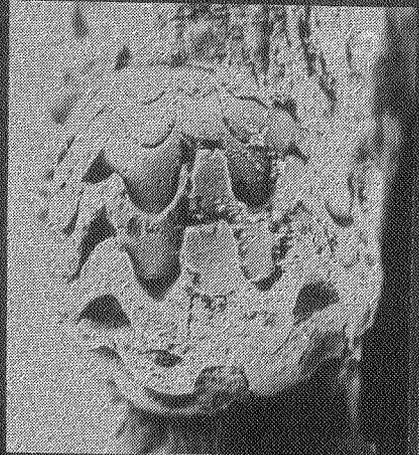
- 1 : GPIT 1676/1791, ventral view, x 10.
 2 : GPIT 1676/1790, a - ventral view, b - side view, both x 8.
 3 : GPIT 1676/1789, ventral view, x 5 (see also fig. 8, right).

Fig. 4-8. *Fayettevillea paprothae* KULLMANN n. sp.

- 4 : GPIT 1676/1658, side view, x 5.
 5 : GPIT 1676/1661, a - front view, b - side view, both x 8.
 6 : GPIT 1676/1660, side view, x 8.
 7 : GPIT 1676/1659, side view, x 5.
 8 : GPIT 1676/1788, side view, x 3 (see also fig. 3 : GPIT 1676/1789, enlarged).



1



2a



b



3



4



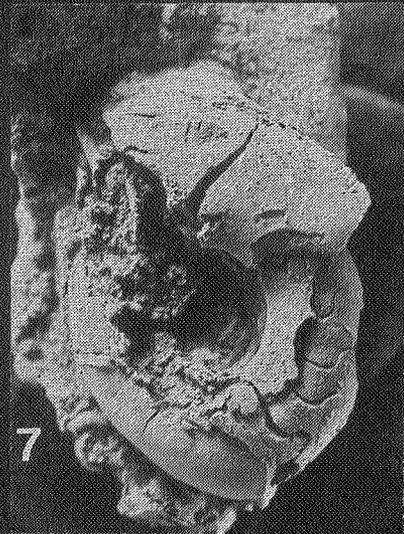
5a



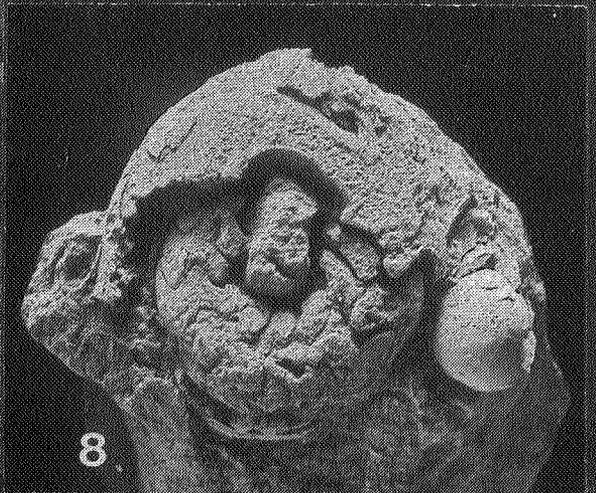
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6



7



8