BRACHIOPODS OF THE LOWER CARBONIFEROUS VEGAMIÁN FORMATION (CANTABRIAN MTS, SPAIN): PART I. INTRODUCTION, LINGULIFORMEA

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ABSTRACT

The history of the Tournaisian Vegamián Formation of the Cantabrian Mts (Spain) consisting of gray to black shales with a typical quiet-water ("Culm") fauna characterised by Linguliformea and small Rhynchonelliformea, is discussed. After an overview of the faunas studied thus far, an evaluation of the age of the Vegamián Formation is given, concluding to the Tournaisian, mainly middle to late Tournaisian. Also, the environment of deposition is discussed.

The linguliform fauna, discussed in this first part, is found mainly in the black, thinly bedded shales. Species of the genera "Lingula", Lachrymyla and Orbiculoidea are described, including the new species Lachrymyla truyolsi. The new subfamily Lachrymylinae of the Lingulidae is created for the genera Lachrymyla and Trigonoglossa. It is distinguished from the Lingulinae by a relatively thick, subtriangular shell with a distinct pedicle groove and a rugose ornamentation.

The rhynchonelliform fauna, occurring mostly in more thickly bedded, often decalcified grayish layers, will be dealt with in a subsequent paper.

Keywords: Brachiopods, Linguliformea, Lower Carboniferous, Vegamián Formation, Cantabrian Mountains, Spain.

RESUMEN

La Formación Vegamián está constituida fundamentalmente por lutitas grises a negras y contiene una fauna típica de aguas tranquilas ("Culm"), caracterizada por Linguliformea y pequeños Rhynchonelliformea. En el presente trabajo se discute la historia de la formación, toda la fauna estudiada hasta el momento, la edad atribuida a la formación (concluyendo que es Tournesien, principalmente Tournesiense medio-superior) y el ambiente de depósito. Por lo que se refiere a los braquiópodos, el trabajo se ocupa del estudio de los Linguliformea, procedentes, en su mayor parte, de lutitas negras en capas delgadas. Se describen especies de los géneros "Lingula", Lachrymyla y Orbiculoidea, incluyendo la nueva especie Lachrymyla truyolsi. Se crea la nueva subfamilia Lachrymylinae, dentro de los Lingulidae, en la que se incluyen los géneros Lachrymyla y Trigonoglossa. La nueva subfamilia se distingue de las Lingulinae por la posesión de una concha relativamente espesa, subtriangular, con desarrollo de un surco peduncular y ornamentación rugosa.

Los Rhynchonelliformea se encuentran generalmente en capas más gruesas, grisáceas y descalcificadas; su estudio será objeto de un trabajo posterior.

Palabras clave: Braquiopodos, Linguliformea, Carbonífero Inferior, Formación Vegamián, Cordillera Cantábrica, España.

INTRODUCTION

VEGAMIÁN FORMATION

The black and grayish to cream-coloured shales of the Vegamián Formation lie, presumably with a slight disconformity, on the Ermita Formation. Deposition of the latter started at the end of the Devonian after a period of uplift resulting in a hiatus of varying length and lies therefore on formations which can be as old as Cambrian or as young as the Late Devonian. The sandstones are of varying composition, depending on the formation they
are derived from, and they may be substituted by (bio)clastic limestones. The top part of the Ermita Formation may reach the Lower Tournaisian.

The Vegamían Formation was first described from the Cantabrian Mountains by Comte (1959, p. 330) as the "couches de Vegamían", although the black shales below the griotte limestones and shales (referred to as "marbre griotte", Alba Formation, or Genicera Formation) have often been mentioned in the older literature (e.g. Barrois, 1882). The type locality S of Vegamían has since been flooded by the Porma Reservoir and Evers (1967, p. 104, fig. 18) described a new type section higher up the mountain. Wagner et al. (1971, p. 624-625) consider this a hypostratotype and interpret it differently, drawing the base of the Genicera Formation considerably lower, i.e. at the base of the brachiopod-bearing red and black shales with limestone nodules. A good section, rich in fossils, is found immediately below the Genicera Formation at its type section, c. 2 km SW of Genicera, León. This locality was completely exposed, measured and sampled by Dr R.H. Wagner and his collaborators (see Wagner, 1963; Higgins et al., 1964).

The combination of the black shales and griotte limestones and shales into one Sella Formation by Brouwer and van Ginkel (1964) was later abandoned (van Ginkel, 1965, p. 182). Also, the rather confusing usage of the Sella Formation for the top part of the Alba Formation and the combination of the Vegamían Formation with the lower part of the Alba Formation, consisting of greenish and red-coloured shales, marls and clastics, into a single Getino Formation (Rácz, 1964) was not followed. Van Staalduinen's usage (1973, p. 179) of the Vegamían Formation apparently comes close to the Getino Formation of Rácz, but one cannot be sure about his exact intentions since he does not give stratigraphic sections.

In his original description, Comte (1959, p. 330) mentions the greenish and reddish shales transitional to the griotte but describes the type section south of Vegamían as consisting of black shales with silico-phosphate nodules. Wagner et al. (1971), in accordance with Winkler Prins' (1968) usage, confined the Vegamían Formation therefore to the black, sometimes greyish, shales, and included the greenish and reddish shales, with the marls and nodular limestones in the Gorgera Member of the Genicera Formation.

It should be noted that the Vegamían Formation is not everywhere found in the Cantabrian Mountains. In its southern and western flank the Baleas Limestone Formation occurs locally as a lateral replacement (Wagner et al., 1971: Truyols Santonja and Sánchez de Posada, 1983; Eichmüller and Seibert, 1984, fig. 3). The Portillas Limestone of the Picos de Europa area (Marquínnez, 1978, p. 297; not to be confounded with the Portilla Formation) could be a similar replacement.

FAUNAL RESEARCH

Brachiopods

Wagner (1963, p. 54) was the first to mention the linguliform brachiopods from the Vegamían Formation, be it only at the generic level, as many did later on (Wagner, in Higgins et al., 1964, p. 221; van Adrichem Boogaert, 1967, p. 163; Winkler Prins, 1983; Martínez Chacón and Winkler Prins, 1993). These citations are not included in the synonymy lists, even though the citations of Orbiculoideidae could have been included in the synonymy of O. cineta. Wagner Prins (1968) described the choanetid and productid brachiopods and gave a provisional list with species identifications of all brachiopods. A single brachiopod from the Picos de Europa near the road Espinama-Aliva (see Maas, 1974, p. 385) tentatively identified by the first author (C.F.W.P.) as Brachythyrta sp. (cited as Brachetyrra sp.) could belong to the Ermita Formation or the basal part of the Alba (= Genicera) Formation, but definitely not to the Vegamían Formation, as he suggests.

It is perhaps also interesting to mention that some fragmentary but well-preserved specimens of Orbiculoideidae from loc. WAG 1165B were made available to Sir Alwyn Williams for study of the shell structure by him and his group (Williams et al., 1998, p. 2021).

Bivalves

Dr R.B. Wilson (in Wagner, 1963, p. 54) gave some tentative identifications, viz. Euchondria cf. losseni (von Koenen) and Posidonia sp., (see also Winkler Prins, 1968, table I: the difference being a question of nomenclature). Amler and Winkler Prins (in press) were the first to make a detailed study of the bivalves found in the Vegamían Formation.

Ammonites

Some squashed goniatites were tentatively attributed by Mrs C.H.T. Wagner-Gentis (in Wagner, 1963, p. 54) to Pericyclus. The only well preserved ammonite found thus far was identified by her (in Wagner et al., 1971) as Muensteroceras arkansanum Gordon, 1970.

Ostracodes

Jordan and Bless (1970) described several new species of pelagic ostracodes from the Vegamían Formation and a list was given in Sánchez de Posada (1976).

Trilobites

Gandl (1973) described the trilobite faunas from the Vegamían Formation in the first of a series of papers on the Carboniferous trilobites from the Cantabrian Mountains and discussed their affinities and palaeoecological implications.

Conodonts

Fairly rich conodont faunas have been described by Higgins (in Higgins et al., 1964; Higgins, 1971) from the Genicera section and later (in Higgins and Wagner-Gentis, 1982) assigned to the Siphonodella cooperi-Polygnathus communis Zone and the lower Scaligognathus anchoralis Zone (top part). Van Adrichem Boogaert (1967) agrees with these identifications and Raven (1983) gives some additional information, notably on conodonts belonging to the intervening G. pseudosemiglaber Zone.
Other faunal elements

Winkler Prins (1968, table I) listed radiolarians and unidentifed fish remains.

AGE

Originally, the black shales of the Vegamíán Formation were considered to be of a Devonian age (comparing e.g. Barrois, 1882, p. 548). There has also been some confusion with the Silurian Formigoso Formation (e.g. Llopis Lladó, 1951, see Sjerp, 1967, p. 77). Comte (1959, p. 331) links the Vegamíán Formation lithologically with his Alba Formation and suggests a (late) Viséan age. De Sitter (1962, p. 258) compares it with similar shales from the Pyrenees and suggests a Tournaisian age. The goniatite fragments found in the Gildar-Montó area by Budinger and Kullmann (1964, p. 418) seem to corroborate the Viséan age, but the sandy shales are quite different from true Vegamíán Shales (cf. Raven, 1983, p. 296); they are overlain by undated black shales with phosphatic nodules which appear to be typical Vegamíán Shales (Wagner and Winkler Prins, personal observations). Higgins (in Higgins et al., 1964) was the first to date the Vegamíán Formation reliably with the help of conodont faunas as middle-late Tournaisian, the S. anchoralis Zone nowadays being considered late Tournaisian. The view of van Adrichem Boogaert (1967, p. 163) that the upper and lower boundaries of the Vegamíán Formation are diachronous and that its fullest development took place in the Palentien facies area is due to the fact that he included the above-mentioned sandy shales as well as cherts that are partly greenish or reddish, which should rather have been included in the overlying Alba (= Genicera) Formation. The top of the underlying Ermita Formation may vary slightly in age, but this does not mean that the age of the base of the Vegamíán should also differ, since a slight hiatus is often observed. Raven (1983) agrees with a middle Tournaisian - early Viséan (S. anchoralis Zone: now late Tournaisian) age for the Vegamíán Formation. Rodríguez Fernández et al. (1985) included in the Vegamíán Formation some black marly limestones with conodonts of the kockelidensitlineatus Zone of early Tournaissian age, with intercalated black shales, which others had included in either the Ermita Formation or the Baleas Formation. The brachiopod data seem to point to a Viséan age, since they compare well with the Culm faunas from NW Europe of Viséan age (cf. Nicolas, 1963; Winkler Prins, 1971) but a Tournaisian age cannot be excluded and the fauna is considered a better indicator for the environment (black shales) than for the age (Winkler Prins, 1968, p. 61). The goniatite Muensteroceras arksanum Gordon, 1970 described by Wagner-Gentis (in Wagner et al., 1971) from the Genicera locality is of late Kinderhookian age perhaps ranging into the early Osagean, which could perhaps best be interpreted as middle Tournaisian. Gandl (1973, p. 30) concludes to a late Tournaisian age for the trilobite faunas. In conclusion one may state that a middle-late Tournaisian age for the Vegamíán Formation is firmly established and a possible extension into the Viséan depends on whether one wants to include the sandy shales of the Montó area in it.

ENVIRONMENT OF DEPOSITION

The Vegamíán Formation is generally considered a quiet-water or "Culm" deposit (e.g. Winkler Prins, 1968; Gandl, 1973; Martínez Chacón and Winkler Prins, 1993). The most likely model is a relatively shallow sea with a flat bottom with a slope of only a few degrees at the most (Winkler Prins, 1968, p. 55), which prevents wave action and thus causes a restricted environment with anaerobic bottom conditions at least most of the time (Wagner et al., 1971, p. 645). The Vegamíán Formation is closely comparable with other black shale ("Culm") deposits from the Viséan of NW Europe (e.g. Dixon and Vaughan, 1911; Nicolas, 1963).

The linguliform brachiopods are found more...
commonly in the black shales, whilst the grayish to
cream-coloured shales are richer in rhynchonelliform
brachiopods. The latter are generally decalcified, except
at the locality of Oseja de Sajambre, where the shales are
siliceous.

The Vegamián Formation fits well in a sequence that
started with the epeirogenetic movements that caused the
hiatus, forming an angular unconformity on the map,
below the Ermita Formation. The relief was levelled
during the deposition of the Ermita Sandstones and a
relatively shallow (c. 50 m?), cool sea with a flat bottom
was the result, where organic rich muds were deposited
at a slow rate (Vegamián Black Shales). In shallow parts
closer to the shore high-energetic limestones of the
Balears Formation were formed. When the anaerobic
conditions became less extreme, the black colour
changed to grey-green and green when it was still a
reducing environment, but became red under oxidising
conditions (cf. Winkler Prins, 1968, p. 59). These
colours are found in the overlying Genicera Formation
which consists of shales, nodular limestones and cherts,
still considered to have been deposited below wave base.
This may indicate a shallowing of the sea as discussed by
van den Bosch (1969, p. 173) on the basis of the studies
by McKelvey. Sediment supply must have been very low
and the region tectonically very quiet. Deposition was
mainly influenced by eustatic sea-level movements. At
the end of the Genicera Formation the basin started to
deepen again and we see the reverse order of events: the
red limestones become grey-greenish and are followed
by the black, euxinic, laminated limestones of the
Barcaliente Formation, which can reach a considerable
thickness.

COLLECTING LOCALITIES (Fig. 1)

Genicera (WAG 1165B)
An exposure 2 km SW of Genicera on the eastern bank
of the arroyo Canalón (sheet 104, Boñar, of the geological
map of Spain 1:50.000, coordinates 42°56′23″N
5°29′47″W; León), dug out to measure the Vegamián
Formation (see Wagner, 1963, p. 224; Higgins et al., 1964,
fig. 2). Material in part collected by Dr R.H. Wagner and
company (op. cit.) and partly by the first author (C.F.W.P.).

Tolibia de Abajo (WP 12)
An exposure situated c. 1500 m SE of Tolibia de Abajo
in a tributary of the Valle de Valdeñarri (sheet 104, Boñar,
coordinates 42°57′19″N 5°23′22″W; León), on the east
bank of the River Curueño when leaving the gorge formed
by the river in the Barcaliente and Valdeteja limestones of
the Bodón thrust unit (Evers, 1967). Material collected by
both authors.

Valdecastillo (VCO-5)
Locality 300 m W of church of the village of
Valdecastillo (sheet 104, Boñar, coordinates 42°54′32″N
5°19′W; León). Material collected by Dr J.M.G. Raven in
1981-1982 (then at Leiden Univ.) and by both authors.

Oseja de Sajambre (WP 17)
Exposure on the main road before tunnel. 1 km SE of
Oseja de Sajambre (sheet 80, Burón, coordinates
43°07′34″N 5°01′51″W; León). Material collected by both
authors. The locality is of special interest because the shell
material of the articulate brachiopods is preserved in the
black siliceous shales.

San Antolín (SA)
Beach at San Antolín (sheet 31, Ribadesella, of the
geological map of Spain 1:50.000, coordinates 43°26′39″N
4°52′18″W; Asturias). Material collected mainly by the
second author (M.L.M.Ch.) and Dr L. Sánchez de Posada
(Univ. of Oviedo).

SYSTEMATIC DESCRIPTIONS

The main classification is based on the modern views
that presumably will be used for the new edition of the
brachiopod volume of the Treatise on Invertebrate Paleontology (cf. Holmer et al., 1995; Williams et al., 1996).

The material is deposited at the Nationaal Natuurhistorisch Museum in Leiden (prefix RGM) and at the Departamento de Geologia of the Universidad de Oviedo (prefix DPO).

PHYLUM BRACHIOPODA Duméril, 1806
SUBPHYLUM LINGULIFORMEA Williams, Carlson, Brunton, Holmer and Popov, 1996
CLASS LINGULATA Gorjansky and Popov, 1985
ORDER LINGULIDA Waagen, 1885
Superfamily LINGULOIDEA Menke, 1828
Family Lingulidae Menke, 1828
Subfamily Lingulinae Menke, 1828
Genus Lingula Bruguière, 1797

Type species: Lingula anatina Lamarck, 1801 (ICZN decision 1355, see Melville, 1985).

Remarks
The genus deserves a place in the Guinness Book of Records as the longest ranging genus (Ordovician-Recent: c. 500 Ma). Whether all material really should be included in one and the same genus seems doubtful. Insufficient knowledge of internal structures of the older species makes assignment to Lingula often a matter of convenience, as is actually the case with the present material. Recently, new genera have been created for Mesozoic material (Lingularia Biernat and Emig, 1993) and Late Palaeozoic material (Semilingula Popov, in Egorov and Popov, 1990) based on the internal structures (muscle scars, mantle canals, etc.). Part of the Late Palaeozoic material may even belong to the Pseudolingulidae, as for example Liralingula, which is considered a junior synonym of the pseudolingulid Bicarinatina by Popov et al. (1994, p. 1217). When known, the musculature differs significantly from these genera, as is the case for the Carboniferous species “L.” squamiformis and “L.” straeleni (cf. Graham, 1970, fig. 6).

Since a detailed investigation of the internal structure of the Carboniferous species of Lingula, studying type material, is beyond the scope of this paper, we have refrained from creating a new genus for (part of) the Carboniferous species, which are provisionally referred to as “Lingula”.

“Lingula” mytiloides J. Sowerby, 1812
Fig. 2a-b

1959 Lingula mytiloides Sowerby: Vangerow, 50-51, table 2, pl. 10; pl. 11, figs. 1-3, 6.
1968 Lingula mytiloides Sow.; Winkler Prins, table 1.
1970 Lingula mytiloides J. Sowerby; Graham, 143-147, text-figs. 2-4, pl. XIV, XV, figs. 1?, 9-11, pl. XX, fig. 4 (cum syn.).
1972 Lingula mytiloides Winkler Prins, in Bless and Winkler Prins, 234 (table 2).
1979 Lingula mytiloides Sow.; Korejwo, 468-469, pl. 1, figs. 1-3.

Diagnosis
Small, moderately convex “Lingula” with an elliptical outline, the anterior margin being rounded, rather than acuminate or almost straight. Length/width ratio averages 1.8, the ratio being higher in the smaller specimens. Almost equivalent, the pedicle valve having an acuminate umbo. Ornamentation of weakly developed rugae and irregular subconcentric filae. Internally a subconcentric corrugation and fine radial striae are developed.

Material: Fourteen specimens from locality WAG 1165B: 3 collected by Dr R.H. Wagner and colleagues (see Higgins et al., 1964; RGM 142 594?, 142 654, 142 685) and 11 by the first author (C.F.W.P.; RGM 131 008-015, 020-021, 023); 3 specimens were collected by the second author from locality WP 12 (M.L.M.Ch.; DPO 33 982-984); both brachial and pedicle valves.

Description
The present material is rather small for the species, the largest specimen measuring less than 5 mm in length. Almost equivalent, the pedicle valve having an acuminate umbo and that of the brachial valve showing a large umbonal angle; the valves cannot always be distinguished. The shape is elliptical and the length width ratio varies between 1.5 and 2.0, the smaller specimens normally having the larger ratio. A colour-banding is observed varying from whitish to grey or light brown. The ornamentation consists of weakly developed rugae with fine subconcentric filae (growth lines?) superimposed. The internal surface shows a fine subconcentric corrugation and weakly developed radial striae. Muscle scars were not observed.

Occasionally a groove is observed on the umbonal part of some pedicle valves (Fig. 2b), similar to the ones shown for L. squamiformis by Graham (1970, pl. XVI, figs. 9, 12) and presumably due to crushing. They are also found on other parts of the valves.

Measurements (in mm):

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Discussion

The species has been excellently described by Graham (1970), who also designated a lectotype. He gave reasons for differentiating between “L.” mytiloides J. Sowerby, 1812, “L.” straeleni Demanet, 1934, and “L.” squamiformis Phillips, 1836, which hold true for the present material. Besides, the fact that the growth lines of “L.” squamiformis indicate that juvenile specimens have the typical shape and were not suboval clearly indicate that the two species can and should be differentiated.

The pair of diverging folds (= “radial ridges or costae”) of Graham (1970) are considered by us to have a similar function as the diverging septae of the Glottidiidae (Archbold, 1981).

Occurrences

“L.” mytiloides is widely found in the Viséan-Bolsovian (ex Westphalian C) of Western Europe and in Spain it is found in the Tournaisian Vegamáin Formation and may occasionally occur in younger, Pennsylvanian (= Upper Carboniferous s.l., i.e. above the mid-Carboniferous boundary; cf. Wagner and Winkler Prins, 1994) strata of the Cantabrian Mts. It is very likely that the species also occurs in the former Soviet Union, but descriptions and figures are often insufficient for a detailed comparison (e.g. Sarycheva and Sokolskaja, 1952), so no attempt has been made to include the Soviet literature in the synonymy. Also, no comparison has been made with Carboniferous species of Lingula from other continents, since this would mean a revision of these species including the study of type material, which is outside the scope of this paper.

“Lingula” squamiformis Phillips, 1836

Fig. 2c-d

*1836 Lingula squamiformis Phillips, 221, pl. XI, fig. 14.
1934 Lingula squamiformis Phillips; Demanet, 13-14, pl. I, figs. 1-3.
1943 Lingula credeni Geinitz; Dorsman, 18, pl. 1, fig. 2.
1943 Lingula squamiformis Phillips; Dorsman, 19, pl. 1, fig. 6.
1959 Lingula aff. squamiformis Phillips; Vangerow, 53, table 2, pl. 12, fig. 1.
1970 Lingula squamiformis Phillips; Graham, 150, textfigs. 3, 6d, pl. XVI, figs. 5-15 (cum syn.).
1984 Lingulipora squamiformis (Phillips); Zakowa and Chlebowsky, pl. I, fig. 7.
1989 Lingula squamiformis (Phillips); Winkler Prins, B10, fig. 40.

Diagnosis

Medium-sized, weakly convex, subquadrate, thin-shelled “Lingula” with a truncate anterior margin. Length/width ratio averages 1.5. Almost equivaIe, the pedicle valve being slightly extended at the umbo. Ornamentation of growth lines. Two radial folds are normally observed. Internally a fine subconcentric corrugation and radial striae are developed.

Material: Seven specimens from locality WAG 1165B: 4 collected by Dr R.H. Wagner and colleagues (see Higgins et al., 1964; RGM 142 705, 293 329-331) and 3 by the first author (C.F.W.P.; RGM 131 007, 019, 293 335); 3 specimens from loc. WP 17 (293 337; DPO 33 985) are tentatively assigned to this species.

Description

The present material is rather small for the species, the largest specimen measuring 7.6 mm in length. The shape is subquadrate with parallel lateral margins and a truncate (almost straight) anterior margin. Almost equivaIe, the pedicle valve is slightly extended at the umbo, the brachial valve having a nearly straight posterior margin (Fig. 2c). The length/width ratio varies between 1.1 and 1.8, averaging 1.5. A colour-band ing is observed in different shades of brown and dark gray. The ornamentation consists of fine subconcentric filae (growth lines?). The internal surface shows a fine subconcentric corrugation and very weak, irregular radial striae. Muscle scars were not observed.

Measurements (in mm):

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Discussion

The species has been excellently described by Graham (1970), who also gave reasons for differentiating between “L.” mytiloides, “L.” straeleni and “L.” squamiformis (see also Discussion of “L.” mytiloides). In our material no pair of diverging folds were observed (see Discussion of “L.” mytiloides), but this may be due to the rather small size of our specimens, which may not have reached maturity.

Occurrences

“L.” squamiformis is widely found in Viséan-Bolsovian (ex Westphalian C) deposits of Western Europe (see also “L.” mytiloides). In Spain it is found in the Tournaisian Vegamáin Formation of the Cantabrian Mts.

Subfamily Lachrymulinace Winkler Prins and Martínez Chacón, subfam. nov.

Type genus: Lachryma Graham, 1970.

Diagnosis

Lingulidae characterised by relatively thick, subtriangular shells, a distinct pedicle groove and a rugose ornamentation. Internal surface smooth; septae absent.

Genera included

Lachryma Graham, 1970 (Tournaisian-Bolsovian)
and *Trigonoglossa* Dunbar and Condra, 1932 (Carboniferous).

**Discussion**

The outline of the *Lachrymulinia* resembles that of the much older Obolidae, but the latter differ in having well-developed propareas in the pedicle valves and pseudointerareas in the brachial ones. The shape, relatively thick shells, prominent rugae, and the pedicle groove distinguish the *Lachrymulinia* from the true *Lingulinae*. Whether the preservation of *Lachrymulinia* as white shells, in contrast to the more transparent shells of the *Lingulinae*, often showing colour-banding (different shades of brown to black), has any fundamental significance with regard to their shell structure is unknown at the moment.

**Genus *Lachrymula*** Graham, 1970

**Type species**: *Lachrymula inusitata* Graham, 1970 (by original designation).

**Diagnosis**

Rather small, tear-shaped to subovate *Lachrymulinia* with a weakly rugose ornamentation and faint radial striae.

**Species included**

*Lachrymula inusitata* Graham, 1970; *Lingula latior* McCoy, 1852; *Lingula pringlei* Currie, in Currie et al., 1937 and *Lachrymula truyolsi* sp. nov.

**Lachrymula truyolsi** Winkler Prins and Martínez Chacón, sp. nov.

Fig. 3a-e

1993 *Lachrymula aff. inusitata* Graham; Martínez Chacón and Winkler Prins, pl. 1, fig. 1.

**Holotype**: Brachial valve (RGM 131 003; Fig. 3a).

**Type locality**: An exposure 2 km SW of Genicera (León), co-ordinates 51°31'N 4°21'57"W.

**Type horizon**: Fossiliferous level at 1.80 m above base of the Vegamíán Formation (WAG 1165B, see Wagner, 1963, p. 224; Higgins et al., 1964, fig. 2).

**Derivatio nominis**: The species is named after Professor Jaime Truyols Santonja (Oviedo Univ.) to whom this volume is dedicated.

**Diagnosis**

Moderately convex *Lachrymula*, tear-shaped in outline, and up to almost 10 mm in length. L/W ratio 1.5, greatest width anterior of mid length; pedicle valve slightly longer than the brachial one. Umbonal angle 60°. Ornamentation of numerous thin but prominent subconcentric rugae. Brachial valve with short straight posterior margin and two diverging folds. Internal surface (as far as observed) practically smooth; muscle scars not observed.

**Material**: Eleven specimens from locality WAG 1165B: 3 collected by Dr R.H. Wagner and colleagues (see Higgins et al., 1964; RGM 142 607, 609, 131 062) and 8 by the first author (C.F.W.P.; RGM 131 000-001, 003-007, 019).

**Description**

Moderately convex, tear-shaped in outline, and up to almost 10 mm in length. L/W ratio 1.5, greatest width
anterior of mid length; pedicle valve slightly longer than the brachial one, the latter with short straight hinge and two diverging folds. Umbonal angle 60°. Ornamentation of numerous thin but prominent subconcentric rugae.

One specimen (RGM 142 607, Fig. 3b) shows a partially preserved interior, which is smooth except for some faint markings; part with muscle scars not preserved.

**Measurements (in mm):**

<table>
<thead>
<tr>
<th>Number</th>
<th>L</th>
<th>W</th>
<th>L/W</th>
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<td>RGM 142 607</td>
<td>8.7</td>
<td>5.4</td>
<td>1.6</td>
</tr>
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</table>

**Discussion**

*Lachrymula travysi* is distinguished from the closely comparable *L. inusitata* from the Viséan of Scotland by its well developed posterior hinge and pair of diverging radial folds in the brachial valve.

An interesting feature is the preservation of the material of *Lachrymula travysi* as white shells, contrary to the *Lingula* shells which often show concentric colour bands of different shades of brown or gray. This could be due to the rather thick shells and characteristic for *Lachrymula* but we are not sure whether this holds also true for the Scottish material (cf. Graham, 1970, pl. XVIII, figs. 6, 7, 10, versus pl. XIV, figs. 5-6).

**Occurrence:** Type locality only.

Superfamily **DISCINOIDEA** Gray, 1840

Family **Discinidae** Gray, 1840

Subfamily **Orbiculoidinae** Schuchert and LeVene, 1929

Genus **Orbiculoida** d’Orbigny, 1847 (synonym: *Lingulodiscina* Whitfield, 1890)

**Orbiculoida cincta** (Portlock, 1843)

Fig. 4a-h

1843 *Orbcula cincta* Portlock, 446, pl. 32, figs. 15-16 (fide Graham, 1971).
1843 *Orcbula Davreuxiana* de Koninck, 306, pl. XXI, fig. 4.
1934 *Orcbula Davreuxiana* de Koninck; Demanet, 21, pl. I, figs. 10-11; text-fig. 4 (cum syn.).
1963 *Orcbuloidea newberryi marshallensis* (Girty); Nicolaus, 145, pl. 9, fig. 2.
1968 *Orbiculoidea* sp.; Winkler Prins, table 1.
1971 *Orcbucleoida cincta* (Portlock); Graham, 49, pl. III, figs. 1-3; pl. IV, figs. 1-3; pl. V, figs. 7-9 (cum syn.).
1971 *Orcbuloidea* cf. *cincta* (Portlock); Graham, 50, pl. III, figs. 4-5.

**Diagnosis**

Plano-convex, subcircular *Orbiculoida* with a distinct concentric ornamentation, consisting of growth...
lines and some more prominent rugae which may have a lamellose aspect in the pedicle valve.

**Material:** Thirty-two specimens from locality WAG 1165B: 8 collected by Dr R.H. Wagner and colleagues (see Higgins et al., 1964; RGM 142 601-604, 658, 705, 707) and 24 by the first author (C.F.W.P.; RGM 131 019, 021, 024-027, 029-033, 035/6, 039-740, 063, 066, 293 326-328, 332-335); seven specimens collected by the second author from locality WP 12 (M.L.M.Ch.; DPO 33 975-971); four specimens collected by Dr J.M.G. Raven from locality WP 15 (RGM 293 338-340); both brachial and pedicle valves.

**Description**
Both valves are essentially subcircular, small for the species (1-5 mm in diameter). The pedicle valve is flat with a distinct pedicle groove which is closed at the margin in mature specimens (Fig. 4a, b, f, g) but appears open at the margin in juvenile specimens (Fig. 4h). The concentric rugation is in part weakly developed, no more than growth lines, but stronger rugae are intercalated having a lamellose aspect in some mature specimens (Fig. 4f). Internally the surface is practically smooth showing some rugae and fine radial striae, especially near the margin. The brachial valve is conical with a somewhat posteriorly placed umbo. Ornamentation of weakly developed growth lines with some stronger ones, but less strongly developed than in the pedicle one. Internally the surface is smooth with faint radial stria near the margin (Fig. 4d) and some specimens showing very thin ridges diverging from the umbo (Fig. 4e).

**Measurements** (in mm):

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</table>

**Discussion**
The development of the concentric ornamentation is variable in our material (even at one and the same locality), as it appears to be in Graham’s (op. cit.), with some pedicle valves showing a strong, almost lamellose rugation (Fig. 4f) whilst in other material it is only weakly developed. There appears to be a gradual transition to Graham’s O. cf. cineta (cf. Graham, 1971, pl. III, figs. 3-4), which is compared by him with O. davreuxiana de Koninck (op. cit., p. 50). We include the material attributed to the latter species in our synonymy, the more so while the paratype figured by Demanet (1934, text-fig. 4) is closely comparable to our material. Our species is characterised by its subcircular shape and conical pedicle valve with an only slightly eccentric umbo.

This poses the question whether O. cineta or O. davreuxiana has priority. Demanet (op. cit.) gives 1842 as the date of publication of de Koninck’s species, whilst Graham gives (correctly) 1843, the publication itself having been published between 1842 and 1844 (pp. 241-480 in 1843). Since Portlock’s species was published in 1843, the exact date of publication of both species is essential to decide which has priority. We have so far been unable to obtain the necessary information on this issue, and have left O. cineta as the valid species following Graham (op. cit.).

**Occurrences**
O. cineta occurs widely in the Tourmaisian-Bolsovian (ex Westphalian C) of NW Europe and is found in Spain in the Vegamian Formation.

**ACKNOWLEDGEMENTS**

The authors wish to thank Drs A. Cuesta Fernández and C. Aranburu-Zabalza (Universidad de Oviedo) for their help in preparing the figures and to Drs A. Márquez Aliaga (Universidad de Valencia) and F. García Joral (Universidad Complutense de Madrid) for their helpful comments. M.L.M.Ch. acknowledges the projects (DGICYT) PB 94-1337 and IR-98515-1 (University of Oviedo) for financial support. The paper is a contribution to PICG’s project 421.

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*Manuscrito recibido: 15 de enero, 1998
Manuscrito aceptado: 24 de septiembre, 1998