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COLLECTIONS OF THE NATURAL HISTORY MUSEUM OF LILLE. VIII. — DIPLOSTRACA (TYPES AND FIGURED SPECIMENS)

Les collections du Musée d'Histoire Naturelle de Lille. - VIII. — Diplostraca (Types et figurés)

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Abstract. – The Diplostraca (also known as conchostracans; Arthropoda: Crustacea: Branchiopoda: Phyllopoda) are a group that were often collected in the coal basins of northern and eastern France, during the main period of activity of the coal industry (end of 19th Century to beginning of 20th Century); others were collected in Germany, Switzerland, Africa and Russia. Hence, the palaeontological collections of Lille (Natural History Museum of Lille and University of Lille) are especially rich in specimens. This paper presents a reasoned catalogue of the types and figured specimens of the collection of the Natural History Museum of Lille, associated with a brief review of the Palaeozoic diplostracans, and some new or updated data in geology and palaeontology. Fossil Diplostraca are a rather neglected group, which appears however to be important in biostratigraphy, sequential stratigraphy, palaeoclimatology, palaeobiology, palaeoecology and palaeobiogeography during both principal stages of the Late Carboniferous (Pennsylvanian); i.e., during Moscovian (traditionally called Westphalian in western Europe) and Kasimovian times (traditionally called Stephanian).

Résumé. – *Les Diplostraca (autrefois appelés conchostracés ; Arthropoda : Crustacea : Branchiopoda : Phyllopoda) sont un groupe qui a fait l'objet de nombreuses récoltes dans les bassins houillers du nord et de l'est de la France, durant la période d'activité maximale des mines de charbon (c'est-à-dire de la fin du XIXe siècle au début du XXe) ; d'autres exemplaires ont été recueillis en Allemagne, en Suisse, en Afrique et en Russie. Ces très nombreux spécimens ont été rassemblés dans les collections publiques lilloises de paléontologie (Musée d'Histoire Naturelle de Lille et Université de Lille). Cet article présente un catalogue raisonné des collections de types et figurés du Musée d'Histoire Naturelle de Lille ainsi qu'une révision des données générales sur les Diplostraca paléozoïques, et un certain nombre de données géologiques et paléontologiques nouvelles ou actualisées. En effet, ce groupe de fossiles s'avère important en biostratigraphie, stratigraphie séquentielle, paléoclimatologie, paléobiologie, paléoécologie et paléobiogéographie pour les deux périodes principales du Carbonifère supérieur (Pennsylvanien) : le Moscovien (classiquement Westphalien) et le Kasimovien (classiquement Stéphanien).*

Keywords. – Diplostraca, conchostracans, Carboniferous, Nord – Pas-de-Calais Basin, Saar-Lorraine Basin.
Mots-clés. – *Diplostraca, conchostracés, Carbonifère, Bassin du Nord – Pas-de-Calais, Bassin sarro-lorrain*.

I. — HISTORICAL BACKGROUND

The geological and palaeontological collections of the city of Lille (northern France) are particularly rich, insofar as they result from the merging of two collections, that of the Natural History Museum and that of the University of Lille, which both were constituted as early as the 19th century (Oudoire *et al*., 2014). The Faculty of Sciences of Lille was founded in August 1854, but the department of geology was created 10 years later with the appointment of Jules Gosselet to the chair of Geology and Mineralogy (Thiébault, 2011). On the other hand, in the same period, the Society of Sciences, Agriculture and Arts of Lille bequeathed its collection of natural history specimens to the city of Lille, which made it available for the Faculty of Sciences. The city of Lille formalized the creation of the Museum of Geology and Mineralogy on the 18th February, 1877. This museum was first managed by a commission headed by professors of the university, which included Jules Gosselet (Blieck *et al*., 2013, 2014).

Later, the museum and the faculty moved together to a single new building, built in 1894. The Gosselet Museum of Geology was inaugurated in 1902. Subsequently, the collections were therefore enriched thanks to the investigations of the university

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professors and the field excursions organized in the region for the students. Charles Barrois, who was a former student of Jules Gosselet, succeeded him as the head of the Chair of Geology and Mineralogy and founded the Coal Museum in 1907, in order to implement a collaboration between the mining industry and university research. Numerous mining companies were active in the mining area of Nord – Pas-de-Calais (France) during the first part of the 20th century, and a great number of samples were offered by these companies to the University and Museum collections (Oudoire *et al*., 2014). That is why the Natural History Museum and the University have a unique collection of palaeobotanical specimens, as well as of all other fossil forms of life encountered in the coal basin. In the 1960s, the University's buildings located within the city of Lille were found too narrow and not suitable for teaching and housing anymore. Therefore, the University moved to the outskirts of Lille. The geology professors took away their specimens under study, essentially fossil plants, to be received by the new campus of Villeneuve d'Ascq. The rest of the collections (nearly 75%) remained in the older buildings to form the Natural History Museum, henceforth managed by the City of Lille itself. Thus it happened that the palaeontological collection of Lille was divided into two sets of objects (Oudoire *et al*., 2014).

II. — COLLECTIONS MANAGEMENT

The Natural History Museum is a multidisciplinary museum with 393,050 specimens including 120,000 in palaeontology and 56,400 in geology, according to the observatory OCIM in 2011 (Charon, 2014). The core collection encompasses four groups of samples: regional collection (nearly all from the geological Paris basin; 80,000 specimens), extra-regional collection (20,000 specimens), palaeobotany (6,000 specimens) and mineralogy (5,000 specimens). This core collection comes from findings of regional amateurs and scientific samplings (Oudoire *et al*., 2014), like the Pierre Pruvost's work (Pruvost, 1911, 1914, 1919) of the Carboniferous faunas, which provided most of the diplostracan/conchostracan figured specimens of the Museum. Other elements of the collections were provided by Corsin (1932) in his palaeontogical guidebook on the Nord – Pas-de-Calais coal basins, and by Waterlot (1934), who studied conchostracan faunas from the Saar-Lorraine coal basin.

Since the beginning of 21st century, the Museum began an inventory policy with public funding; and several catalogues have been published in the *Annales de la Société Géologique du Nord* (Malvesy, 1999; Malvesy *et al*., 1999, 2000, 2002; Blieck *et al*., 1999, 2013; Oudoire *et al*., 2008, 2011). In parallel, the University proceeds with the inventory and photographs of its collection, in the framework of the national program Trans'Tyfipal (http://transtyfipal.u-bourgogne.fr). Trans'Tyfipal is an online database listing the palaeontological types and figured specimens housed in the French institutions such as the universities and museums. This database was created in 1986 under the name Tyfipal (Thierry, 1995), and was initially coordinated by the University of Bourgogne (Dijon). In the near future, it will be replaced by the great project E-Recolnat of digitization of French taxonomic references. All the specimens reported below are available on the website http://transtyfipal.u-bourgogne.fr/ by implementing the following search criteria: Order: "Diplostraca" / Establishment keeper: "Lille - Museum d'Histoire Naturelle".

III. — DIPLOSTRACA

Diplostraca, formerly named conchostracans, are small branchiopod-phyllopod crustaceans, also called "clam shrimp", with a symmetrical, bivalved, chitinous carapace with growth lines (Lecointre & Le Guyader, 2009). They differ from the ostracods, which have a calcitic shell without preserved growth lines (Meglitch, 1975; Vannier *et al*., 2003). Diplostraca are present from the Devonian to Recent (Tasch, 1969; Monferran *et al*., 2013). Their size varies from 1 millimetre to a few centimetres. They inhabit temporary fresh water bodies (Vannier *et al*., 2003) and consequently, provide good evidence for lacustrine environments in sequential and biostratigraphic analyses (Lucas & Milner, 2006). The geographical distribution of extant Diplostraca is worldwide, except in Antarctica, although Tasch (1987) described many fossil Diplostraca from Antarctica. This very broad distribution can be explained, because their eggs are time- and drought-resistant due to their encystment, and possible, subsequent transportation by birds and winds. These latter characters make diplostracans useful for palaeogeographical reconstructions (Tasch, 1987).

Modern taxonomic descriptions of Diplostraca are principally based on the anatomy of the living animal, not on the carapace; so that, there are no cross checks between extant and fossil specimens. On the other hand, several species were based on only one fossil specimen, in spite of the fact that recent papers suggest the comparison of fossil and extant taxa (Martin & Davis, 2001; Astrop & Hegna, 2015). Molecular and morphological studies have shown that the former "Conchostraca" group was not monophyletic, and now this group is part of the order Diplostraca, which include four extant suborders, viz., Spinicaudata, Laevicaudata, Cyclestherida, and Cladocera, and two extinct suborders, viz., Leaiina and Estheriellina (Martin & Davis, 2001; Monferran *et al*., 2013). The principal characters used to describe the fossil Diplostraca (Fig. 1) are 1) the angle between dorsal and posterior margin; 2) the shape of the shell, which can be subovate, subcircular, subelliptical, subquadrate or subtrapezoidal; 3) the presence or absence and the number of growth lines on the carapace; 4) the position of the umbo, which is placed between the median point and the anterior end of the dorsal margin; 5) the presence of different structures such as spines, nodes and ribs in the umbonal region, the type of structure in the interspaces of growth lines; and 6) the presence or absence and number of radial ornaments, eventually of the carinae or ribs (Raymond, 1946; Kobayashi, 1954; Novozhilov, 1958a, b, c, d; Tasch, 1969; Chen & Shen, 1985).

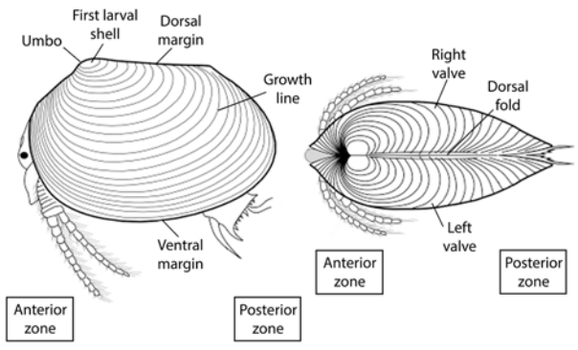


Fig. 1. – Sketch of a diplostracan (modified from Vannier *et al*., 2003).

Fig. 1. – *Schéma d'un diplostracé (modifié d'après Vannier* et al.*, 2003).*

IV. — PRELIMINARY DATA ABOUT THE SYSTEMATIC CATALOGUE

1. *Goals of this catalogue*

This catalogue follows other publications about the palaeontological collections of the Natural History Museum of Lille. The main goal of a catalogue is to help further revisions of a group of organisms, and the collection may be a good tool for studies with modern methods like morphometric analyses, SEM analyses or geochemical investigations.

2. *Abbreviations*

MGL, Musée Gosselet, Lille (Musée d'Histoire Naturelle – Musée de Géologie); MHL, Musée Houiller, Lille (Musée d'Histoire Naturelle – Musée de Géologie); Loc., Locality; Lithost., Lithostratigraphy; Biost., Biostratigraphy; Chronost., Chronostratigraphy.

3. *Adopted coal-units nomenclature*

In the following list, we tried to translate, revise and re-actualize some lithostratigraphic, geographic and toponymic terms traditionally used in the French coal basins and/or coal industry and mines. Names between inverted commas remain directly used below in the text ("Bowette" – intersecting horizontal gallery; "Dressant" – strongly dipped coal seam from 45° to almost vertical; "Voie de fond" – deepest mine gallery); for others, we will use the proposed translations: Assise – Formation; Faisceau – Member; Galerie – gallery; Passée – parasequence; Puits, fosse – pit; Veine – coal seam.

4. *Former numberings of samples*

The Natural History Museum of Lille renumbered specimens with the prefix MGL and a number that can match the historical collection (e.g., MGL 1886 for n°1886) or not (e.g., MGL 6341 for n°1884).

5. *Editorial remark*

We have transliterated the Russian names according to the current phonetic rules based on the English phonetics; for example, we used Novozhilov instead of Novojilov.

6. *Systematic classification of Diplostraca*

The classification followed in this work was established by one of the authors (O.G.) using a compilation of previous established classifications: Novozhilov (1958a, b, c, d), Defretin-Lefranc (1965, 1970), Tasch (1969, 1987), Chen & Shen (1985), Jones & Chen (2000), and Martin & Davis (2001). Some of the specimens mentioned in the catalogue have no clear systematic placement because they lack the main diagnostic characters based on the above mentioned literature. Further detailed studies in the future

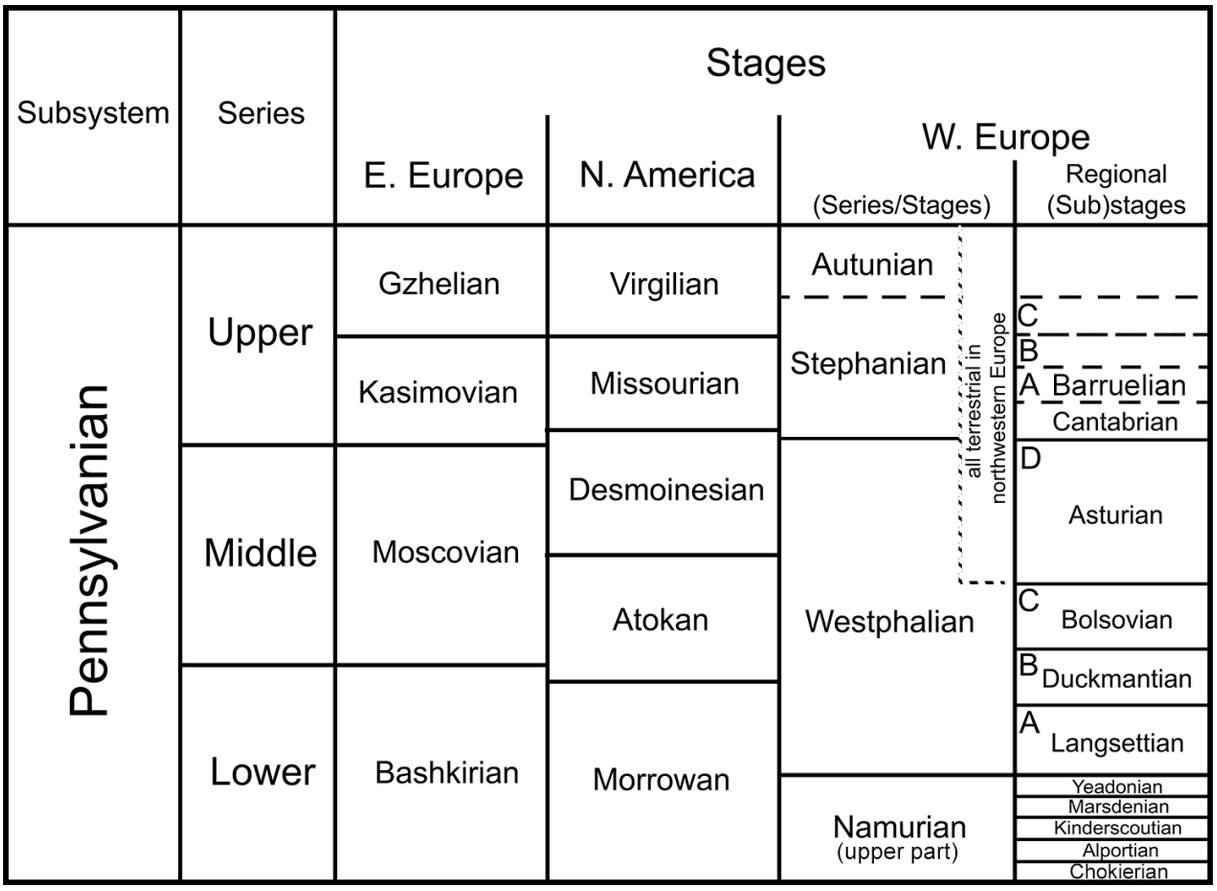


Fig. 2. – Chronostratigraphic correlation in the Pennsylvanian Subsystem (modified from Heckel & Clayton, 2006).

Fig. 2. – *Corrélation chronostratigraphique du sous-système Pennsylvanien (modifié d'après Heckel & Clayton, 2006).*

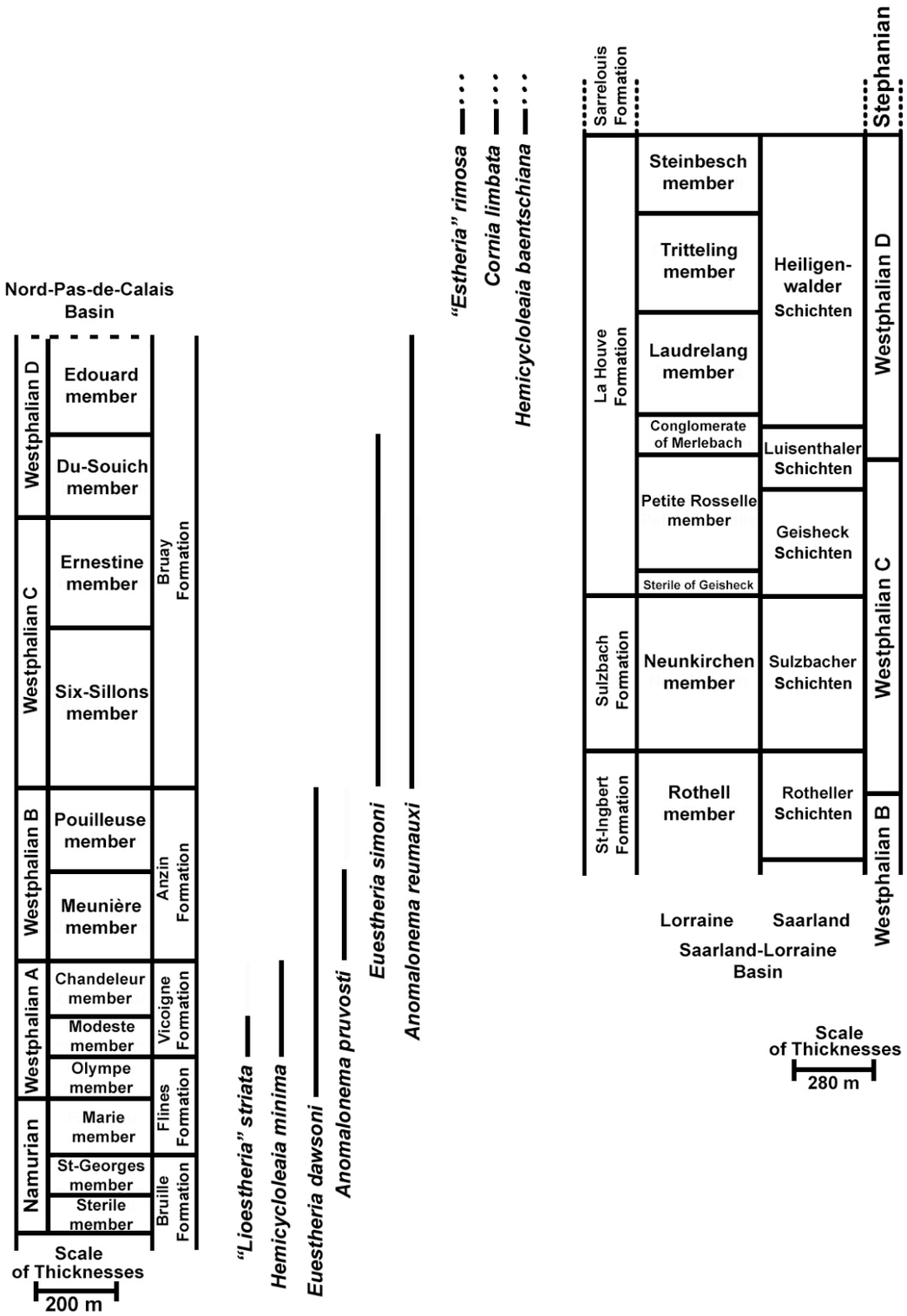


Fig. 3. – Table of stratigraphic correlations and stratigraphic distributions of the Diplostraca specimens of the Natural History Museum of Lille, collected in the coalfields of Nord – Pas-de-Calais and Saarland-Lorraine (modified from Laveine *et al*., 1977).

Fig. 3. *– Tableau récapitulatif des concordances stratigraphiques et des extensions des spécimens de Diplostracés de la collection du Musée d'Histoire Naturelle de Lille, récoltés dans les bassins houillers du Nord – Pas-de-Calais et de Sarre-Lorraine (modifié d'après Laveine* et al.*, 1977).*

could bring new information to the real systematic affinities of these materials. The suborders Leaiina and Spinicaudata are identified in the material analyzed in the present catalogue.

7. *Revised chronostratigraphy*

The chronostratigraphy is revised and re-actualized according to the more recent classification of the Pennsylvanian Subsystem proposed by Heckel & Clayton (2006) (Fig. 2).

8. *Stratigraphic distribution of the principal species mentioned in the catalogue*

Among the 27 listed Diplostraca specimens for the Natural History Museum, 24 come from the Nord – Pas-de-Calais coalfield (Westphalian in age) and three from the Saarland-Lorraine coalfield (Stephanian in age). The stratigraphic distribution of the principal species of diplostracans is indicated along a lithostratigraphic column of each basin (Fig. 3). This catalogue shows the uniqueness of this collection because the majority of the specimens come from the Nord – Pas-de-Calais coalfield, which has become inaccessible and has not been exploited since the end of the 20th century.

V. — SYSTEMATIC CATALOGUE

Authors of taxon names are indicated in small capital letters followed by year of authorship. The corresponding bibliographical references are not listed here in the bibliography section; they can be found in the papers of Novozhilov (1958a, b, c, d), Defretin-Lefranc (1965, 1970), Tasch (1969, 1987), Chen & Shen (1985), Jones & Chen (2000), and Martin & Davis (2001). All other cited papers are in the bibliography section.

Phylum ARTHROPODA von Siebold, 1848
Subphylum CRUSTACEA Brünnich, 1772
Class BRANCHIOPODA Latreille, 1817
Subclass PHYLLOPODA Preuss, 1951
Order DIPLOSTRACA Gerstaecker, 1866
Suborder LEAIINA Kobayashi, 1972
Superfamily LEAIOIDEA Raymond, 1946
Family LEAIIDAE Raymond, 1946
Genus *HEMICYCLOLEAIA* Raymond, 1946
Hemicycloleaia baentschiana (Beyrich, 1864) Raymond, 1946

Comment. The assignment of this species to the genus *Hemicycloleaia* follows Percy Raymond´s proposal and is based on Jones & Chen (2000) and the revision of material (I-02824) housed in the National History Museum of Madrid (Spain).

MGL 5100-1: Right valve *Leaia leidyi* var. *baentschiana* Beyrich, 1864, illustrated as *Leaia baentschi* in Waterlot, 1934, pl. VII, fig. 5.
Loc.: Mining site of Göttelborn, B.I.X. Nördl. Hauptquersch. II Tb. S., 41 metres north of the coal seam Wachlschied (Saarland, Germany).
Lithost.: Sarrelouis Formation.
Biost.: *Leaia* beds.
Chronost.: Carboniferous, Lower Stephanian.

Hemicycloleaia minima (Pruvost, 1914) Raymond, 1946

Comment. The assignment of this species to the genus *Hemicycloleaia* follows Percy Raymond´s proposal and is based on Jones & Chen (2000).

MGL 1888: Right valve illustrated as *Leaia tricarinata* var. *minima* Pruvost, 1914, pl. II, fig. 9; Pruvost, 1919, pl. XXV, fig. 4; Corsin, 1932, pl. XXXVIII, fig. 3.
Loc.: Roof of a parasequence located at 12 metres in the lateral gallery n°3, 0.80 m upon the coal seam, Pit 10, Concession of Lens, Group of Lens (Pas-de-Calais, France).
Lithost.: Vicoigne Formation.
Chronost.: Carboniferous, Westphalian A.
Comment. The exact location of the type locality (i.e., its height above roof) is most probably 12 m, as inscribed on the label associated with the sample, rather than 11 m or 2 m, as indicated in the publications of Pruvost (1914, 1919) or Corsin (1932).

MGL 6035-1: Right valve illustrated as *Leaia tricarinata* var. *minima* in Pruvost, 1914, pl. II, fig. 12; 1919, pl. XXV, fig. 3.
Loc.: Roof of the coal seam Nord 4, Pit Déjardin, Concession of Aniche, Group of Douai (Nord, France).
Lithost.: Vicoigne Formation, Modeste Member.
Chronost.: Carboniferous, Westphalian A.

MGL 6035-2: Right valve illustrated as *Leaia tricarinata* var. *minima* in Pruvost, 1914, pl. II, fig. 11; 1919, pl. XXV, fig. 2; Corsin, 1932, pl. XXXVIII, fig. 2.
Loc., lithost., chronost.: As for the specimen MGL 6035-1.

MGL 6035-3: Positive impression of a left valve and fragments of the negative impression of a right valve illustrated as *Leaia tricarinata* var. *minima* in Pruvost, 1914, pl. II, fig. 10; 1919, pl. XXV, fig. 1.
Loc., lithost., chronost.: As for the specimen MGL 6035-1.

Suborder SPINICAUDATA Linder, 1945
Superfamily EOSESTHERIOIDEA Zhang & Chen in Zhang *et al*., 1976
Family EUESTHERIIDAE Defretin-Lefranc, 1965
Genus *EUESTHERIA* Depéret & Mazeran, 1912
Euestheria dawsoni (Jones, 1870) Pruvost, 1919

Comment. The species *dawsoni* was assigned to the genus *Estheria*, *Pseudestheria* or *Euestheria* according to the authors. The latter assignment currently prevails; however, due to the absence of a distinctive ornamentation pattern, Raymond (1946) mentioned that the species most probably belongs to the Limnadiidae, as it has a large umbonal region / larval carapace, conspicuous in the Jones' specimens.

MGL 1899-A: Right valve illustrated as *Estheria dawsoni* in Pruvost, 1919, pl. XXIV, fig. 27.
Loc.: "Dressant" at 523 m in the "bowette" 1303, Pit 13, Concession of Lens, Group of Lens (Pas-de-Calais, France).
Lithost.: Anzin Formation, Meunière Member.
Chronost.: Carboniferous, Westphalian B.

MGL 1900: Right valve illustrated as *Estheria dawsoni* in Pruvost, 1919, pl. XXIV, fig. 25.
Loc.: Coal seam n° 6, Pit 4, Concession of L'Escarpelle, Group of Douai (Nord, France).
Lithost., chronost.: As for the specimen MGL 1899-A.
Comment. The sample MGL 1900, relocated by us in the collections, had the same numbering and the same locality as in the Pruvost's publication. However, neither one of the four fragments of mudstone, which comprise the sample, corresponded to the specimen illustrated in this latter publication.

MGL 1901-1: Right valve illustrated as *Estheria dawsoni* in Pruvost, 1919, pl. XXIV, fig. 26.
Loc.: Coal seam Bernicourt, Pit Notre-Dame, Concession of Aniche, Group of Douai (Nord, France).
Lithost., chronost.: As for the specimen MGL 1899-A.

MGL 6028-1: Left valve illustrated as *Estheria dawsoni* in Pruvost, 1919, pl. XXIV, fig. 24.
Loc.: Thirth parasequence in lower part of the Désirée coal seam, Pit 4, Concession of Meurchin, Group of Lens (Pas-de-Calais, France).
Lithost.: Flines Formation, Olympe Member.
Chronost.: Carboniferous, Westphalian A.

? Euestheria simoni (Pruvost, 1911) Pruvost, 1919

Comment. The species *E. simoni*, similarly to *E. dawsoni*, was first assigned to the genus *Estheria* or *Pseudestheria*, due to the absence of a conspicuous ornamentation. Defretin-Lefranc (1970) described then the reticular ornamentation of this species. Based on our newly investigated specimens, we suggest that the taxon most probably belongs to the Palaeolimnadiidae, because of its large and smooth umbonal regions. However, a more accurate and detailed study is necessary for modifying the assignment, to Palaeolimnadiidae or to Euestheriidae.

MGL 1892: Group of valves (Paratype of *Estheria simoni* in Pruvost, 1919, pl. XXIV, figs. 30-32; Corsin, 1932, pl. XXXIX, figs. 1-5).
Loc.: Deepest mine gallery 2001, roof of the coal seam Beaumont, Pit 8, Concession of Lens, Group of Lens (Pas-de-Calais, France).
Lithost.: Bruay Formation, Dusouich Member.
Chronost.: Carboniferous, Westphalian D.

MGL 6029: Left valve (Holotype of *Estheria simoni* designed by Pruvost, 1911, pl. I, figs. 4-8; Pruvost, 1919, pl. XXIV, fig. 29; Piveteau, 1953, p. 264, pl. I).
Loc.: "Bowette" 811, "voie de fond" n° 2187, roof of the coal seam Beaumont, Pit 8, Concession of Lens, Group of Lens (Pas-de-Calais, France).
Chronost.: Carboniferous, Westphalian C.

MGL 6030: Right valve (Paratype of *Estheria simoni* in Pruvost, 1911, pl. I, fig. 5).
Loc.: Roof of the coal seam Beaumont, Pit 3, Concession of Liévin, Group of Liévin (Pas-de-Calais, France).
Chronost.: Carboniferous, Westphalian C.

MGL 6031: Left valve (Paratype of *Estheria simoni* in Pruvost, 1911, pl. I, fig. 6).
Loc.: Roof of the coal seam Marie, Pit 9, Concession of Courrières, Group of Hénin-Liétard (Pas-de-Calais, France).
Chronost.: As for the specimen MGL 6030.

MGL 6032: Left valve (Paratype of *Estheria simoni* in Pruvost, 1919, pl. XXIV, fig. 31).
Loc.: Coal seam Beaumont, Concession of Lens, Group of Lens (Pas-de-Calais, France).
Chronost.: Carboniferous, Westphalian?

MGL 6033-1: Left valve (Paratype of *Estheria simoni* in Pruvost, 1919, pl. XXIV, fig. 33).
Loc.: Roof of coal seam Beaumont, Pit 4, Concession of Liévin, Group of Liévin (Pas-de-Calais, France).
Lithost.: Bruay Formation, Dusouich Member.
Chronost.: Carboniferous, Westphalian D.

"Estheria" rimosa (Goldenberg, 1877)

Comment. Raymond (1946), who has been the principal revisor of this taxon, indicated, 1) that both species, *"Estheria" limbata* and *"E." rimosa,* were erected by Goldenberg (1877), and 2) that Pruvost and Waterlot speculated that *E. rimosa* was only a form of *E. limbata*, because they are often found together among the fossil assemblages. Raymond (1946) maintained the individuality of two different species, but assigned them to the genus *Pseudestheria*. Kobayashi (1954, p. 160, 165) renamed both taxa *Cornia* (?) *limbata* and *Euestheria rimosa*, respectively, but he provided no taxonomic details for justifying these taxonomic changes. Our specimens are totally devoted of structures in the umbonal area. That indicates that they differ from *Cornia* (?) *limbata*, the genus assignment of which remains however doubtful, as suggested by previous authors.

MGL 5101-1: Group of valves illustrated as *Estheria limbata* Goldenberg, 1877 in Waterlot, 1934, pl. VI, figs. 14-15-15a.
Loc.: Schiffweiler (Saarland, Germany).
Lithost.: Sarrelouis Formation in Göttelborn area.
Chronost.: Carboniferous, Lower Stephanian.

Superfamily ESTHERITEOIDEA Zhang & Chen in Zhang *et al*., 1976
Family FUSHUNOGRAPTIDAE Wang in Hong *et al*., 1974 Genus indet.
"Lioestheria" striata Münster in Goldfuss, 1826 emend. Pruvost, 1919

Comment. As discussed above, the taxonomy of the fossil Spinicaudata remains questionable at different hierarchical levels. One of these problematic taxa is the family Asmussiidae, which is an interesting group, defined on the straight, long dorsal margin and the strong angles at both ends and subcentral umbo. The original diagnosis (Kobayashi, 1954, as emended by Tasch, 1969) emphasized that it showed an ornamentation ranging from smooth, punctuate, radial lirae to alveolar. Chen & Shen (1985) assigned this family to the superfamily Estheriteoidea, due to its radial ornamentation, nevertheless, the type genus (*Asmussia*) and its type species (*A. membranacea* Pacht) both display a reticulate ornamentation. Furthermore, the species *L. striata* was included by Defretin-Lefranc (1970) in the genus *Pseudoasmussia* (the name of which was changed by Tasch (1987) into *Pseudoasmussiata*, due to the homonymy with *Pseudoasmussia* (Novozhilov, 1954)); nevertheless, many of the species of genus, including the type species (*P. grassmücki* Defretin-Lefranc, 1969), show a reticulate ornamentation. However, as the species *L. striata* exhibits a radial lirae ornamentation, its assignment to the genus *Lioestheria* Depéret & Mazeran (*sensu* Tasch 1969, neither in the sense of Kozur *et al*., 1981 or Holub & Kozur, 1981) might be justified. This possibility was already suggested by Pruvost (1919), Raymond (1946) and Kobayashi (1954). Further studies are necessary to understand to which genus belongs this species.

MGL 1896-1: Left valve illustrated as *Estheria striata* in Pruvost, 1919, pl. XXIV, fig. 20-20a; Corsin, 1932, pl. XXXVIII, fig. 6.
Loc.: "Bowette" 1302, second parasequence at the bottom of the coal seam n° 11, Pit 13, Concession of Lens, Group of Lens (Pas-de-Calais, France).
Lithost.: Vicoigne Formation, Modeste Member.
Chronost.: Carboniferous, Westphalian A.

MGL 6034-5: Right valve illustrated as *Estheria striata* in Pruvost, 1919, pl. XXIV, fig. 21; Corsin, 1932, pl. XXXVIII, fig. 7.
Loc.: Coal seam Saint-Charles, Pit 3, Concession of Meurchin, Group of Lens (Pas-de-Calais, France).
Lithost.: Vicoigne Formation, Modeste Member.
Chronost.: Carboniferous, Westphalian A.

MGL 6034-7: Left valve illustrated as *Estheria striata* in Pruvost, 1919, pl. XXIV, fig. 23; Corsin, 1932, pl. XXXVIII, fig. 9.
Loc., lithost., chronost.: As for the specimen 6034-5.

MGL 6034-12: Left valve illustrated as *Estheria striata* in Pruvost, 1919, pl. XXIV, fig. 22; Corsin, 1932, pl. XXXVIII, fig. 8.
Loc., lithost., chronost.: As for the specimen 6034-5.

Superfamily VERTEXIOIDEA Kobayashi, 1954
(*sensu* Zhang *et al*., 1976)
Family LIOESTHERIIDAE (Raymond, 1946) emend.
Holub & Kozur, 1981
Subfamily VERTEXIINAE Kobayashi, 1954
Genus *CORNIA* Lyutkevich, 1937
Cornia limbata (Goldenberg, 1877) Kobayashi, 1954

Comment. The revision of this specimen shows the presence of nodes in the umbonal area that support Kobayashi´s (1954) assignment of it to the genus *Cornia*.

MGL 5099: Group of valves illustrated as *Estheria limbata* Goldenberg, 1877 in Waterlot, 1934, pl. VI, figs. 13-13a-13b.
Loc.: "Bowette" of Hirschbach at 766.50 m (Saarland, Germany).
Lithost.: Sarrelouis Formation.
Chronost.: Carboniferous, Lower Stephanian.

Family PALAEOLIMNADIOPSEIDAE Defretin-Lefranc, 1965
Subfamily ANOMALONEMATINAE Novozhilov, 1958d
Genus *ANOMALONEMA* Raymond, 1946
Anomalonema reumauxi (Pruvost, 1911) Raymond, 1946

MGL 1886: Right valve (Paratype of *Estheriella reumauxi* Pruvost, 1911 in Pruvost, 1919, pl. XXIV, fig. 34; Corsin, 1932, pl. XXXIX, fig. 6; Tasch, 1960, pl. 42, figs. 2a-2b) (Fig. 4A).
Loc.: "Bowette" 167, Coal seam Arago, Pit 1, Concession of Liévin, Group of Liévin (Pas-de-Calais, France).
Lithost.: Bruay Formation.
Chronost.: Carboniferous, Westphalian C-D.
Comment. Defretin-Lefranc (1970) has indicated that the valve illustrated on her pl. 13, fig. 10 is identical to that of Pruvost (1919, pl. 24, fig. 34). Pruvost's valve corresponds to a specimen of our collections numbered MGL 1886 (Fig. 4A). That is in contradiction to the legend of plate 13 of Defretin-Lefranc (1970), the published number of which is 1884 (then, re-numbered MGL 6341). Evidently, the specimen of Defretin-Lefranc is the specimen number 1884 (= MGL 6341) (Fig. 4B) and differs from the specimen number 1886 (= MGL 1886) (Fig. 4A). Unfortunately, the specimen number 1886 was designated as the holotype of a new genus by Novozhilov (1958d) and renamed *Pierrepruvostia defretinae*. Subsequently, Chen & Shen (1985, p. 78-79) synonymized the genus defined by Novozhilov (1958d) with the genus *Anomalonema*.

MGL 1895: Right valve (Paratype of *Estheriella reumauxi* in Pruvost, 1911, pl. I, fig. 3).
Loc.: Roof of the coal seam Arago, Pit 9, Concession of Lens, Group of Lens (Pas-de-Calais, France).
Chronost.: Carboniferous, Westphalian C.

MGL 6340-2: Right valve (Paratype of *Estheriella reumauxi* in Pruvost, 1911, pl. I, fig. 2).
Loc.: Roof of the coal seam Arago, Pit 1, Concession of Liévin, Group of Liévin (Pas-de-Calais, France).
Chronost.: Carboniferous, Westphalian C.

MGL 6341: Right valve (Holotype of *Estheriella reumauxi* in Pruvost, 1911, pl. I, figs. 1-1a-1b; Pruvost, 1919, pl. XXIV, figs. 35-35a; Corsin, 1932, pl. XXXIX, figs. 7-7a; Tasch, 1960, pl. 42, figs. 3-4a-4b; Defretin-Lefranc, 1970, pl. XIII, fig. 10) (Fig. 4B).
Loc.: Roof of the coal seam Arago, Pit 12, Concession of Lens, Group of Lens-Liévin (Pas-de-Calais, France).
Lithost.: Bruay Formation, Dusouich Member.
Chronost.: Carboniferous, Westphalian D.
Comment. Defretin-Lefranc (1970) was mistaken about the number of the valve; she indicated n°1886 in her text, whereas this number is in reality 1884 (= MGL 6341). On the other hand, Tasch (1960) suggested that this specimen was identical to the specimen illustrated in pl. 1, fig. 16 of Pruvost (1911); this is probably another mistake, because this plate does not include 16 photos; and the identified figure is most probably 1a, and not 16.

Anomalonema pruvosti (Raymond, 1946)

MGL 1902-A: Right valve illustrated as *Estheria dawsoni* in Pruvost, 1919, pl. XXIV, fig. 28.
Loc.: Terris, Pit 6, Concession of Ostricourt, Group of Oignies (Nord, France).
Lithost.: Anzin Formation, Meunière Member.
Chronost.: Carboniferous, Westphalian B.

MGL 1902bis-A: Right valve illustrated as *Estheria dawsoni* in Pruvost, 1919, pl. XXIV, fig. 28bis.
Loc.: Roof of the 0.55 m-thick coal seam, Pit 5, Concession of Ostricourt, Group of Oignies (Nord, France).
Lithost., chronost.: As for the specimen MGL 1902-A.

We think that five other illustrated specimens were probably deposited in the Natural History Museum collection because this museum was the repository of the majority of the specimens of these publications. Up to now, these specimens have not been re-found. These five specimens encompass one specimen figured by Pruvost in 1911 (*Estheria simoni*, pl. I, fig. 7), two specimens figured by Pruvost in 1914 (*Leaia tricarinata*, pl. II, figs. 4-5; pl. II, figs. 6-7) and two specimens figured by Corsin in 1932 (as *Estheria mathieui*, pl. XXXIX, figs. 8-9; and *Leaia tricarinata*, pl. XXXVIII, fig. 1).

VI. — DISCUSSION AND CONCLUSION

This catalogue allows us to investigate the validity of many of the mentioned species. The investigated collection is constituted by nine species included in two suborders, four superfamilies, five families and five genera; among them, we revised two species of *Anomalonema,* one species of *Cornia*, one species of "*Estheria"*, two species of *Euestheria*, two species of *Hemicycloleaia,* and a species of *"Lioestheria"*. Our numerous collections, from different stratigraphic and geographical localities, demonstrate that several species, e.g., *Hemicycloleaia baentschiana* and *Euestheria simoni*, provide additional possibilities to develop detailed population (autoecological) studies, for defining intraspecific variations. On the other hand, as these type localities are closely related with the coal seams, the use of the Diplostraca in the parasequences provides new tools for the correlation and interpretation of the bearing sequences. This investigation also led to the re-discovery of Diplostraca with internal structures interpreted as "eggs" by Pruvost in 1919 (see MGL 1896-1 (Fig. 4C), MGL 6034-7 (Fig. 4D)). Moreover, our collections have yielded more specimens with "eggs", not yet illustrated, which might give additional informations about these types of enigmatic structures. It is completely possible that this collection is still concealing several specimens with other well-preserved soft parts (e.g., legs, claspers, furcas, shell gland, muscle scars and digestive tract; the previous global records of which were summarized by Zhang *et al*., 1990 and Shen & Schram, 2014). Fossil-Lagerstätten with well-preserved Diplostraca are known in Ireland (Orr & Briggs, 1999), from localities, the geology of which differs from that of our outcrops and their specimens with possible eggs.

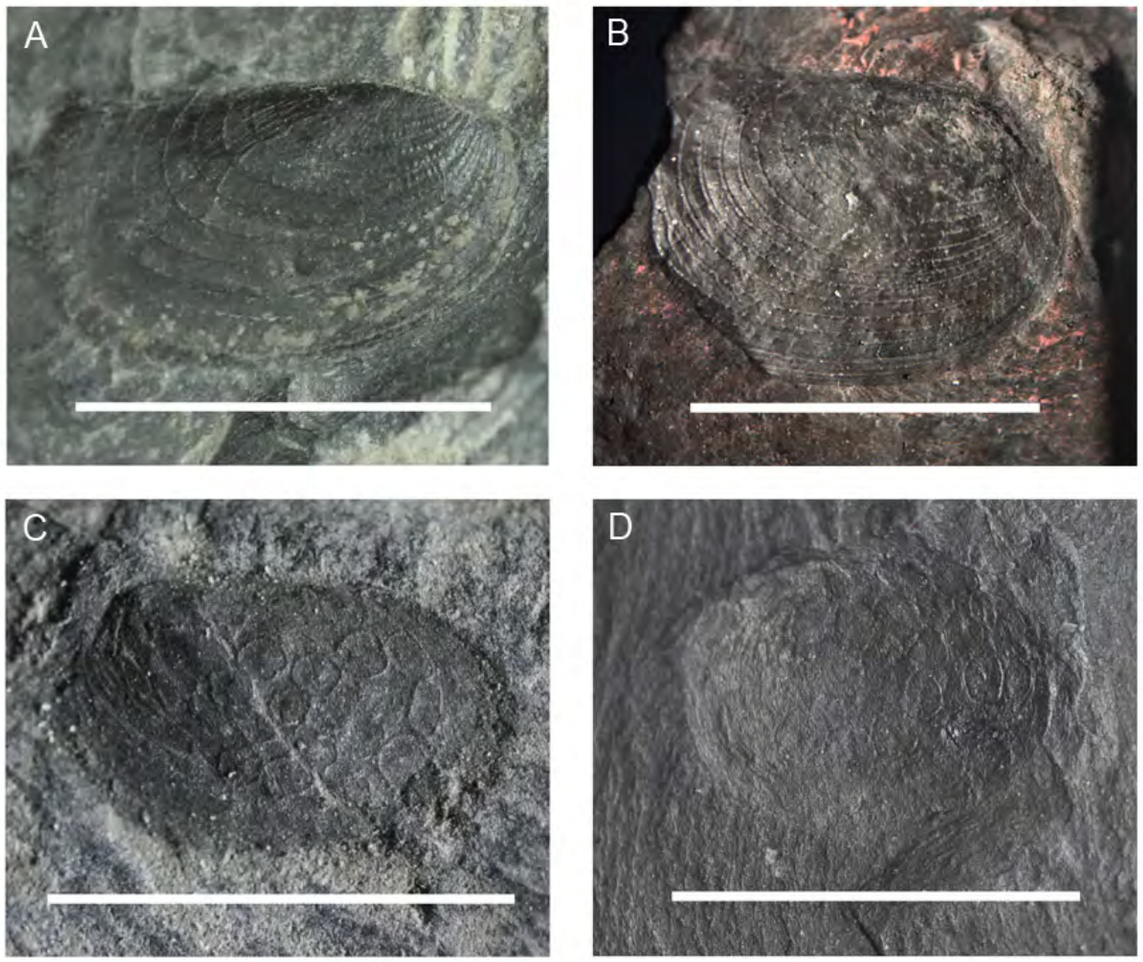


Fig. 4. - A - *Anomalonema reumauxi*, MGL 1886 (former number MHL 1886), Westphalian C-D. B - *Anomalonema reumauxi*, MGL 6341 (former number MHL 1884). Westphalian D. C - "*Lioestheria*" *striata* with internal structures interpreted by Pruvost as "eggs", MGL 1896-1, Westphalian A. D - "*Lioestheria*" *striata* with internal structures interpreted by Pruvost as "eggs", MGL 6034-7. Westphalian A. Scale bar represents 5 mm.

Fig. 4. *- A -* Anomalonema reumauxi, *MGL 1886 (ancien numéro MHL 1886), Westphalien C-D. B -* Anomalonema reumauxi, *MGL 6341 (ancien numéro MHL 1884). Westphalien D. C -* "Lioestheria" striata *avec des structures internes interprétées par Pruvost comme des "oeufs", MGL 1896-1, Westphalien A. D -* "Lioestheria" striata *avec des structures internes interprétées par Pruvost comme des "oeufs", MGL 6034-7. Westphalien A. L'échelle représente 5 mm.*

It must be noted that this catalogue only inventories a small portion of the Diplostraca of the collection, i.e., the types and illustrated specimens. Many of the specimens have been collected by the palaeontologists of Lille during the 20th century and could be useful in the study of morphological variability via morphometric tools. Diplostraca have been used as tools for the correlation and interpretation of the fossil-bearing sequences since the beginning of the mining industry. There is a large palaeontological collection of different groups from the Nord – Pas-de-Calais coalfield, with well-known type localities in the mine galleries. This large collection could permit further new biostratigraphical, palaeoecological and palaeoenvironmental investigations of the Pennsylvanian Diplostraca.

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