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DISUSED PALAEOZOIC REGIONAL STAGES FROM BELGIUM: DEVILLIAN, REVINIAN, SALMIAN, GEDINNIAN AND BURNOTIAN

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(2 figures)

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ABSTRACT. The current status of some Palaeozoic stratigraphic units named in Belgium and the North of France (French Ardennes), and used until recently, is examined. Following the decisions of the International Commission on Stratigraphy (ICS), notably Gradstein *et al* (2004)'s paper, the terms Devillian, Revinian, Salmian, Gedinnian and Burnotian should be avoided as chronostratigraphic units. The names Revin, Deville, Salm and Burnot could however be used to characterise lithostratigraphic units of Belgium and adjacent areas.

KEYWORDS: Chronostratigraphy, lithostratigraphy, Palaeozoic, Cambrian, Ordovician, Lower Devonian, Devillian, Revinian, Salmian, Gedinnian, Burnotian.

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1. Introduction

When nations started to map their country, they gave names deriving from local or regional terms to series of rocks having lithological similarities (the so-called "assises" in the Belgian literature). Later on, they dated these rocks by means of fossils and grouped some of these lithological units in stages or series, which also received either local names or those used in adjacent areas. Thanks to the progress of biostratigraphy, detailed works on geological correlations showed that the same chronostratigraphic units often received different names in various parts of the world. Standardisation is a matter of international agreement. The International Commission on Stratigraphy (ICS) belonging to the International Union of Geological Sciences (IUGS) faced this problem. This is the largest scientific body within the International Union of Geological Sciences and the only organisation concerned with stratigraphy on a global scale. One of its major objectives is the establishment of a standard, globally applicable stratigraphic scale, which it seeks to achieve through the co-ordinated contributions of a network of Subcommissions and Working Groups with a specific, limited mandate. Some of its statuary scientific goals are:

- the establishment and publication of a standard and global geological time scale and the preparation and publication of global correlation charts, with explanatory notes;
- the unification of regional chronostratigraphic nomenclature by organising and documenting stratigraphic units on a global database.

In 2004, Gradstein *et al.* published a new Geological Time Scale issued under auspices of the International Commission on Stratigraphy. This document points out that some chronostratigraphic units named in Belgium, northern France and the southern part of The Netherlands are retained as international terms (see part 1 of this book); however, for some units, the international status is still under discussion (see part 2 of this book). Some Belgian terms have lost their worldwide validity but can be used as European chronostratigraphic units (see part 3 of this book). At least, some terms should definitively be abandoned (part 4 of the book, this paper with regard to the former Palaeozoic units from Belgium and adjacent areas).

The regional terms that should be abandoned in the future as Palaeozoic chronostratigraphic units are examined hereafter. The reason why they are not retained as international stages is explained. The current status of these terms is also documented.

2. Devillian (Jacques VERNIERS)

2.1. Definition

The "Devillian" Stage was already referred to without naming it by Dumont (1836) and it received its name from Dumont (1847, 1848), as part of his "terrain ardennais". It was meant to comprise the lowermost stratigraphic units in the "assises" of Belgium and northern France,, containing green rocks in Deville (France) and purple to sometimes greenish rocks in Fumay (France), both localities situated in the Rocroi Massif.
It was described further in greater detail and subdivided in "assises" and "sous-assises" in the Lower Palaeozoic inliers of Belgium and surrounding areas, called "massifs" (Rocroi, Stavelot and Brabant) by Gosselet (1888), Lohest & Forir (1899), Corin (1926), Geukens (1950, 1986, 1999), Graulich (1954) and Beugnies (1960a, b). In the lithostratigraphic scale of Belgium of 2001, it is elevated to the level of a lithostratigraphic group: the Deville Group (Verniers *et al.*, 2001).

2.2. Why the Devillian is not an international stage

The "Devillian" was defined as a local chronostratigraphic unit. However, chronostratigraphic terms are defined by their limits which are based on boundaries of biozones (biostratigraphy) (Hedberg, 1976). The "Devillian" contains few fossils: only the ichnofossil genus *Oldhamia* and acritarchs (Vanguestaine, 1974). The boundaries of the "Devillian" were not defined in terms of biozones. Hence it could not be proposed as an international chronostratigraphic unit, because only acritarchs and an ichnofossil were present to correlate with other units elsewhere in the world. The fossil groups often used for Cambrian biostratigraphy, archaeocyathids or trilobites, are missing in Belgium. Correlations in the literature of the Devillian t from one area or "massif" to another, were based mainly on lithological characters and additionally by the presence of the ichnofossil *Oldhamia*. In practice the Devillian was treated as a lithostratigraphical unit.

The name "Devillian" has no historical priority over the term Lower Cambrian because the term "Devillian" was defined in 1847. The term Cambrian System (both words) was already defined in fossil rich strata of Wales by Sedgwick & Murchison in 1835. This is even before the first mentionof the unit (without naming) it by Dumont in 1836.

2.3. The status of the name

The term "Devillian" should be avoided because it was defined mainly as a higher-ranking lithostratigraphic unit. Instead the lithostratigraphic term Deville Group should be used. An overview of the formations and members included in the Deville Group is summarised

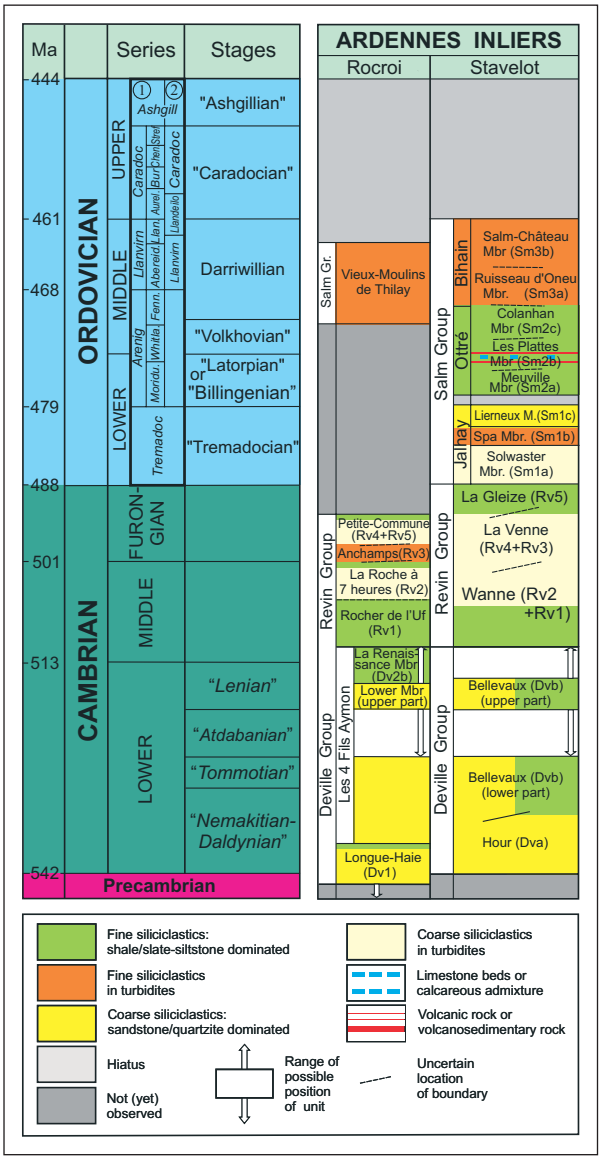

Figure 1. Chronostratigraphic scale of the Cambrian and the Ordovician of the Ardennes inliers with corresponding lithostratigraphic units.

in Verniers *et al.* (2001) and illustrated in Fig. 1. Dating with the ichnofossil *Oldhamia* and more accurately with acritarchs placed the "Devillian" in the Lower Cambrian. Chronostratigraphically it is placed in the Lower Cambrian Series and it has an early Cambrian age.

3. Revinian (Jacques VERNIERS)

3.1. Definition

The "Revinian" Stage was already referred to without giving it a name by Dumont (1836). Dumont (1847, 1848) subsequently named it as part of his "terrain ardennais". It was meant to compris black slates and dark quartzites around the city of Revin (France) and the village of

Bogny (France), both localities situated in the south of the Rocroi Massif.
It was described in greater detail and subdivided in "assises" and "sous-assises" in the Lower Palaeozoic inliers of Belgium and surrounding areas, called "massifs" (Rocroi, Stavelot and Brabant) by Gosselet (1888), Lohest & Forir (1899), Corin (1926), Geukens (1950, 1986, 1999), Graulich (1954)and Beugnies (1960a,b). In the lithostratigraphic scale of Belgium (2001), it is elevated to the level of a lithostratigraphic group: the Revin Group (Verniers *et al.*, 2001).

3.2. Why the Revinian is not an international stage

The "Revinian" was defined as a local chronostratigraphical unit. However, as discussed above for the "Devillian", chronostratigraphical terms are defined by their limits, which are based on boundaries of biozones (Hedberg, 1976). The boundaries of the "Revinian" were not defined originally in terms of biozones. Therefore it is not appropriate to propose it as an international chronostratigraphical unit. Correlations in the literature of the "Revinian" from one area or "massif" to another were based mainly on lithological characters. In practice then it was treated as a lithostratigraphical unit., Acritarchs were discovered for the first time in 1967 in the Revin Group by Vanguestaine whoused them to date the different formations and members of that group (see Vanguestaine, 1992).
The name "Revinian" has no historical priority over the term Middle and Upper Cambrian, because the term "Revinian" was defined in 1847. The term Cambrian System (both words) was already defined in fossil rich strata of Wales by Sedgwick & Murchison in 1835. This is even before the first mention of the unit (without naming it) by Dumont in 1836.

3.3. The status of the name

The term "Revinian" should be avoided because it was defined primarily as a higher-ranking lithostratigraphic unit. Instead the lithostratigraphic term Revin Group should be used. An overview of the formations and members included in the Revin Group are summarised in Verniers *et al.* (2001) and illustrated in Fig. 1. Dating with acritarchs placed the "Revinian" in the Middle and Upper Cambrian Series without reaching the uppermost part of it. Chronostratigraphically it is placed in the Middle and the Upper Cambrian Series and hence it has a mid to late Cambrian age.

4. Salmian (Alain HERBOSCH)

4.1. Definition

The word "Salmian" refers to the River Salm, which crosses the southern part of the Stavelot Massif from SE to NW. The "Salmian" Stage was already referred to without naming it by Dumont (1832). It received its name from Dumont (1847 p. 18), the "système salmien", as part of his "terrain ardennais". It was meant to comprise the lowermost stratigraphic units in Belgium subdivided in "système devillien", "système revinien" and "système salmien". At that time, the upper "système salmien" was only known in the Stavelot Massif and was characterised by green and red slate and shale. Later, this stage was also used in the Brabant Massif (Légende de la carte géologique de Belgique, 1892; Malaise, 1910; Fourmarier, 1920; de la Vallée Poussin, 1931) based mainly on lithological correlation,.
It was described in more detail and subdivided into "assises" and "sous-assises" (Sm1a,b; Sm2a,b,c; Sm3a,b) in the Lower Palaeozoic inliers of Stavelot (called «Stavelot Massif») by Gosselet (1888), Lohest & Forir (1899), Geukens (1950, 1986, 1999), Graulich (1954). The presence of the "Salmian" in the Rocroi inlier was only recently proved (Roche *et al.,* 1986). In the lithostratigraphical scale of Belgium of 2001, it is elevated to the level of a lithostratigraphical group: the Salm Group (Vanguestaine, 1992; Verniers *et al.*, 2001).

4.2. Why the Salmian is not an international stage

The "Salmian" was defined as a local chronostratigraphical unit. However, as noted above for the "Devillian" and "Revinian", chronostratigraphical terms are defined by their limits, which are based on boundaries of biozones (Hedberg, 1976). The Salmian contains more fossils than the "Devillian" and "Revinian". At the base, graptolites (*Rhabdinopora sp.)* have been described since the 19th century (Malaise, 1866); more recently, acritarchs (Vanguestaine, 1974, 1986, 1992, 2004; Vanguestaine & Servais, 2002) and chitinozoan (Verniers *et al.*, 2004); and very recently, conodonts were described (Vanguestaine *et al., 2004).* However, the boundaries of the "Salmian" were also not defined in terms of biozones. Hence it could also not be proposed as an international chronostratigraphical unit, because of the absence of fossils. Correlations in the literature of the "Salmian" from one area or "massif" to another were based mainly on lithological characters and only additionally by the presence of the graptolites. In practice it was treated as a lithostratigraphical unit.

4.3. The status of the name

The term "Salmian" should be avoided because it was defined primarily as a higher-ranking lithostratigraphic unit. Instead the lithostratigraphic term Salm Group should be used. An overview of the formations and members included in the Salm Group is summarised in Verniers *et al.* (2001) and illustrated in Fig. 1. Dating with graptolites and more accurately with acritarchs and chitinozoans raised the "Salmian" from the Lower Ordovician (Tremadocian) to the Middle to Upper Ordovician (late

Darriwillian, but a late Llanvirn to early Caradoc age can not be excluded; Vanguestaine *et al.*, 2004; Vanguestaine, 2004). Chronostratigraphically, it is placed in the Lower and Middle (Upper?) Ordovician Series and hence it has an early to mid (Upper?) Ordovician age.

5. Gedinnian (Philippe STEEMANS)

5.1. Definition

The name Gedinnian was introduced by Dumont (1847). The small village of Gedinne used as the type area for this "stage" is located in southern Belgium, close to the border with France, on the south-east flank of the Cambro-Ordovician Massif of Rocroi.
Dumont (1847, 1848) described the main unconformity, which divides the Palaeozoic rocks of the Ardenne, Belgium, into two large lithostratigraphic units. The layers below the discordance were named "Terrain Ardennais" and those above the discordance "Terrain Rhénan" or Lower Devonian. The latter was subdivided into three "systems" for which no stratotypes have ever been clearly designated. They are, in stratigraphic order: the "Gedinnian System", the "Coblentzian System" and the "Ahrian System" (Fig. 2).
The base of the "Gedinnian System" was drawn at the base of the conglomerate which overlay the unconformity. The top was set at the base of the "Coblentzian System", characterised by the first appearance of white, grey or bluish sandstones (this "system" was later called the "Siegenian stage" by de Dorlodot, 1900 – Fig. 2).
Subsequently, various authors created new lithostratigraphic subdivisions of these systems (Asselberghs, 1944, 1945, 1946, 1954; de Dorlodot, 1900; Godefroid *et al.* 1994; Gosselet 1868, 1880, 1888; Maillieux, 1910, 1932, 1940; Maillieux & Demanet, 1929).
In the area of Gedinne, layers previously attributed to the "Gedinnian" are subdivided into four formations (Godefroid *et al.*, 1994). They are in stratigraphic order: - the Fépin Formation composed of conglomerates, breccias, sandstones, siltstones and shales; the Mondrepuis Formation composed mainly of blue shales with numerous marine macrofossils like lamellibranchia, brachiopods, trilobites etc.; the Oignies Formation characterised by the red colour affecting the different lithofacies (sandstones and shales); and the Saint Hubert Formation composed of thick intervals of green and blue shales with intercalations of green and pale sandstones.
The Gedinnian sediments are considered to have accumulated in continental to near shore basins. The scarcity of marine fossils prevented accurate biostratigraphic subdivision. In addition, palynological research on dispersed miospores (Steemans, 1989b) has demonstrated that most of the Lower Devonian layers are diachronous through the Ardenne. This is particularly clear for both the base and the top of the Gedinnian.

5.2. Why the Gedinnian is not an international stage

As described here, the Gedinnian is essentially a lithostratigraphical unit delimited at its base by a major discordance. The absence of marine fossils prevents accurate subdivision of the unit and international correlation (especially with sediments deposited in marine environments). Regional correlations based on miospores have demonstrated that the boundaries of the Gedinnian are diachronous (Steemans, 1989a,b). For all those reasons, it is undesirable that the Gedinnian be considered as an international stage.

5.3. The status of the name

The term "Gedinnian" should be avoided because it was defined predominantly using lithostratigraphic characteristics. It could however be used in a lithostratigraphic sense.
The Gedinnian deposits have been correlated with the Lochkovian deposits of Brittany where miospores are found together with other marine micro- and macrofossils. Thanks to these correlations, it has been demonstrated that the "Gedinnian" of the Southern Ardenne corresponds more or less to the Lochkovian Stage from the Klonk stratotype in the Czech Republic (Steemans, 1989b). However, the base of the "Gedinnian" is somewhat younger than the base of the Lochkovian and the top of the Gedinnian is close to the top of the Lochkovian.
An overview of the formations and members included in the Lower Devonian is published in Godefroid *et al.* (1994).

6. Burnotian (Léon DEJONGHE)

6.1. Definition

The name "Burnotian" is derived from the River Burnot, a small tributary of the River Meuse, which flows into the Meuse at the village of Rivière situated between the localities of Profondeville and Annevoie-Rouillon. The term "Poudingue de Burnot" was used for the first time by d'Omalius d'Halloy (1839 p. 449). de Beaumont (1841) considered that it corresponded to all the Lower Devonian of the Ardenne. Gosselet (1873), however, referred it to the "Système du Poudingue de Burnot" restricting, however, its stratigraphic range to the top of the Lower Devonian. From the beginning, this unit was defined as a lithostratigraphical formation. It is mainly made up of red, coarse-grained sandstones and conglomerates, with frequent tourmalinite pebbles occurring in lenticular beds interlayered with red and less frequently green shales. Plant remains may occur in the shales. Other fossils are lacking. This unit extends at the N and NE limbs of the Dinant Synclinorium, up to the Xhoris Fault.

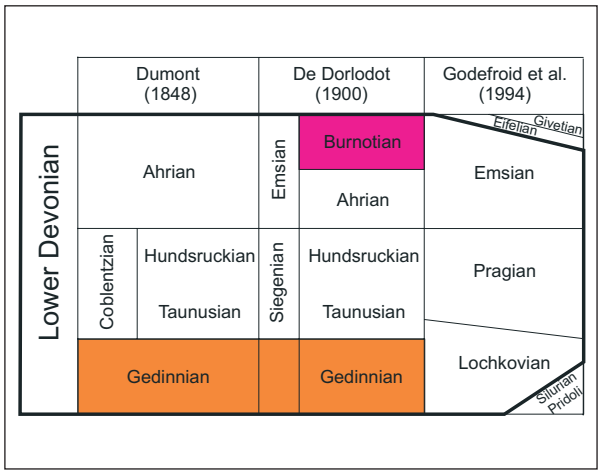

Figure 2. Stratigraphic divisions of the Lower Devonian.

The term "étage burnotien" was used for the first time in 1892, in the first "Légende de la carte géologique de Belgique". Later on, "poudingue de Burnot", "assise burnotienne" and "Burnotien" were considered as synonymous. An historical review of the "Poudingue de Burnot" concept as well as its stratigraphic position and composition is given on pages 53 and 54 of the "Lexique stratigraphique international (1957)". It is however erroneously mentioned in this book that Elie de Beaumont created the name (See also the updated historical review by Stainier (1994) who introduced the concept of the Burnot Formation). Since Kaisin *et al.* (1922), although no biostratigraphical dating has ever been performed, this unit is considered as being of Upper Emsian in age (Fig. 2). Its upper part could perhaps also be of Eifelian age.

6.2. Why the Burnotian is not an international stage

Due to the absence of fossils (except plant debris without any stratigraphical value), it is impossible to determine biostratigraphical limits (based on boundaries of biozones) for this unit. Up to now, all attempts to date this unit have failed. "Burnotian" is a purely lithostratigraphical concept without any chronostratigraphical implications and cannot be considered as a stage.

6.3. Status of the name

The word "Burnotian" should definitively be avoided as a chronostratigraphical unit. The name "Burnot" is however used to characterise a lithological formation, the Burnot Formation, belonging to the Lower Devonian (Stainier, 1994; Bultynck & Dejonghe, 2001).

7. Conclusions

Following the decisions of the International Commission on Stratigraphy (ICS), notably Gradstein *et al* (2004)'s paper, the terms Devillian, Revinian, Salmian, Gedinnian and Burnotian should be avoided as Palaeozoic chronostratigraphical units. The terms Deville, Revin, Salm and Burnot are however valid terms to use as lithostratigraphical units in Belgium and adjacent areas (see Guide to a revised lithostratigraphic scale of Belgium, Bultynck & Dejonghe, eds, 2001).

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