

## SILURIAN FORMATIONS BETWEEN NEUVILLE-SOUS-HUY AND OMBRET : THEIR CORRELATION, AGE AND STRUCTURE<sup>1</sup>

by

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(3 figures)

**RESUME.**- Le levé détaillé et l'analyse des gîtes à graptolites des sédiments siluriens situés entre Neuville-sous-Huy et Ombret ont conduit à une nouvelle interprétation chronostratigraphique et structurale des séquences étudiées. Les séquences des ravins 700 mE et 1200 mE ainsi que celle observable près de l'étang septentrional du parc de La Neuville sont en position normale et vont du Llandoveryen supérieur au Wenlockien inférieur. La séquence observable le long de l'étang méridional du parc de La Neuville est en position renversée et va du Wenlockien moyen ou supérieur au Ludlowien inférieur.

**ABSTRACT.**- Fieldwork and collecting of graptolites from outcrops between Neuville-sous-Huy and Ombret resulted in a revision of the stratigraphical position and of the structural framework of the sequences studied. The sequences of the ravine 700 mE and 1200 mE and the sequence along the most northerly pond of the park of La Neuville are normal and range from Upper Llandovery to Lower Wenlock. The sequence along the most southerly pond of the park is reversed and ranges from Middle or Upper Wenlock to Lower Ludlow.

### I.- INTRODUCTION

The area studied is situated 6 km eastwards of Huy. It belongs to the elongate strip of Ordovician and Silurian sediments called "bande silurienne du Condroz" or "Massif de Dave", cropping out along the major Hercynian thrust fault called "Faille du Midi".

P. MICHOT (1932, 1934 and 1954) made the first comprehensive study of these formations and his conclusions are still largely valid. We can add to this scheme more detailed correlations of several outcrops, thanks to new descriptions and faunal analyses. The sections are located as shown in fig. 1.

Fieldwork was carried out by G. MAES, L. ROMBOUITS and N. VANDEVELDE; graptolites were identified by R.B. RICKARDS. These studies were conducted within the framework of a broader micropaleontological project of which the results (chitinozoans and acritarchs) remain to be published.

### II.- SECTION 1200 mE

This section is situated in the gully of a small watercourse, running from south to north. Fig. 2a gives a schematic representation of the lithological sequence

with an indication of graptolite levels. From north to south we can distinguish :

Unit A :

- lithology : coarse-grained, brown-grey, quartzitic shales, with volcanoclastic layer VI near the top.
- graptolites : g1 (x means relative abundance)

*Monograptus priodon* s.l. (xxx), *Monograptus marri* (x), *Monograptus* cf. *marri* (xx), *Monograptus rickardsi* (xxx), *Monograptus* cf. *gemmatus* (x), *Monograptus exiguus* (x), *Monograptus rickardsi* s.s. (xx), *Monograptus barrandei* (xx), *Climacograptus* cf. *nebula* (x), "*Médiograptus* sp." or "*Streptograptus* sp." (x), *Retiolites geinitzianus* s.l. (x), *Rastites* sp. (x).

- biostratigraphy : *M. turriculatus* zone.

Unit B :

- lithology : dark green, coarse-grained shales.
- no graptolites found.

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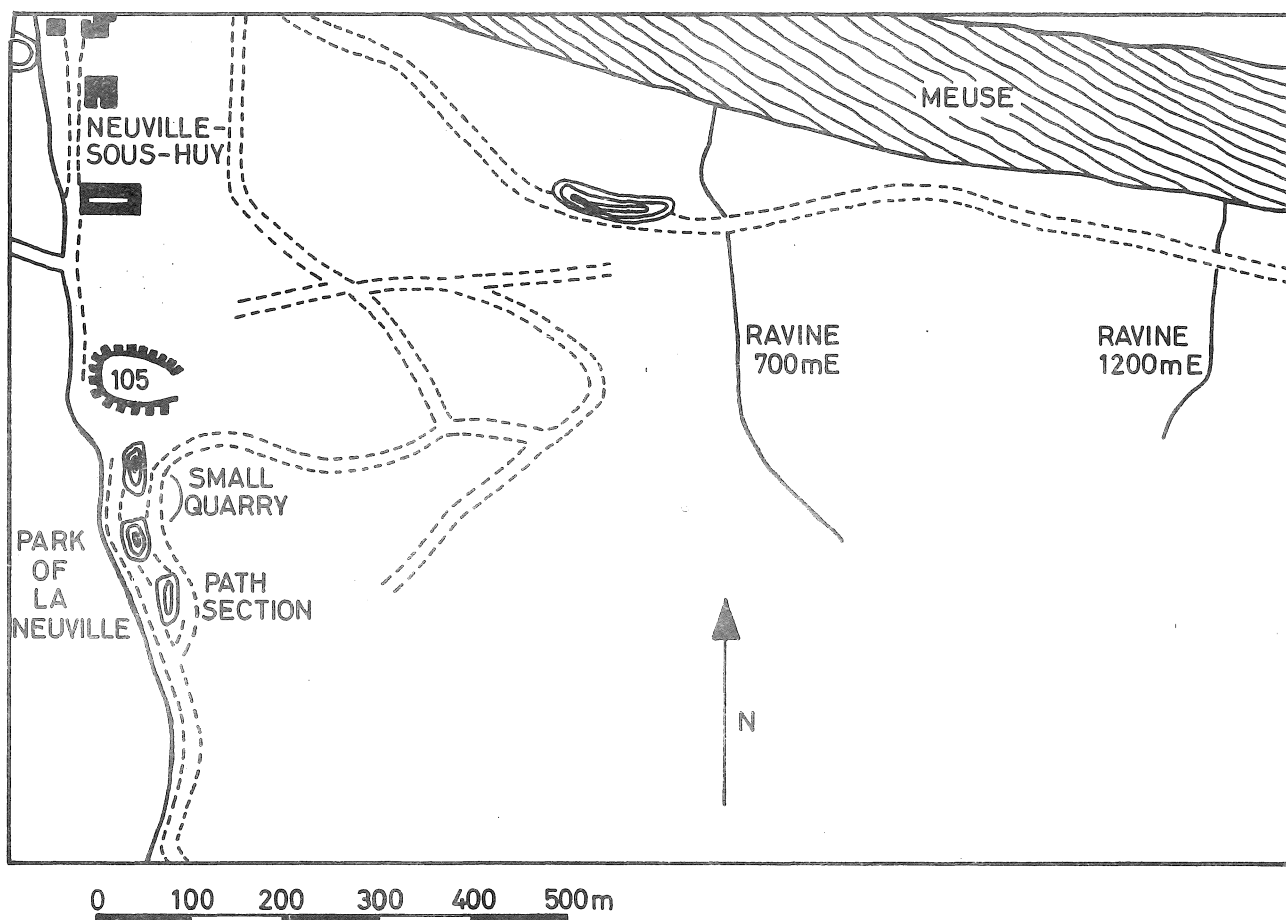


Figure 1.- Location map.

Unit C :

- lithology : alternating sequence of red and green shales.
- no graptolites found.

Fault FI conceals units C, D and E.

Unit G :

- lithology : olive-green to grey-green shales with intercalations of blue-grey shales; alternating with red shales in the upper 5 m.
- no graptolites found.

Unit H :

- lithology : transition between unit G and unit I.
- graptolites : g2.

*Monoclimacis* sp. (xx), *Monograptus priodon* s.l. (xx), *Monograptus spiralis* (xx), *Monograptus cf. spiralis* (xx), *Monograptus* sp. (xx), *Monograptus*

*?parapriodon* (x), *Monograptus ?marri* (x), *Monograptus tullberi* (x), *Monoclimacis cf. crenulata* sensu ELLES & WOOD (xxx), *?Monoclimacis vomerina* (xx), *Monoclimacis griestoniensis* s.l. (x), *Pristiograptus denemarkae* (xx), *Retiolites geinitzianus* (xx).

- biostratigraphy : *M. crenulata* zone.

Unit I :

- lithology : green to green-grey shales with intercalations of psammites and of fine layers of red shales; contains coarse-grained, grey-blue volcaniclastic layer V2.
- no graptolites found.

Unit J :

- lithology : alternating sequence of red and green shales.
- no graptolites found.

## Unit K :

- lithology : green shales.
- no graptolites found.

## Unit L :

- lithology : arkose.
- no graptolites found.

## Unit M :

- lithology : transition between unit L and unit N.
- graptolites : g3.

*Monoclimacis vomerina cf. vomerina (xxx)*, *Monoclimacis vomerina vomerina (x)*, *Monoclimacis griestoniensis (x)*, *Monograptus ?singularis (xx)*, *Monograptus priodon s.l. (x)*, *Monograptus priodon (xx)*, *Monoclimacis cf. crenulata sensu ELLES & WOOD (x)*, *Monograptus ?marri (x)*, *Monograptus ? rickardsi (x)*, *Monograptus ? cultellus (x)*, *Monoclimacis sp. (x)*, *Pristiograptus nudus (x)*, *Pristiograptus denemarkae (x)*, *Pseudoplegmatoraptus sp. (x)*, *Barrandeograptus pulchellus (x)*, *Retiolites geinitzianus (x)*, *Retiolites geinitzianus angustidens (x)*.

- biostratigraphy : *M. crenulata* zone.

Fault F2 conceals unit M with limited displacement.

## Unit N :

- lithology : blue-grey, finely lamellated shales.
- graptolites : g4.

*Monograptus priodon s.l. (xx)*, *Monoclimacis vomerina s.l. (xxx)*, *Monoclimacis vomerina basilica (xxx)*, *Monoclimacis vomerina cf. basilica (xxx)*, *Monograptus cf. kodymi (x)*, *Monoclimacis griestoniensis cf. nicoli (x)*, *Monograptus koihai (x)*, *Monoclimacis sp. (x)*, *Retiolites cf. geinitzianus (x)*, *Retiolites geinitzianus geinitzianus (x)*, *Retiolites geinitzianus angustidens (x)*.

- biostratigraphy : *C. centrifugus* zone.

## III.- SECTION 700 mE

The section, also exposed in the gully of a small watercourse running south-north is shown in Fig. 2b. The following units were observed from north to south :

## Unit D :

- lithology : dark-grey-green, quartzitic shales.
- no graptolites found.

## Unit E :

- lithology : transition between unit D and unit G; contains three volcanic layers : a grey-green volcanoclastic layer V3, a grey to brown-grey volcanoclastic layer V4 and a weathered volcanoclastic layer V5.

- graptolites : g5.

*Monograptus sp. (x)*, *Pristiograptus nudus (xxx)*, *Monograptus cf. rickardsi (xx)*.

- biostratigraphy : post - *M. turriculatus* zone (Upper Llandovery fauna).

## Unit G :

- lithology : olive-green to grey-green shales with intercalations of blue-grey shales, alternating with red shales in the upper 5 m; contains three volcanoclastic layers; a weathered V6, green-grey coarse-grained V7 and a green-grey, clearly stratified volcanoclastic layer V8.

- graptolites : g6, g7, g8, g9, g10.

g6 : *Monograptus marri (xxx)*, *Monograptus cf. spiralis (xx)*, *Pristiograptus nudus (x)*.

g7 : *Monograptus marri (x)*, *Monograptus cf. parapriodon (x)*.

g8 : *Monoclimacis vomerina (xxx)*, *Monograptus priodon (x)*, *Monograptus spiralis (x)*, *Pristiograptus cf. nudus (x)*.

g9 : *Monoclimacis cf. crenulata (xxx)*, *Monograptus marri (x)*, *Monograptus cf. pragensis (x)*, *Monograptus priodon (xxx)*, *Monograptus spiralis (xxx)*, *Monograptus sp. (x)*, *Monograptus cf. exiguus (x)*, *Monoclimacis cf. griestoniensis (xxx)*, *Pristiograptus sp. (x)*, *Diversograptus sp. (x)*, *Monoclimacis sp. (x)*, *Monograptus discus (x)*, *Monograptus cf. parapriodon (x)*, *Monograptus rickardsi (xx)*, *Monograptus cf. rickardsi (xx)*, *Pristiograptus nudus (xxx)*, *Diversograptus cf. ramosus (x)*.

g10 : *Diversograptus cf. ramosus (xx)*, *Monoclimacis cf. crenulata (xx)*, *Monograptus cf. discus (xx)*, *Retiolites geinitzianus (xx)*, *Monoclimacis cf. crenulata (x)*, *Monograptus cf. priodon (xxx)*, *Monograptus cf. rickardsi (xx)*, *Monograptus spiralis (xxx)*, *Pristiograptus nudus (xx)*, *Monograptus priodon (xx)*, *Monoclimacis sp. (xx)*, *Monoclimacis griestoniensis (xx)*, *Monoclimacis vomerina (xxx)*.

- biostratigraphy : the graptolites of g6, g7 and g8 are not indicative of a very precise zone, but are probably referable to the *M. crispus* zone; g9 belongs to the *M. griestoniensis* zone and g10 to the *M. crenulata* zone.

## Unit H :

- lithology : transition between unit G and unit I.
- no graptolites found.

Fault F1 conceals unit H.

## Unit X :

- lithology : green to green-grey shales with intercalations of psammites and of fine layers of red shales; contains a volcanoclastic layer V9, coarse-grained at the base, aphanitic upwards and fine-grained at the top (thickness  $\pm 1,50$  m), and a volcanoclastic layer V10 with aphanitic structure.
- no graptolites found.

## Unit Y :

- lithology : transition between unit X and unit Z; contains a volcanoclastic layer VII with aphanitic structure.
- graptolites : g11.  
*Cyrtograptus cladium* (x), *Monoclimacis* sp. (x), *Monoclimacis* cf. *linnarsoni* (xxx), *Monograptus priodon* (xx), *Monoclimacis vomerina* (xxx), *Monoclimacis vomerina* cf. *vomerina* (xx), *Monograptus* sp. (x), *Retiolites geinitzianus* (xx), *Retiolites* sp. (x).
- biostratigraphy : this assemblage does not refer to a precise zone, but indicates certainly a lower Wenlock age.

Fault F3, not very conspicuous and with very limited displacement, conceals unit Y.

## Unit Z :

- lithology : grey-brown, sandy, laminated shales.
- graptolites : g12.  
*Cyrtograptus cladium* (x), *Cyrtograptus* cf. *linnarsoni* (x), *Monoclimacis flumendosae* (x), *Monograptus flemingii* (xxx), *Plectograptus* sp. (x), *Pristiograptus dubius* (xxx), *Prostiograptus* cf. *meneghini* (x), *Pristiograptus* sp. (x).
- biostratigraphy : this assemblage belongs likely to the *C. linnarsoni* zone and certainly indicates a middle Wenlock age.

#### IV.- CORRELATION BETWEEN BOTH SECTIONS (1200 mE and 700 mE)

The stratigraphical correlation is based partly on the lithological characters, partly on the graptolite content. Our interpretation of the relative position of the strata is reflected by the alphabetical order of the lithological units, as indicated in Fig. 2.

## 1.- CORRELATION :

The important faults concealing unit C in section 1200 mE and unit H in section 700 mE, are assumed to be the same, namely fault F1. The fault F1, which has a slope smaller than that of the strata, has cut away deposits belonging to the *M. crispus* and *M. griestoniensis* zones in Section 1200 mE and deposits belonging to the *M. crenulata* zone and probably also deposits of lower Wenlock age in section 700 mE. The two sections have only 7 m of sediments in common, belonging to the G and H units, and in which no volcanoclastic layers are present; therefore, lithological connections between the two sections are not obvious.

## 2.- CHRONOSTRATIGRAPHY :

Units A, B, C, D, E, G, H, I, J, K, L and M can be attributed to the Upper Llandovery (alias the formerly defined "Assise de Dave"), units N, X and Y to the Lower Wenlock (alias the "Assise de Naninne") and unit Z to the Middle Wenlock (alias the "Assise de Jonquoi").

#### V. SECTIONS OF THE PARK OF LA NEUVILLE

## 1.- DESCRIPTION :

MICHOT described here three sections; mame-lon 105, an old quarry near the northerly pond and the path along the southerly pond. The two former sections (fig. 2) can be correlated on lithological grounds with the sections 1200 mE and 700 mE : units J, K, L and N are present there. The southernmost path section (fig. 3) is described here separately because the strata are in a different tectonic situation. Sedimentological and petrographic polarity criteria such as microravination demonstrated indeed that the sequence is inverted; the strata are thus older from north to south. This inversion is also confirmed by the relative age of the graptolite levels; it was not observed by MICHOT (1932



and 1934), who considered the sequence as normal. Furthermore we did not find the graptolite species *Cyrtograptus purchisoni* nor the fault concealing b, as indicated by MICHOT (1932). The units a, b and c, defined by the latter author can be refined as follows (Fig 3) :

#### Subunit a1 :

- lithology : olive-green, nodular shales
- palaeontology : this subunit contains several graptolite levels (g13, g14, g15, g16 and g17), of which one (g14) contains also brachiopods, crinoids, ostracods, cephalopods and conulariids.
  - g13 : *Pristiograptus dubius* (xxx), *Bohemograptus bohemicus* (x), *Saetograptus chimaera* (x), *Lobograptus scanicus* (x).
  - g14 : *Bohemograptus bohemicus* (xx), *Lobograptus scanicus s.l.* (xxx), *Saetograptus chimaera* (xxx), *Pristiograptus dubius* (xx), *Saetograptus incipiens* (x).
  - g15 : *Bohemograptus bohemicus* (xxx), *Pristiograptus dubius* (x), *Saetograptus chimaera* (xx), *Lobograptus scanicus* (x), *Monograptus uncinatus* (x).
  - g16 : *Saetograptus chimaera* (xxx), *Pristiograptus dubius* (xxx), ?*Saetograptus varians* (x), *Saetograptus incipiens* (xx), *Monograptus sp.* (x).
  - g17 : *Pristiograptus dubius* (xxx), *Saetograptus cf. chimaera* (x).
- biostratigraphy : g13 and g14 belong to the *L. scanicus* zone and g15, g16 and g17 to the *P. nilssoni* zone.

#### Subunit a2 :

- lithology : olive-green, finely debited shales; a bifurcating fault was observed.
- no graptolites found.

#### Subunit b1 :

- lithology : grey-blue, finely lamellated shales.
- graptolites : g18.
  - Monograptus cf. flemingii* (xx), *Monograptus flemingii* (x), *Pristiograptus dubius* (xx), *Cyrtograptus ?rigidus* (x).
- biostratigraphy : *C. rigidus* - *C. lundgreni* zone; if *C. rigidus* (uncertain determination) does occur, the subunit b1 should be at least partially attributed to the *C. rigidus* zone.

#### Subunit b2 :

- lithology : green, finely lamellated shales, locally reddish by weathering. The calcareous nodules, found at the extreme outcrop of subunit b2, show a stratification parallel to that of the surrounding shales, and are presumed to be of secondary origin.

- graptolites : g19.

*Monograptus flemingii* (x), *Monograptus cf. flemingii* (x), *Pristiograptus dubius* (x).

- biostratigraphy : somewhere in *C. rigidus* - *C. lundgreni* zones.

#### Unit c :

- lithology : olive-green shales.
- no graptolites found.

### 2.- CHRONOSTRATIGRAPHICAL INTERPRETATION OF THE INVERTED SEQUENCE :

Unit a (i.e. subunit a1 and a2) can be attributed to the Lower Ludlow (alias the "Assise de Thimensart") and unit b (i.e. subunits b1 and b2) to the middle or upper Wenlock (alias the "Assise de Jonquoi"). It is not possible to locate precisely the Wenlock - Ludlow boundary in the section because of the lack of closely spaced palaeontological horizons.

## VI.- GENERAL CONCLUSIONS

The exposed sequences can be assigned to two tectonical units :

1. Normal sequences of upper Llandovery to lower Wenlock age (section 1200 mE, 700 mE and the quarry along the most northerly pond of the park).
2. An inverted sequence of middle or upper Wenlock to lower Ludlow age (path section along the most southerly pond).

Strong tectonic disturbances are here limiting factors in the biozonation.

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