STRUNIAN

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(2 figures)

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ABSTRACT: The uppermost Famennian Substage or Strunian has been used widely and internationally in a chronostatigraphic sense since the nineteenth-century based on macrofossils described from the Etrooeungt area and fauna. A new definition based on microfossils with distinct reference sections for neritic and pelagic facies is proposed to International agreement.

KEYWORDS: Strunian, uppermost Famennian, Etrooeungt, macrofauna, microfauna, microflora, reference sections, neritic, pelagic


1. Name

Strunian (English), Struniaan (Dutch), Strunium (German), Strunien (French).

2. Age

This uppermost Substage of the Famennian (see #5) ranges from about 363 to about 360 Ma (Trapp et al. 2004)

3. Author

The term “Strunien” was introduced by de Lapparent (1900, p. 860) and later considered as a stage by Barrois (1913, p.16) and Mailleux & Demanet (1928). (See also Brice & Mistiaen 2003)

4. Historical type area

As stated by Sartenaer (1997) “the Strunian rests upon solid foundations”, the Etrooeungt Limestone (“Calcaire d’Etrooeungt”), of which the stratotype is located in the Parcq quarry in Etrooeungt near Avesnes (Department of the North, France).

The geological map of France (Avesnes, 1:50,000 edition 1967, revision Delattre, Polvèche, Waterlot) uses the term “Strunien” with the connotation “h.a.”. Conil et al. (1964) and Conil & Lys (1980) proposed the Avesnelles railroad trench as a parastratotype.

5. Description

The 24.05 m thick Etrooeungt Limestone has been described bed by bed by Gosselé (1857), formally named “schistes et calcaire d’Etrooeungt” by the same author in 1860 and the description updated by Sartenaer & Mamet (1964). Later, Mamet et al. (1965) suggested to extend lower the base of the Strunian to the first appearance of the foraminifer Quasenoodya kobeitana. Conil et al. (1976) proposed an even lower base, at the first appearance of the miospore Retispora lepidophyta.

6. Historical background

The terms Strunian and Etrooeungt have been (and are still) used widely and internationally (Fig. 1) in a chronostatigraphic sense for beds containing a transitional fauna between the late Devonian and early Carboniferous (Nicolin & Brice, 2004). Until 1990, Franco-Belgian and Russian authors have often considered the Strunian as belonging to the lowermost part of the Carboniferous System in opposition with the proposals made at the Heerlen Congress (1935) which were accepted generally by the German authors. The I.U.G.S. Devonian–Carboniferous Working Group (Paproth & Streel, 1984), after more than ten years of activities, recommended a GSSP for the base of the Carboniferous System at the base of Bed 89 of the section La Serre (Montagne Noire, southern France), i.e. at the base of the conodont Siphonodella sulcata in a section displaying an evolutionary lineage of S. praesulcata to S. sulcata. A decision was ratified by the
I.U.G.S in 1990 (Paproth et al., 1991). This stratigraphic level has become consequently the top of an uppermost Famennian Substage. 
For several years, an informal international Working Group has been considering a definition for the base of this Substage (Streel et al., 1998). The most recent proposal (Streel, 2004) made during the 2004 International Congress at Florence (Italy) and still to be ratified by postal ballot by the Titular Members of the Subcommission on Devonian Stratigraphy, was to define the base of the uppermost Substage of the Famennian at the base of the conodont zone Late expansa which is considered by Streel et al. (2004) to be an equivalent of the base of the foraminifer Quasiendothyra kobeitiana kobeitiana Zone.

7. Lithology
See Famennian, Thorez et al., same volume.

8. Sedimentology
See Famennian, Thorez et al., same volume.

9. Palaeontology
The Etroeungt macrofossils are traditionally described (See Dehé, 1929; Lemaitre, 1933) as the Etroeungt Fauna. During Strunian time, the Stromatoporoids in Western Europe (according to B. Mistiaen), begin to recover diversity after a large regression which started before the Frasnian/Famennian (F/F) boundary. All the recognized genera typically belong to the stromatoporoid assemblage n°3 (Stearn, 1987; Stearn et al., 1987; Cockbain, 1989; Mistiaen & Weyer, 1999) with only genera already present during Givetian and Frasnian. Stromatoporoids of the Order Clathrodictyida are the most frequent, particularly

**Figure 1.** Geographical distribution of Strunian outcrops with brachiopods, goniatites and foraminifers fauna (after Brice & Mistiaen, 2003, Fig. 13).
genera such as _Anostylostroma_, _Atelidiictyon_, _Clathroidictyon_, _Gerronostroma_ (and probably _Petridiostroma_ and _Schistodictyon_) but some other genera _Clathrocodula_, _Sromatospora_, _Trupostroma_ are also present. The dendroid genus _Amphilopora_ considered for a long time to be extinguished at the F/F boundary (Kellwasser event), is also present (Mistraen, 1997).

The Tabulate coral fauna (according to B. Mistraen), largely developed during Givetian and Frasnian, is poorly represented during the Upper Famennian. Only _Yavorscia_ and several species of _Syringopora_ are usually observed (Tourneur et al., 1989).

Concerning the Rugose Corals from the Etroeungt area (according to J.C. Rohart, in Milhau et al., 1997), Carpenter, Vaughan, Salée and Dehé gave sketches or short descriptions. Names given below refer to these works but need further systematic revisions. Most species are: _Clisophyllum malaisii_ Haime, _Clisophyllum sp._ _Campophyllum flexuosum_ (Goldfuss), _Campophyllum sp._ nov. Poty, 1984 (pl. 2, fig. 4), _Paleosmita aquagranensis_ (Frech), _Caminia dorlodoti_ Salée in Dehé, 1929 (non Salée, 1912),_Tabuloplium_ sp. nov. Poty, 1984 (pl. 1, fig. 8 a-b)

Recently (Poty et al., in press) wrote that, in the Namur-Dinant Basin, the first marked radiation of Rugosa started in the upper part of the _Eoendothyra regularis_ Foraminiferal Zone, approximately at the base of the Strunian Substage sensu Conil et al. (1986). This radiation marks the base of the RC0 Zone. It is characterized by the appearance of _Clisophyllids_ (i.e. corals developing an axial structure of clisophyllid type, a character usually typical of Carboniferous taxa), and of _Campophyllum Milne-Edwards & Haime_. Most of these rugose coral species disappeared in the lower part of the _Eoendothyra_ “with radial inner layer” Foraminiferal Zone but some gave rise to those reappearing in a second radiation, from the uppermost _Eoendothyra_ “with radial inner layer” Foraminiferal Zone to the lower part of the _Quasiendothyra koeiteusana_ Foraminiferal Zone.

The most common corals of the second radiation are _Campophyllum flexuosum_ (Goldfuss), _Campophyllum gosseleii_ Weyer, _Clisophyllum malaisii_ Haime, _Dibunophyllum praecursor_ Frech, and _Paleosmita aquagranensis_ (Frech), the latter two being homeomorphs of _Viséan_ Rugosa. These two distinct coral radiations allow the recognition of the two new subzones RC0α and RC0β, the last one encompassing the new suggested Strunian base defined higher in 5. Unfortunately Famennian coral faunas are almost entirely endemic, and corals found in other parts of Eurasia usually belong to other taxa.

Among the Brachiopods (according to D. Brice), Orthids, Athyrids and Spiriferids are found in the Strunian with some species belonging to genera known from the upper Devonian (Frasnian and Famennian) and in some cases from below such as _Schizophroria_, _Aulacella_, _Compsisa_, _Cleithrydina_, _Crytina_, _Cyrtospirifer_. These taxa are associated with several genera, which occur, in the latest Famennian such as _Lamelloathyris_, _Prospira_ ( _Prospira struniana_ Gosselet, 1879, in Brice, 1997),_Sphenospira_ (determination J.P. Nicollin). Rhychnonellids are usually rare and they are represented by _Centrokhynus_ which appears in the upper Famennian and _Arratella_ (an index genus of Strunian according to Sartenën & Płodowski, 2003). Chonetids and strophomenids are well represented at some levels. Among the Productids, _Legrand-Blain_ (1990) and _Legrand-Blain_ (in Mistraen et al., 1998), recognize: (?)_Mesopica_ (i.e.) _nigerasformis_, _Spinocarinifera_ (_Spinocarinifera_) aff. _lotzi_, _Spinocarinifera_ (_Seminicella_)?, _Semi productus irregularicostatus_ in the Strunian.

10. Chronostratigraphy

See Famennian, Thorez et al., same volume.

11. Geochronology

See Famennian, Thorez et al., same volume.

12. Structural setting

See Famennian, Thorez et al., same volume.

13. Reference sections

1. In the Chanxhe section (Ourthe valley, eastern Belgium) the Late _expansa_ conodont Zone is present but, until very recently, the base of the zone was unknown in the area. However new data from the Refrath 1 borehole (Bergisches Land, western Germany) now fills this gap in our knowledge. The conclusion is that the base of the Late _expansa_ conodont Zone and the base of the _Q. k. koeiteusana_ (DF3ε) foraminifer Zone are obviously much closer than previously thought. The Chanxhe section may be considered therefore as an excellent reference section for the neritic facies where correlation with continental facies by miozones is well documented. Such correlation can be applied to widespread regions in Eurasia (Fig. 2) particularly in Belarus and Timan-Pechora (Durkina, Dreesen & Strel, in Strel 2001, tab. 2).

2. The base of the Late _expansa_ Zone has been intensively investigated in the Carnic Alps by Perri & Spalletta (1998 and new unpublished data). Four sections are studied: Rio Boreado (RB), Casera collinita di Sotto A (CSA), Malpasso (ML) and Sentriro Storic A (SSA). In all four sections, _Bispathodus ultimus_, _Pseudopolygnathus marburgensis_ trigericus and _Palmaetepis gracilis_ geniscymeniae occur at the same level. The Malpasso section (Spalletta & Perri 2001), which also contains ammonoids (Korn 1998), might serve as a reference section for the pelagic facies. However, the correlation between the base of the _late expansa_ and the base of the Wocklumeria Zone is still uncertain. Although this correlation has been suspected
Figure 2. Geographical distribution of characteristic foraminifers and miozones of the Strunian substage (after Streel et al., 1998, Fig. 3).

\textbullet\ Retispora lepidophyta Zones
\textasteriskcentered Quasiendothrya kobeitusan Zone

for a long time, it is however not conclusively demonstrated that the "Wocklum German Stufe" base can be correlated with the latest Middle or with the earlier Late \textit{expansa} Zone.

The geographical distribution of Strunian outcrops is shown in figure 1.

14. Main contributions

Regarding the old original concept of the Etroeugnt or Strunian we recommend the following papers: Conil \textit{et al.} (1964), Conil & Lys (1980), Gosselet (1857), Lemaître (1933), Mamet \textit{et al.} (1965), Sartenaer & Mamet (1964).


References


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