

**Strud: old quarry, new discoveries.
Preliminary report**
**[Strud : Nouvelles découvertes dans une vieille carrière.
Étude préliminaire]**

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1. Introduction

The Strud quarry is located in the uppermost levels of the Dinant Synclinorium, Belgium. It exposes a part of the Upper Famennian (Upper Devonian) "Condros sandstones", composed mainly of fine-grained, more or less micaceous, arkosic sandstones interlayered with thin shale or siltstone beds and, but rarely, with dolomite beds (these may occur either as evaporites or as immature dolcrete) (THOREZ & DREESEN, 1986).

In Belgium, most of the fossil-bearing beds in "Psammites du Condros" are found in the Evieux Formation (FAIRON-DEMARET, 1996). The quarry was first investigated by HOCK (1878). He mentioned only the presence of remarkably well-preserved specimens of *Rhacophyton condrosorum* CRÉPIN, 1875. STOCKMANS, in 1948, published a monograph on the Upper Devonian plants of Belgium. He described several localities, including Strud. The aim of the present study is to update the data set concerning Strud and to date the quarry correctly.

2. Biostratigraphy

The Strud quarry has been recently and densely sampled for miospores. Two samples have provided a miospore association that preliminary study has indicated surprisingly to be the Lower GF spore biozone characterized by *Grandispora gracilis-Grandispora famenensis*. Commonly, this biozone dates the Monfort Formation which in other areas of the Dinant Synclinorium lies below the Evieux Formation. Here, the Evieux Formation is dated by the slightly younger VCo (*versabilis cornuta*) biozone and by the lithology described above.

Taking into account the actual Strud lithology and its miospore association, one may conclude that the sequence exposed in the quarry is in reality facies of an Evieux type and does correspond biostratigraphically to the Evieux Formation as was thought previously: the data clearly demonstrate that the Evieux facies has a diachronous character dependent on Upper Famennian palaeogeography (THOREZ *et alii*, 2006).

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3. Fossil remains

The quarry has yielded various fossil remains. An important vertebrate assemblage including a mandible of the early tetrapod *Ichtyostega* (CLÉMENT *et alii*, 2004) has been found. The palaeozoological material found in the quarry is currently under study by Gaél CLÉMENT (Museum d'Histoire Naturelle, Paris).

The outcrop has also yielded plant remains. The first collection was made by F. STOCKMANS before 1950 and is housed at the Institut Royal des Sciences Naturelles de Belgique. The fossils are preserved as strongly oxidized, red- to brown-coloured compressions. The state of preservation does not allow any anatomical study.

The second collection (Pl. 1, figs. 1-7) is newly collected material and is housed in the collections of the University of Liège. The plants are less well-preserved than the older specimens. This can be explained by the fact that the Strud quarry has not been exploited for more than 100 years. The outcrop has thus been exposed to weathering processes for a long time.

STOCKMANS's floristic index mentions 5 taxa for the quarry. All are classical members of the "Eviex flora" (STOCKMANS, 1948; FAIRON-DEMARET, 1996). This index is summarized in Table 1.

Zosterophylloside <i>Barinophyton citrulliforme</i>	Gymnospermes <i>Moresnetia zalesskyi</i> <i>Pseudosporogonites hallei</i>
Filicopside Zygopteridale <i>Rhacophyton condrusorum</i>	Incertae sedis <i>Cf. Calathlops sp.</i>

Table 1: Paleofloristic assemblage of Strud as described by STOCKMANS (1948).

Progymnospermes <i>Archaeopteris roemeriana</i>	Gymnospermes <i>Moresnetia zalesskyi</i> <i>Pseudosporogonites hallei</i> <i>Condrusia rumex</i>
Zosterophylloside <i>Barinophyton citrulliforme</i>	Incertae sedis <i>Cf. Calathlops sp.</i> <i>Sphenopteris flaccida</i> <i>Sphenopteris modavensis</i>
Filicopside Zygopteridale <i>Rhacophyton condrusorum</i>	

Table 2: Paleofloristic assemblage of Strud as determined in this work.

The new collection increases the floristic index of the locality to 9 taxa (Table 2). It shows the presence of nearly all important upper Devonian plant groups: Progymnosperms, Ferns, Gymnosperms and Barinophytes.

Progymnosperms:

Archaeopteris remains are the only representatives of this group (Pl. 1, fig. 1). In contrast with a number of Belgian localities (FAIRON-DEMARET, 1996), *Archaeopteris* remains are rare at Strud. Only three fragments have been recovered. The organisation of their axis and the shape of their leaves are characteristic of the species *Archaeopteris roemeriana* (GÖPPERT) *sensu* STOCKMANS, 1948. This species should probably be synonymised with *Archaeopteris halliana* (GÖPPERT) DAWSON, 1871 (FAIRON-DEMARET *et alii*, 2001).

Ferns:

This group is represented by *Rhacophyton condrusorum* (Pl. 1, fig. 4). It was the first plant to have been described from the quarry

(Hock, 1878). The remains of this plant consist of large rachis without fertile parts or vegetative endings. In other beds from the same quarry, Hock (1878) described very fine and well preserved *Rhacophyton* fertile parts.

Spermatophytes:

They consist of three different taxa: *Moresnetia zalesskyi* STOCKMANS, 1948, emend. FAIRON-DEMARET *et* SCHECKLER, 1987 (Pl. 1, figs. 6-7), *Condrusia rumex* STOCKMANS, 1948 (Pl. 1, fig. 3) and *Pseudosporogonites hallei* STOCKMANS, 1948 (see STOCKMANS, 1948, Pl. XI, fig. 18). *Moresnetia* and *Pseudosporogonites* dominate this assemblage.

4. Discussion

Based on megafossils only, the locality is attributed to Famennian biozone number 7 of EDWARDS *et alii* (2000). If a palynological age of mid GF is confirmed, the locality would represent the earliest occurrence of cupulate early seed plants, if we exclude the poorly understood Russian *Moresnetia* mentioned by JURINA (1988) in the OG Russian Frasnian miospore zone.



Plate 1:

figure 1. *Archaeopteris roemeriana* (GÖPPERT) STOCKMANS, ULg n° 15201, scale: 0.5 cm.

figure 2. *Sphenopteris modavensis* STOCKMANS 1948, ULg n° 15221, scale: 1 mm.

figure 3. *Condrusia rumex* STOCKMANS, ULg n° 15222, scale 1 mm.

figure 4. *Rhacophyton* sp. CRÉPIN, ULg n° 15203, scale 1 cm.

figure 5. *Sphenopteris flaccida* STOCKMANS 1948, ULg n° 15215, scale 5 mm.

figures 6-7. *Moresnetia zalesskyi* STOCKMANS, ULg n° 15216 and 15217, scales 0.5 mm.

The greatest diversity among the plants observed in the quarry is found in the spermatophytes, represented by 3 very different genera: the classical *Moresnetia zaleskyi*, and the less well-known *Condrusia rumex* and *Pseudosporogonites hallei*. These three seed-plant genera illustrate a wide range of morphological variation both in the cupule and in the integument (FAIRON-DEMARET & SCHECKLER, 1987; PRESTIANNI, 2005; PRESTIANNI *et alii*, 2006a), representing three distinct architectural schemes (HILTON, 1999; PRESTIANNI, 2005).

Such diversity in a group suggests a long evolutionary story. The origin of seed plants is thus presumably to be found earlier in the geological record. The description of the proto-seed *Runcaria heinzellinii* (GERRIENNE *et alii*, 2004), the discovery of a highly diversified Givetian megaspore assemblage (PRESTIANNI *et alii*, 2006b; VILLE de GOYET *et alii*, 2007) and the two seed megaspores *Spermasporites allenii* MARSHALL *et* HEMSLEY, 2003 and *Granditetrasporites zharkovae* ARKHANGELSKAYA *et* TURNAU, 2003 are all supplementary indications of the probable Middle Devonian origin of the seed plant lineage.

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