Bollettino della Società Paleontologica Italiana	23 (2)	1984	361-374	4 pls.	Modena, Settembre 1985

Koskinobullina socialis Cherchi & Schroeder, 1979: a colonial microfossil *incertae sedis* (algae ?) from Jurassic-Cretaceous of the mediterranean region

Antonietta CHERCHI
Dipartimento di Scienze della Terra
Università di Cagliari

Rolf SCHROEDER
Geologisch-Paläontologisches Institut
Universität Frankfurt

KEY WORDS — Problematic fossils, Algae, Jurassic-Cretaceous, Sardinia, Spain.

ABSTRACT — Well preserved material of Koskinobullina socialis *Cherchi & Schroeder, 1979 form the Bathonian of NW Sardinia and the Middle Cenomanian of N Spain allows the detailed description of this micro-organism, which was regarded by previous authors as an alga, an acervulinid foraminifer or a problematic microfossil.* Koskinobullina *shows strong affinities to the problematic Paleozoic genus* Wetheredella *Wood, with which it is placed in the revised family Wetheredellidae Vachard.. The interpretation of* Koskinobullina *as an acervulinid foraminifer is rejected; the systematic position of this genus is still unknown.*

RIASSUNTO — [*Koskinobullina socialis* Cherchi & Schroeder: un microfossile in colonia *incertae sedis* (algae ?) del Giurese-Cretaceo della regione mediterranea] — *Materiale ben conservato di* Koskinobullina socialis *Cherchi & Schroeder, 1979, proveniente dal Batoniano della Sardegna NW e dal Cenomaniano medio del N della Spagna ha permesso la descrizione dettagliata di questo microorganismo, che veniva interpretato dagli autori precedenti sia come un'alga, o un foraminifero acervulinide o un microfossile problematico.* Koskinobullina *mostra forti affinità col genere problematico paleozoico* Wetheredella *Wood, assieme al quale è stato incluso nella famiglia Wetheredellidae Vachard, revisionata in questo lavoro. Non viene accettata l'interpretazione di* Koskinobullina *come foraminifero acervulinide; la posizione sistematica di questo genere è ancora sconosciuta.*

INTRODUCTION

The micro-organism which are the subject of this paper, have been known for almost thirty years in neritic Jurassic and Cretaceous deposits of the Mediterranean region and were figured for the first time by Aurouze *et al.* (1956) as « organisme indéterminé » from the Bathonian of the Paris Basin. The same group has also been described by many authors from numerous localities of the Mediterranean region under different names: « section multicellulaire *incertae sedis* » (Cuvillier & Deloffre 1964, p. 8), « fragment de test d'Acervulinide » (Gisiger 1967, p. 306), « organisme en arceaux » (Bernier 1968, p. 108), « Problematicum » (Bolliger & Burri 1970, p. 39), « *Wetheredella* » (Masse 1976, pp. 231-232), etc.

These nearly always very vague determinations reflect the lack of knowledge regarding the organisation, the internal structures and the systematic position of these microfossils, which have usually been interpreted by previous authors as algae or foraminifera.

The discovery of well preserved material in the Barremian of NW Sardinia gave the opportunity to study in detail these problematic organisms. In a preliminary note (Cherchi & Schroeder 1979) these specimens were described under the name *Koskinobullina socialis* n. gen. n. sp., who regarded them with some reservation as algae. During the preparation of the 19th European Micropaleontological Colloquium (Sardinia, 1985) we also found *K. socialis* in the Bathonian of Monte Zirra (Nurra, NW Sardinia). A rich collection of *K. socialis* from the Cenomanian of Incinillas (Prov. Burgos, N Spain) furnished additional information which makes possible a more detailed description and discussion on the systematic position of these organisms.

All thin sections containing the specimens described and figured in this paper are deposited at the Institute of Geology and Paleontology of Frankfurt University (Cherchi-Schroeder collection).

Research financially supported by the Consiglio Nazionale delle Ricerche and the Ministero alla Pubblica Istruzione.

LOCALITIES AND STRATIGRAPHIC POSITION OF THE MATERIAL STUDIED

A) Sardinia

1. Upper Bathonian of Monte Zirra (Nurra, NW Sardinia) [sheet 179 II S.O. (La Corte) 1:25.000].

Sample ZO 3-2 containing *K. socialis* was taken in the valley between Monte Gamba de Moro and height 91 m, and is situated approx. 3,50 m above the top of a 40-45 m thick dolomitic series. For detailed location of the sample see Cherchi (1985). The sample is a calcarenite containing small oncoids and marly intraclasts.

The following foraminifera have been found:

Orbitammina elliptica (D'Archiac)
Mesoendothyra croatica Gusić
Nubecularia reicheli Rat
Trocholina palastiniensis Henson

This assemblage indicates a Late Bathonian age.

2. Lower Barremian of Torre del Bulo (Capo Caccia, Nurra) [sheet 192 IV S.E. (Capo Caccia) 1:25.000].

Type-locality of *K. socialis*. Sample TB-10 (=sample BU 32 *in* Cherchi 1985) containing the holotype was taken between Cala Dragonara and Torre del Bulo, on the west side of the old path to Capo Caccia. It is located approx. 4 m below the top of the Lower Barremian of Urgonian facies, which is overlain by transgressive Coniacian.

The presence of *K. socialis* from this locality was already reported by Cherchi & Schroeder (1976, p. 74), who cited this form as « sections multicellulaires ».

K. socialis is associated in sample TB-10 with the following species:

Algae (determined by F. Barattolo, Napoli)

Heteroporella paucicalcarea Conrad
Salpingoporella genevensis (Conrad)
Salpingoporella muehlbergii (Lorenz)
Angioporella fouryae Conrad, Masse & Radoičić
Vermiporella? tenuipora Conrad

Foraminifera

Earlandia? conradi Arnaud-Vanneau
Glomospira urgoniana Arnaud-Vanneau
Nezzazatinella macovei Neagu
Arenobulimina cf. *flandrini* Moullade
Patellovalvulina patruliusi Neagu
Charentia cf. *cuvillieri* Neumann
Pseudolituonella gavonensis Foury
Dictyorbitolina ichnusae Cherchi & Schroeder
Paleodictyoconus cuvillieri Foury
Orbitolinopsis inflata Moullade
Paracoskinolina cf. *sunnilandensis* (Maync)
Sabaudia capitata Arnaud-Vanneau
Nummoloculina sp.
Trocholina sp.

B) Northern Spain

1. Upper Oxfordian - Kimmeridgian of Monillo 1 well (core IV/6) (SW of Castro Urdiales, Prov. Santander) [sheet 60 (Valmaseda) 1:50.000].

The presence of *Pseudocyclammina jaccardi* (Schrodt) in this sample indicates a Late Oxfordian - Kimmeridgian age.

2. Aptian of San José (Prov. Santander).

The exact position of this locality is unknown. The sample (coll. G. Cormy, Paris) comes from the region south of Laredo and Castro Urdiales.

3. Middle Cenomanian of Incinillas (Prov. Burgos) [sheet 109 (Villarcayo) 1:50:000].

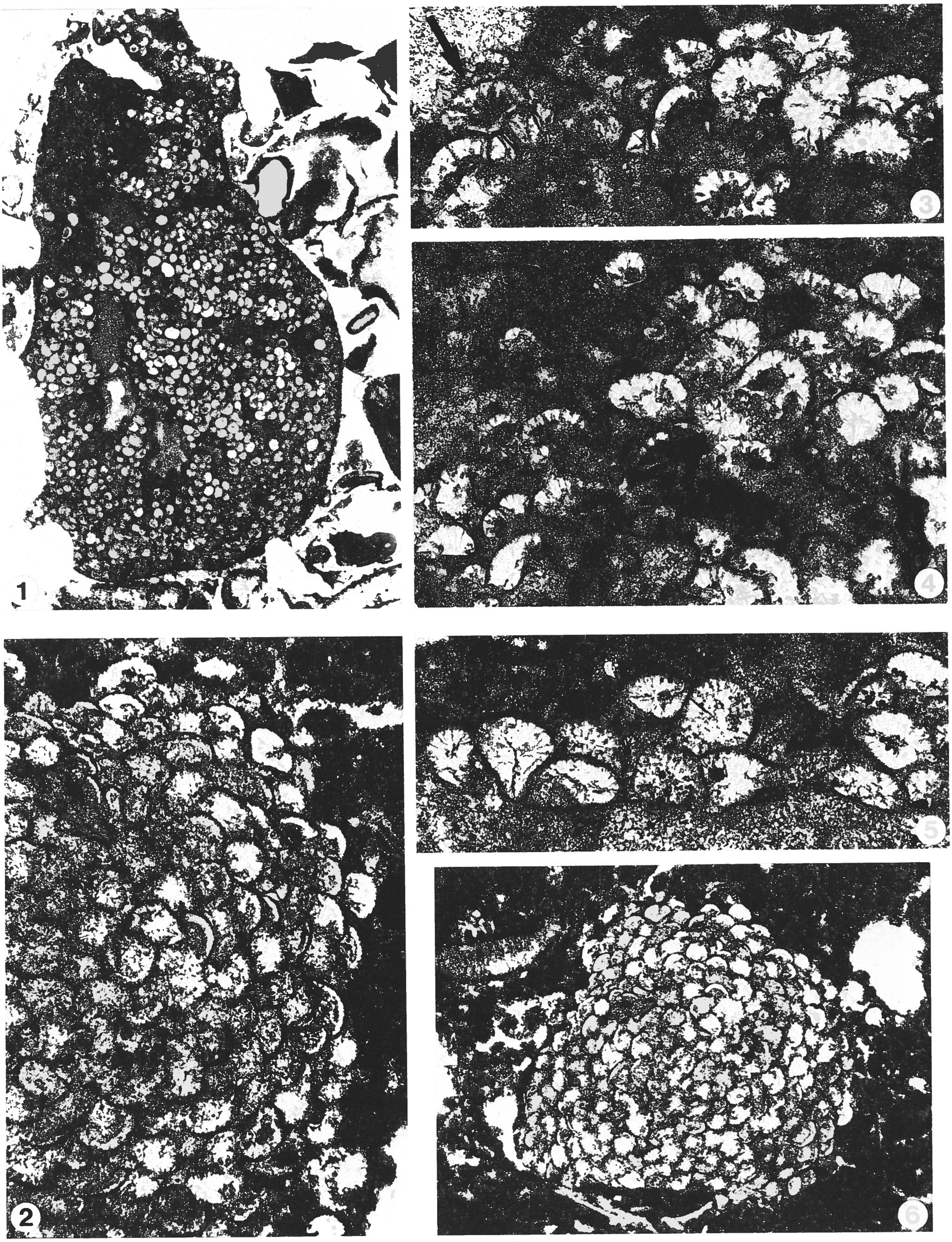
3 kms south of the village Incinillas, the east-west striking Cretaceous anticline of Sierra de Tesla is cut and deeply eroded by the Ebro river. The anticlinal core is well exposed on both sides of the road between Villarcayo and Oña, and consists of un-

---

EXPLANATION OF PLATE 1

Koskinobullina socialis Cherchi & Schroeder, 1979.

Fig. 1 - Horizontal section of a large colony. Monillo 1 well (Prov. Santander, N Spain). Upper Oxfordian-Kimmeridgian. 94/1. x 32.
Fig. 2 - Horizontal section of a colony (enlarged part of fig. 6). Monte Zirra (Nurra, NW Sardinia). Upper Bathonian. ZO 3-2. x 128.
Fig. 3 - Colony showing the holotype (marked by an arrow). Torre del Bulo, Capo Caccia peninsula (Nurra, NW Sardinia). Lower Barremian. TB 10-1. x 128.
Fig. 4 - Transversal section of a colony. Torre del Bulo, Capo Caccia peninsula (Nurra, NW Sardinia). Lower Barremian. TB 10-1. x 128.
Fig. 5 - Small colony fixed on a mollusc shell. San José (Prov. Santander, N Spain). Upper Aptian. 96/1. x 128.
Fig. 6 - Horizontal section of a colony (see also fig. 2). Monte Zirra (Nurra, NW Sardinia). Upper Bathonian. ZO 3-2. x 60.


1
2
3
4
5
6

fossiliferous continental sands and sandstones, which are overlain by Cenomanian sandy bioclastic limestones. Sample 93 with *Koskinobullina socialis* was taken from the northern side of the anticline at the base of the Cenomanian limestones outcropping on the eastern side of the road. The first 30 meters of this Cenomanian succession are characterized by *Orbitolina (Conicorbitolina) conica* (D'Archiac), *Pseudolituonella reicheli* Marie, *Cuneolina pavonia* D'Orbigny, *Chrysalidina gradata* D'Orbigny, *Praealveolina* sp. and *Ovalveolina ovum* (D'Orbigny). This assemblage indicates a Middle Cenomanian age.

Sample 93 contains the following taxa:

Algae
- *Koskinobullina socialis* Cherchi & Schroeder
- *Lithocodium aggregatum* Elliott
- *Ethelia alba* (Pfender)
- Rhodophycean algae

Foraminifera
- *Placopsilina cenomana* D'Orbigny
- « *Peneroplis* » *turonicus* Said & Kennawy
- *Dictyopsella libanica* Saint-Marc
- *Pseudocyclammina rugosa* (D'Orbigny)
- *Nezzazata simplex* Omara
- *Cuneolina pavonia* D'Orbigny
- *Nummoloculina heimi* Bonet
- *Ovalveolina ovum* (D'Orbigny).

DESCRIPTION OF *KOSKINOBULLINA SOCIALIS* CHERCHI & SCHROEDER, 1979

Family WETHEREDELLIDAE Vachard, 1977

Genus KOSKINOBULLINA Cherchi & Schroeder, 1979

KOSKINOBULLINA SOCIALIS Cherchi & Schroeder, 1979

Pl. 1, figs. 1-6; pl. 2, figs. 1-2; pl. 3, figs. 1-6; pl. 4, figs. 1-6

1956 Organisme indéterminé - AUROUZE *et al.*, p. 10, fig. 5.
1964 Section multicellulaire *incertae sedis* - CUVILLIER & DELOFFRE, p. 8, pl. 3, figs. 1-3.
1965 Organisme indéterminé - GRIFFON, pl. 3, figs. 1-3.
1966 « Section multicellulaires » Cuvillier & Deloffre 1964, *incertae sedis* - PRATURLON, p. 180, text-fig. 8.
1967 Fragment de test d'Acervulinide - GISIGER, p. 306, pl 1, fig. 8.
1968 « Organisme en arceaux » - BERNIER, p. 108, pl. 16, fig. 4.
1970 Acervulinidae(?) - HUGUET & LESPINASSE - LEGRAND, p. 281, pl. 2, figs. 3-4.
1970 *Problematicum* (vermutlich Alge) - BOLLIGER & BURRI, p. 39, pl. 8, fig. 2.
1971 « Organisme en arceaux » - RAMALHO, p. 189, pl. 38, figs. 4-6.
1971 « Acervulinidae » sp. - WERNLI, p. 349, pl. 10, figs. 4-5.
1971 « Acervulinidae » - WERNLI & SEPTFONTAINE, p. 443.
1972 *Acervulina* sp. - SAMUEL, BORZA & KÖHLER, p. 109, figs. 1-4.
1975 *Acervulina* sp. - DRAGASTAN, p. 54, pl. 30, fig. 2.
1976 Organisme *incertae sedis* Aurouze *et al.* - PEYBERNÈS, pl. 10, fig. 12.
v 1976 « Section multicellulaires » Cuvillier & Deloffre - CHERCHI & SCHROEDER, p. 74.
1976 *Wetheredella* Wood 1948 - MASSE, pp. 231-232, pl. 8, figs. 13-14.
? 1976 *Planorbulina cretae* Marsson - DECROUEZ, pp. 112-113, pl. 21, fig. 12.
v*1979 *Koskinobullina socialis* n. gen. n. sp. - CHERCHI & SCHROEDER, pp. 520-522, pl. 1, figs. 1-3.
v 1981 *Koskinobullina sarda* Cherchi & Schroeder - SCHROEDER, p. 392, pl. 1, fig. 14 (nom. null.).
1981 *Koskinobullina socialis* Cherchi-Schroeder - MIŠIK & SYKORA, p. 43, pl. 14, fig. 1.
1981 *Koskinobullina socialis* Cherchi & Schroeder - MIŠIK *et al.*, p. 32, pl. 2, fig. 5.
1982 *Koskinobullina socialis* Cherchi et Schroeder - MIŠIK & SYKORA, p. 59, pl. 5, fig. 2.
v 1983 *Koskinobullina socialis* Cherchi & Schroeder - SCHROEDER & WILLEMS, p. 76, text-fig. 4/13.
1983 Organisme multicellulaire inc. sed. - SEPTFONTAINE, pl 6, fig. 8.

1. *General organisation*

It has already been pointed out (Cherchi & Schroeder 1979, p. 520), that we interpret *Koskinobullina* as small vesicular *individuals* forming *colonies* of varying dimensions, which are fixed upon a substrate. In the following description first the form and structure of the individuals are considered, followed by a discussion of the morphology and the substrate on which the colonies are fixed.

2. *Morphology and structure of the individuals*

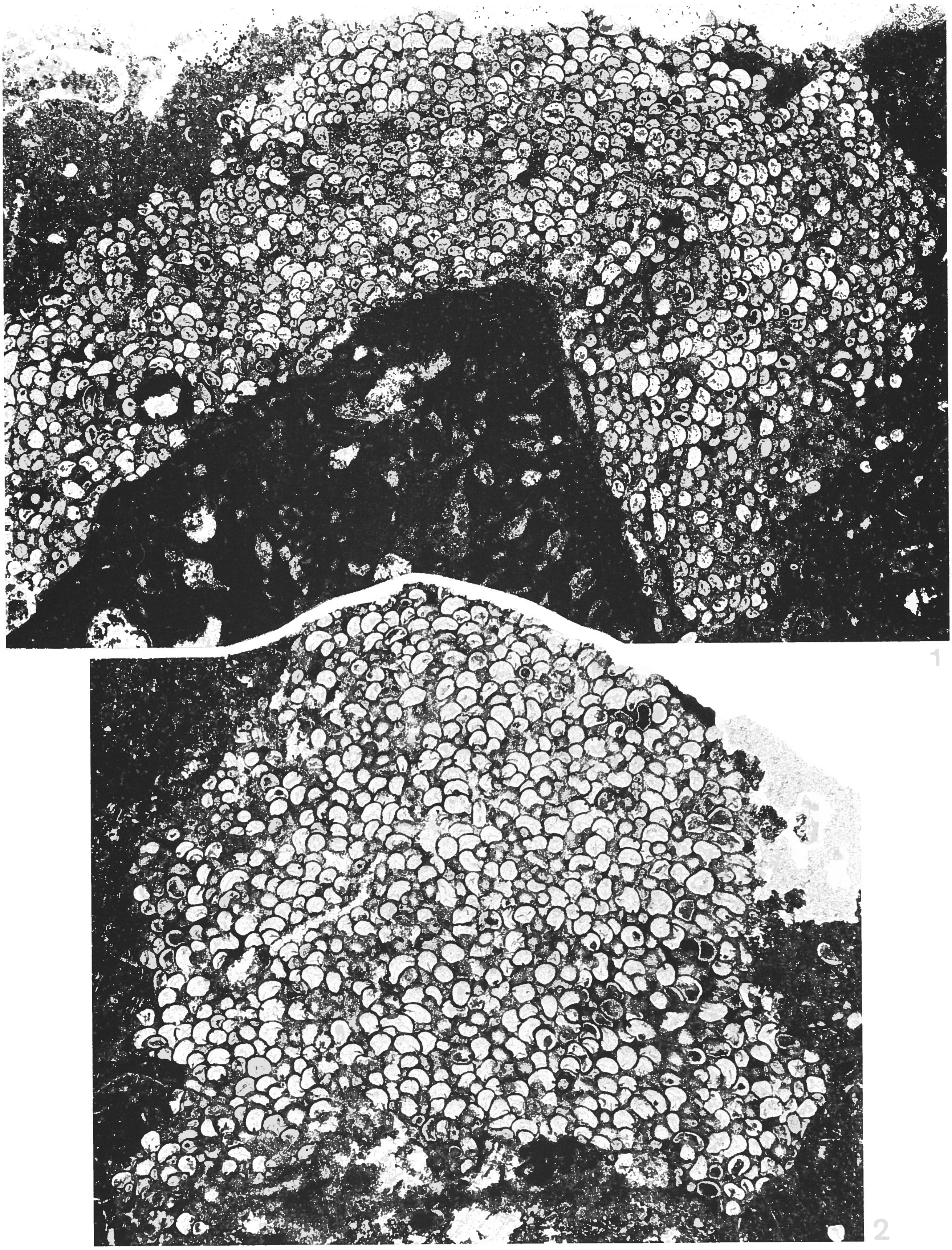
The single individuals of *K. socialis* are irregularly vesicular; the inner cavity is completely surrounded by a perforated wall. The distal part of this wall is relatively thick and is regularly convexe, whereas the thinner proximal part follows more or less the morphology of the substratum, which is commonly the underlying individuals of the colony (pl. 3, figs. 2-3, 6).

EXPLANATION OF PLATE 2

Koskinobullina socialis Cherchi & Schroeder, 1979. Incinillas (Prov. Burgos, N Spain). Middle Cenomanian.

Fig. 1 - Oblique section of a large cap-shaped colony, fixed on *Lithocodium aggregatum* Elliot. 93/27. x 25.

Fig. 2 - Horizontal section of a large colony. 93/28. x 28.



1

2

The clear and radial-fibrous calcitic wall is pierced by rounded perforations at regular intervals (pl. 3, fig. 1), which are tubular in the distal part (pl. 3, fig. 5). In the proximal part of the wall the perforations have the character of simple pores and are, in general, hardly recognizable (pl. 3, fig. 6; large individual in the center of the figure). The wall is frequently covered by a thin, dark outer layer (pl. 3, figs. 3, 5), which is probably the result of secondary micritisation by schizophytes (pl. 3, figs. 3, 5).

The inner cavity of the individuals is commonly filled with sparite, which also shows a radial-fibrous structure (pl. 3, fig. 1). In such cases, the boundary between the cavity and the wall is not recognizable. There is no doubt that the fibrous character of the wall is not a primary structure, but is due to a secondary recrystallisation.

Horizontal sections through agglomerations of *K. socialis* clearly show that the individuals of a colony have, in general, more or less the same dimensions (pl. 1, figs. 1, 6; pl. 2, fig. 2; pl. 3, fig. 4). Exceptionally, however, some smaller individuals also occur between the « normal »-sized specimens. A good example of a colony consisting of individuals of different sizes was figured by Ramalho (1971, pl. 38, fig. 4) from the Upper Jurassic of Portugal.

Within the evolution of *K. socialis* during the time interval of Bathonian - Cenomanian a continuous increase of diameter of individuals and thickness of wall occurs (see table 1). The Cenomanian forms are more than twice as large as the Bathonian specimens. This increase in size could be used for stratigraphic purposes. However, it is not justified to use this evolutionary trend for a splitting into different species, because the limits between these taxa would be completely arbitrary. In parallel to this increase in size, the outer form of the individuals becomes somewhat more irregular. Horizontal sections of Bathonian forms show circular or oval outlines (pl. 1, figs. 1-2, 6); sections in the same direction through Cenomanian specimens (pl. 2, fig. 2; pl. 3, fig. 4) are more elongated and sometimes irregularly reniform. This evolutionary trend is also continuous.

3. *Morphology and substrate of the colonies*

K. socialis is a sessile organism, which is fixed on a substrate either as a solitary individual or, more frequently, in the form of crust-like agglomerations of varying dimensions.

The number of individuals which form a colony is very variable. Many agglomerations consist only of few individuals forming a thin layer on the substrate (pl. 1, fig. 5). Sometimes one can observe solitary individuals in the direct vicinity of small colonies. This latter case could be interpreted either as being the result of sections through a branched colony, or due to the incomplete settlement of a surface by solitary specimens and small colonies.

Larger colonies may attain a diameter of more than 10 mm consisting of some hundreds or even thousands (!) of individuals (pl. 2, fig. 1). The outer form of a colony greatly depends of the morphology of the substrate. Agglomerations fixed on the surface of relatively flat substrates are in the form of thin crusts. Individuals settled on a convexe substrate are concentrated in thick cap-like or pillow-like colonies thinning out at the margins and sometimes passing into thin crusts (pl. 2, fig. 1).

Frequently occuring voids in a colony (pl. 3, fig. 1) indicate a relatively loose connection between the individuals.

The boundary between a colony and its substrate is always very clear. On the other hand, the surface of the colonies is irregular (pl. 2, fig. 1) sometimes showing projections which are built-up of small groups of individuals. Colonies with a very smooth surface can be interpreted as rolled bioclasts (pl. 1, fig. 1).

There are no relations between the form and the diameter of the colonies and their geological age. The last known colonies (Middle Cenomanian of Incinillas, N Spain) certainly represent the largest agglomeration of our material, but comparable crusts consisting of hundreds of individuals are figured from the Oxfordian of the Pyrenees (Peybernès 1976, pl. 10, fig. 12) and from the Portlandian of Portugal (Ramalho 1971, pl. 38, fig. 6). It is therefore be-

---

EXPLANATION OF PLATE 3

Koskinobullina socialis Cherchi & Schroeder, 1979. Incinillas (Prov. Burgos, N Spain). Middle Cenomanian.

Fig. 1 - Horizontal section through a part of a colony (enlarged part of pl. 3, fig. 2 and pl. 2, fig. 2). The specimens are filled with sparite or micrite. 93/28. x 186.

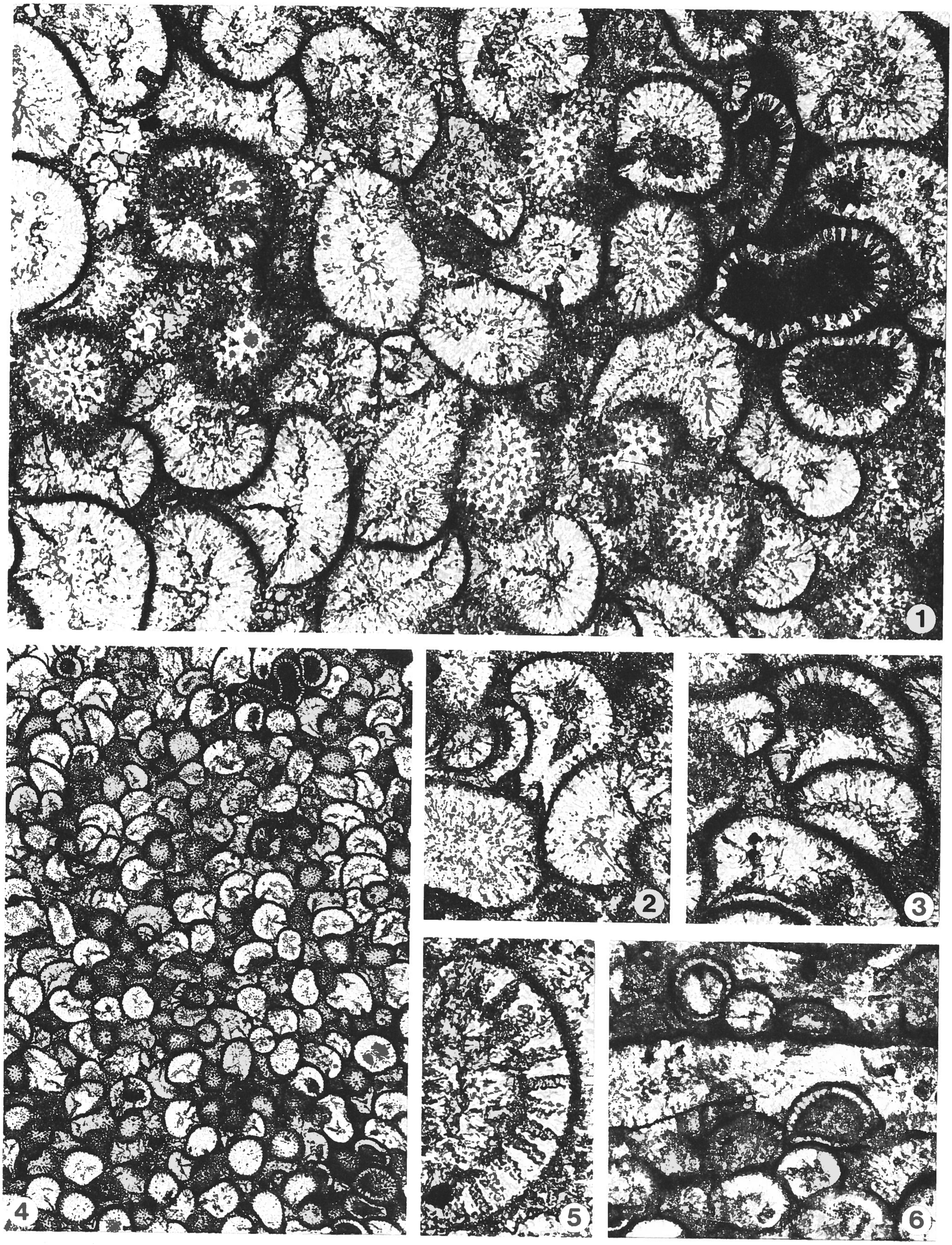
Fig. 2 - Strongly deformed specimen within a colony. 93/20. x 186.

Fig. 3 - Strongly deformed specimen within a colony. 93/28. x 186.

Fig. 4 - Horizontal section through a part of a colony (enlarged part of pl. 2, fig. 2). 93/28. x 51.

Fig. 5 - Transversal section of the perforated wall of a specimen. 93/15. x 465.

Fig. 6 - *Ethelia alba* (Pfender) within a colony of *Koskinobullina socialis*. 93/8. x 128.


1
2
3
4
5
6

lieved that the outer form of the colonies depends exclusively on ecological factors and is without any systematic or stratigraphic value.

The substrate of the colonies are almost always fragments of mollusc shells (mainly rudists) or algae. The crusts from the Cenomanian of Incinillas are attached to the thalli of *Lithocodium aggregatum* Elliott (pl. 2, fig. 1; pl. 4, fig. 6), *Ethelia alba* (Pfender) (pl. 3, fig. 6), indeterminated rhodophycean algae (pl. 4, figs. 1-5) as well as to the surface of the sessile foraminifer *Placopsilina cenomana* D'Orbigny and fragments of caprinid rudists. The sample from Incinillas contains also some crusts with a smooth base but not attached to any substrate. These colonies are either detached from the substrate or they were fixed on a unfossilized organic base (plant remains?; cf. Voigt 1966, pp. 404-407). The smooth base of detached crusts can also serve as substrate for new colonies growing in the opposite direction.

The agglomerations of *K. socialis* from Incinillas are sometimes covered by thalli of rhodophycean algae hindering a further growth of the colonies. Good examples of such a case of biomuration are figured on pl. 4, figs. 1-5. When the colonies are very large, the rhodophycean thalli are, in general, not able to cover the whole surface. In this case, the lateral extension of the rhodophyceans is frequently hindered by overgrowing individuals of *K. socialis* (pl. 4, figs. 1-2). This mutual biomuration within a colony can take place repeatedly and the time taken for each episode can be very different (pl. 4, fig. 5). Sometimes, an overgrowth of very short duration by rhodophycean thalli is shown in transversal sections through a colony by thin black layers (pl. 4, fig. 3).

K. socialis from Incinillas is not only represented in the form of colonies but frequently as isolated individuals which are embedded in the sediment. These individuals may be partially interpreted as detached single specimens. However, the presence of numerous deformed specimens indicates an original position within a colony which was later destroyed. The destruction of colonies is assisted by the relatively loose connection between the individuals.

Sometimes, isolated individuals can also be agglutinated by lituolid larger foraminifera. In the sample of Incinillas we have found some specimens of *Pseudocyclammina rugosa* showing agglutinated *K. socialis* in their wall structure.

REMARKS ON THE SYSTEMATIC POSITION OF *KOSKINOBULLINA*

1. *Comparison with* Wetheredella *Wood, 1948*

Cuvillier & Deloffre (1964, p. 10) pointed out for the first time certain structural similarities between their « section multicellulaire, *incertae sedis* » and some specimens of *Wetheredella*? sp. described by Johnson (1964, pl. 28, figs. 3-4) from the Early Devonian of New South Wales (Australia), but they refuted a strong affinity between the two groups of micro-organisms.

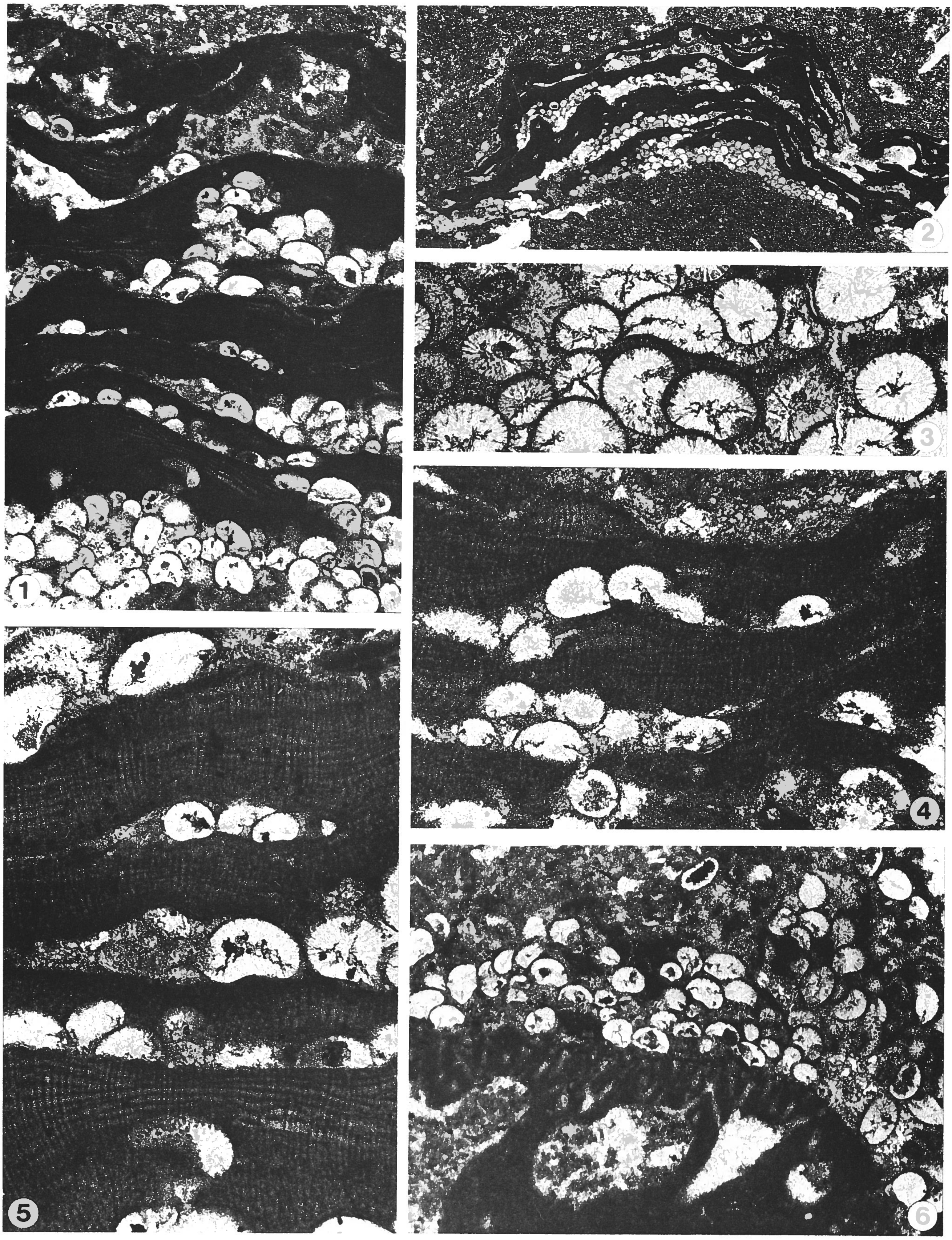
The genus *Wetheredella* was established by Wood (1948) in his revision of *Sphaerocodium gothlandicum* Rothpletz, 1908 and *S. munthei* Rothpletz, 1913 from the Wenlockian of Gotland Island (Swede). Rothpletz had characterized these two species as cellular threads (« Zellfäden ») with different diameters growing concentrically around a foreign body and showing tube-like enlargements (« Schlauchzellen », resp. « Endzellen »). He had interpreted these enlargements as organs serving assimilation and reproduction. Pia (1927, p. 38) thought that *Sphaerocodium* represented a knotty intergrowth of different species of *Girvanella, Pycnostroma* and other algae. Wood (1948) showed that the thread-like elements belong partly to *Girvanella* and partly to a new genus which he named *Rothpletzella.* He interpreted the tube-like enlargements, named « Endzellen » by Rothpletz, as sessile foraminifera living in symbiosis with *Rothpletzella* and described them under the name *Wetheredella silurica* n. gen. n. sp. Identical forms had already been figured by Wethered (1983, pl. 6, fig. 2) from the Wenlockian of May Hill, Gloucestershire, U.K.

According to Wood (1948, p. 20), the thallus of *Wetheredella silurica* is composed of subcircular

EXPLANATION OF PLATE 4

Koskinobullina socialis Cherchi & Schroeder, 1979. Incinillas (Prov. Burgos, N Spain). Middle Cenomanian.

Figs. 1-5 - Colonies interbedded with thalli of rhodophycean algae (dark layers).
Fig. 1 - Enlarged part of fig. 2. 93/35. x 51.
Fig. 2 - Mound consisting of *Koskinobullina socialis* and rhodophycean algae. 93/35. x 13.
Fig. 3 - Thin rhodophycean thallus (dark layer) within a colony of *Koskinobullina socialis*. 93/34. x 128.
Fig. 4 - 93/32. x 128.
Fig. 5 - Enlarged part of fig. 1. 93/35. x 128.
Fig. 6 - A part of a colony of *Koskinobullina socialis*, fixed on the surface of *Lithocodium aggregatum* Elliot. 93/7. x 51.


1
2
3
4
5
6

tubes of small diameter (0,1 mm), growing concentrically around a foreign body. The wall of these tubes is relatively thick (0,030 mm), and is composed of radially set fibres of calcite and perforated by sparsely set rounded pores (0,01 mm in diameter). The tubes are not subdivided and are interpreted as branching irregularly. However, the specimens figured by Wood give no evidence of this latter statement.

Sections through tubes of *W. silurica* (Wood 1948, pl. 3, fig. B) and through individuals of *Koskinobullina* show numerous similarities. The proximal parts of the wall of the two organisms are concave following the morphology of the underlying individuals. The perforated walls consist of radially arranged calcite fibres, which were considered in *Wetheredella* by Wood (1948, p. 16) as primary structures. A thin micritic layer (« algal dust » *in* Wood) covers the surface of the individuals.

The most distinctive difference between the two genera is the morphology of the individuals, which is vesicular in *Koskinobullina,* whereas the thallus of *Wetheredella* is characterized, according to the original diagnosis, by curved and irregularly arranged tubes.

In the last years, two other species of *Wetheredella* have been established. *W. tumulus* Copper, 1976 from the Ashgillian of Anticosti Island (Quebec, Canada) and *W. cuniculi* Vachard, 1977 from the Early Carboniferous of Zonguldak (NW Turkey).

According to Copper (1976, p. 280) *W. tumulus* differs from *W. silurica* « in their greater variability in tube diameter and ability to grow into digitate stacks forming substantial mounds. » However, Riding (1977, p. 94) has shown, that the first statement is untenable, whereas the second criterion depends upon ecological factors. Therefore, he placed *W. tumulus* in synonymy with *W. silurica.* In our opinion, it is very dubious if *W. tumulus* belongs to this genus, because the walls are described by Copper as « nonporous ».

W. cuniculi is distinguished from *W. silurica* by a thinner wall and by indistinct pores (Vachard, *in* Dîl *et al.* 1977, p. 432). However, in the same paper (p. 431) the author says that he could not find any pores in the wall. Moreover he observed, that only the distal part of the tubes is covered by a calcitic wall, whereas the proximal part is limited by the walls of the preceeding tubes. This latter remark indicates, that *W. cuniculi* is probably a multichambered organism, not an agglomeration like *Wetheredella,* where every individual is completely surrounded by a proper wall. However, Bourque *et al.* (1981, p. 118) have regarded *W. cuniculi* as a synonym of *W. silurica.*

2. *Comparison with* Sphaeroporella *Antropov, 1967*

Spaeroporella aksubaica, the type of this genus, was established by Antropov (1967, pp. 122-123) from the Tournaisian of the Eastern Russian Platform and interpreted as a chlorophycean alga. This species has been described as a calcareous cylindrical and irregularly coiled thallus (0,1-0,2 mm in diameter), which is fixed on a substrate. The wall consists of a dark outer microgranular layer (0,002-0,004 mm) and a clear inner fibrous layer (0,008-0,025 mm) and is perforated by numerous pores with a diameter of 0,002-0,004 mm.

Apparently Antropov has interpreted this species as a single tube being irregularly coiled like the foraminiferal genus *Glomospira.* In this case, *Sphaeroporella* should be very different from *Koskinobullina.* However, there is some incertainty whether the sections figured by Antropov represent agglomerations of small, drop-like single individuals. This latter interpretation was already given by Mamet & Roux (1975, pp. 175). A decision in favour of this interpretation can only be based on the study of new material from the type-locality.

This problem very clearly indicates the general difficulties in the distinction of *Wetheredella, Koskinobullina* and *Sphaeroporella.* Suboval or crescent-shaped sections can belong either to drop-like individuals (*Koskinobullina*) or can be interpreted as transversal sections of tube-like elements (*Wetheredella*). A decision between these two possibilities is only possible by the study of horizontal sections through larger colonies.

3. *Remarks on the definition of the family Wetheredellidae Vachard, 1977*

The strong affinities between *Wetheredella* and *Koskinobullina* made it possible (Cherchi & Schroeder 1979) to place the latter genus in the family Wetheredellidae, which was established by Vachard (*in* Dîl *et al.* 1977, p. 428) with the following diagnosis:

« Organismes encroûtants, tubulaires, indivis, à section transverse circulaire ou semi-circulaire, à section longitudinale ovoïde ou piriforme à extrémités arrondies. Tubes réunies en lits, en couches ou en grappes. Paroi hyaline fibro-radiée, parfois perforée, doublée d'une bordure externe microgranulaire plus ou moins nette. »

Vachard placed within this family the following genera: *Wetheredella* Wood, 1948, *Disonella* Conil & Lys, 1964 and *Asphaltina* Mamet, *in* Petryk & Mamet, 1972. We completely agree with Mamet & Roux (1978, p. 22) that the Wetheredellidae *sensu* Vachard are a group of organisms belonging to completely different systematic categories.

Disonella (type-species. *D. lucens* Conil & Lys, 1964) from the Upper Devonian of Verviers (Belgium) has been interpreted by its authors as a tournayellid foraminifer (see also Mamet & Roux 1978, p. 23). The sections of *D. lucens* figured by Conil & Lys (1964, pl. 9, figs. 155-157) show an irregularly coiled tubular chamber increasing in diameter during ontogenesis. The non-perforated tube is irregularly constricted producing poorly developed septa, which have never been observed in *Wetheredella*.

Asphaltina (type-species: *A cordillerensis* Mamet, 1972), originally described from the Namurian of N America, but known to occur globally in the Tournaisian, Visean and Namurian (Mamet & Roux 1975, p. 164), is a weaving of cylindrical tubes. The wall consists of a very thin dark outer microgranular layer and a thick inner « pseudo-fibroradiate » layer. Pores could not be observed. The systematic position of *Asphaltina* is incertain: Mamet & Roux (1975) and Rich (1974) described them as an alga; according to Mamet & Roux (1978, p. 23), the algal nature of this organism is dubious.

Belka (1981, p. 263) placed within the family Wetheredellidae the genera *Wetheredella* Wood, *Disonella* Conil & Lys, *Sphaeroporella* Antropov, *Asphaltina* Mamet, *Koskinobullina* Cherchi & Schroeder and also *Aphralysia* Garwood, 1914. However, Mamet & Roux (1983, p. 98) have shown that the specimens named *Aphralysia* by Belka are in fact identical with *Wetheredella*.

The obvious heterogenity of the Wetheredellidae *sensu* Vachard which includes foraminifera, algae and organisms *incertae sedis* led Mamet & Roux (1978, p. 23) to abandon this family being « sans objet » (Mamet & Roux 1983, p. 99). This procedure, however, is not in conformity with the rules of nomenclature, because the family Wetheredellidae is characterized by the genus *Wetheredella* Wood.

At present, the family Wetheredellidae is represented by at least two genera: *Wetheredella* Wood (perhaps including *Sphaeroporella* Antropov) and *Koskinobullina* Cherchi & Schroeder. The diagnosis of the family, given by Vachard, has to be modified as follows:

Sessile agglomerations of undivided tubular or vesicular individuals. The wall consists of a thin dark outer microgranular layer and a thick inner fibrous layer being perforated by transversal pores. The distal part of the wall is convexe, the proximal part is mostly concave following the morphology of the underlying individuals.

CONSIDERATIONS ON THE SYSTEMATIC POSITION OF THE WETHEREDELLIDAE

The examination of numerous crusts of *Koskinobullina* has shown that the single vesicular elements are very irregularly arranged and are frequently separated from each other by relatively large voids (pl. 3, fig. 1). Sometimes individuals can occur in an isolated position. Furthermore, we have seen that each individual is completely surrounded by a separate perforated wall. There are no direct connections in the form of a special stolon-system between the single elements. All these observations lead us to the opinion that the crusts of *Koskinobullina* are agglomerations of unilocular individuals and cannot be considered as multichambered organisms. For this reason we do not agree with some authors, which have interpreted *Koskinobullina* as sessile larger foraminifera belonging to the family Acervulinidae (personal communication of Brönnimann and Reichel *in* Gisiger 1967, p. 306; Belka 1981). We have never observed an early spiral stage, which is characteristic of the Acervulinidae. Furthermore, the representatives of this family only develop a separate wall in the distal part of the chamber (Hofker 1960, text-fig. 145c; Loeblich & Tappan, text-fig. 566).

The strong structural affinities between *Koskinobullina* and the Paleozoic *Wetheredella* Wood justify the grouping of these two genera in a common family (Cherchi & Schroeder 1979).

The systematic position of *Wetheredella* has often been discussed but is still uncertain. Wood (1948, p. 20) noted a very close resemblance in habit of growth with the foraminiferal genus *Nubecularia*. However, Loeblich & Tappan (1964, p. C787) called into question the foraminiferal nature of *Wetheredella* and regarded them as an alga. According to Belka (1981), « *Aphralysia* » from S Poland (= *Wetheredella*) belongs to the acervulinid foraminifera, but Mamet & Roux (1983, p. 98-99) have convincingly shown that the main arguments in favour of this diagnosis (subdivision of chambers into chamberlets, presence of an initial stage, etc.) are based on incorrect structural interpretations. Kobluk & James (1979, p. 200) discovered *Wetheredella* as cavity-dwelling organisms in Lower Cambrian patch reefs from Southern Labrador (Canada) and regarded them as the earliest known benthic encrusting foraminifera.

Some authors have proposed placing *Wetheredella* within the algae (Praturlon 1966, p. 180; Bolliger & Burri 1970, p. 39; Cherchi & Schroeder 1979). This genus has been regarded by Mamet & Roux (1975, p. 166) as a problematic clorophycean alga and by Copper (1976, p. 277) as a cyanophycean. The latter interpretation was criticised by Riding (1977, p. 94), who pointed out that *Wetheredella* is distinguished from the cyanophycean algae by its larger tubes and by relatively thin walls (15% of total tube diameter). Bourque *et al.* (1981, p. 116) and Mamet & Roux (1983, p. 98) regarded *Wetheredella* as an alga *incertae sedis*.

Tubular and vesicular elements which characterize the genera *Wetheredella* and *Koskinobullina* as well as the presence of perforated walls, are features which one can observe not only in algae but also in foraminifera. However, in the latter group we do not know of agglomerations of such elements showing perforated walls. Therefore, an interpretation of the Wetheredellidae as foraminifera seems very improbable, but a final decision on the systematic position of these organisms cannot be made at present.

	Monte Zirra (Sardinia) Bathonian	Torre del Bulo (Sardinia) Barremian	Incinillas (Spain) Cenomanian
Diameter of individuals	0,08 - 0,10	0,10 - 0,12	0,14 - 0,24
Thickness of wall (distal part)	0,009 - 0,014	0,017 - 0,018	0,017 - 0,027
Thickness of wall (proximal part)	0,003	0,006	0,011
Diameter of pores	0,005 - 0,006	0,005 - 0,006	0,005 - 0,006

Tab. 1 - External and internal dimensions (in mm) of *Koskinobullina socialis* Cherchi & Schroeder from some Western European localities.

GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION OF *KOSKINOBULLINA SOCIALIS*

In the following list all available data on the geographic and stratigraphic distribution of *K. socialis* is arranged in stratigraphic order.

Dogger

— Upper Bajocian(?) - Bathonian of Southern Jura Mountains (E France) (Wernli 1971, p. 349).
— Bathonian of the « Préalpes médianes plastiques romandes », Fribourg region (Switzerland) (Gisiger 1967, p. 306; Wernli & Septfontaine 1971, p. 442).
— Bathonian of Banthelu 1 well, Paris Basin (France) (Aurouze *et al.* 1956, pl. 10, fig. 5).
— Bathonian of Eastern Corbières (Dép. Aude, France) (Huguet & Lespinasse-Legrand 1970, p. 281).
— Bathonian of Monte Zirra, Nurra (Sardinia) (this paper).
— Bathonian?, Malm? of Tetuan (Morocco) (Griffon 1965, pl. 3, figs. 1-3).
— Callovian of the « Préalpes médianes » (Switzerland) (Septfontaine 1983, pl. 6, fig. 8).

Malm

— Middle-Upper Oxfordian (Vellerat Formation) of Central Jura Mountains (Switzerland) (Bolliger & Burri 1970, p. 34).
— Upper Oxfordian of Pont de Suert (Prov. Lérida, N Spain) (Peybernès 1976, pl. 10, fig. 12).
— Upper Oxfordian-Kimmeridgian of Monillo 1 well, Castro Urdiales (Prov. Santander, N Spain) (this paper).
— Upper Oxfordian-Portlandian of Lisbon (Portugal) (Ramalho 1971, p. 189).
— Kimmeridgian-Upper Tithonian of West Carpathians (Czechoslovakia) (Mišik & Sýkora 1982, p. 59).

Early Cretaceous

— Upper Hauterivian of Marseilleveyre, Provence (SE France) (Masse 1976, p. 231).
— Lower Barremian of Capo Caccia, Nurra (Sardinia) (Cherchi & Schroeder 1976, p. 74; this paper).
— Upper Barremian of Tegernsee, Bavaria (W Germany) (Schroeder 1981, p. 391).
— Barremian-Aptian of West Carpathians (Czechoslovakia) (Mišik *et al.* 1981, p. 32).
— Barremian-Aptian of Váh Valley, West Carpathians (Czechoslovakia) (Samuel *et al.* 1972, pl. 109, figs. 1-4).
— Uppermost Barremian-Aptian of « Pieniny-Klippenzone », Carpathians (Czechoslovakia) (Mišik & Sýkora 1981, p. 43).
— Upper Aptian of Aquitaine (SW France) (Cuvillier & Deloffre 1964, p. 8).
— Upper Aptian of Tarboulak near Penjao (Central Afghanistan) (unpublished).
— Aptian of San José (Prov. Santander, N Spain) (this paper).
— Early Cretaceous of Villalago, Marsica (Central Italia) (Praturlon 1966, p. 180).

Middle Cretaceous

— Upper Albian of Caniego (Prov. Burgos, N Spain) (Schroeder & Willems 1983, p. 76).
— Middle Cenomanian of Incinillas (Prov. Burgos, N Spain) (this paper).

This list indicates that *Koskinobullina socialis* ranges from the Bathonian to the Middle Cenomanian and is relatively common in the Bathonian and in the Barremian-Aptian (Urgonian facies).

REFERENCES

Antropov, J.A., 1967, Vodorosli devona i nischnego karbona (Turne) centralnoj tschasti Vostoka Russkoy Platform: Akad Nauk S.S.S.R., Sibirsk. Otdel., Inst. Geol. Geophys., pp. 118-125, pls. 27-28, Moskva.

Aurouze G., Bellon, J., Bizon, J.-J. & Journell, C., 1956, Sur la présence du genre *Kilianina* dans le bassin de Paris: Bull. Soc. géol. France, ser. 6, v. 6, pp. 221-225, pl. 10, text-fig. 1.

Belka, Z., 1981, The alleged algal genus *Aphralysia* is a foraminifer: N. b. Geol. Paläont. Mh., v. 1981, n. 5, pp. 257-266, text-figs. 1-5, Stuttgart.

Bernier, P. 1968, Le « Portlandien » de la bordure méridionale des Cévennes (Montagne de la Séranne - Montagne des Cagnasses): Géobios, v. 1, n. 1, pp. 103-118, pls. 15-17, text-figs. 1-8, Lyon.

Bolliger, W. & Burri, P., 1970, Sedimentologie von Schelf Carbonaten und Beckenablagerungen im Oxfordien des zentralen Schweizer Jura. Mit Beiträgen zur Stratigraphie und Ökologie: Beitr. geol. Kte. Schweiz, n. ser., v. 140, pp. 1-96, pls. 1-16, text-figs. 1-37, Bern.

Bourque, P.-A., Mamet, B. & Roux, A., 1981, Algues siluriennes du synclinorium de la Baie des Chaleurs, Québec, Canada: Rev. Micropaléont., v. 24, n. 2, pp. 83-126, pls. 1-9, text-figs. 1-9, Paris.

Cherchi, A., Editor, 1985, Guide book: 19th European Micropaleontological Colloquium, Sardinia October 1-10, 1985.

—, & Schroeder, R., 1976, *Eclusia decastroi* n. sp. (Lituolidae, Foram.) del Barremiano della Sardegna nord-occidentale: Boll. Soc. Paleont. Ital., v. 14 (1975), n. 1, pp. 65-74, pls. 1-3, text-figs. 1-2, Modena.

—, —, 1979, *Koskinobullina* n. gen., microorganisme en colonie *incertae sedis* (algues?) du Jurassique - Crétacé de la région méditerronéenne. Note préliminaire: Bull. Cent. Rech. Explor. - Prod. Elf - Aquitaine, v. 3, n. 2, pp. 519-523, pl. 1, Pau.

Conil, R. & Lys, M., 1964, Matériaux pour l'étude micropaléontologique du Dinantien de la Belgique et de la France: Mém. Inst. Géol. Univ. Louvain, v. 23, pp. 1-296, pls. 1-42, Louvain.

Copper, P., 1976, The cyanophyte *Wetheredella* in Ordovician reefs and off-reef sediments: Lethaia, v. 9, n. 3, pp. 273-281, text-figs. 1-3, Oslo.

Cuvillier, J. & Deloffre, R., 1964, Organismes peu connus ou « *incertae sedis* » dans le Crétacé inférieur du sud-ouest de l'Aquitaine: Rev. Micropaléont., v. 7, n. 1, pp. 3-13 pls. 1-4, text-fig. 1, Paris.

Decrouez, D., 1976, Etude stratigraphique et micropaléontologique du Crétacé d'Argolide (Péloponnèse septentrional, Grèce): Thesis Univ. Genève, n. 1708, pp. 1-157, pls. 1-24, text-figs. 1-54, Genève.

Dîl, N., Termier, G., Termier, H. & Vachard, D., 1976, Contribution à l'étude stratigraphique et paléontologique du Viséen supérieur et du Namurien inférieur du bassin houiller de Zonguldak (Nord-ouest de la Turquie): Ann. Soc. geol. Belgique, v. 99, pp. 401-449, pls. 1-7, text-figs. 1-17, Bruxelles.

Dragastan, O., 1975, Upper Jurassic and Lower Cretaceous microfacies from the Bicaz valley bassin (East Carpathians): Mém. Inst. Géol. Géophys., v. 21, pp. 1-87, pls. 1-95, text-figs. 1-13, Bucarest.

Gisiger, M., 1967, Géologie de la région Lac Noir-Kaiseregg-Schafberg (Préalpes médianes plastiques fribourgeoises et bernoises): Ecl. geol. Helv., v. 60, n. 1, pp. 237-349, pls. 1-4, text-figs. 1-45, Basel.

Griffon, J.-C., 1965, La Dorsale calcaire au sud de Tetouan: Notes Mém. Sedv. géol. Maroc, v. 184, pp. 149-224, pls. 1-5, text-figs. 1-35, Rabat.

Hofker, J., 1960, Foraminiferen aus dem Golf von Neapel: Paläont. Z., v. 34, n. 3-4, pp. 233-262, text-figs. 1-184, Stuttgart.

Huguet, J. & Lespinasse-Legrand, N., 1970, Preuves paléontologiques de l'existence du Dogger dans la partie nord-est de la nappe des Corbières orientales (Aude): C. r. Séances Acad. Sc. Paris, ser. D, v. 270, pp. 279-282, pls. 1-2, text-figs. 1-2, Paris.

Johnson, J.H., 1964, Lower Devonian algae and encrusting foraminifera from New South Wales: J. Paleont., v. 38, n. 1, pp. 98-108. pls. 25-29, text-fig. 1, Menasha (Wisconsin).

Kobluk, D.R. & James, N.P., 1979, Cavity-dwelling organisms in Lower Cambrian patch reefs from southern Labrador: Lethaia, v. 1, n. 3, pp. 193-218, text-figs. 1-17, Oslo.

Loeblich, A. & Tappan, H., 1964, Sarcodina, chiefly « Thecamoebians » and Foraminiferida. *In* R.C. Moore (Editor). Treatise on Invertebrate Paleontology (C), v. 2, pp. C1-C900, text-figs. 1-653, Lawrence (Kansas).

Mamet, B. & Roux, A., 1975, Algues dévoniennes et carbonifères de la Téthys occidentale. Troisième partie: Rev. Micropaléont., v. 18, n. 3, pp. 134-178, pls. 1-15, text-figs. 1-4, Paris.

— & —, 1978, Sur l'attribution de thalles algaires carbonifères et permiens aux éponges hypercalcifiées: Rev. Micropaléont., v. 21, n. 1, pp. 19-27, pl. 1, text-fig. 1, Paris.

— & —, 1983, Algues dévono-carbonifères de l'Australie: Rev. Micropaléont., v. 26, n. 2, pp. 63-131, pls. 1-16, text-figs. 1-5, Paris.

Masse, J.-P., 1976, Les calcaires urgoniens de Provence. Valanginien-Aptien inferieur: Thesis Univ. Marseille, v. 1-3, pp. 1-445, pls. 1-60, text-figs. 1-124, Marseille.

Mišik, M., Jablonsky, J., Mock, R. & Sykora, M., 1981, Konglomerate mit exotischem Material in dem Alb der Zentralen Westkarpate - paläogeographische und tektonische Interpretation: Acta geol. Univ. comenianae. Geol., v. 37, pp. 1-55, pls. 1-4, text-fig. 1, Bratislava.

— & Sykora, M., 1981, Pieninský exotický chrbát rekonštruovaný z valúnov karbonátových hornín kriedových zlepencov bradlového pásma a manínskey jednotky: Západné Karpaty, Sér. Geológia, pp. 7-111, pls. 1-28, text-figs. 1-3, Bratislava.

— & —, 1982, Allodapische Barmsteinkalke im Malm des Gebirges Čachtické Karpaty: Geol. Zborn. - Geol. carpath., v. 33, n. 1, pp. 51-78, pls. 1-6, text-figs. 1-4, Bratislava.

PEYBERNÈS, B., 1976, Le Jurassique et le Crétacé inférieur des Pyrénées franco-espagnoles entre la Garonne et la Méditerranée. Thesis Univ. Toulouse, pp. 1-459, pls. 1-42, text-figs. 1-149, Toulouse.

PIA, P., 1927, Thallophyta. *In* M. Hirmer (Editor). Handbuch der Paläobotanik, v. 1 (Thallophyta, Bryophyta, Pteridophyta), pp. 31-136, text-figs. 14-129, R. Oldenbourg, München-Berlin.

PRATURLON, A., 1966, Algal assemblages from Lias to Paleocene in southern Latium-Abruzzi: a review: Boll. Soc. Geol. Ital., v. 85, pp. 167-194, text-figs. 1-16, Roma.

RAMALHO, M.M., 1971, Contribution à l'étude micropaléontologique et stratigraphique du Jurassique supérieur et du Crétacé inférieur des environs de Lisbonne (Portugal): Mem. Serv. geol. Portugal, v. 19, pp. 1-212, pls. 1-39, text-figs. 1-8, Lisboa.

RICH, M., 1974, Upper Mississippian (Carboniferous) calcareous algae from northeastern Alabama, south central Tennessee and north-western Georgia: J. Paleont., v. 48, n. 2, pp. 360-374, pls. 1-5, text-fig. 1, Tulsa.

RIDING, R., 1977, Systematics of *Wetheredella*: Lethaia, v. 10, n. 2, p. 94, Oslo.

ROTHPLETZ, A., 1908, Ueber Algen und Hydrozoen in Silur von Gotland und Oesel: Kungl. svenska Vetenskapsaka dem. Handl., v. 43, n. 5, pp. 1-25, pls. 1-6, Uppsala-Stockholm.

—, 1913, Über die Kalkalgen, Spongiostromen und einige andere Fossilien aus dem Obersilur Gottlands: Sverig. geol. Undersökn., ser. Ca, v. 10, pp. 1-57, pls. 1-9, Stockholm.

SAMUEL, O., BORZA, K. & KÖHLER, E., 1972, Microfauna and lithostratigraphy of the Paleogene and adjacent Cretaceous of the middle Váh valley (West Carpathian), pp. 1-232, pls. 1-153, text-figs. 1-23, Bratislava.

SCHROEDER, R., 1981, Mikrofossilien aus dem Schrattenkalk (Oberes Barrême) westlich des Tegernsees und dem Unter-Cenoman südwestlich von Ruhpolding (Oberbayern): Geol. bavarica, v. 82, pp. 389-398, pls. 1-2, München.

— & WILLEMS, H., 1983, Über einen submarinen Durchbruch des Diapirs von Villasana de Mena (Prov. Burgos, N-Spanien) an der Wende Unter-/Oberkreide: N. Jb. Geol. Paläont. Abh., v. 166, n. 1, pp. 65-85, text-figs. 1-7, Stuttgart.

SEPTFONTAINE, M., 1983, Le Dogger des Préalpes médianes suisses et françaises. Stratigraphie, évolution paléogéographique et paléotectonique: Denkschr. schweiz. naturforsch. Ges., v. 97, pp. 1-121, pls. 1-11, text-figs. 1-35, Basel.

VOIGT, E., 1966, Die Erhaltung vergängliches Organismen durch Abformung infolge Inkrustation durch sessile Tiere unter besonderer Berücksichtigung einiger Bryozoen und Hydrozoen aus der oberen Kreide: N. Jb. Geol. Paläont. Abh., v. 125, pp. 401-422, pls. 33-37, text-figs. 1-6, Stuttgart.

WERNLI, R., 1971, Les Foraminifères du Dogger du Jura méridional (France): Arch. Sc. Genève, v. 24, n. 1, pp. 305-364, pls. 1-10, Genève.

— & SEPTFONTAINE, M., 1971, Micropaléontologie comparée du Dogger du Jura méridional (France) et des Préalpes Médianes Plastiques romandes (Suisse): Ecl. geol. Helv., v. 64, n. 3, pp. 437-458, text-fig. 1-5, Basel.

WETHRED, E., 1893, On the microscopic structure of the Wenlock Limestone, with remarks on the formation generally: Quart. J. geol. Soc. London, v. 49, pp. 236-248, pl. 1, London.

WOOD, A., 1948, « *Sphaerocodium* », s misinterpreted fossil from the Wenlock Limestone: Proceed. geol. Assoc., v. 59, n. 1, pp. 9-22, pls. 1-5, London.

(manuscript received April 2, 1985 accepted May 2, 1985)

Antonietta CHERCHI
Dipartimento di Scienze della Terra, Università di Cagliari, Via Trentino 51, I-09100 Cagliari, Italia.

Rolf SCHROEDER
Geologisch-Paläontologisches Institut, Universität Frankfurt, Senckenberg-Anlage 32-34, D-6000 Frankfurt a.M., Federal Republic of Germany