CALCAREOUS MARINE ALGAE FROM THE CARBONIFEROUS (MOSCOVIAN-GZHELIAN) OF THE CANTABRIAN ZONE (NW SPAIN)

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ABSTRACT

A taxonomic revision of shallow-water Carboniferous (Pennsylvanian) red and green algae observed in Ponga, Picos de Europa and Pisuerga-Carrión Units in NW Spain is presented. Some microproblematics are included. Thirty-two genera are described; three genera and four species are new: Anatolipora cantabriensis n. sp., Pelayella multiporosa n. gen., n. sp., Kasimophyllum demuesensis n. gen., n. sp. and Penella pongaensis n. gen., n. sp.

The microflora is typically Western Paleotethyan and remarkably similar to that observed in the Carnic Alps and Central Urals.

Keywords: Carboniferous microflora, taxonomy, green algae, red algae.

RESUMEN

Se realiza una revisión de las algas verdes y rojas de ambientes someros registrados en los depósitos del Carbonífero superior de las unidades del Ponga, Picos de Europa y Pisuerga-Carrión en el NO de España, incluyendo algunos grupos problemáticos. Se describen formas pertenecientes a treinta y dos géneros, entre las que se encuentran tres nuevos géneros y cuatro nuevas especies: Anatolipora cantabriensis n. sp., Pelayella multiporosa n. gen., n. sp., Kasimophyllum demuesensis n. gen., n. sp. and Penella pongaensis n. gen., n. sp. La microflora estudiada es típica del Paleotethys occidental, presentando grandes semejanzas con la que se ha descrito en los Alpes Cárnicos y en los Urales Centrales.

Palabras clave: Microflora carbonífera, taxonomía, algas verdes, algas rojas.

INTRODUCTION

The abundance of algae in the Carboniferous of northern Spain is well documented since the pioneering work of Rácz (1966 a, b) who reported their morphology with great taxonomic accuracy. These two papers by Rácz, as well as other studies on algae (or containing information related to algae) developed subsequently in the Cantabrian Zone (Riding, 1979; Bowman, 1979; Eichmüller and Seibert, 1984; Eichmüller, 1985; Rácz, 1984; Dingle et al., 1993; Hensen et al., 1995; Barba Regidor, 1998; Samankassou, 2001; Della Porta et al., 2002; Della Porta, 2003), dealt mostly with Bashkirian and (especially) Moscovian materials. Algae from the final part of the Carboniferous succession, e.g., that embracing from the uppermost Moscovian to the lower Gzhelian, have remained rather unknown until recently as a result of the fact that the stratigraphy of this final part of the Carboniferous succession has not been so deeply investigated in the Cantabrian Zone until much later than the older Carboniferous. Among the few papers containing information on latest Carboniferous algae, we can mention studies on Kasimovian algae by Rodríguez and Moreno-Eiris (1986) and Minwegen (2001), the latter also studying numerous Moscovian localities.

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During the late 1980’s and 1990’s, the SCCS program for establishing levels of correlation in the upper part of the Carboniferous system has led to an intensive biostratigraphic study of successions of this age through the Cantabrian Zone and, particularly, of those outcropping in the Picos de Europa structural unit (Figs. 1-2). In parallel with these studies, several investigations on the regional geology of the eastern part of the Cantabrian Zone, the area where younger Carboniferous successions of this zone exist, were carried out, leading to a a better knowledge of its stratigraphy (Villa and Martínez García, 1989; Martínez García and Villa, 1998, 1999; Venturini et al., 1998; Sánchez de Posada et al., 1999). Especially significant is the study on the stratigraphy and sedimentology of the latest Carboniferous successions of the northern part of the Picos de Europa massifs carried out by Merino-Tomé et al. (2001).

UPPERMOST CARBONIFEROUS FROM THE EASTERN CANTABRIAN ZONE

The Cantabrian Zone (Lotze, 1945), situated in the northwestern part of the Iberian Peninsula, constitutes a foreland basin, deformed by thin-skinned tectonics into an arcuate fold belt. Stratigraphic and structural characters have been used by Julivert (1971) and Pérez Estaún et al. (1988) to distinguish within the Cantabrian Zone several major geological provinces (or structural units; Fig. 1). These units spread along the provinces of Asturias, Cantabria, León and Palencia, in northern Spain.

The most complete Carboniferous successions of the Cantabrian Zone are present in the eastern units (Central Asturian Coalfield, Ponga Unit, Picos de Europa Unit, and Pisuerga-Carrión Unit). A remarkable feature in these successions is that, during late Carboniferous, the sedimentation was strongly influenced by tectonics, resulting in synorogenic deposits with important facies and thickness variations. As a result of the west-eastern progression of deformation, the top of the Carboniferous succession becomes younger in an eastern direction. The Picos de Europa Unit is the only region where sedimentation in a shallow carbonate platform lasted until Gzhelian.

Materials analyzed in this work come from sections and localities situated in the Ponga Unit (Pen section), Picos de Europa Unit (Las Llacerias, Demués, Berodia-I, Berodia-II sections, and Inguanzo locality), and Pisuerga-Carrión Unit (Sierra Corisa locality). The location of sections is shown in figures 1-2, the correlation in figure 3, and the stratigraphic position of samples studied in tables 1-2. The list of species, as well as their range in the sections and localities studied in this paper are given in table 3.

Pen section

This section (Figs. 2-3, Table 2) exposes an unconformable marine succession consisting of a thin calcareous band at the base, which is overlain by siliciclastics. The calcareous band yields fusulinaceans belonging to the Protriticites Zone and algae at closely situated various levels (samples BM-78, BM-79, BM-85). Further stratigraphic information on these deposits is given in Martínez García et al. (1985) and Villa (1995).

Las Llacerias section

This section outcrops in the vicinity of Covadonga, Asturias (Figs. 2-3, Table 1). The upper part of this section (the one studied in this paper) is the most extensively studied succession of the Cantabrian Zone embracing the Moscovian/Kasimovian transition. This part corresponds to the Picos de Europa (part) and Las Llacerias formations (Fig. 3). Diverse fossil groups (brachiopods, corals, conodonts, fusulinaceans, spores and algae) have been collected from these strata (Marquinez et al., 1982; Villa et al., 1993, 1997; Coquel and Rodríguez, 1994; Méndez, 2002). Their age has been mainly established on the base of the fusulinoidean faunas and it ranges from upper Krevyakinian to upper Khamovnikian (van Ginkel and Villa, 1999; Villa and van Ginkel, 2000). The upper part of the Picos de Europa Formation represents sedimentation in a platform-lagoonal environment which evolved towards more open marine conditions. Towards the top of the formation organic build-ups are found. According to Bahamonde et al. (2000), the uppermost part of the Picos

Figure 1. Sketch showing the main structural units of the Cantabrian Zone. Box shows the area enlarged in figure 2.
de Europa Formation represents the evolution from a shallow to a drowned platform, which was finally replaced by a mixed ramp represented by Las Llacerias strata. The latter consists of packstones and wackestones alternating with grainstones and marls. Its upper part corresponds to a megasequence of tempestites made up of grainstone to mudstone. On the whole, the materials of the Las Llacerias Formation are deposits that accumulated on a storm-dominated monoclinal platform-slope (ramp), under conditions of high sedimentation rate (Leyva in Villa et al., 1993).

**Demués section**

This section (Figs. 2-3, Table 2) exposes strata belonging to the Demués Formation along the trail leading from the village of Demués to the pastures in the northern slope of the Picos de Europa mountains. Different studies on the stratigraphical, sedimentological and paleontological characteristics of this section have been carried out by Bruner et al. (1998), Martínez García and Villa (1998), and Sánchez de Posada et al. (1999, 2002). The Demués Formation is composed of an alternation of limestones, marls, shales, carbonaceous shales, sandstones and calcareous conglomerates, and a thin coal-seam. Marine beds yield fossils belonging to many benthic groups (especially brachiopods, porifera, molluscs, foraminifers, ostracods, and algae), all of them reflecting shallow-marine environments. Spores have been recovered from beds at different levels throughout the entire succession. Fusulinaceans and spores allowed dating these rocks in terms of both the West-European and the Russian stratigraphical scales. The succession at Demués section ranges in age from uppermost Moscovian or basal Kasimovian to the middle part of the Kasimovian (upper Khamovnikian) in the Russian stratigraphic scale, and probably from Cantabrian (lower?) to a level near the Barruelian/Stephanian B boundary in the West European stratigraphic scale (Sánchez de Posada et al. 1999, 2002).

**Berodia sections**

The name Berodia-I and Berodia-II refer to Puentellés Formation outcrops located along the road leading from the Casaño River valley to the small village of Berodia (Figs. 2-3, Table 2). The Puentellés Formation outcrops in this area splitted in two structural units, which are separated by a thrust fault (Martínez García and Villa, 1998). Berodia-I is the section located closest to the village of Berodia.

The Puentellés Formation is a thick calcareous succession ranging from upper Kasimovian to lower Gzhelian within which two different members can be recognized: a lower member consisting of reworked and resedimented carbonates, and an upper member, made up of authochthonous limestones (Merino-Tomé et al., 2001). Lower member strata are bedded alternations of calcareous breccias.
Table 1. Stratigraphic position and age of samples from Las Llacerias section mentioned in this paper.

| Sample | Stratigraphic position with respect to samples in Villa et al., 1997, and Villa & van Ginkel, 2000 | Age | Fusulinid zone |
|--------|------------------------------------------------------------------------------------------------|-----|----------------|
| BM-11  | Picos de Europa Fm. (upper part of the upper member), 4 m below LL-9001                      | Late Moscovian (Myachkovian) | Fusulinella Zone (upper part) |
| BM-12  | idem                                                                                          | idem | idem |
| BM-13  | idem, 0.5 m above LL-9001                                                                     | idem | idem |
| BM-14  | idem, 4 m above LL-9001                                                                       | idem | idem |
| BM-16  | idem, 0.5 m below LL-9003                                                                      | idem | idem |
| BM-17  | idem, equivalent to LL-9003                                                                    | late Myachkovian | idem |
| BM-18  | idem, 0.4 m below LL-9004                                                                      | idem | idem |
| BM-19  | idem, equivalent to LL-9005                                                                      | idem | idem |
| BM-25  | idem, 0.8 m above LL-9008                                                                      | idem | idem |
| BM-28  | idem, equivalent to LL-9009                                                                      | idem | idem |
| BM-31  | idem, 4.8 m above LL-9009                                                                      | idem | idem |
| BM-38  | idem, equivalent to LL-9011                                                                     | Moscovian/Kasimovian transition interval | Protriticites Zone |
| BM-39  | idem, 2 m above LL-9011                                                                        | idem | idem |
| BM-40  | idem, 4 m above LL-9011                                                                        | idem | idem |
| BM-46  | idem, 4 m below LL-9014                                                                        | earliest Kasimovian (early Kreviakinian) | idem |
| BM-47  | idem, equivalent to LL-9014                                                                      | idem | idem |
| BM-52  | idem, equivalent to LL-9016                                                                      | early Kasimovian (Kreviakinian) | idem |
| BM-63  | idem, equivalent to LL-9024                                                                      | idem | idem |
| BM-69  | Las Llacerias Fm., equivalent to LL-9031                                                         | idem | idem |
| BM-70  | idem, equivalent to S-236                                                                        | idem | idem |
| BM-72  | idem, equivalent to LL-9034                                                                      | idem | idem |
| BM-74  | idem, equivalent to LL-9037                                                                      | Kasimovian (early Khamovnikian) | Montiparus Zone |
| BM-74B | idem, equivalent to LL-9038                                                                      | idem | idem |
| BM-76  | idem, equivalent to LL-9044                                                                      | late Khamovnikian | idem |
| BM-76B | idem, slightly above LL-9044                                                                     | idem | idem |
| BM-77B | idem, equivalent to LL-9047                                                                      | idem | idem |

and conglomerates, pebbly sandstones, graded and laminated silty and sandy limestones, skeletal grainstones and bioturbated marly limestones and marls. Accumulations of the fusulinioidean *Ferganites* occur in this member at several levels (Villa and Bahamonde, 2001). The upper member consists of dark pseudo-nodular mudstones and skeletal wackestones with intercalations of thick bedded algal bafflestones and isolated mud mounds. In contrast to the lower member, the upper one yielded more varied fusulinacean assemblages, including *Rauzerites*, *Jigulites*, *Quasifusulina* and *Ferganites*, which allowed accurate dating (Villa and van Ginkel, 1999; Villa and Ueno, 2002; Villa et al., 2003). Further data on the sedimentological characteristics of this formation are in Merino-Tomé et al. (2001), Villa and Bahamonde (2001), and Villa et al. (2003). With the exception of one taxon, all algal samples from the Puentejel Formation studied in this paper have been collected from the upper member.
Inguanzo locality
The two samples labeled “Inguanzo” have been collected from strata of the upper member of the Puentellés Formation exposed at the cut road leading to the Casaño River valley to the village of Inguanzo (Fig. 2, Table 2), situated 1 km east of Berodia. This outcrop constitutes the eastern extension of the unit exposed at the Berodia-II section.

Sierra Corisa locality
The Sierra Corisa locality belongs to the Pisuerga Carrión Unit (Fig. 1, Table 2) of the Cantabrian Zone. It is situated in the Castillería Syncline, in the northern part of the Palencia province. Samples for the present study were collected from the Corisa Formation, a thick calcareous succession of late Myachkovian age (van Ginkel, 1965; van Ginkel and Villa, 1991).

**GENERALITIES ON CALCAREOUS ALGAE**

Algae are important contributors to the formation of modern bioconstructions (“reefs”) and carbonate platforms and it can be inferred that they have played the same role since the Paleozoic (Wray, 1977). Taxonomic problems are present, but classification difficulties should not blur the geological importance of the microflora.

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Table 2. Stratigraphic position and age of other samples, apart from those of the Las Llacerias section, mentioned in this paper.
We have also included, in this article, a number of microproblematics that play a crucial role in carbonate accumulations. We are conscious that their taxonomic position is open to question but, associated with the microflora, they equally contribute to the microfacies. Algal proliferation is linked to various factors such as biotic turnover, nutrients, paleolatitude, turbidity, upwelling, temperature (Kroeger et al., 2003). Thus, a warm low latitude photozoan association and its opposite, a cold high latitude heterozoan association, can occur in Late Paleozoic sequences (e.g., in the Carnic Alps; Samankassou, 2002).

The presently described algae are basically light dependent. The upper part of the photic zone is favorable to all categories (cyanophytes, chlorophytes, phaeophytes, rhodophytes). The euphotic/dysphotic zone sees the progressive elimination of the first two categories. The dysphotic zone is characterized by the latter two categories that peter out in the aphotic zone (Madi et al., 1996).

As the Carboniferous succession of the Cantabrian Zone is cyclic, with concomitant variations in bathymetry/luminosity, the nearly complete gamut of algae is observed. This abundance and diversity indicate overall warm water temperature and not necessarily mixing of cold versus warm waters as suggested by Samankassou (2002) for the Auernig Group in the Carnic Alps.

The most important algal flora that contribute to Carboniferous Paleotethyan carbonates are (Mamet et al., 1987; Mamet, 1992):

1. Archaeolithophyllum, Kasimophyllum and Archaeolithoporella (encrusting red algae) (Wahlman, 1988; Razgallah and Vachard, 1991; this paper).
2. Beresellids (Beresella, Dvinella) (green algae) (Mamet and Stemmerik, 2000).
3. Donezella (discussion in Della Porta et al., 2002).
4. Komia-Ungdarella (red algae) (Mamet, 1991).
5. Petschoria (red alga) (Mamet et al., 1987).
6. Phylloid algae (Eugonophyllum, Ivanovia, Neodichrochium) (discussion in Torres, 1997, fide Wahlman, 2002).
7. Tubiphytes (for references and discussion, see Sowbari-Daryan and Flügel, 1993).
8. Uraloporella (green alga) (Mamet and Villa, 1995).

**PREVIOUS STUDIES ON CALCAREOUS ALGAE FROM THE CANTABRIAN ZONE**

As mentioned above, pioneering works on algae from the Cantabrian Zone have been those by Rácz (1966a, 1966b). In these papers, Rácz proposed that Donezella and
associated Paleosiphonocladales were characteristic of a restricted calm milieu and *Archaeolithophyllum*, of more agitated waters. He also postulated that algal assemblages were stratigraphically useful, a potential that has not been confirmed.

Donezella mud-mounds were described by Riding (1979), Bowman (1979), Eichmüller and Seibert (1984), and Eichmüller (1985). While Riding favored extensive reworking of the thalli, Eichmüller proposed an alternative bindstone-bafflestone effect. The associated biota in shallow platform surrounded by pelagic sediments yielded *Petschoria*-phylloids in low energy, *Komia* in intermediate energy and *Archaeolithophyllum* in high energy environments.

Rácz (1966a, 1984) felt that *Donezella* had a baffling-trapping action, an opinion shared by Dingle et al. (1993) and Hensen et al. (1995). Sedimentological problems connected to *Donezella* are summarized in Della Porta et al. (2002) and Della Porta (2003).

Upper Carboniferous algal-bryozoan assemblages were described in the Cármenes Syncline (southern Cantabrian Mountains) by Dingle et al. (1993). From the same region, *Donezella-Archaeolithophyllum* associated with worm tubes and microbes are reported by Samankassou (2001). The red *Archaeolithophyllum* and the green *Donezella* acted as bafflestones associated with encrusting bryozoans. Cementstones were commonly produced by the *Donezella*-bryozoan associations.

| CALCAREOUS MARINE ALGAE | MOSCOV. (part) | KASIMOVIAN | GZHEL. (part) |
|--------------------------|----------------|------------|---------------|
| Anatolipora cantabriensis n. sp. | | | |
| Anchicodium funde Johnson 1948 sensu Torres & Baur 1992 | | | |
| Anthracoporella spectabilis Pia 1920 | | | |
| Anthracoporella vicina Kochansky and Herak 1960 | | | |
| Anthracoporellopsis machaei Moslov 1956 | | | |
| Archaeolithophyllum johnsoni Rácz 1966 | | | |
| Archaeolithophyllum deliciosum Johnson 1956 | | | |
| Berezovia herminae Rácz 1966 | | | |
| Berevstovia flatkis (Berechenko 1982) | | | |
| Claracrusta catenides (Hornem 1972) | | | |
| Claracrusta reitae Rácz 1966 | | | |
| Donezella lutfiina Moslov 1929 | | | |
| Ellesmerella permica (Pia 1937) | | | |
| Epimastopora asymmetrica (Johnson 1951) | | | |
| Eurygnathophyllum johnsoni Komishi and Wray 1961 | | | |
| Eurygnathophyllum mulderi Rácz 1966 | | | |
| Fourstronella fusiformis (Brady 1876) | | | |
| Fourstronella johnsoni (Flügel 1966) | | | |
| Gyroporella divisa (Chuvashov 1774) | | | |
| Gyroporella prisca Kochansky-Devidé 1970 | | | |
| Herkiella paradoxo Kochansky-Devidé 1970 | | | |
| Hikorocodium furanotol Nakamura 1994 | | | |
| Hikorocodium? sp. | | | |
| Ivanovia tenusima Khvorova 1946 | | | |
| Kasimovichium demuesensis n. gen., n. sp. | | | |
| Microporella ginbeki Rácz 1966 | | | |
| Palaeeberezella lahaseni (von Möller 1879) | | | |
| Petalvella multiforma n. gen., n. sp. | | | |
| Penella pongensis n. gen., n. sp. | | | |
| Pseudokorouia conicaconus Rácz 1966 | | | |
| Pseudorehbitella simplex (Kochansky-Devidé 1970) Mamet & Roux 1978 | | | |
| "Psuedorehbitella" avamatau Ishijima, Ozaki & Nakamura 1971 | | | |
| Stockia marginoloides Brady 1876 | | | |
| Tabitiopora obscura Moslov 1956 | | | |
| Uagadarella arabica Moslov 1956 | | | |
| Uagadarella artemia Rácz 1956 | | | |
| Uraloporella variabilis Korde 1950 emend. Mamet & Villa 1995 | | | |
| "Vermiporella" hispanica Rácz 1966 | | | |
| Zaporella cantabriensis Rácz 1966 | | | |

Table 3. Stratigraphic distribution of the algae described in this paper. Absence of species of late Kasimovian age is due to unfavourable facies in the Dorogomilovian strata from the area investigated.
Riding (1979) and Dingle et al. (1993) noted that algae constituted “only” 5-20% of the mud-mound, thus were unable to produce a bafflestone. However as early as 1962, Dunham documented that branching thalli could form stable boundstones. In our opinion, rocks containing 15% of branching thalli are probably in situ (bafflestone, bindstone) while rocks composed of >20% thalli are formed by hydrodynamically-transported fragments.

Barba Regidor (1998) described two types of carbonate mounds in the Cantabrian Zone: the Archaeolithophyllum/Ungdarella bindstones/bafflestones and the Beresella bafflestones. These floral elements can be associated with Palaeoaplysina (see Antoshkina, 1998), a hydrozoan (?), referred to phylloid algae plates (Davies and Nassichuk, 1973; Kiessling et al., 1999), sponges (Bourque et al., 1995), bryozoans (Ernst, 2000), chaetetids (Stanton et al., 1994) and microbial structures (Riding, 2000; Riding and Awramic, 2000). Other biotic associations are fenestelloid-Tubiphytes cementstones, red-green algal-calcisponge cementstones and siliceous sponge-bryozoan-Archaeolithoporella cementstones.

Minwegen (2001) recognized in the Carboniferous succession of northern Spain a number of bioconstructions dominated by metazoans, algae or pelmatozoans. Metazoan-dominated buildups are: 1) Beresellidae-chaetetids mounds, 2) chaetetids biostromes, 3) Syringopora-chaetetids reef-mounds, 4) rugose corals, and 5) sponge-algal meadows. Algal constructions are characterized by the abundance of: 6) Petschoria-Donezella, 7) phylloid algae, 8) Anthracoporella, and 9) Archaeolithophyllum. Pelmatozoans mounds are: 10) undiversified dominated by pelmatozoans, or 11) diversified associated with bryozoans, brachiopods, etc. A bit surprising is the lack of recognition of algal encrusters like Claracrusta-Berestoria that stabilize Donezella mounds and the Beresellidae-chaetetids association. Also lacking is the role of Tubiphytes, which is an enigmatic microproliferative fossil.

Della Porta et al. (2002, 2003) and Della Porta (2003) describe in great detail the sedimentology of a carbonate platform/ramp in the Sierra del Cuera, with extensive microbial boundstones. Analysis of Donezella accumulations (Della Porta et al., 2002) suggest that this organism was able to thrive over a large depth range, which led these authors to think that either Donezella did not belong to the green calcareous algae or, alternatively, the Sierra del Cuera depositional system was affected by particular paleo-oceanographic conditions that extended the euphotic zone below the average depth.

**TAXONOMY**

The material described below is held in the collections of the Département des Sciences de la Terre et de l’Environnement, Faculté des Sciences, Université Libre de Bruxelles. Specimens are labelled U. of M., for the University of Montreal where the thin sections were made.

**PHYLLUM CHLOROPHYCOPHYTA Papenfuss 1946**

**Genus Anatolipora Konishi 1956**

**Anatolipora cantabriensis n. sp.**  
Fig. 4, 7 e

**Origin of name:** From the Cantabrian Mountains.

**Holotype:** Figure 7 e. Repository number: U. of M. 823/13.

**Diagnosis:** Simple tapening pores with slightly irregular oblique arrangement.

**Description:** Thallus (cortex and medula) continuous, cylindrical. Diameter, around 400 µm. Medula, 170 µm. Cortex, 100-130 µm, perforated by numerous, regular, plioiphyore pores with oblique, irregular insertion. Pores are about 15 µm thick with interpores of 20-25 µm. There are 24-27 pores per linear millimeter. The taxon belongs to the Salpingoporellinae. See idealized sections at Figure 4.

**Figure 4.** Idealized cross-oblique and longitudinal sections of Anatolipora cantabriensis n. sp. diameter of thallus around 400 µm.
Comparison: Diffsers from *Anthracoporella carbonica*, the type of the genus, by the very regular (non-twisted) thallus, the greater number of pores per linear millimeter and the slight irregular disposition of the branches. Note that the original drawing of Konishi is somewhat idealized (Mamet, 2002).

Stratigraphic distribution and range: Known from the Late Moscovian (Miachkovian) of the Picos de Europa Formation (*Fusulinella Zone*). The highest recorded occurrence of *Anthracoporella* is Namurian and *cantabriensis* extends the range into the Moscovian. The holotype is derived from the upper part of the Picos de Europa Formation (sample BM-11, Myachkovian) at Las Llacerias section, associated with algal-rich baffles-tones and grainstones. The most prolific algae are *Anchicodium*, *Anthracoporella*, *Beresella*, *Donezella*, *Fourstonella*, *Hikorocodium*, *Komia*, *Pseudokomia*, *Tubiphytes* and *Ungdarella*.

Genus *Anchicodium* Johnson 1946

*Anchicodium funile* Johnson 1946 sensu Torres and Baars 1992

1946 *Anchicodium funile* Johnson, OD; 1100, pl.2, fig. 3; pl. 3, fig. 4; pl.7, fig. 1.
1974 *Anchicodium funile* Johnson; Chuvashev, 17, pl. 2, figs. 1, 2.
1992 *Anchicodium funile* Johnson; Torres and Baars, 675-677, fig. 1/1-6.

Description: Thallus grossly cylindrical, small (300-600 µm) with central stalk and irregular long and short branches (diameter 15-20 µm) forming a twig-like structure.

Stratigraphic distribution and range: From the Late Carboniferous (Virgilian) to the Early Permian (Asselian). Observed in Spain in the upper part of the Picos de Europa Formation (sample BM-12, Myachkovian) at Las Llacerias section. Considered as a central North American flora, but should be extended to Spain in the upper part of the Picos de Europa Formation (sample BM-12, BM-52, BM-72).

Genus *Anthracoporella* Pia 1920

*Anthracoporella vicina* Kochansky and Herak 1960

1960 *Anthracoporella vicina* Kochansky and Herak, OD; 69, pl.1, figs. 1-5.
1964a *Anthracoporella vicina* Kochansky and Herak; Kochansky-Devidié, pl. 3, figs. 2-3.
1966 *Anthracoporella vicina* Kochansky and Herak; Kochansky-Devidié and Ramovš, 16, pl. 6, figs. 1-4.
1970 *Anthracoporella vicina* Kochansky and Herak; Kochansky-Devidié, 212, pl. 22, fig. 4.
1971 *Anthracoporella vicina* Kochansky and Herak; Ramovš, 1387, pl.1, fig.3.

1978 *Anthracoporella vicina* Kochansky and Herak; Ramovš, pl. 6, fig. 1.
2000 *Anthracoporella vicina* Kochansky and Herak; Granier and Grgasovic, 15-16, figs. 2-3.
2001 *Anthracoporella sp.*; Minwegen, pl. 12, figs. 3-6.
2003 *Anthracoporella vicina* Kochansky and Herak; Khodjanyazova and Mamet, pl. 3, figs. 21, 28.

Description: Thallus important, ramose, sometimes centimetric in size. Medula occupying 4/5 of the thallus, hence a thin cortex. Pores numerous, regular, very thin (25 µm). Interpores twice the pore diameter.

Stratigraphic distribution and range: Paleotethyan flora. Reported from the “Uralian”-Kasimovian of Yugoslavia. In Spain, abundant in the upper part of the Carboniferous (upper Moscovian- lower Kasimovian). It has been recorded from the Las Llacerias section, where it occurs at the upper part of the Picos de Europa Formation and the lower-middle part of the Las Llacerias Formation (samples BM-12, BM-52, BM-72).

For 85 illustrated references of the taxon, see Homann (1972: 189-191) and update in Granier and Grgasovic (2000: 12-15). Add to the list:

1984 *Anthracoporella spectabilis* Pia; Saltovskaya, pl. 31, figs. 1-3.
1985 *Anthracoporella sp.*; Mu, pl. 14, figs. 7-8.
1993 *Anthracoporella spectabilis* Pia; Perret, pl. 13, fig. 16.
1994 *Anthracoporella spectabilis* Pia; Nakamura, 15, pl. 9, figs. 7-12.
1994 *Anthracoporella spectabilis* Pia; Fontaine et al., pl. 7, fig. 2.
1994 *Anthracoporella yowarensis* Nakamura, OD, 16-17, pl. 10, fig. 1; pl. 11, figs. 1-4.
1995 *Anthracoporella spectabilis* Pia; Pajic and Filipovic, pl. 51, figs. 2-5.
2001 *Anthracoporella spectabilis* Pia; Minwegen, pl. 12, figs. 1-2.
2001a *Anthracoporella spectabilis* Pia; Vachard et al., 385-387, fig. 12/1-10.
2002 *Anthracoporella spectabilis* Pia; De Castro, 3-12.
2002 *Anthracoporella spectabilis* Pia; Mamet, pl. 3, figs. 1-2.
2003 *Anthracoporella spectabilis* Pia; Khodjanyazova and Mamet, pl. 3, fig. 24.

Description: Thallus cylindrical, large, plurimillimetric, bifurcated. Branches 30-50 µm, usually 40 µm, aspondyl, ramified once. Wall (100-150 µm), yellowish, of iron-rich calcite.

Discussion: De Castro (2002), Granier and Hofmann (2003), Mu *et al.* (2003) have recently questioned the dasycladale affinity of *Anthracoporella spectabilis* on the presence of calcified sheaths and perforated (?) material apparently growing in the stem. However, these characters appear to be secondary features developed after the decay of the alga, the stem being filled by bacterial (?)
micritic material. This hypothesis has been proposed again by Granier and Hofmann (2003) and by Mu et al. (2003). These authors compare the irregular “pores” to codiacean “filaments” (e.g. Garwoodia). Remnants of muscular filaments are also reported which would discard a dasycladale affinity. In the Spanish material, although abundant and well preserved, the central cavity does not disclose the presence of muscular tubes and their existence ought to be corroborated by further studies. The same holds true for the Carnic Alps material studied by Samankassou (2002).

Stratigraphic distribution and range: Cosmopolitan. Mid-Carboniferous to mid-Permian. Reports of the genus in the Devonian (Vachard et al., 2001a) are due to confusion with other dasycladales (e.g. Couvinianella). The drawing (A) of an “atypical” Anthracoporella is indeed very atypical. Forms the Anthracoporella Community of Flügel (1977, p. 322 and 332). In Spain it has been recorded from the Picos de Europa Formation (upper part) and the Las Llaceras Formation at the Las Llaceras section (samples BM-12, BM-52, BM-72, BM-76).

**Anthracoporellopsis machaevii** Maslov 1956

**Fig. 10 g-h**

1956 *Anthracoporellopsis machaevii* Maslov, OD; 62, pl. 13, fig. 3-4.
1979 (non) *Anthracoporellopsis machaevii* Maslov; Muromtseva, 91, pl. 1, fig. 3, 8-10.
1964 (?) *Anthracoporellopsis machaevii* Maslov; Chanton, 565, pl. 17, fig. 3-4.
1968 (non) *Anthracoporellopsis machaevii* Maslov; Pelhate, 901, pl. 32, fig. 15.
1969 (non) *Anthracoporellopsis machaevii* Maslov; Pelhate, 67-68, pl. 6, figs. 74-76.
1974 (pars) *Donezella lunaensis* Rácz; Chuvashov, 33, pl. 20, fig. 1-2 (non 3-4).
1975 *Anthracoporellopsis machaevii* Maslov; Mamet and Roux, 264, pl. 13, figs. 9-11.
1979a *Anthracoporellopsis aff. machaevii* Maslov; Mamet et al., 360, pl. 3, fig. 16.
1985 *Anthracoporellopsis machaevii* Maslov; Mamet and Pinard, pl. 1, fig. 15.
1987 *Anthracoporellopsis machaevii* Maslov; Shuishy, pl. 15, fig. 12.
1987 *Anthracoporellopsis machaevii* Maslov; Mamet et al., 23, pl. 10, figs. 7-8; pl. 11, figs. 4-5.
1988 *Anthracoporellopsis machaevii* Maslov; Ivanova and Bogush, pl. 15, fig. 16.
1988 *Anthracoporellopsis machaevii* Maslov; Ivanova, pl. 2, fig. 9.
1989 *Anthracoporellopsis machaevii* Maslov; Deloffre, pl. 1, figs. 25-26.
1989 *Anthracoporellopsis machaevii* Maslov; Skompski et al., pl. 2, fig. 4-7.
1989 *Anthracoporellopsis machaevii* Maslov; Vachard et al., 706, pl. 1, fig. 9.
1990 *Anthracoporellopsis machaevii* Maslov; Bogush et al., pl. 10, figs. 5-7.
1991 *Anthracoporellopsis machaevii* Maslov; Vachard and Beckary, 324, pl. 2, fig. 2.
1991 *Anthracoporellopsis machaevii* Maslov; Vachard and Tahiri, pl. 4, figs. 7-8.
1991 *Anthracoporellopsis machaevii* Maslov; Mamet, pl. 3, fig. 1.
1991 *Anthracoporellopsis machaevii* Maslov; Riding, pl. 3, fig. a.
1993 *Anthracoporellopsis machaevii* Maslov; Chuvashov et al., pl. 12, fig. 5.
1995 (?) *Anthracoporellopsis machaevii* Maslov; Pajic and Filipovic, pl. 48, figs. 4-5.
1996 *Anthracoporellopsis machaevii* Maslov (pars); Skompski, 225-226, pl. 11, figs. 1-9; pl. 12, figs. 2-6 (non 1).
1996 *Anthracoporellopsis machaevii* Maslov; Vachard and Maslo, pl. 2, figs. 10-13.
1999 *Anthracoporellopsis machaevii* Maslov; Sebbar and Mamet, pl. 2, fig. 6.
2000 *Anthracoporellopsis machaevii* Maslov; Mamet and Stemmerik, pl. 3, figs. D-E.
2002 *Anthracoporellopsis machaevii* Maslov; Mamet, pl. 1, fig. 7.

**Description:** Very irregular *Anthracoporellopsis* with an external diameter of 200-400 µm. Cortex 30-60 µm. Pores simple, disposed in irregular directions (5-8 µm in diameter).

Stratigraphic distribution and range: Cosmopolitan (Mamet, 1992). Rare in Visean, common in Middle and late Carboniferous (Moscovian, Gzhelian). Reported as late as Early Permian in the Urals. It has been recovered (uncommon) in Spain from upper Moscovian (Myachkovan) beds from the Las Llaceras section (upper part of the Picos de Europa Formation, samples BM-12, and BM-25).

**Genus Beresella** (Makhaev 1937) Maslov and Kulik 1956

**Beresella herminae** Rácz 1966a

**Fig. 9 a-f, Fig. 10 a-b, k**

1966a *Beresella herminae* Rácz, OD; 93, pl. 1, figs. 1-3.
1980 (?) *Beresella herminae* Rácz; Buchroithner et al., 23, pl. 4/5, pl. 5/6.
1985 *Beresella herminae* Rácz; Eichmüller, pl. 9, fig. 7.
1986 *Beresella herminae* Rácz; Poncet, 189, pl. 2, figs. 1, 2.
1999 *Beresella herminae* Rácz; Sebbar and Mamet, pl. 2, fig. 2.
2001 *Beresella* sp.; Minwegen, pl. 4, fig. 1, 5; pl. 6, fig. 8.
2003 *Beresella* sp.; Della Porta, pl. 6/1.8.

**Description:** A heavily calcified beresellid, stouter than most representatives of the genus. Diameter 300-400 µm, reaching 500 µm. Thick (up to 100 µm) cortex. Length of clear rings, 25-50 µm. Length of dark rings (micritized pores), 70-200 µm.

**Stratigraphic distribution and range:** Western Paleotethyan flora (Mamet, 1992). Late Bashkirian/Moscovian where they
form bafflestones. The species is usually not as prolific as its counterparts *Beresella erecta* Maslov and Kulik 1956 and *Beresella ishimica* Kulik 1964. It has been recorded in Spain from the upper part of the Picos de Europa Formation at Las Llaceras section. Beds of late Moscovian (Myachkovian) age, samples BM-12, BM-16.

**Genus Clavaporella** Kochansky and Herak 1960

*Clavaporella reinae* Rácz 1966b.

Fig. 11 f

1966b *Clavaporella reinae* Rácz, OD; 253, pl. 1, figs. 2-7; pl. 2, fig. 6.
1987 *Clavaporella reinae* Rácz; Mamet et al., 44, pl. 14, figs. 1-11; pl. 15, figs. 1-7.
1988 *Clavaporella reinae* Rácz; Chuvashov and Anfimov, 66-67, pl. 28, figs. 5-8.
2003 *Clavaporella reinae* Rácz; Khodjanyazova and Mamet, pl. 3, figs. 14-15.

**Description:** Thallus segmented, ovoid to conical. Maximum diameter 1000-1700 μ. Upper part of the segment contains the verticillated radiating pores. Such segments reach 500-700 μ. Central part subcylindrical (300-700 μ). Pore diameter 40-60 μ, increasing towards the periphery (up to 100 μ). Vestibule present.

**Stratigraphic distribution and range:** Originally reported by Rácz from the Middle Moscovian (“Calcereous Zone IV”). It has been recorded in Spain from the Las Llaceras Formation, Las Llaceras section, sample BM-72, lower Kasimovian (Krevaikanian). Belongs to the *Orthriosiphonoides* flora (Mamet, 1992).

**Genus Donezella** Maslov 1929

*Donezella lutugini* Maslov 1929

Fig. 10 j

To the 24 references cited by Mamet et al. (1987), add the following:
1980 (*non* *Donezella lutugini* Maslov; Buchroithner et al., 25, pl. 2/5, pl. 5/7-9.
1983 *Donezella lunaensis* Rácz; Berchenko, pl. 85, fig. 13.
1983 (*non* *Donezella lutugini* Maslov; Berchenko, pl. 86, figs. 1-4.
1985 *Donezella lunaensis* Maslov; Eichmüller, pl. 9/9, pl. 14/1.
1985 *Donezella lutugini* Maslov; Skipp et al., pl. 7, figs. 1, 6.
1986 *Donezella lutugini* Maslov; Groves, 484, figs. 66/11-13.
1991 *Donezella lutugini* Maslov; Riding, pl. 2, fig. 1.
1992 (*non* *Donezella cf. lutugini* Maslov; Vachard and Berkhli, pl. 4, fig. 18.
1993 *Donezella lutugini* Maslov; Chuvashov et al., pl. 12, figs. 1-2.
1995 *Donezella lutugini* Maslov; Pajic and Filipovic, pl. 45, fig. 4.

1995 *Donezella lunaensis* Rácz; Pajic and Filipovic, pl. 32, fig. 11, pl. 46, figs. 1-3.
1996 *Donezella lutugini* Maslov; Proust et al., pl. 1, fig. 1; pl. 2, figs. 1-8.
1996 *Donezella lunaensis* Rácz; Proust et al., pl. 1, fig. 4; pl. 3, fig. 1-6.
1996 *Donezella sp.;* Proust et al., pl. 3, figs. 7-9.
1996 *Donezella lutugini* Maslov; Vachard and Maslo, pl. 2, fig. 7.
1996 *Donezella lunaensis* Rácz; Vachard and Maslo, pl. 2, figs. 8-9.
1996 *Donezella lutugini* Maslov; Sebbar and Mamet, pl. 2, figs. 3, 6.
1997 *Donezella sp.;* Harris et al., fig. 9/3.
1997 *Donezella lutugini* Maslov; Harris et al., fig. 9/1, 4.
2000 *Donezella lutugini* Maslov; Mamet and Stemmerik, figs. 5/C, D, E.
2001 *Beresella* sp.; Minwegen, pl. 7, figs. 3-4.
2002 *Donezella sp.;* Della Porta et al., fig. 3/A, C, E; pl. 26, fig. 5, 6.
2002 *Donezella lutugini* Maslov; Mamet, pl. 1, fig. 5.
2003 *Donezella sp.;* Della Porta, fig. 3.4 K; fig. 4.4 K; fig. 4.5 A, D; pl. 4.1, fig. 5; pl. 5.6, fig. 1; pl. 5.7, fig. 3; pl. 6.1, figs. 1, 5-7; pl. 6.2, figs. 6-9, 11; pl. 6.3, figs. 2-7.
2003 *Donezella lutugini* Maslov; Khodjanyazova and Mamet, pl. 2, fig. 16.

**Description:** Thallus erect, a highly branching tuft. Considerable dimension variations depending on the position of the thin-section cut. External diameter ranges from 65 to 260 μ and can reach 450 μ. Perforated cortex, 12-60 μ. Pores usually micritized forming irregular “dark bands”. Thin external mucilagineous coating, now transformed in cement. Spacing of the pseudo-partitions proportional to the external diameter.

**Stratigraphic distribution and range:** While beresselids are considered green algae forming bafflestones, the taxonomic position of their “cousin” *Donezella*, in spite of the same pore morphology, is still controversial (see Della Porta et al., 2002). A common cosmopolitan taxon (Mamet, 1992) from the Bashkirian to the end of the Carboniferous. This paper records an occurrence of *Donezella lutugini* in the upper part of the Picos de Europa Formation at Las Llaceras section, sample BM-28, uppermost Moscovian, closely below the Moscovian/Kasimovian transition beds.

**Genus Dvinella** Khvorova 1949

*Dvinella comata* Khvorova 1949

Fig. 8 q

To the 20 references of Granier and Grgasovic (2000: 50), add: 2000 *Dvinella comata* Mamet and Stemmerik, pl. 6, K-L.

**Description:** Strongly calcified beresselid alga. External diameter 200-250 μ. Thickness of cortex 50-75 μ. Pores numerous, forming a triangular “dark band”. Spacing of these bands rather uniform.
Stratigraphic distribution and range: Same as Beresella. The two genera are usually associated in meadows and bioconstructions.

Genus *Epimastopora* Pia 1922 emend. Roux 1979

*Epimastopora symetrica* (Johnson 1951)  
Fig. 8 p

To the 24 references of Granier and Grgasovic (2000), add:

1991 *Epimastopora symetrica* (Johnson); Riding, 381, pl. 3, figs. n-o.
2001 *Globuliferoporella piai* (Kordé 1951) n. comb.; Vachard and Krainer, pl. 3, fig. 8.

Description: An important plurimillimetric *Epimastopora* but fragile and usually encountered in small fragments. Cortex, 150-300 µm. Pores, double-gourd shaped, 75-150 µm in diameter.

Stratigraphic distribution and range: Cosmopolitan, known from the Middle Carboniferous to the Early Permian. This paper records an occurrence from the upper member of the Puen-tellés Formation at the Berodia-II section, sample BM-123, lower Gzhelian.

Genus *Gyroporella* (Gümbel 1872) Benecke 1876

*Gyroporella dissecta* Chuvashov 1974  
Fig. 8 n

1974 *Gyroporella dissecta* Chuvashov, OD; 29, pl. 15, figs. 1-6.
1979 *Gyroporella dissecta* Chuvashov; Zadorodnjuk, pl. 2, fig. 2.
1982 *Gyroporella dissecta* Chuvashov; Mu, 226, pl. 6, figs. 7-10.
1993 *Gyroporella dissecta* Chuvashov; Chuvashov et al., pl. 14, figs. 15-17.
2000 *Gyroporella dissecta* Chuvashov; Granier and Grgasovic, 72.
2001 *Gyroporella dissecta* Chuvashov; Vachard and Krainer, pl. 5, fig. 4.

Description: Elongated club-shaped thallus and similarly shaped medula (175-250 µm). Diameter rather small compared to other representatives of the genus. Pores aspondyl, vesiculiferous, 75-150 µm at the base of the cortex and twice as large at the surface.

Stratigraphic distribution and range: The species is reported from the Upper Carboniferous to the Early Permian. Our Spanish material comes from the uppermost part of the Picos de Europa Formation at the Las Llacerias section, sample BM-46, lower Gzhelian.

Genus *Herakella* Kochansky-Devidé 1970

*Herakella paradoxa* Kochansky-Devidé 1970  
Fig. 11 a, b

1970 *Herakella paradoxa* Kochansky-Devidé, OD; 22-25, pl. 5, fig. 1; pl. 12, figs. 5-9; pl. 13, figs. 1-11; pl. 14, figs. 1-13; pl. 15, fig. 11-2.
1982 *Herakella paradoxa* Kochansky-Devidé; Milanovic, 23, pl. 10, fig. 5.
1988 *Herakella paradoxa* Kochansky-Devidé; Deloffre, pl. 6, fig. 13.
1990 (?) *Herakella paradoxa* Kochansky-Devidé; Bogush et al., pl. 14, fig. 1.
2000 *Herakella* sp.; Forke and Samankassou, pl. 33, figs. 1-6.
2001 *Herakella paradoxa* Kochansky-Devidé; Vachard and Krainer, pl. 5, fig. 1.
2003 *Herakella paradoxa* Kochansky-Devidé; Khodjanyazova and Mamet, pl. 3, figs. 25-27.

**Description:** Cortex cylindrical, segmented. Crescentic segments. Diameter, 1000-2000 μm. Medula continuous, cylindrical. Diameter 300-800 μm, average 500 μm. Five to ten metastromatopore pores in bundles perforating the cortex at an angle of 20°-40°.

**Stratigraphic distribution and range:** The taxon is reported in the Paleotethys from the Late Moscovian to the Kasimovian. Our Spanish material comes from the upper part of the Picos de Europa Formation at the Las Llacerias section, sample BM-12, upper Moscovian (Myachkovian). A probable *Macroporella* kuramotoi (Nakamura) is usually connected to Permian shallow water carbonates, although Nakamura described *Hikorocodium* kuramotoi from the Carboniferous of Japan (Yowora). In Spain this taxon is observed in the upper part of the Picos de Europa Formation, Las Llacerias section, sample BM-12, upper Moscovian (Myachkovian).

**Genus Hikorocodium** Endo 1951

*Hikorocodium kuramotoi* Nakamura 1994

**Description:** Thallus nodular, around 2 mm in all specimens. Pith-like central cavity surrounded by a micritized cortex perforated by numerous anastomosed constricted tubes. Tubes thin, 20 μm at departure from central cavity and thicker towards the periphery.

**Stratigraphic distribution and range:** The *Hikorocodium* flora is usually connected to Permian shallow water carbonates, although Nakamura described *Hikorocodium* kuramotoi from the Carboniferous of Japan (Yowora). In Spain this taxon is observed in the upper part of the Picos de Europa Formation, Las Llacerias section, sample BM-12, upper Moscovian (Myachkovian). A probable *Hikorocodium (Hikorocodium?*) sp. is illustrated in Fig. 11 g: the latter comes from a Khamovnian bed of the Las Llacerias Formation, sample BM-74B.

**Genus Macroporella** Pia 1912

*Macroporella ginkeli* Rácz 1966a

**Description:** Thallus cylindrical with a diameter ranging from 1.5 to 2 mm. Important (50-60 % of the thallus) unsegmented medula. Slightly inclined (15 °) branches without ramifications and with a progressive diameter increase towards the outer part of the cortex.

**Stratigraphic distribution and range:** Originally reported from the Moscovian. Known range in the Paleotethys: Moscovian-Kasimovian. Observed in the top of the Picos de Europa Formation sample BM-63 (lower Kasimovian), Las Llacerias section.

**Genus Palaeoberesella** Mamet and Roux 1974

*Palaeoberesella lahuseni* (von Möller 1879)

**Fig. 8 h**

1879 *Nodosinella lahuseni* von Möller, OD; 75, pl. 5, figs. 6a-b, 7.
1948 *Nodosinella lahuseni* von Möller; Rauzer-Chernoussova, figs. 4-9.
1972 *Kamaena lahuseni* (von Möller); Mamet and Rudloff, 87, pl. 5, figs. 13-14.
1973 *Anthracoporellopsis* sp.; Ivanova, pl. 10, fig. 2.
1974 *Palaeoberesella lahuseni* (von Möller); Mamet and Roux, 144, 148, pl. 2, figs. 20-28; pl. 3, figs. 1-29; pl. 4, figs. 1-17.
1975 *Nodosinella? scalaris* Malakhova, OD; 85-86, pl. 9, fig. 5-11.
1976 *Palaeoberesella lahuseni* (von Möller); Mamet, pl. 6, fig. 2; pl. 56, fig. 3; pl. 59, fig. 3.
1978 *Palaeoberesella lahuseni* (von Möller); Jansa et al., 1434, pl. 1, figs. 15, 18.
1979 *Palaeoberesella (sic); Radionova, pl. 1, fig. 7.
1979 *Palaeoberesella lahuseni (sic) (von Möller); Radionova, pl. 1, figs. 8-10.
1981 *Palaeoberesella lahuseni* (von Möller); Mamet and Martínez, pl. 2, fig. 1.
1981 *Palaeoberesella lahuseni* (von Möller); Vachard, 312-314, pl. 13, fig. 2.
1983 *Palaeoberesella lahuseni* (von Möller); Cnudde and Mamet, pl. 1, fig. 5.
1986 *Palaeoberesella lahuseni* (von Möller); Mamet et al., 30, pl. 12, fig. 9.
1987 *Palaeoberesella lahuseni* (von Möller); Shuysky, pl. 16, fig. 9.
1988 *Palaeoberesella lahuseni* (von Möller); Flügel and Kahler, 144, pl. 20, fig. 1.
1988 *Palaeoberesella lahuseni* (von Möller); Ivanova and Bogush, pl. 7, figs. 2-4.
1990 *Palaeoberesella lahuseni* (von Möller); Bogush et al., 96-97, pl. 8, figs. 6-11.
1990 *Palaeoberesella scalaris* (Malakhova); Bogush et al., OD; p. 97, pl. 8, fig. 12.
1991a *Palaeoberesella lahuseni* (von Möller); Vachard, pl. 5, fig. 2.
1992 *Palaeoberesella lahuseni* (von Möller); Mamet and Práat, pl. 1, fig. 14.
1993 *Palaeoberesella lahuseni* (von Möller); Chuvashov et al., pl. 10, fig. 6.
1994 *Palaeoberesella lahuseni* (von Möller); Vachard and Clement, 306, pl. 2, fig. 5; pl. 3, fig. 4.
1995 *Palaeoberesella lahuseni* (von Möller); Sanchez-Chico et al., 74, pl. 1, fig. 11; pl. 2, fig. 11.
1996  Palaeoberesella lahuseni (von Möller); Sebbar and Mamet, pl. 2, fig. 7.

1999  Palaeoberesella lahuseni (von Möller); Mamet et al., pl. 4, figs. 3-4.

Description: Subcylindrical, long muff, straight or slightly curved. Diameter of calcified cortex, 100-200 μm. Medula composed of a succession of irregular cells (up to 25-30 μm), subcircular to subquadratic. Pores simple, thin, straight.

Stratigraphic distribution and range: Cosmopolitan (Mamet, 1992). Rare in mid-Devonian, then extremely abundant in Visean-Serpukhovian where it forms bafflestones in lagoonal environment. Peters out in Late Carboniferous, where it is replaced by the beresellids. This paper reports its occurrence in sample P-21 (upper Myachkovian), Corisa Formation, Sierra Corisa locality, northern Palencia.

Genus Pelayella n. gen.

Type species: Pelayella multiporosa n. gen., n. sp.

Origin of name: For the name of the first Asturian king (Pelayo) who received his crown at Covadonga.

Diagnosis: A club-shaped, regular, aspondyl Salpingoporellinae. Thin pores divided in tufts.

Description: Thallus sinuous, cylindrical, unconstricted. Medula continuous, cylindrical. Cortex important, perforated by a multitude of arched aspondyl pores, with slight oblique insertion. Pores enlarge slowly, then divide in a tuft of 5-6 branches.

Comparison: By its morphology, Pelayella is similar to Anatolipora and belongs to the same tribe (Salpingoporellinae). It differs from the latter by the nature of the pore dichotomy.

Stratigraphic distribution and range: Known from the Kasimovian of the Las Llacerias Formation (sample BM-72), Las Llacerias section (vicinity of Covadonga), where it is associated with a very rich flora of Anthracoporella variabilis, A. vicina, Archaeolithiphyllum delicatum, A. johnsoni, Claracrusta, Cuneiphycus, Epimastopora symetrica, Ivanovia tenuissima, Penella pongaensis, Tubiphytes obscura and Zaporella cantabriensis.

Pelayella multiporosa n. gen., n. sp.

Fig. 11 d

Origin of name: From the multiple pores.

Holotype: Figure 11 d. Repository number U. of M. 728/2

Diagnosis: See the genus.

Description: Thallus cylindrical, club-shaped, sinuous, with a diameter of 900-1000 μm. Medula continuous, 270-300 μm. Cortex, 300-350 μm. There are 21-24 aspondyl pores per linear millimeter. Pores are very thin, 3-5 μm, with oblique insertion. They enlarge progressively up to two-thirds of their length, then form a tuft of 5-6 (3-5 μm) branches. Due to heavy micritization, the tufts are dissolved and form an epidermic cone that reaches up to 30 μm in diameter.

Stratigraphic distribution and range: See the genus.

Genus Pseudovelebitella Mamet and Roux 1978

Pseudovelebitella simplex (Kochansky-Devidé 1964b) Mamet and Roux 1978

Fig. 8 i-j

1964b Velebitella simplex Kochansky-Devidé, OD; 136-137, pl. 1, fig. 1, a-h; pl. 2, fig. 1-9.

1964a Velebitella simplex Kochansky-Devidé, 188, pl. 19, fig. 1.

1977 Velebitella sp.; Vachard in Termier et al., 15, pl. 2, fig. 7.

1978 Pseudovelebitella simplex (Kochansky-Devidé); Mamet and Roux, 75.

1985 Velebitella simplex Kochansky-Devidé; Vachard, 273, pl. 2, figs. 5-7.

1988 Pseudovelebitella simplex (Kochansky-Devidé); Deloffre, fig. 12.

2000 Pseudovelebitella simplex (Kochansky-Devidé); Granier and Grgasovic, 147, figs. 24-25 (reproduction of part of Kochansky’s material).

2003 Pseudovelebitella simplex (Kochansky-Devidé); Khodjanyazova and Mamet, pl. 3, figs. 22-23.

Description: Diplopore composed of a succession of barrel-shaped articles (diameter 500-600 μm). Medula very large and poorly developed “napkin-ring” cortex. Divergent bundles of thin pores, starting from a small vestibule and concentrated in the median part of the articles.

Stratigraphic distribution and range: Belongs to the Paleotethyan flora. Moscovian to Early Permian. Quite scarce in the Asturian material; it occurs in the upper part of the Picos de Europa Formation, samples BM-14 (upper Myachkovian), and BM-46 (lowest Kreviakinian).

Genus Vermiporella Stolley 1893 sensu Pia 1927

“Vermiporella” hispanica Rácz 1966b

Fig. 11 h

1966b Vermiporella hispanica Rácz, OD.; 257, pl. 5, figs. 23-26.

Description: Thallus millimetric, tubular, irregular, sinuous, ramified. Cortex uniform, much less important than the medula (150-200 μm), perforated by simple cylindrical branches, perpendicular to the stem (20-40 μm). Interpore length, half that of the pores.

Note: Vermiporella is an Early Paleozoic Dasyporellaeae, abundant in Ordovician-Silurian, that peters out in the Devonian. Its
presence in the Carboniferous is debatable and the Cantabrian material ought to be transferred to a new genus.

**Stratigraphic distribution and range:** Rácz reports *hispanica* from the Late Moscovian. It is also present in the Kasimovian. Our material comes from sample BM-101, upper member of the Puentellés Formation, lower Gzhelian, Berodia-I section.

Genus *Uraloporella* Kordé 1950

*Uraloporella variabilis* Kordé 1950 *emend.* Mamet and Villa 1995

For taxonomy, refer to the 23 references in Granier and Grgasovic (2000: 160-161), and add:

1980 *Uraloporella variabilis* Kordé; Mamet and Stemmerik, fig. 4, A-I.

1981 *Uraloporella variabilis* Kordé; Minwegen, pl. 4, fig. 1 (pars), 6-7.

1981 *Uraloporella sp.;* Minwegen, pl. 6, fig. 8 (pars), pl. 15, fig. 4.

1983 *Uraloporella sp.;* Della Porta, fig. 3.5. A (pars).

1983 *Uraloporella variabilis* Kordé; Khodjanyazova and Mamet, pl. 2, fig. 19.

**Description:** Long, unsegmented, cylindrical thallus with an external diameter ranging from 150 to 600 μm. Internal cavity unsegmented. Cortex perforated by “innumerable” micrometric pores (up to one hundred in a single axial section!) The species has been emended from the upper Moscovian (Podolian) of La Huelga beach section, Asturias, where it forms extensive boundstones.

**Stratigraphic distribution and range:** Reported from the Middle Carboniferous in the Paleotethyan and Arctic realms. Very abundant in the Moscovian, usually associated with beresellids. Similar distribution in Spain. Present material comes from the upper part of the Picos de Europa Formation, sample BM-19 (upper Moscovian, upper Myachkovian), Las Llacerias section.

Genus *Zaporella* Rácz 1966a

*Zaporella cantabriensis* Rácz 1966a

1966a *Zaporella cantabriensis* Rácz, OD: 102-103, pl. 1, figs. 4-7.

1985 *Zaporella cantabriensis* Rácz; Eichmüller, pl. 14, fig. 8.

**Description:** Thallus grossly cylindrical, unbranched. Diameter millimetric (1.5-5 mm). Cortex thick, medula reduced. Pores simple, undivided, 50 μm in diameter. Interpores of similar magnitude.

**Comparison:** Our material has fewer and thicker pores than the microfossils illustrated by Rácz and Eichmüller. Note: Granier and Grgasovic (2000) indicate 1964 as the valid date of the genus. The correct date appears to be 1966, when the formal description “became available”.

**Stratigraphic distribution and range:** Quite rare. Previously reported from the Moscovian. Observed in our material from the upper part of the Picos de Europa Formation (sample BM-11, upper Moscovian, Myachkovian) and Las Llacerias Formation (sample BM-72, lower Kasimovian, top of Krevyakinian) at Las Llacerias section.

**PHYLLUM CHLOROPHYCOPHYTA?** Papenfuss 1946

**or RHODOPHYCOPHYTA?** Papenfuss 1946

Genus *Eugonophyllum* Konishi and Wray 1961

*Eugonophyllum johnsoni* Konishi and Wray 1961

1961 *Eugonophyllum johnsoni* Konishi and Wray; Vachard et al., pl. 1, fig. 1.

1964 *Eugonophyllum johnsoni* Konishi and Wray; Nakamura, 35, pl. 18, figs. 10-12.

1993 *Eugonophyllum johnsoni* Konishi and Wray; Fajic and Filipovic, pl. 50, figs. 8-9.

2001 Phylloid algae (pars); Minwegen, pl. 1, fig. 6.

2003 *Eugonophyllum johnsoni* Konishi and Wray; Khodjanyazova and Mamet, pl. 4, fig. 10.

**Description:** Plurimillimetric to pluricentimetric phylloid blade. Thickness 500-1500 μm. External cortex thin, 30-50 μm. Internal cortex 30-100 μm. Utricles 20-60 μm.

**Stratigraphic distribution and range:** Cosmopolitan. Total range Moscovian to Mid-Permian (same as *Ivanovia*). In NW Spain, Moscovian and earliest Kasimovian where it proliferates and forms boundstones. Recorded in the Las Llacerias section from the Picos de Europa Formation (sample BM-12, upper Myachkovian, and sample BM-46, lower Kasimovian, top of Krevyakinian). It has been also recorded from the Corisa Formation in Sierra Corisa locality, northern Palencia (sample P-21, upper Myachkovian).

*Eugonophyllum mulderi* Rácz 1966a

1966a *Eugonophyllum mulderi* Rácz, OD: 106, pl. 12, figs. 1-4.

1970 *Eugonophyllum mulderi* Rácz; Kochansky-Devidé, 10-11, pl. 2, fig. 1.

1978 *Eugonophyllum mulderi* Rácz; Kulik, 185-186, pl. 1, figs. 4-5.

1980 *Eugonophyllum mulderi* Rácz; Flügel and Flügel-Kahler, 120, pl. 1, fig. 8.
1997. Known from the western part of the Paleotethyan Realm. Late Moscovian for Rácz. Extended to the Kasimovian by Kochansky-Devidé and to the Asselian by Khodjanyazova and Mamet. Forms phylloid algae mounds in the Cantabrian Mts. and in Yugoslavia. Present material has been collected from the lowest Kasimovian of the Las Llaceras section (sample BM-47) and Las Llaceras Formation (sample BM-276, Demués Formation), and the lower Gzhelian of Berodia-I section (sample BM-105, upper member of the Puente llé Formations). 

Genus Ivanovia Khvorova 1946

Ivanovia tenuissima Khvorova 1946

Fig. 12 a, j-n

To the 8 references in Mamet et al. 1987, 19-20, add:
1991 Ivanovia tenuissima Khvorova; Riding, pl. 3, fig. f.
1995 Ivanovia tenuissima Khvorova; Pajic and Filipovic, pl. 47, figs. 6-7.
1995 Ivanovia tenuissima Khvorova; Forke, 240, pl. 20, figs. 1-4.
1996 Ivanovia tenuissima Khvorova; Mamet, pl. 1, fig. 8.
2000 Ivanovia tenuissima Khvorova; Mamet and Stemmerik, fig. 9A.
2003 Ivanovia tenuissima Khvorova; Khodjanyazova and Mamet, pl. 4, fig. 9.

Description: Plurimillimetric to pluricentimetric phylloid blade. Thickness 500 to 1500 m. Cortical zone reduced to 100 m. Angular utricles perpendicular to cortex (15-30 m). Note: For a detailed discussion on Ivanovia, refer to Torres (1997).

Stratigraphic distribution and range: Originally created from the Upper Carboniferous of the Moscow Basin. Probable range, Moscovian to mid Permian (Artinskian or younger). In NW Spain, abundant in the Kasimovian and forms mounds associated with Tubiphytes. Present material was collected at Las Llaceras section from the uppermost part of the Picos de Europa Formation (sample BM-47) and Las Llaceras Formation (samples BM-69, BM-70, BM-72), lower Kasimovian (Krevya-kinian).

PHYLLUM RHODOPHYCOPHYTA Papenfuss 1946

Genus Four Stonella Cummings 1955

Four Stonella fusiformis (Brady 1876)

Fig. 14 e

1876 Stachea fusiformis Brady, OD; 114, pl. 8, figs. 12-16.

1955 Four Stonella fusiformis (Brady 1876); Cummings, 7, figs. 4, 5, F-G.
1956 Stachea fusiformis Brady; Braznikhova, 50, pl. 2, fig. 9; pl. 10, fig. 9.
1964 Four Stonella fusiformis (Brady 1876); Loeblich and Tappan, C331, fig. 246.
1967 Four Stonella fusiformis (Brady 1876); Eickhoff, 37-38, pl. 3, fig. 5; pl. 4, figs. 6-8.
1977 Four Stonella fusiformis (Brady 1876); Perret and Vachard, 114, pl. 5, fig. 3.
1977 Four Stonella fusiformis (Brady 1876); Mamet and Roux, 222-223, pl. 2, fig. 4.
1978 Four Stonella fusiformis (Brady 1876); Jansa et al., 1436, pl. 1, fig. 21.
1986 Four Stonella fusiformis (Brady 1876); Skompski, pl. 15, figs. 1-5.
1988 Four Stonella fusiformis (Brady 1876); Ivanova and Bogush, pl. 18, fig. 14.
1989 Four Stonella fusiformis (Brady 1876); Skompski et al., pl. 2, fig. 3.
1990 Four Stonella fusiformis (Brady 1876); Bogush et al., 126-127, pl. 26, fig. 8-9; pl. 27, figs. 1-2.
1995 Four Stonella fusiformis (Brady 1876); Sanchez-Chico et al., 76, pl. 3, figs. 10-11; pl. 4, figs. 9-10.
1996 Four Stonella fusiformis (Brady 1876); Mamet, pl. 3, fig. 1.

Description: Thallus fusiform, with a regular addition of curvilinear rows that overlap each other. The alga is attached to a central support, usually a (now) dissolved phaeophyte or a sponge megasclere. Overall diameter 400-600 m. Thickness of interlaminae 10 m. Height of rows, 20-25 m.

Stratigraphic distribution and range: A widespread and long ranging species observed from the Visean to the Early Permian. Our illustrated Spanish material is from the Kasimovian.

Genus Four Stonella? Cummings 1955 or Cuneiphycus? Johnson 1960 or Efluegelia? (Vachard in Massa and Vachard 1979) Ramovš and Kochansky-Devidé 1981 nom. corr.

Four Stonella? johnsoni (Flügel 1966)

Fig. 14 f

1966 Cuneiphycus johnsoni Flügel, OD; 17-19, pl. 2, figs. 1-5.
1969 Cuneiphycus sp. cf. C. johnsoni Flügel; Toomey, 1318, pl. 151, figs. 3-4.
1972 Cuneiphycus johnsoni Flügel; Homann, 165-169, pl. 2, fig. 12.
1974 Cuneiphycus johnsoni Flügel; Chuvashov, 32, pl. 21, figs. 1-8.
1977 Cuneiphycus johnsoni Flügel; Mamet and Roux, 238, pl. 9, figs. 8-11.
1978 Cuneiphycus johnsoni Flügel; Mamet and Roux, 83, pl. 7, figs. 11-12.
than vertical partitions (5 µm). Khodjanyazova and Mamet (2001a) suggested a con- striction between four of them. It has been collected from the upper part of the Las Llacerias Formation (sample BM-77B, upper Khamovnikian) at Las Llacerias section.

**Genus Archaeolithophyllum** Johnson 1956

**Archaeolithophyllum johnsoni** Rácz 1966a

**Description:** Thallus branching, 500-800 µm thick, with poor development of small regular perithallic cells (10-15 µm). Polygonal hypothallic cells, 60-80 µm in length.

**Stratigraphic distribution and range:** Bashkirian-Moscovian of Spain and Algerian Sahara. Extends probably up to lower Gzhelian in the Picos de Europa area of Spain (samples BM-72, Las Llacerias section, and BM-257, Ingouzno).

**Archaeolithophyllum delicatum** Johnson 1956 (nom. corr.)

**Description:** Thallus slender (300-400 µm thick), arched, branching. Rather small peri- and hypothallic cells, poorly differentiated (respectively 10-15 and 15-40 µm).

**Stratigraphic distribution and range:** Reported from the Late Carboniferous and Late Pennsylvanian of the Carnic Alps and American Midcontinent. Observed in Spain in the Las Llacerias Formation (sample BM-72, Khamovnikian) at Las Llacerias section, in the Demués Formation (sample BM-281, Khamovnikian) at the Demués section, and in the Puenteolí Formation (sample BM-128, lower Gzhelian?) at Berodia-II section.

**Remark:** Vachard et al. (2001a) have suggested a continuum between Archaeolithophyllum and the Anchicodiaceae. Such transition is not substantiated by the study of our material.

**Genus Kasimophyllum** n. gen.

**Type species:** Kasimophyllum demuesensis n.gen., n.sp.

**Origin of name:** From the Kasimovian succession, from which the type is derived.

**Diagnosis:** Crustose Archaeolithophyllumacea Chuvashov, 1987, composed of irregular bundles of hypothallic cells.
Figure 5.  

**a**, Idealized drawing of the type of *Kasimophyllum demuesensis* n. gen., n. sp. Order of magnitude of the thallus diameter: 1 mm. **b**, Compare with an idealized section of *Archaeolithophyllum*. Order of magnitude of the thallus diameter: 900 µm.

**Description**: Crustose interwoven sheets or bundles of differentiated angular cells. Hypothallus composed of large, polygonal cells with no apparent growth patterns and of angular, irregular smaller cells. Perithallic cells as rows of very small, thin, subquadratic cells. Conceptacles not observed. See idealized section at figure 5 a and compare with *Archaeolithophyllum*, figure 5 b.

**Comparison**: Figure 5 a-b permit comparison of *Kasimophyllum* with its "cousin" *Archaeolithophyllum*. The latter has a regular coaxial hypothallus and the hexagonal cells are disposed in somewhat regular convex rows. In *Kasimophyllum*, the sheets of radiating bundles of cells are irregular and have no consistent growth habit. Two types of hypothallic cells are present, one very coarse angular and the other smaller and irregular. The perithallic cells are well developed and disposed in regular rows. It is probable that *Archaeolithophyllum?* sp., described in 1966 by Flügel from the Permian of the Carnic Alps and some *Archaeolithophyllum* of Minwegen, 2001, should be transferred to *Kasimophyllum*.
Stratigraphic distribution and range: The material from which the holotype is derived is a marine Archaeolithophyllum-phylloid bafflestone with associated brachiopods, echinoderms, sponges and trilobites. There are minor amounts of bryozoans and mollusks. Foraminifers and microproblematics encountered in the level are Biseriella, Bradyina, Bradyinelloides, Climacamina, Endothyra, Endothyranella, Globivalvulina, Ozawainella, Priscella, ?Pseudotaxis, Syzrania, Tetrax. Algae and incertae sedis are Anthracoporella, Archaeolithophyllum, Eugenophyllum, Tuberitina, Tubiphytes. It has been collected from the Kasimovian (probably from Khamovnikian beds) of the Demués Formation at El Pontón section (river Cares valley, Spain). Observed in Samankassou’s material from the Carnic Alps (Auernig Group, Kasimovian-Gzhelian).

Kasimophyllum demuesensis n. gen., n. sp.
Figs. 5 a, 13 a-b
2001 Archaeolithophyllum sp.; Minwegen, pl. 13, fig. 3; pl. 14, figs. 1, 5, 7.

Origin of name: From the Demués section.

Holotype: Figure 13 b (enlarged and with different light orientation), figure 13 a, and idealized figure 5 a. Repository number: U. of M. 827/9-11.

Diagnosis: See the genus.

Description: Thallus crustose, more than a millimeter wide and 3 millimeters long. Interwoven bundles and sheets of subhexagonal cells (50-120 mµ) associated with irregular 10-40 mµ cells forming the hypothallus. Perithallial cells, well developed as rows (up to 200 mµ long) or grids of tiny, regular, quadratic cells (20-30 mµ).

Stratigraphic distribution and range: See the genus.

Genus Pseudokomia Rácz 1966a

Pseudokomia cansecoensis Rácz 1966a
Fig. 14 a-d
1966a Pseudokomia cansecoensis Rácz, OD; 90-91, pl. 9, figs. 5-6; pl. 10, figs. 1-3.
1987 Pseudokomia cansecoensis Rácz; Mamet et al., 51, pl. 25, fig. 5.
2003 Komia sp.; Della Porta, fig. 3.4, J, pl. 6.2.10.

Description: Thallus grossly cylindrical, up to one millimeter in diameter, unbranched, with strong hypo/perithallial differentiation. Perithallus composed of concentric rows of small (15-20 mµ) subquadratic cells. Hypothalline cells numerous forming filaments 15-30 mµ thick.

Stratigraphic distribution and range: This uncommon alga is known from the Moscovian of the Arctic Realm (Uraloporella flora). The same age was originally reported by Rácz and observed in our material, which comes from the upper Moscovian of the Las Llacerias section (samples BM-18, BM-19, upper part of the Picos de Europa Formation, upper Myachkovian).

Genus Stacheia Brady 1876

Stacheia marginuloides Brady 1876
Fig. 14 i

For 7 taxonomic references to the taxon, see Mamet et al. (1987: 45), and add:
1983 Stacheia marginuloides Brady; Berchenko, pl. 82, fig. 5.
1986 Stacheia marginuloides Brady; Skompski, 270, pl. 14, fig. 1.
1992 Stacheia marginuloides (pars) Brady; Vachard and Berkli, pl. 4, fig. 17 (only).
1995 Stacheia marginuloides Brady; Sanchez-Chico et al., 75, pl. 6, fig. 1.
2002 Stacheia marginuloides Brady; Mamet, pl. 6, fig. 8.

Description: Thallus fusiform, with a central axis. Succession of strongly calcified arched laminae (40-60 mµ in height). Lateral wall of cells quite thin (5-10 mµ). Cells quadratic to subquadratic in vertical section.

Stratigraphic distribution and range: Cosmopolitan and very common from Visean to Serpukhovian. Extends into the Moscovian in the Arctic Realm and is rarely observed at that level in NW Spain. Present material was collected from the upper part of the Picos de Europa Formation at Las Llacerias section (sample BM-13, upper Moscovian, Myachkovian).

Genus Ungdarella Kordé 1951

Ungdarella uralica Maslov 1956 (non 1950)
Fig. 14 j

For taxonomy, see 20 references in Mamet et al. (1987: 52), and add:
1979 (non) Ungdarella uralica Maslov; Bensaid et al., pl. 16, fig. 4.
1980 Ungdarella uralica Maslov; Buchroithner et al., 26, pl. 26, fig. 1.
1981 Ungdarella ex.gr. uralica Maslov; Vachard and Monte- nat, 65-66, pl. 11, figs. 1, 13.
1985 Ungdarella uralica Maslov; Mamet and Pinard, pl. 3, fig. 1.
1986a Ungdarella uralica Maslov; Nguyen, pl. 10, fig. 1.
1986b Ungdarella uralica Maslov; Nguyen, 138, pl. 15, figs. 7-8.
1988 Ungdarella uralica Maslov; Flügel and Kahler, 145, pl. 20, fig. 9.
1988 Ungdarella uralica Maslov; Fontaine and Suteethorn, pl. 77, fig. 8.
1989 Ungdarella ex.gr. uralica Maslov; Köylüoglu and Altiner, pl. 1, fig. 10.
1990 Ungdarella uralica Maslov; Flügel, pl. 3, fig. 5.
Description: Thallus grossly cylindrical, elongated, sometimes dichotomous. Diameter reaches one millimeter. Hypothallic single (sometimes two) row(s) of quadratic cells. They are twice the size of the surrounding cells. Multiple rows of 15-25 μm perithallic cells. Filaments at 10°-20° angle from the hypothalles. Extensive calcification makes hazardous the estimation of cell thickness.

Note: Ungdarellae are difficult to identify (Ungdarella Kordé 1951, non Maslov 1950, Komia, Pseudokomia Rác 1966, Chegatella Poncet 1989, Ungdarellina Mamet 2002 and Pecharella nom.nud.) If the genera represent genuine morphological differences, they are often obscured by diagenesis. Ungdarellids are strongly calcified, hence robust carbonate stabilizers.

Stratigraphic distribution and range: A common cosmopolitan alga (Mamet, 1992) that appears in Late Viséan and is omnipresent in Bashkirian-Moscovian boundstones. It peters out in higher horizons. Observed in Spain in the upper part of the Picos de Europa Formation (sample BM-17, upper Myachkovian) at Las Llacerias section.

Genus Ungdarellita n. gen.

Type species: Ungdarellita articulata n. gen., n. sp.

Origin of name: From the relation with Ungdarella.

Diagnosis: A segmented articulated Ungdarellaceae with regular rectangular perithallic cells.

Description: Thallus composed of a series of annular to barrel-shaped segments growing in different directions, but with an elongated pattern of growth direction (Fig. 6). Each segment composed of a central hypothallic stem and a bundle of peripheral perithallic rectangular cells with oblique insertion. See idealized reconstruction, figure 6.

Comparison: All previously described Ungdarellaceae (Ungdarella, Chegatella) have rather continuous rarely branched thalli. The new genus is articulated.

Stratigraphic distribution and range: Observed in a boundstone, Late Moscovian, Las Llacerias section. The type is derived from an Ungdarellid-beresellid-spongiostromid pellet bafflesstone associated with sponges and chains of fenestellid bryozoans. It is associated with Anchicodium, Anthracoporella, Beresella, Donezella, Eugonophyllum, Komia, Stacheia, Tubiphytes and Zaporella. Foraminifers are: Apterinellids, Bradyina, Bradyinelloides, Climacocammina, Endothyra, Eolasiodiscus, Ozawainella, Pseudobradyina, Sycrania and Tetrataxis. Studied from the upper part of the Picos de Europa Formation, sample BM-16, upper Moscovian (Myachkovian), Las Llacerias section.

Ungdarellita articulata n. gen., n. sp.

Fig. 14 g-h

Origin of name: From its articulated stem.

Holotype: Figure 14 g. Repository number: U. of M. 815/17
Figure 7.  

- **a-d.** *Anthracoporella spectabilis* Pia 1920; a, U. of M. 728/8, BM-52, x30; b, U. of M. 816/0, BM-12, x30; c, U. of M. 728/25, BM-76, x30; d, U. of M. 814/24, BM-72, x41.  
- **e.** *Anatolipora cantabriensis* n. sp., associated with *Anthracoporella spectabilis* Pia 1920; U. of M. 823/13, BM-11, x30, longitudinal section, holotype.  
- **f.** *Anthracoporella* sp. U. of M. 815/2, BM-76, x26.  
- **g.** *Macroporella ginkeli* Rácz 1966. U. of M. 728/16, BM-63, x30.  
- **h-k.** *Zaporella cantabriensis* Rácz 1966; h, U. of M. 814/9, BM-72, x62; i, U. of M. 816/4, BM-11, x62; j, U. of M. 814/7, BM-72, x62; k, U. of M. 816/9, BM-11, x62. All from the Las Llacerias section.
Diagnosis: See the genus.

Description: Thallus plurimillimetric (2mm or more) composed of 20-30 (up tp 45) barrel-shaped segments. At the base they have a diameter of 200-300 mm, for a length of 350 µm. They progressively diminish in size to reach 50-100 µm (or less) and a length of 100-180 µm. Each segment composed of a central stem with coarse hypothallic threads surrounded by a small number of perithallic cells disposed at 20° from the stem. There are 18-20 rows of rectangular cells in the basal segments and only half that number in the terminal segments. Rectangular cells are 20 µm wide and 40-60 µm long.

Stratigraphic distribution and range: See the genus.

INCERTAE SEDIS
Genus Berestovia Berchenko 1982 (non Berchenko 1983)

Berestovia filaris Berchenko 1982 (non 1983)
Fig. 14 n-o

1982 Berestovia filaris Berchenko, OD; 53-54, pl. 12, figs. 1-4.
1983 (non) Berestovia filaris Berchenko; Berchenko, 128, pl. 84, fig. 2; pl. 86, figs. 5-6; pl. 87, fig. 1.
1986 Claracrusta catenoides (Hommann); Poncet, 192, pl. 3, fig. 5.
1997 Berestovia filaris Berchenko; Harris et al., pl. 9, fig. 12.

Description: Encrusting, wavy, irregular, thread-like rows of contiguous cells. Rows about 40-60 mm thick, containing interconnected cells.

Note: There is confusion in the literature as the original description of the genus by Berchenko (1982) is different from the subsequent description of 1983 that is to be referred to Vachard’s Claracrusta 1981. Both genera have similar encrusting habits.

Stratigraphic distribution and range: Widespread, cosmopolitan (Eurasia-Arctic-North America. Serpukhovian to Kasimovian. It has been recorded in Spain from the Moscovian/Kasimovian transition at the Las Llaceras section (Picos de Europa Formation, sample BM-40), and from the lower Gzhelian at the Berodia-I section (upper member of the Puentellés Formation, sample BM-103).

Genus Claracrusta Vachard 1981

Claracrusta catenoides (Hommann 1972)
Fig. 14 k-m, Fig. 15 o

1972 Girvanella catenoides Homann, OD; 237-241, pl. 8, fig. 59 a-c.
1980 Girvanella catenoides Homann; Flügel, pl. 9, figs. 2-5.
1981 Claracrusta catenoides (Homann); Vachard, 392-393, pl. 3, fig. 1; pl. 7, fig. 5; pl. 25, fig. 17; pl. 26, figs. 1-3.
1981 Claracrusta catenoides (Homann); Vachard and Montenat, 57-58, pl. 1, fig. 1; pl. 8, figs. 8, 10-11; pl. 9, fig. 1; pl. 12, fig. 10.
1983 Berestovia filaris Berchenko; Berchenko, 128, pl. 86, figs. 5-6; pl. 87, fig. 1.
1984 Iberiaella carbonica Rácza, 338, fig. 3, a-f.
1986 (non) Claracrusta catenoides (Hommann); Poncet, 192, pl. 3, fig. 5.
1990 Claracrusta catenoides (Hommann); Flügel, pl. 1, fig. 4.
1990 (?) Claracrusta catenoides (Hommann); Bogush et al., 84, pl. 5, fig. 10.
1991 Claracrusta sp.; Legrand-Blain and Poncet, 776, pl. 2, figs. 3-4.
1992 “Osagia” - Filaments encrusting Kansaphyllum; Baars, figs. 2-4.
1993 Claracrusta catenoides (Hommann); Vachard et al., pl. 2, fig. 5.
1995 Claracrusta catenoides (Hommann)(pars); Forke, pl. 17, fig. 5; (non) pl. 15, fig. 7.
1996 Claracrusta catenoides (Hommann); Mamet, pl. 2, figs. 8-14; pl. 3, figs. 6-7.
1996 (?) Claracrusta catenoides (Hommann); Vachard and Maslo, 369, pl. 1, fig. 1?.
2001 (non) Claracrusta catenoides (Hommann); Vachard and Krainer, pl. 5, fig. 8.
2001 Iberiaella sp.; Minwegen pl. 5, fig. 5.
2003 Claracrusta catenoides (Hommann); Khodjanyazova and Mamet, pl. 5, figs. 8-9.

Description: Encrusting, thread-like rows of irregular cells, around 60-80 µm in height. Base of rows is planar, while the top is wavy. Cells reported in the literature as tubular, but they are apparently circular-subquadratic (50-60 µm). Dimensions difficult to estimate due to calcification. Wall yellowish, Fe-rich calcite.

Stratigraphic distribution and range: Claracrusta is a very common component of the Ottonosia-Osagia oncolitic structures. Apparently world-wide. Serpukhovian to Early Permian. In NW Spain, very abundant in association with Donezelia in Bashkirian-Moscovian strata. Illustrated here from the Kasimovian of Las Llaceras section (samples BM-76, BM-77B, uppermost part of the Las Llaceras Fm, upper Khamovnikian), and the Pen section (sample BM-78, Pen Limestone, Krevian-Kinian).

Genus Ellesmerella Mamet, Roux and Nassichuk 1987

Ellesmerella permica (Pia 1937)
Fig. 15 p

1937 Girvanella permica Pia, OD; 816, 820, pl. 9, fig. 1.
1963 Girvanella permica Pia; Johnson, pl. 78, fig. 3.
1963 Girvanella permica Pia; H. Flügel, 91-92, pl. 22, fig. 5
1966 Girvanella permica Pia; E. Flügel, 45-51, pl. 8, figs. 4-5.
1972 Girvanella permica Pia; Homann, 243-324, pl. 8, fig. 61; pl. 9, fig. 65
1981 Girvanella permica Pia; Vachard, 323, pl. 7, fig. 4.
1983 Girvanella permica Pia; Jenny-Deshusses, 160, pl. 16, fig. 1; pl. 24, fig. 2.
1987 Ellesmerella permica (Pia); Mamet, Roux and Nassichuk, 15-16, pl. 3, figs. 9-11.
Figure 8. a-g, *Gyroporella? prisca* Kochansky-Devidé 1970; a, U. of M. 815/19-20, BM-46, x26. b, U. of M. 810/16, as a. c, U. of M. 810/17, as a. d, U. of M. 810/8, BM-39, x41. e, U. of M. 810/13-14, as a. f, U. of M. 815/21, as a. g, U. of M. 810/7, BM-38, x26. h, *Palaeoberesella lahuseni* (von Möller 1879); U. of M. 813/17, P21-39, x62. i-j, *Pseudovelebitella simplex* (Kochanky-Devidé 1970); i, U. of M. 833/37, BM-46, x41. j, U. of M. 816/13, BM-14, x62. k, m, *Clavaporella reinae* Rácz 1966; k, U. of M. 833/12, BM-28, x62. m, U. of M. 728/17, BM-72, x30. l, Dissolved Albertaporelleae; U. of M. 814/19, BM-74, x41. n, *Gyroporella dissecta* (Chuvashov 1974); U. of M. 833/4, BM-46, x62. o, «*Pseudogyroporella* annulata» Ishizima, Ozaki and Nakamura 1971; U. of M. 728/15, BM-63, x62. p, *Epimastopora symetrica* (Johnson 1951); U. of M. 818/17, BM-123, x30. q, *Dvinella comata* Khvororova 1949; U. of M. 727/13, Las Llacerias section, BM-18, x61. All from the Las Llacerias section, except P-21 (Sierra Corisa), and BM-123 (Berodia-II section).
Genus Tubiphytes Maslov 1956

Tubiphytes obscurus Maslov 1956

Fig. 15 a, l-m

To the 29 references reported by Homann (1972) and 26 references in Senowbari-Daryan and Flügel (1993), update the list by adding:

1989 Tubiphytes obscurus Maslov; Köyliöglu and Altiner, pl. 1, fig. 12.
1989 Tubiphytes obscurus Maslov; Razgallah et al., pl. 1, fig. D.
1991 Tubiphytes obscurus Maslov (pars); Vachard and Ferrière, pl. 1, fig. 1, (non) 4.
1991 Tubiphytes obscurus Maslov (pars); Vachard and Clift, pl. 3, fig. 1-3, 6, (non) 4.
1993 Shamovella obscura (Maslov); Riding, p. 72.
1993 Tubiphytes obscurus Maslov; Chuvashov et al., pl. 14, figs. 2-5.
1993 (non) Tubiphytes obscurus Maslov; Vachard et al., pl. 3, figs. 1-2.
1993 Tubiphytes obscurus Maslov; Vachard, pl. 8, fig. 17.
1995 Tubiphytes obscurus Maslov; Forke, pl. 15, fig. 9.
1995 Tubiphytes obscurus Maslov; Pajic and Filipovic, pl. 50, fig. 10.
1996 Tubiphytes obscurus Maslov; Sano and Kanmera, pl. 59, figs. 1-2; pl. 61, fig. 1-27.
1997 Tubiphytes obscurus Maslov; Vachard and Fagerstrom, pl. 12, fig. 1.
1999 Tubiphytes obscurus Maslov; Weidlich and Fagerstrom, fig. 5, E-G, fig. 6, F, fig. 8, B-D.
2000 Tubiphytes obscurus Maslov; Mamet and Stemmerik, fig. 9, H-J.
2001 Tubiphytes obscurus Maslov; Vachard and Krainer, pl. 1, fig. 2.
2001 Tubiphytes obscurus Maslov; Vachard et al., pl. 3, figs. 2-3.
2001 Tubiphytes sp.; Minwegen, pl. 10, fig. 6; pl. 16, figs. 6-7.
2002 Tubiphytes sp.; Vennin et al., 2002, Fig. 5, E-H, Fig. 6, C.
2002 Tubiphytes sp.; Wahlman and Konovalova, fig. 7 A-B, fig. 8 A, fig. 9 B-E, fig. 11 A-D, fig. 12 A-D, fig. 13 A, C, E, fig. 14 E, fig. 15 C, fig. 16 A.
2003 Tubiphytes obscurus Maslov; Khodjanyazova and Mamet, pl. 5, fig. 10.

Description: Oncolitic encrustation, composed of subhorizontal files of continuous, unsegmented irregular tubes. Height of tubes variable, 10 to 40 m. Micritized wall, 10-20 m.

Stratigraphic distribution and range: Widespread in Eurasia-Arctic. Up to now, observed only in the Permian (see Vachard and Krainer, 2001). The Spanish material extends this range slightly lower in the Kasimovian; it has been recorded from the uppermost part of the Picos de Europa Formation at Las Llacerias section (sample BM-52, lower Kasimovian, Krevian-Kinian).

Taxonomic note: It seems appropriate to attempt to bring here some light to the origin of Tubiphytes (=Shamovella). This microproblematicum has been the subject of numerous hypothesis that are summarized in Senowbari-Daryan and Flügel, 1993. The controversial taxon is indeed abundant in Late Paleozoic time and omnipresent in Carboniferous-Permian biocostrutions. Its ultrastructure is observed (Tubiphytes obscurus!) by intense micritization.

Tubiphytes encrusts various organisms such as foraminifers, sponges, bryozoans, phaeophytes, and has been erroneously attributed to various phyla.

If our hypothesis is correct, Tubiphytes is related to encrusting red algae. This fits the known wide bathymetric distribution of this baffler-guild. Tubiphytes is abundant in the upper euphotic zone associated with bacteria, in the lower euphotic zone attached to dasycladales or to phylloids, and in the dysphotic zone with Archaeolithoporella. It reaches the dysphotic/apophytic boundary, as could be anticipated from a rhodophyte.

Stratigraphic distribution and range: An important cosmopolitan microproblematic often associated in mounds with Archaeolithoporella and epimastoporids (Razgallah and Vachard, 1991). Abundant from the Moscovian to the Late Permian. Our Asturian illustrated material comes from the upper part of the Las Llacerias Formation at Las Llacerias section (sample BM-76B, Kasimovian, upper Khamovnian) and the upper member of the Puentellés Formation at Berodia-II section (sample BM-122, probably lower Gzhelian).
Figure 9. a-f. *Beressella herminae* Rácz 1966; a, U. of M. 809/12, BM-16, x78, with normal «dark bands» and «egg-shaped white bands»; b, U. of M. 809/9, as a, but x97; c, U. of M. 809/10, as a, with abnormally curved «egg-shaped white bands»; d, U. of M. 809/13, as a, with thallus dichotomy; e, U. of M. 809/1, as a, with «egg-shaped white bands»; f, U. of M. 809/7, BM-12, x97, with remnants of parietal conceptacles inside the medulla. g-j. *Anthracoporella vicina* Kochansky and Herak 1960; g, U. of M. 816/16-18, BM-72, x26; h, U. of M. 728/7, BM-52, x26; an axial section of *Protriticites* sp. is present. i, U. of M. 814/12-15, as g; j, U. of M. 814/3, as g. All from the Las Llaceries section.
Genus *Penella* n. gen.

**Type species:** *Penella pongaensis* n.gen., n.sp.

**Origin of name:** From the hamlet of Pen.

**Diagnosis:** Cluster of sphaeroidal microproblematic.

**Description:** Sphere or coalescent cluster of spheres of various size. Wall micritic, imperforated.

**Discussion:** The wall of most *Penella* is usually dissolved and replaced by neomorphic cement. However, a few exceptionally well preserved walls show that it was originally densely micritic. In most cases, the original structure is destroyed and replaced by acicular cement or blocky sparite (compare figure 15 i, j, k and same figure a-h).

Although sponge spicules are often observed in association with *Penella*, they are not responsible of swarms of spheroidal microfossils. Moreover, *Penella* has a characteristic wall-structure unknown among calcareous sponges.

**Comparison:** *Penella* is somewhat similar to *Calcisphaera*, but calcispheres do not form interconnected clusters of spheres. *Penella* is also somewhat similar to the *incertae sedis* *Tuberitina* (and the *Tuberitinidae*), but does not have attachment disks. Moreover, tuberitinids form chains, while *Penella* form clusters that are random. A number of similar microproblematics that form swarms are known in the Devonian and Carboniferous. For instance *Bisphaera* Birina 1948, *Baculella* Conil and Dreesen 1985 and *Saccaminopsis* Sollas 1921 (“Saccammina-bands”, Brady, 1871). For a discussion on *Baculella-Saccaminopsis* see Poncet (1989) and Skompski (1993). The “*Bisphaera* beds” are common at the Devonian-Carboniferous transition of Russia. Similarly the Kasimovian beds of Asturias are riddled with enigmatic little spheres. They are associated with sponges (*in situ* sclerites) and algae (*Anthracoporella, Anthacoporellopsis*).

The type material of *Penella* at Pen is rich in foraminifers such as: *Apterrinellidae, Hemigordius, Pseudopalaespiroplectammina, Syzrania, Syzranella, Tetrataxis*. The microflora and *incertae sedis* *Tuberitina* are composed of *Clara-crusta, Cuneiphycus, Ivanovia, Tubiphytes and Zaporella*.

*Penella* has recently been observed in the Carnic Alps, Austria. We used the material collected by E. Samankas-sou (see 2002). It is abundant in fine-grained matrix bafflestone associated with *Anthracoporella* and sponge spicules. The genus is abundant in the Kasimovian-Gzhelian Auernig Group and in the Gzhelian lower *Pseudoschwagerina* Limestone, Rattendorf Group.

**Stratigraphic distribution and range:** Up to now, recognized from the lower Kasimovian of the Pen section (Pen limestone, samples BM-78, BM-79, BM-85), the upper Kasimovian of the Berodia-I section (Puentellés Formation, sample BM-98), and either the upper Kasimovian or the lower Gzhelian of the Inguanzo locality (sample BM-251, Puentellés Formation).

*Penella pongaensis* n. gen., n. sp.

Fig. 15 b-k

2001 Spiculitic wackestone with monoaxons sponge spicules. Minwegen, pl. 13, figs. 7-8.

**Origin of name:** From the Ponga river valley, where the locality of Pen is situated.

**Holotype:** Figure 15 j (here designated). The rest of figure 15 (b-i, k) are paratypes.

**Diagnosis:** See the genus.

**Description:** Micritic sphere of group of 2, 3, up to 8 spheres that communicate with each other by means of an interruption in the wall. Average dimensions of the spheres 90-150 µm, some reaching up to 310 µm. Wall micritic, 12-20 µm. When dissolved, it is enlarged and reaches 30 µm. No known functional aperture. No attachment disk.

**Stratigraphic distribution and age:** See the genus.

**REMARKS AND CONCLUSIONS**

This report is uncomplete as it is based on a rather limited number of sections. For instance, we have not observed in our material common algal builders that have been previously illustrated in the region (e. g. *Renalcis* illustrated by Della Porta, 2003, fig. 4.4.1, or *Petschoria*, reported by Minwegen, 2001, pl. 7, fig. 1.2). However, in spite of its limitation, it is a badly needed taxonomic update. Since the early work of Rácz, much progress has been made in suprageneric classification. But if there is much advance to be achieved, the study of Paleozoic algae remains a fascinating aspect of paleobotany.

The majority of the microflora is composed of dasycladales, observed in the form of reworked broken thalli or in growth position. Not only are they abundant and diverse, but they form intertwined bafflestones and framestones within the upper part of the euphotic zone. Donzelids and beresellids thrive in bindstones coated by *Claracrusta* and *Berestoria* but also in associated lagoons. Phylloids are fragile but can form frameworks that indicate early marine cementation and lithification (early bacterial infestation). Red algae are more resistant than their green counterparts, hence withstand higher energy in the rarefied light of deeper waters.

The flora is typically Western Paleotethyan and is similar to that of the Carnic Alps or Central Urals. The number
Figure 10. a-b, Beresella herminae Rácz 1966; a, U. of M. 815/16, BM-16, x62; b, U. of M. 809/6, BM-12, x97, with conceptacles simulating pseudo-septation; this Beresellae could be confused with a Palaeobereselleae. c-f, Anthracoporella vicina Kochansky and Herak 1960; c, U. of M. 816/1-2, as b, but x26; d, U. of M. 814/4, BM-72, x26, epidermic section; e, U. of M. 814/0bis, as d, showing pore dichotomies; f, U. of M. 816/5-6, as b, but x26. g-h, Anthracoporellopsis machaevii Maslov 1956; g, U. of M. 816/10, as f, but x30, transverse section; h, U. of M. 807/17, BM-25, x62, longitudinal section with poorly developed pseudo-septation and extensively developed pore dichotomy. i, Uraloporella variabilis Korde 1950. U. of M. 820/22, BM-19, x62, longitudinal section. j, Bafflestone of Donezella lutugini Maslov 1929. U. of M. 833/15, BM-28, x26. k, Bafflestone of Beresella herminae Rácz 1966. U. of M. 810/3, BM-31, x26. All from the Las Llacerias section.
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Figure 11. a-b, *Herakella paradoxa* Kochansky-Devidé 1970; a, U. of M. 833/13-14, BM-28, x26, longitudinal section; b, U. of M. 809/21-24, as a, oblique section. c, *Hikorocodium karamoto* Nakamura 1994. U. of M. 816/7-8, BM-12, x26, longitudinal section. d, *Pelayella multiporosa* n. gen., n. sp. U. of M. 728/22, BM-72, x30, oblique longitudinal section, holotype. e, *Anchicodium funile* Johnson 1948 sensu Torres and Baars 1992. U. of M. 833/8, as c, f, *Clavaporella reinae* Rácz 1966. U. of M. 814/5, BM-72, x41. g, *Hikorocodium?* sp. U. of M. 728/24, BM-74B, x62. h, *«Vermiparella» hispanica* Rácz 1966. U. of M. 818/3, BM-101, x26. All from the Las Llacerias section, except BM-101 (Berodia-I section).
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Figure 12. a, j-n, *Ivanovia tenuisima* Khvorova 1946; a, U. of M. 813/24, BM-72, x26. *Ivanovia* bafflestone with phylloid blades criss-crossing the sediment. Associated are bacterial pellets, a gastropod, *Tubiphytes*, *Syzyntia*, and *in situ* sponge sclerites; j, U. of M. 728/21, BM-69, x62; k, U. of M. 813/23, BM-70, x30; l, U. of M. 813/22, as k; m, U. of M. 728/18, as a, but x62; n, U. of M. 728/3, BM-47, x62.

Eugonophyllum mulderi Rácz 1966; b, U. of M. 827/14, BM-276, x26. *Eugonophyllum mulderi* bafflestone; scattered sessile foraminifers (one attached to the blade, obstructing the utricular packages), sponge sclerites, altered echinid spine; c, U. of M. 833/21-22, BM-47, x26; d, U. of M. 816/6-7, BM-105, x26; e, U. of M. 827/3, as b, but x62. f-i, *Eugonophyllum johnsoni* Konishi and Wray 1961; f, U. of M. 813/15, P-21, x30; g, U. of M. 833/18, BM-46, x30; h, U. of M. 813/12, as f; i, U. of M. 809/4, BM-12, x62. All from the Las Llacerias section, except BM-276 (Demués section), BM-105 (Berodia-I section), and P-21 (Sierra Corisa).
Figure 13. a-b, *Kasimophyllum demuesensis* n. gen., n. sp.; a, U. of M. 827/9-11, BM-277, Demués section, x62, longitudinal section, enlargement of part of the holotype, with different nicol orientation; b, Same as a, x 26, holotype. c-e, *Archaeolithophyllum johnsoni* Rácz 1966; c, U. of M. 825/3, BM-257, Inguanzo, x26, longitudinal section; d, U. of M. 725/19-20, BM-72, Las Llacerias section, x26, longitudinal section with a fragment of *Hikorocodium*?; e, U. of M. 815/23, BM-11, Las Llacerias section, x26. f-i, *Archaeolithophyllum delicatum* Johnson 1956; f, U. of M. 814/6, as d, but x30, longitudinal section; g, U. of M. 825/14, as c, but x30, showing branches; h, U. of M. 818/20-21, BM-128, Berodía-II section, x26, longitudinal section; i, U. of M. 827/18, BM-281, Demués section, x26, with the perithallic cells.
Figure 14. a-d, *Pseudokomia cansecoensis* Rácz 1966; a, U. of M. 820/17, BM-18, x62; b, U. of M. 822/18, BM-19, x26, encrusted by *Tubiphytes obscurs* Maslov 1956; c, U. of M. 822/10, as b, but x62, transverse section; d, U. of M. 822/9, as c, oblique transverse section. e, *Fourstonella fusiformis* (Brady 1876), U. of M. 814/10, BM-72, x62, oblique longitudinal section. f, «*Fourstonella*»(?) *johnsoni* (Flügel 1966) (=*Efluegelia*), U. of M. 728/29, BM-77B, x62, longitudinal section. g-h, *Ungdarellita articulata* n. gen., n. sp.; g, U. of M. 815/17, BM-16, x41, longitudinal section along growth axis, holotype; h, U. of M. 809/15, as g, but x30, oblique section, paratype; i, *Stacheia marginuloides* Brady 1876. U. of M. 809/8, BM-13, x97, longitudinal section; j, *Ungdarella uralica* Maslov 1956, U. of M. 819/10, BM-17, x30, longitudinal section. k-m, *Claracrusta catenoides* (Homann 1972); k, U. of M. 815/10, BM-78, x26; l, U. of M. 728/28, BM-77B, x62; m, U. of M. 728/26, BM-76, x62. n-o, *Berestovia filaris* (Berchenko 1982); n, U. of M. 810/10, BM-40, x62; o, U. of M. 818/4, BM-103, x62. All from the Las Llacerias section, except BM-78 (Pen section), and BM-103 (Berodia-I section).
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Figure 15. b-k, *Penella pongaensis* n. gen., n. sp.; b, U. of M. 825/2, BM-251, Ingkanzo, x41; swarms of cement filled *Penella*, sponge spicules and ostracods; c, U. of M. 825/3, same as a; budding *Penella*, microscleres, macrocysters and sessile foraminifer; d, U. of M. 816/20, BM-85, Pen section, x62; cement filled *Penella* with remnants of wall, *Anthracoporellopsis*, sponge microscleres and echinoderm plates; e, U. of M. 816/18, BM-79, Pen section, x62; f, U. of M. 816/22, as d, but x30; g, U. of M. 818/1, BM-98, Berodia-I section, x97; filled by neomorphic cement; h, U. of M. 818/2, BM-78, Pen section, x97; i, U. of M. 816/21a, as d; j, U. of M. 816/21b, as d, Holotype; k, U. of M. 816/21c, as d. a, l-m, *Tubiphytes obscurus* Maslov 1956 [= *Shamovella obscura* (Maslov 1956)]; a, U. of M. 948/15, BM-FER 147, entrance of Marble Canyon, British Columbia, Cache Creek Formation, Roadian, associated with *Codonofusiella-Kahlerina*, x121; collected with C. Ross and F. Kobayashi; l, U. of M. 814/23, BM-76B, Las Llacerias section, x26. Encrusting *Anthracoporella*; note in the tissue the presence of sponge sclerites and of an ostracod; they do not suggest that *Tubiphytes* is either a sponge or an arthropod; m, U. of M. 818/16, BM-122, Berodia-II section, x30. Note the growth surfaces. n, *Claracrusta*? sp., U. of M. 810/0, BM-28, Las Llacerias section, x26. o, *Claracrusta catenoides* (Homann 1972), U. of M. 815/8, BM-78, Pen section, x62. p, *Ellesmerella permica* (Pia 1937), U. of M. 728/4, BM-52, Las Llacerias section, x62.
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