III. GEOGRAPHIC LOCATION OF THE PROPOSED BOUNDARY STRATOTYPE

by P. SARTENAER

The auxiliary boundary stratotype is situated in the town of Nismes. The town lies in the central part of the southern flank of the Dinant Basin, and specifically in the Fagne natural region. Nismes is at 4.5 km north-east of the town of Couvin, 2.85 km east of the village of Frasnes, and 22 km south-west of the town of Givet.

The exact location of the outcrop is indicated on the following aerial photograph, and also on figure 1 of the first paper (conodonts) in chapter V.

An aerial photograph of another excellent outcrop, the Sourd d'Ave section, is also included herein.

IV. RECOGNITION OF THE AUXILIARY BOUNDARY STRATOTYPE ON THE SOUTHERN FLANK OF THE DINANT BASIN IN BELGIUM AND FRANCE

The auxiliary boundary stratotype of Nismes is not the only outcrop in the area where the Givetian-Frasnian boundary beds can be studied.

The following is a list of the principal localities, from West to East :

1. Central part of the southern flank of the Dinant Basin :
   - Boussu-en-Fagne ("chemin de l'ermitage"), Belgium (*see* P. SARTENAER *in* chapter V)
   - Nismes, Belgium (*see* P. BULTYNCK, J. GODEFROID and L. JACOBS, P. SARTENAER, M. COEN-AUBERT and M. COEN *in* chapter V ; *see* L. JACOBS *in* chapter VI)
   - Fort de Charlemont, France (*see* M. COEN-AUBERT *in* chapter V)
   - Moulin Boreux, France
   - Fromelennes, France (*see* P. BULTYNCK and M. COEN-AUBERT *in* chapter V)
   - Martouzin, Belgium (*see* J. GODEFROID and L. JACOBS *in* chapter V)
   - Genimont
   - Sourd d'Ave (*see* P. BULTYNCK, J. GODEFROID and L. JACOBS, M. COEN-AUBERT and J.G. CASIER *in* chapter V)

2. Eastern part of the southern flank of the Dinant Basin :
   - Ny (*see* P. BULTYNCK and M. COEN *in* chapter V)
   - Sy (*see* P. BULTYNCK, J. GODEFROID and L. JACOBS, and P. SARTENAER *in* chapter V)

V. FAUNAS

CONODONTS by P. BULTYNCK

Conodont faunas of late Givetian and early Frasnian age in the type area have been described in a series of papers by M. COEN (1973), A. MOURAVIEFF (1974 and 1982), P. BULTYNCK (1974), P. BULTYNCK and M. COEN (1982) and P. BULTYNCK and L. JACOBS (1982).
In the last -mentionned paper, conodont distributions within the auxiliary boundary stratotype at Nismes and in two other sections (Sourd d'Ave and Sy) are detailed.

By definition, the entry of *Ancyrodella rotundiloba rotundiloba* (BRYANT, W.L., 1921) corresponds to the base of the Lower *P. asymmetricus* Zone ZIEGLER, W., 1971. The subspecies derives from *Ancyrodella binodosa* UYENO, T.T., 1967 by the development of the platform and its ornamentation and by reduction and change of outline of the pit. Many transitional forms, demonstrating the phylogenetic relationship between the two taxa occur through a succession of samples from the auxiliary boundary stratotype. The inception of *A. binodosa* at the very base of the Frasnes Group (the Pont d'Avignon Member of the Nismes Formation) is documented as follows : in bed n° 37, Nismes section ; in bed n° 8, Fromelennes section, according to N. MOURAVIEFF (1974, p. 1) ; in bed 19a, Sourd d'Ave section ; and in bed n° 2, Ny section. These initial appearances are sharp and possibly facies controlled, in view of the distinct lithological change at this level. *A. rotundiloba rotundiloba* enters within a more homogeneous lithological succession 1.50 m higher in bed n° 41, Nismes section ; 0.50 m higher in bed n° 20, Sourd d'Ave section and 1.75 m higher in bed n° 26, Ny section.

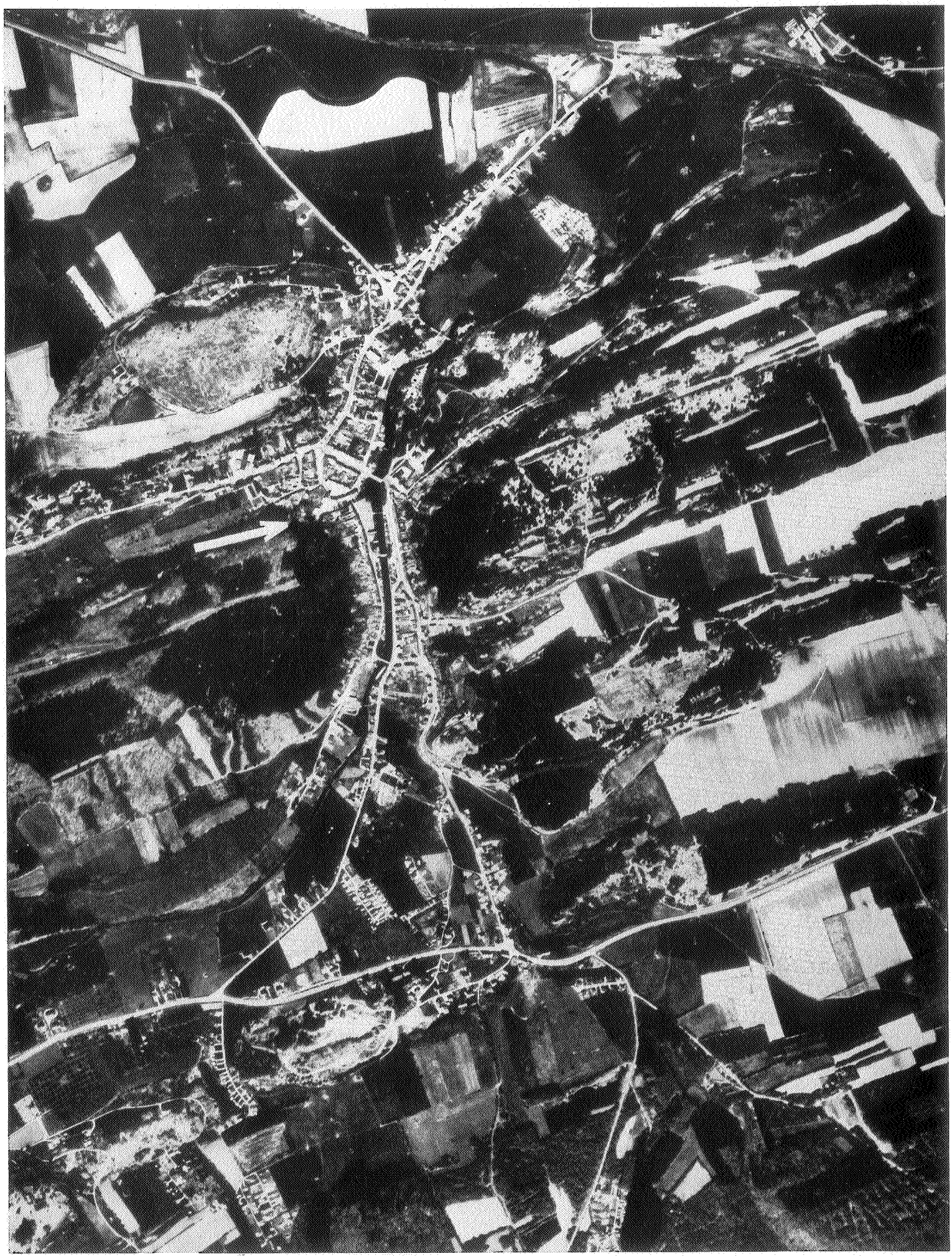
The detailed conodont distribution within the sections at Nismes, Sourd d'Ave, and Sy is given in tables 1-3 ; fig. 8 summarizes the stratigraphic ranges of thirty three taxa represented. The ranges of these taxa in reference to the standard conodont zones is briefly discussed below.

G. KLAPPER and W. ZIEGLER (1979, p. 212) and G. KLAPPER and J.G. JOHNSON (1980, p. 403) recognized in ascending order the *S. hermanni - P. cristatus* Zone, the *P. dengleri* Zone, and the Lowermost and Lower *P. asymmetricus* Zones, collectively embracing the upper Givetian and lower Frasnian.

Recently, W. ZIEGLER and G. KLAPPER (1982) proposed the *K. disparilis* Zone as equivalent to the uppermost *S. hermanni - P. cristatus* Zone and the *P. dengleri* Zone. P. BULTYNCK and L. JACOBS (1983, p. 37) recognized four Ancyrodella Faunas : the *A. binodosa* Fauna corresponding to the top of the Lowermost *P. asymmetricus* Zone ; and the *A. rotundilobo rotundiloba* Fauna, the *A. rotundiloba alata* Fauna, and the *A. rugosa* Fauna as subdivisions of the Lower *P. asymmetricus* Zone. The subdivisions have been recognized on an intercontinental scale as demonstrated by the correlation charts discussed later in the present paper, they cannot always be clearly detected in condensed sequences.

The Upper *P. dengleri* Subzone

This term is preferred here to the *disparilis* Zone as none of the guide forms of the *K. disparilis* Zone is present, whereas



Aerial view of the Nismes area. Part of aerial view (B4 87 F57-58 nr 1523) with authorization A894 of the "Nationaal Geografisch Instituut".

Aerial view of the Sourd d'Ave (Wellin) area. Part of the aerial views (BIR 84 F58-E-59 nr 1312) with authorization A894 of the "Nationaal Geografisch Instituut".

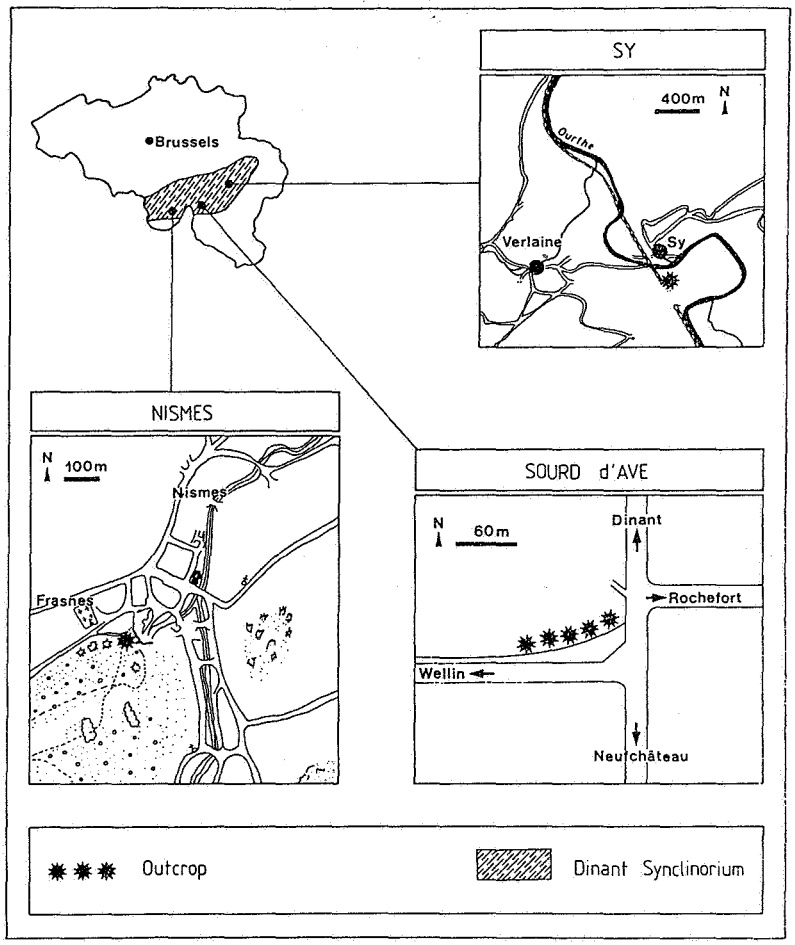
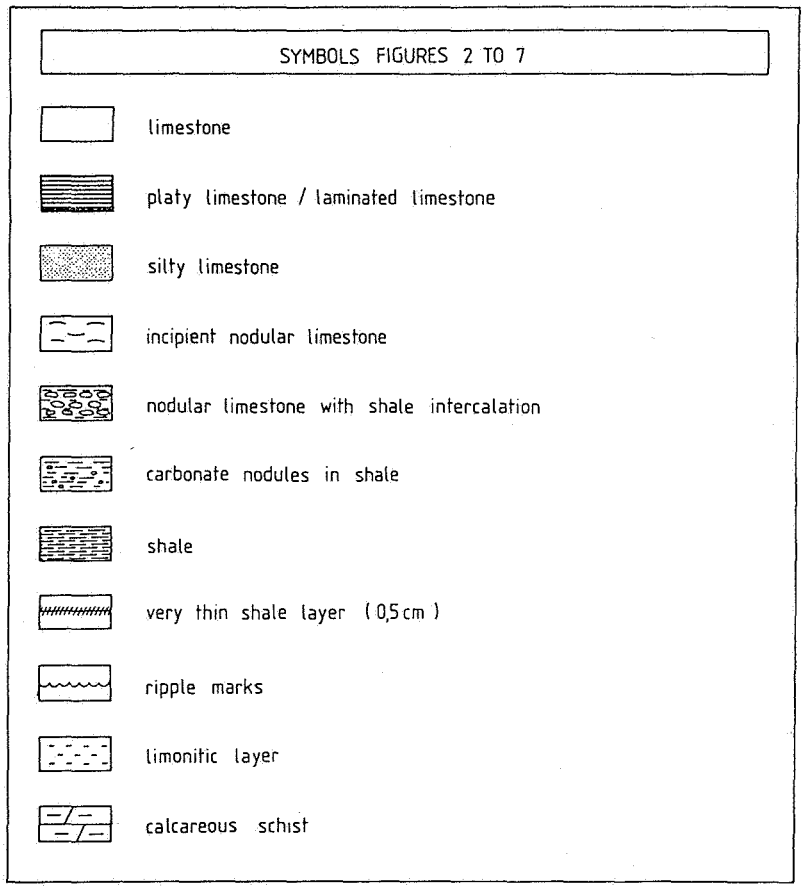
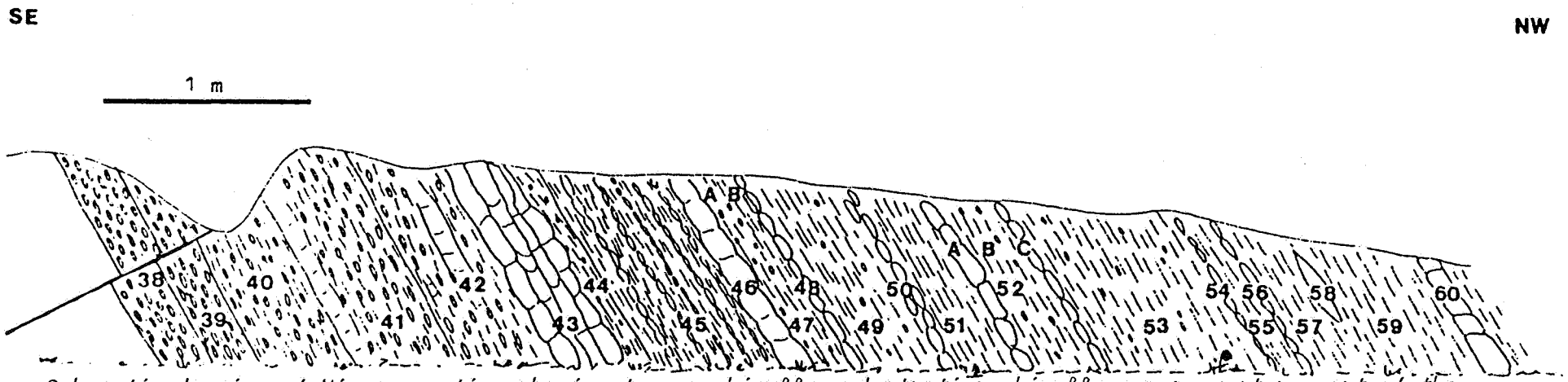


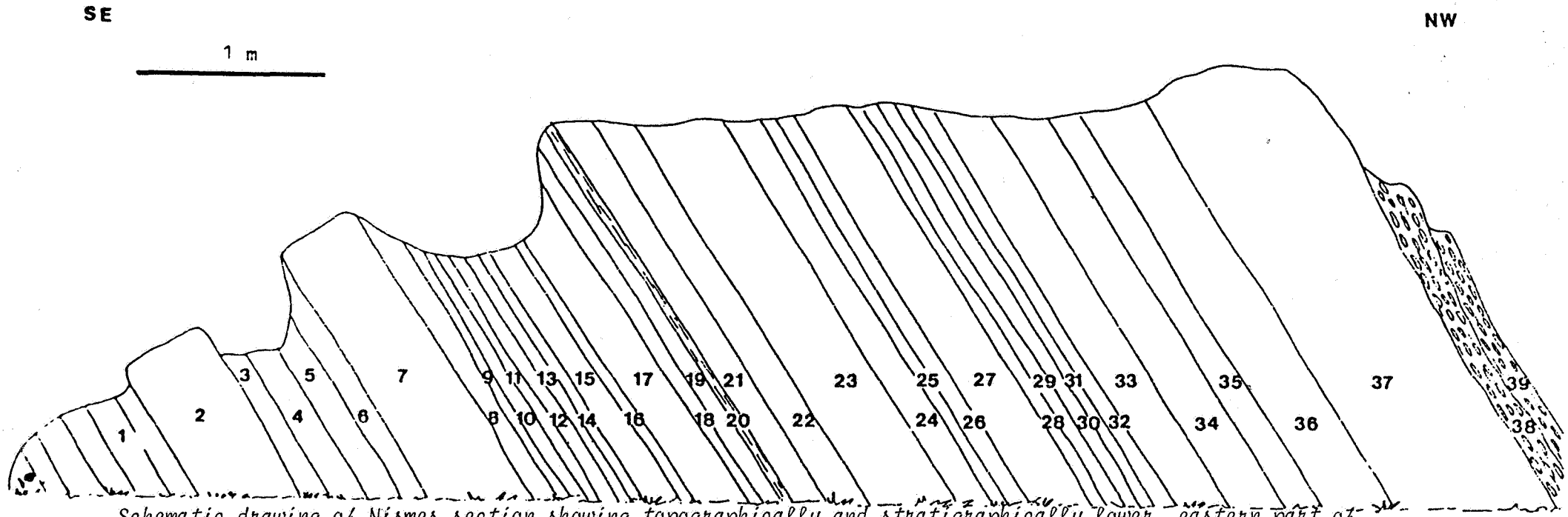
Figure 1. From P. BULTYNCK & J. JACOBS, 1982, fig. 1.



From P. BULTYNCK & L. JACOBS, 1982. 258



Schematic drawing of Nismes section showing topographically and stratigraphically upper, western part of the outcrop. From L. JACOBS, 1978, fig. 4.



Schematic drawing of Nismes section showing topographically and stratigraphically lower, eastern part of the outcrop. From L. JACOBS, 1978, fig. 3.

Figure 2a.

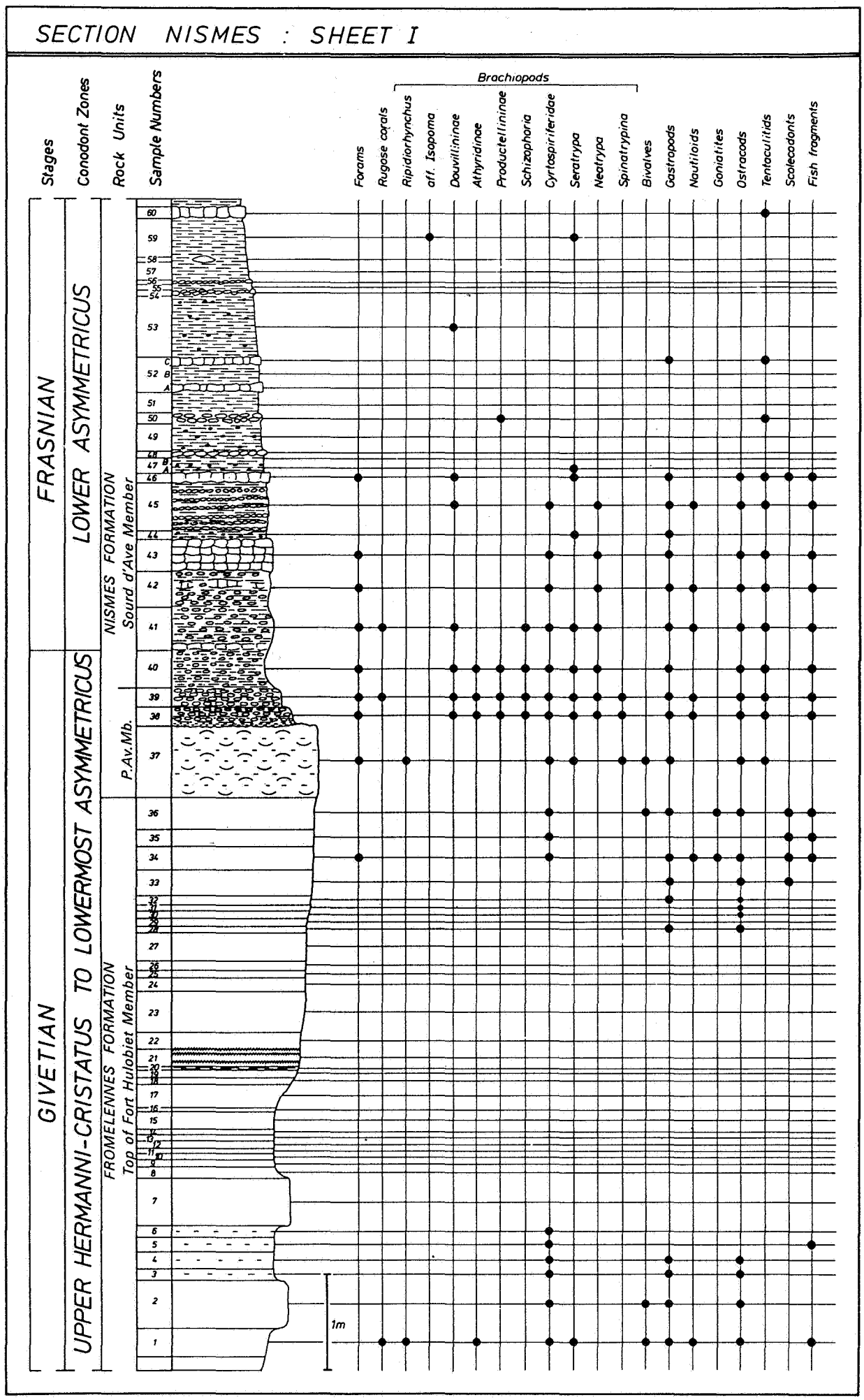


Figure 2b. From P. BULTYNCK & L. JACOBS, 1982, fig. 2, modified.

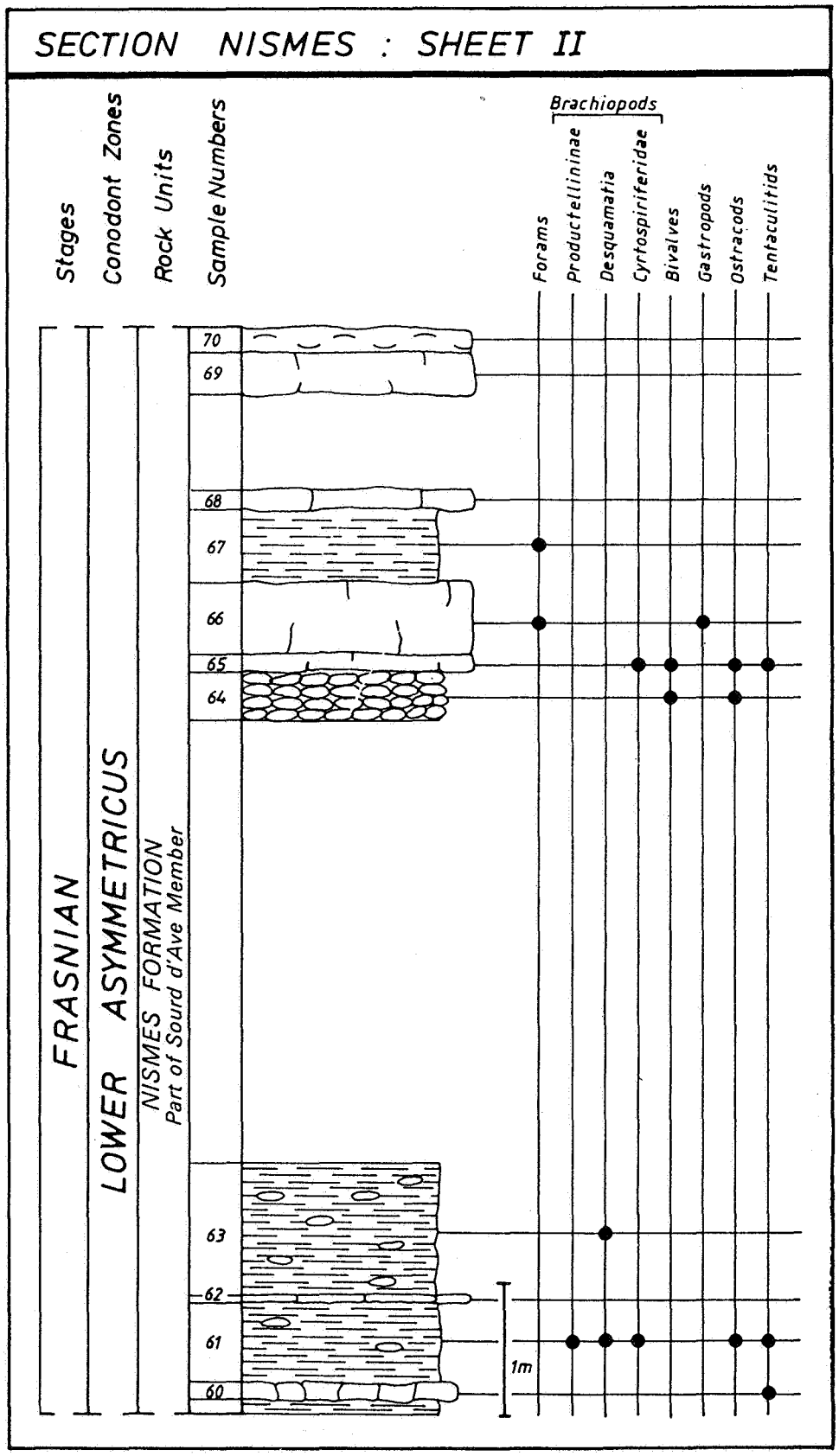


Figure 3. From P. BULTYNCK & L. JACOBS, 1982, fig. 3, modified.

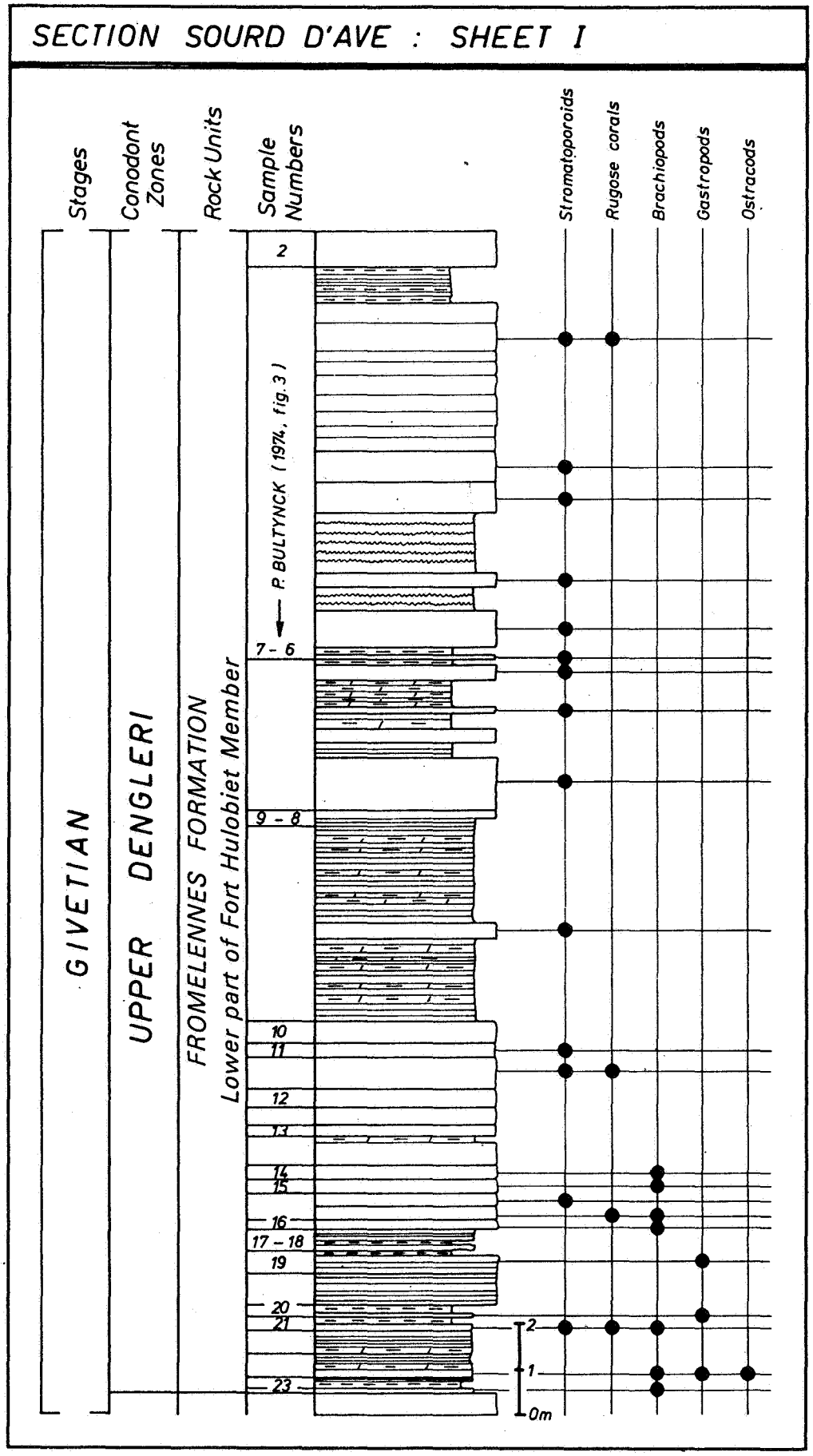


Figure 4. From P. BULTYNCK & L. JACOBS, 1982, fig. 4, modified.

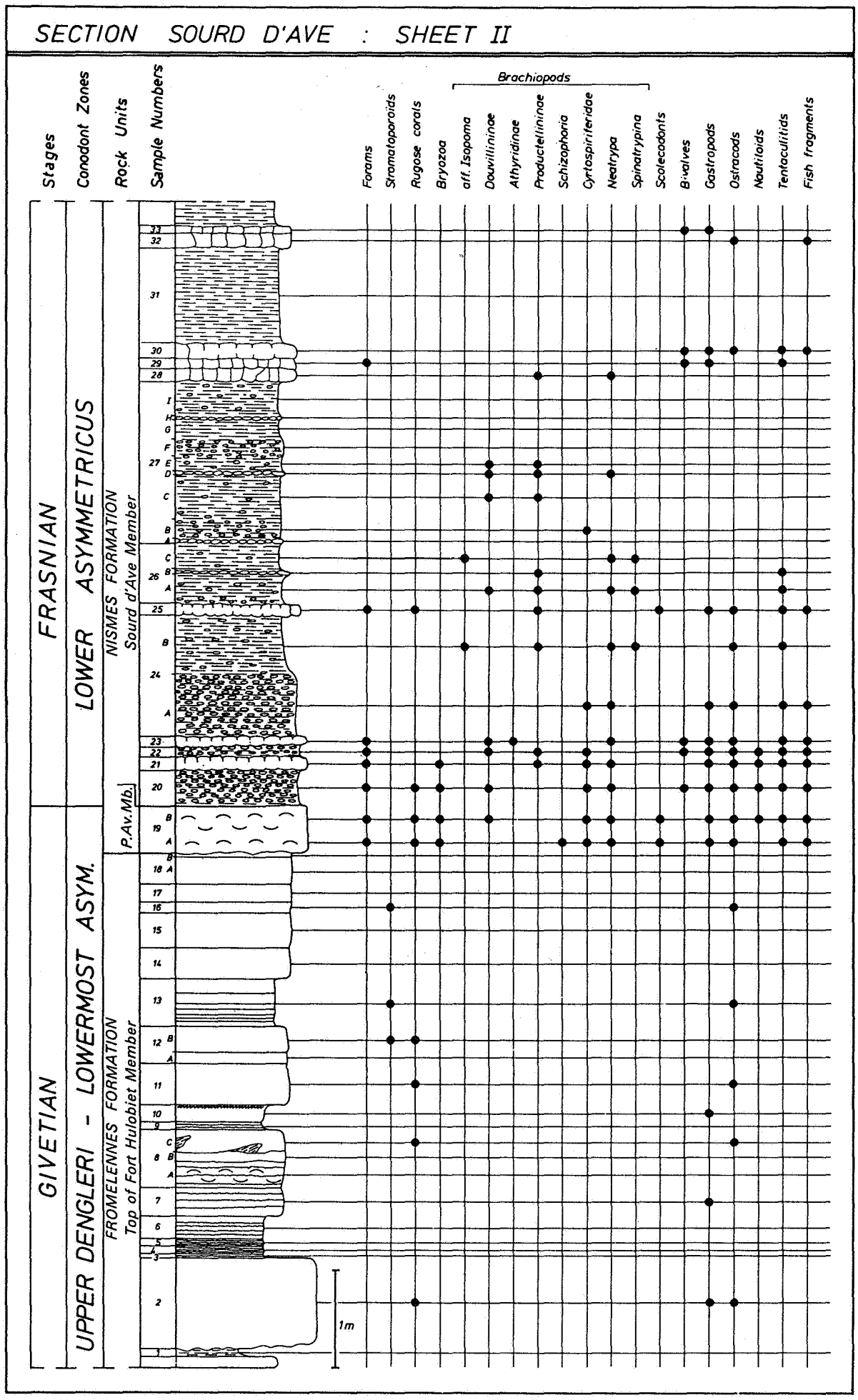


Figure 5. From P. BULTYNCK & L. JACOBS, 1982, fig. 5, modified.

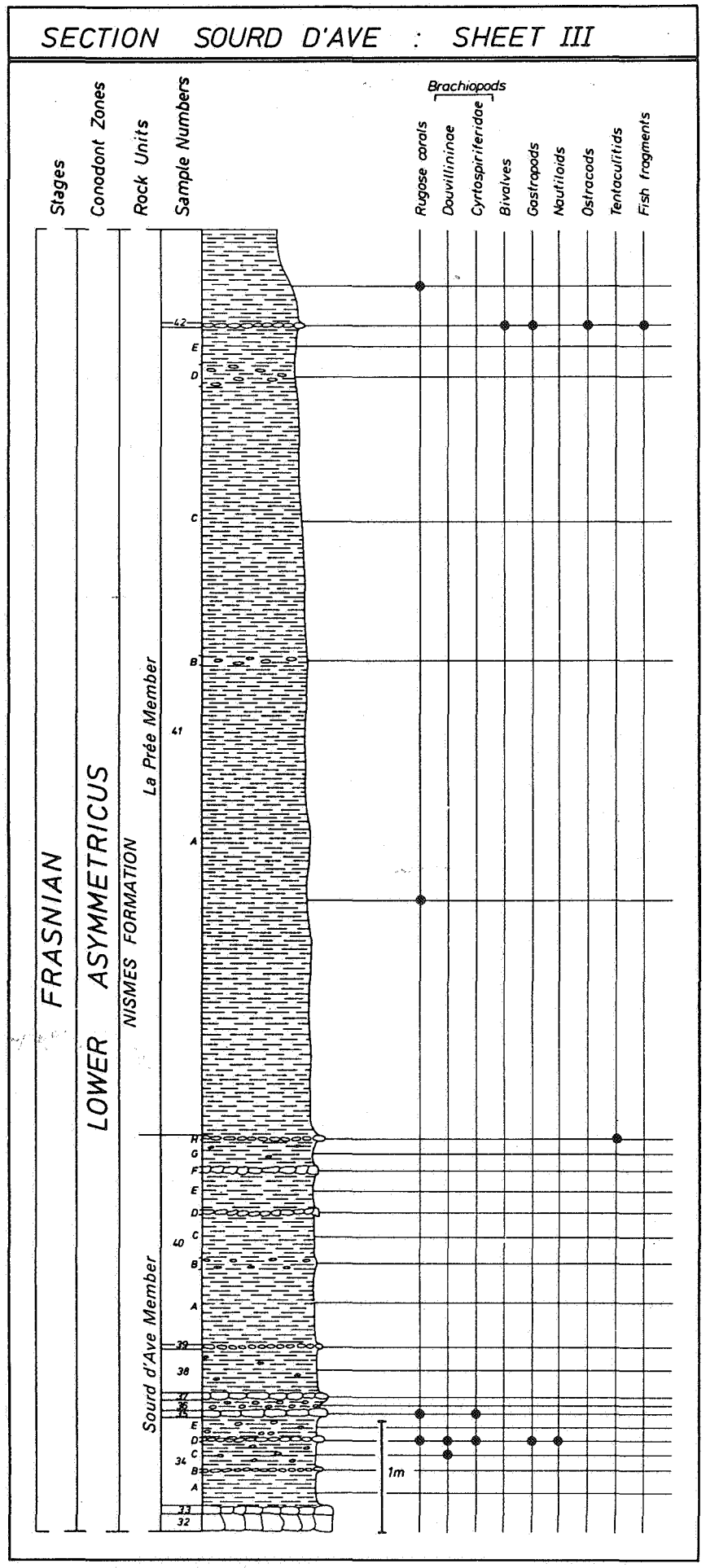


Figure 6. From P. BULTYNCK & L. JACOBS, 1982, fig. 6, modified.

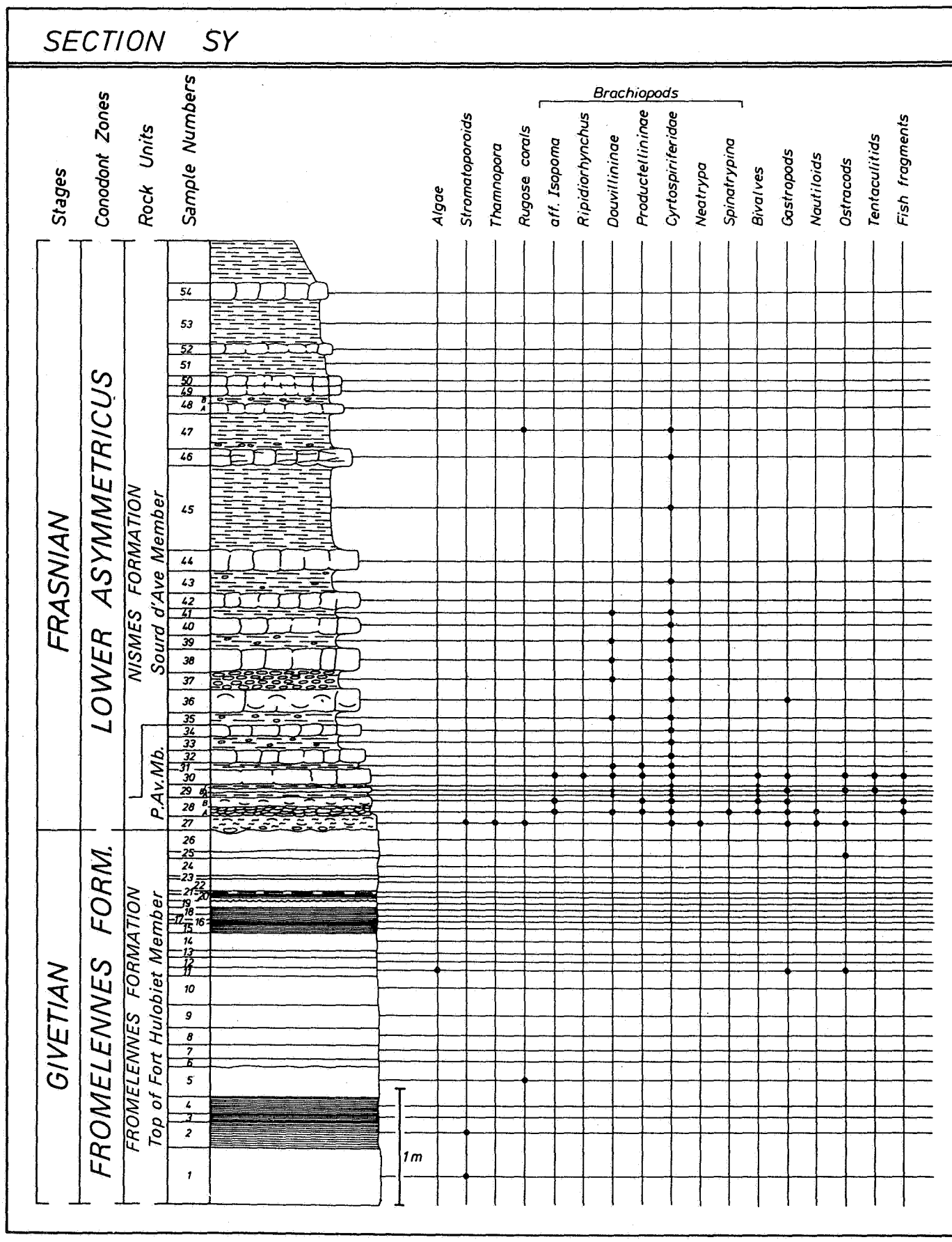


Figure 7. From P. BULTYNCK & L. JACOBS, 1982, fig. 7, modified.

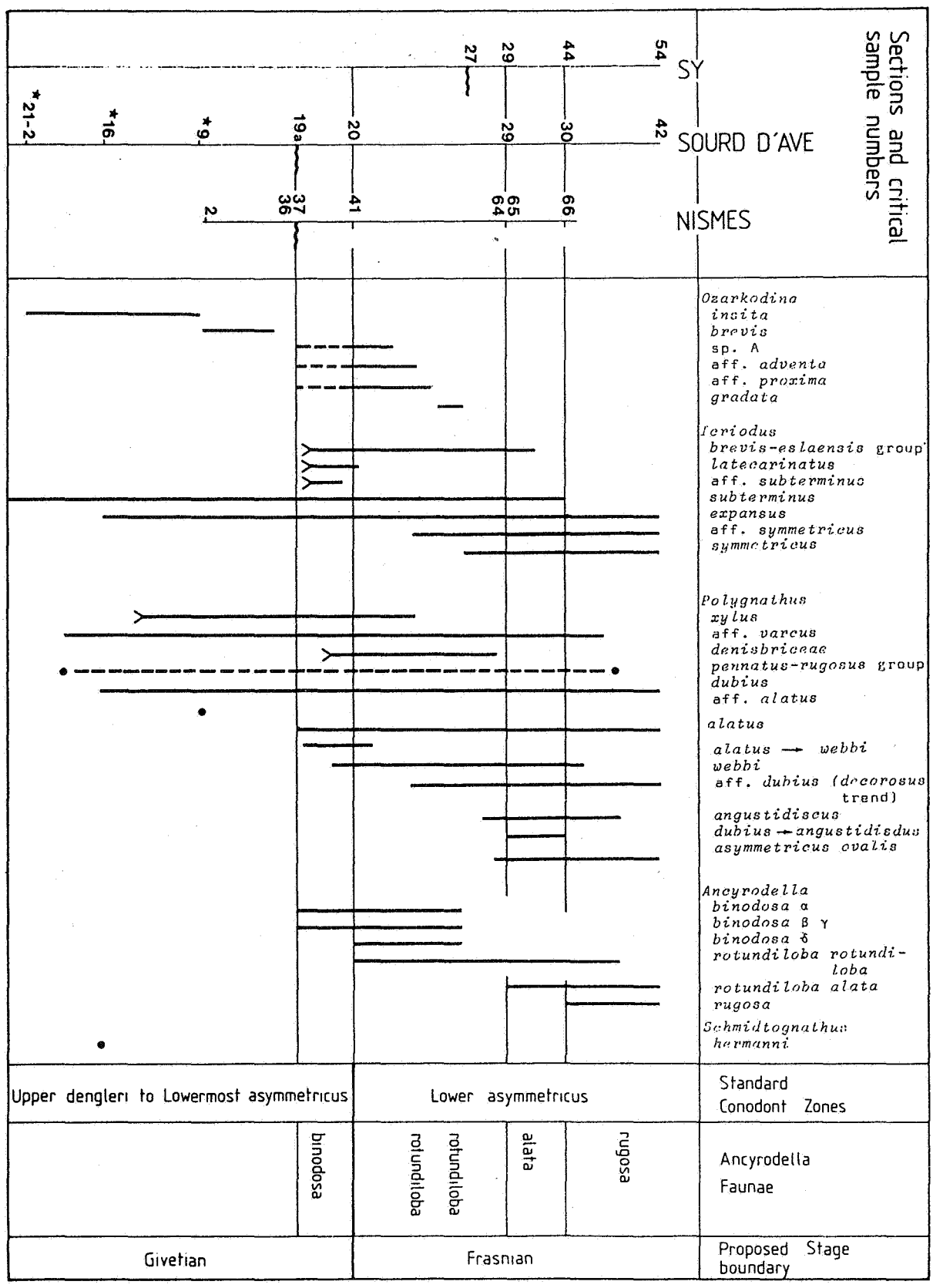


Figure 8. From P. BULTYNCK & L. JACOBS, 1982, fig. 8.
Summary distribution chart of conodonts in the sections Nismes, Sourd d'Ave and Sy ; isolated occurrences are indicated by • ; ranges of taxa also known from the Lower Member of the Fromelennes Formation begin with ∧ , ——— observed range ; - - - - assumed ; ~~~ boundary between Givet Limestone and Frasnes Group ; ★ samples P. Bultynck, 1974.

FROMELENNES F①(M.g.m.17-18)

LECOMPTE, M. - Ann.Soc.géol.Belg.,T.83, pp.1-134, 1960.

COEN, M. & COEN-AUBERT, M. - Ann.Soc.Géol.Belg.,T.94,fasc.1, p.5-20. 71.

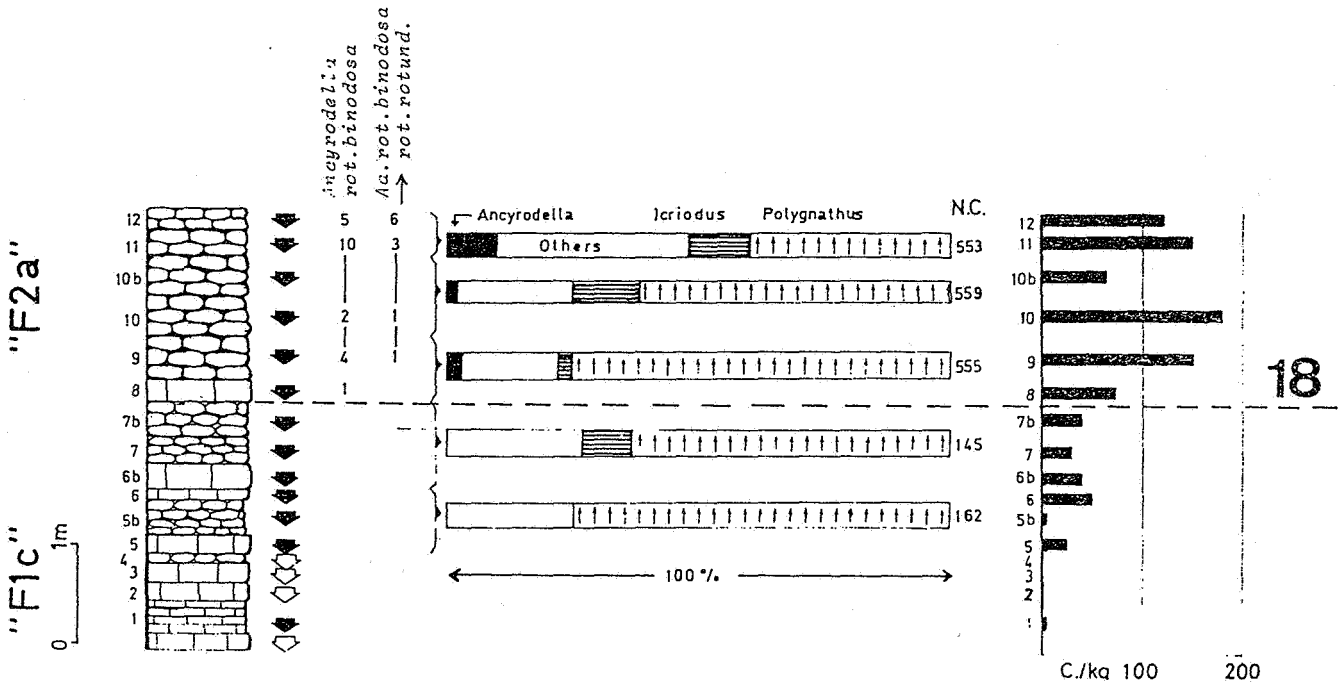


Figure 9. From N. MOURAVIEFF, 1974, p. 1.

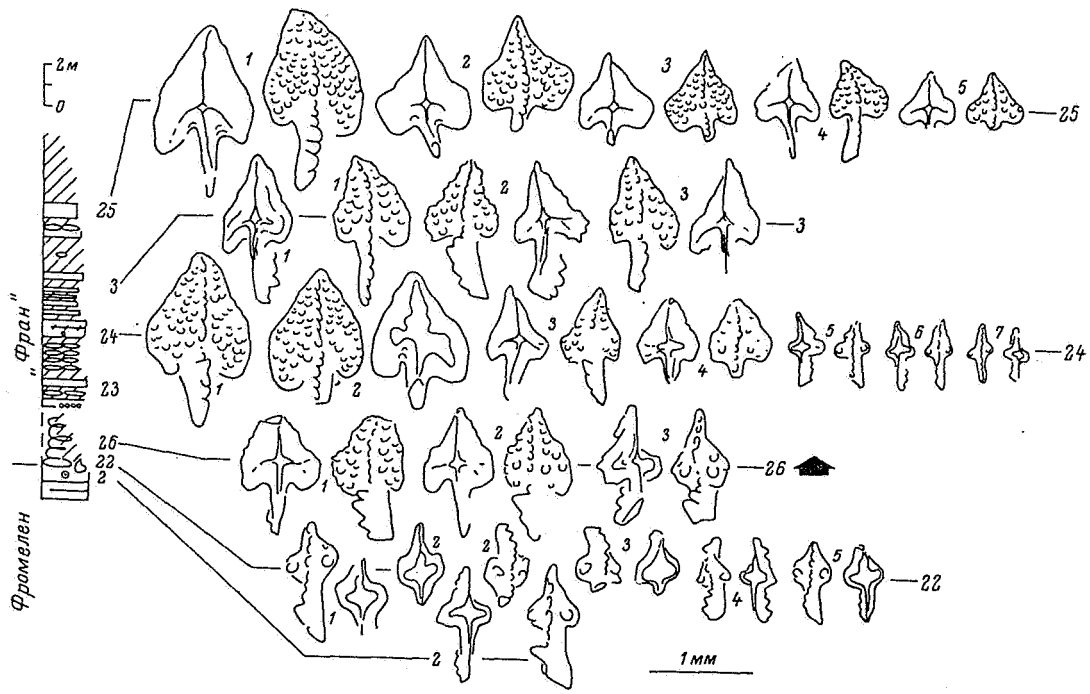


Рис. 3. Разрез у Ню.

Figure 10. From P. BULTYNCK & M. COEN, 1982, p. 41, fig. 3
Section at Ny
Samples 2, 22 (1-5), 26 (3) and 24 (5-7) — *Ancryodella binodosa*
Samples 26 (1, 2), 24 (1-3), 3 (1-3) and 25 (1, 4) — *Ancyrodella rotundiloba rotundiloba*
Samples 25 (2, 3 and 5) — *Ancyrodella rotundiloba alata*

Table 1. From P. BULTYNCK & L. JACOBS, 1982, table 1.

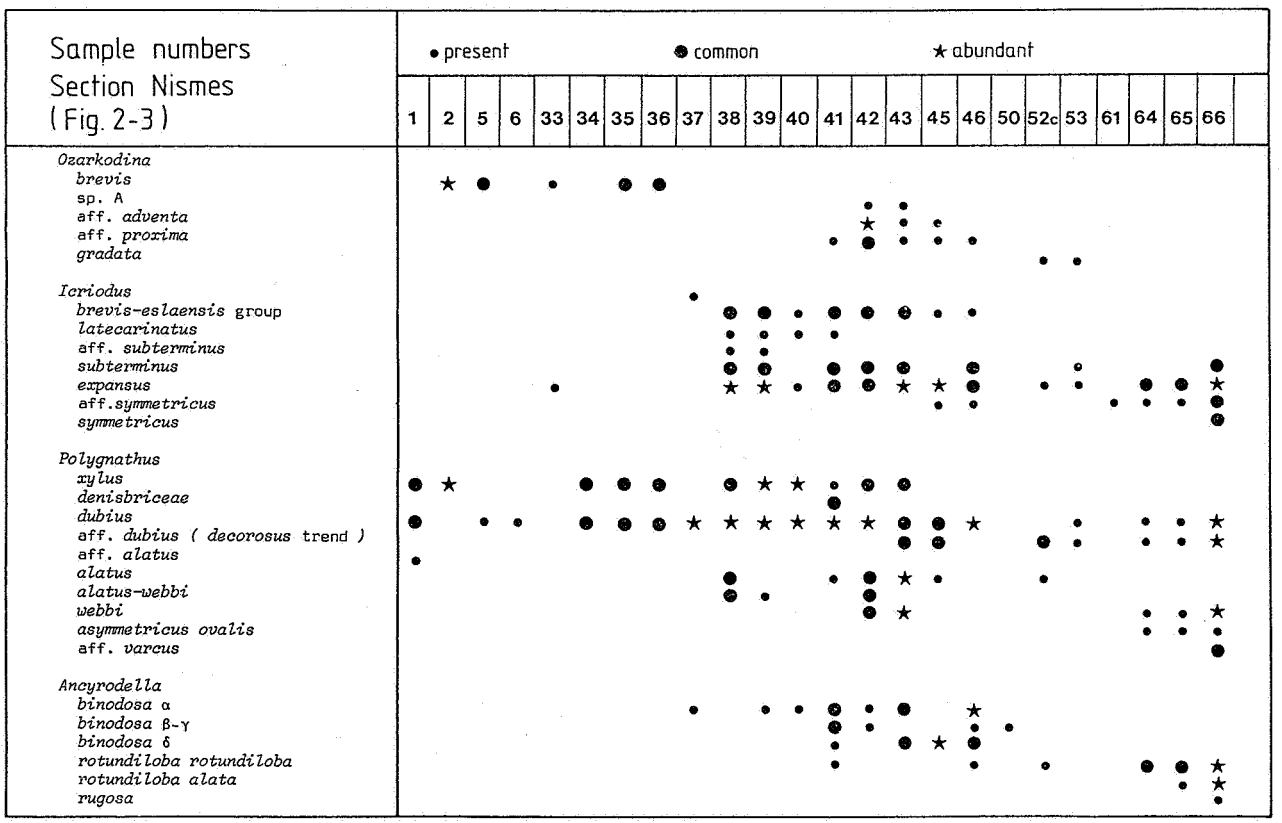


Table 2. From P. BULTYNCK & L. JACOBS, 1982, table 2.

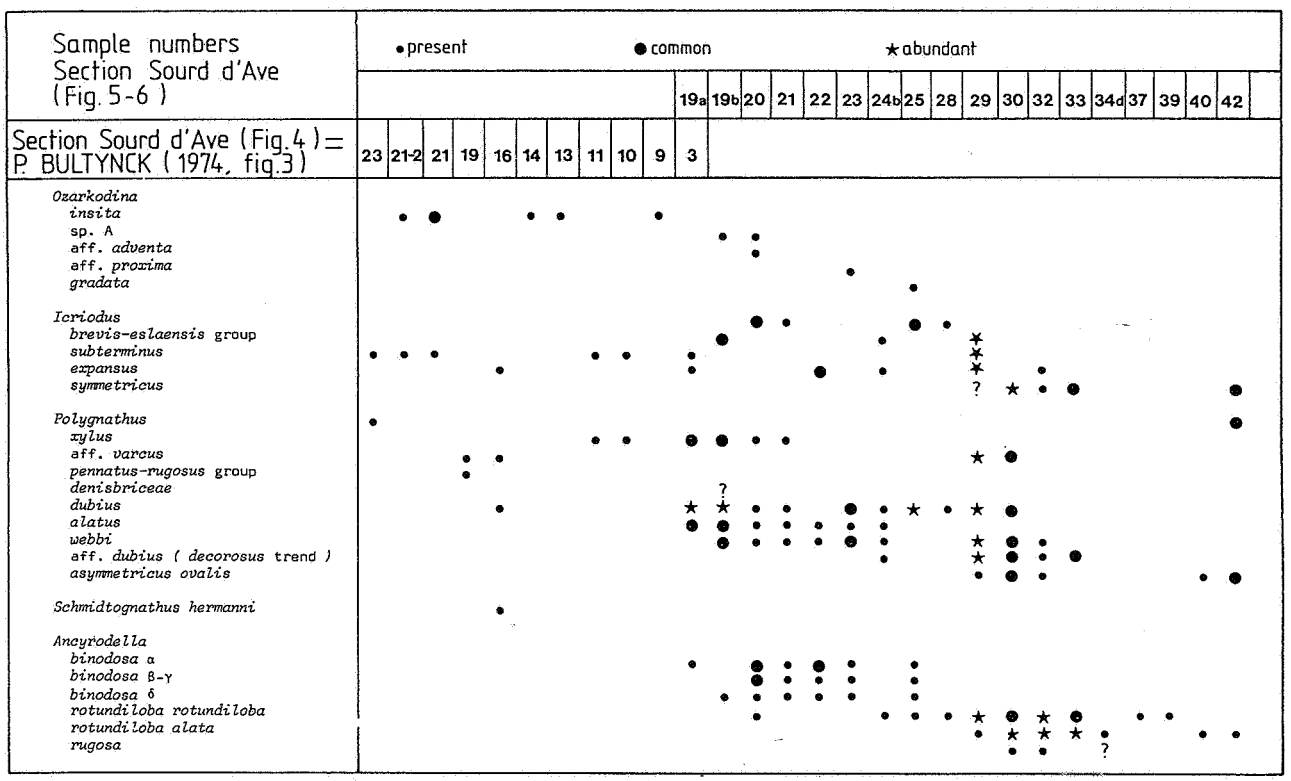
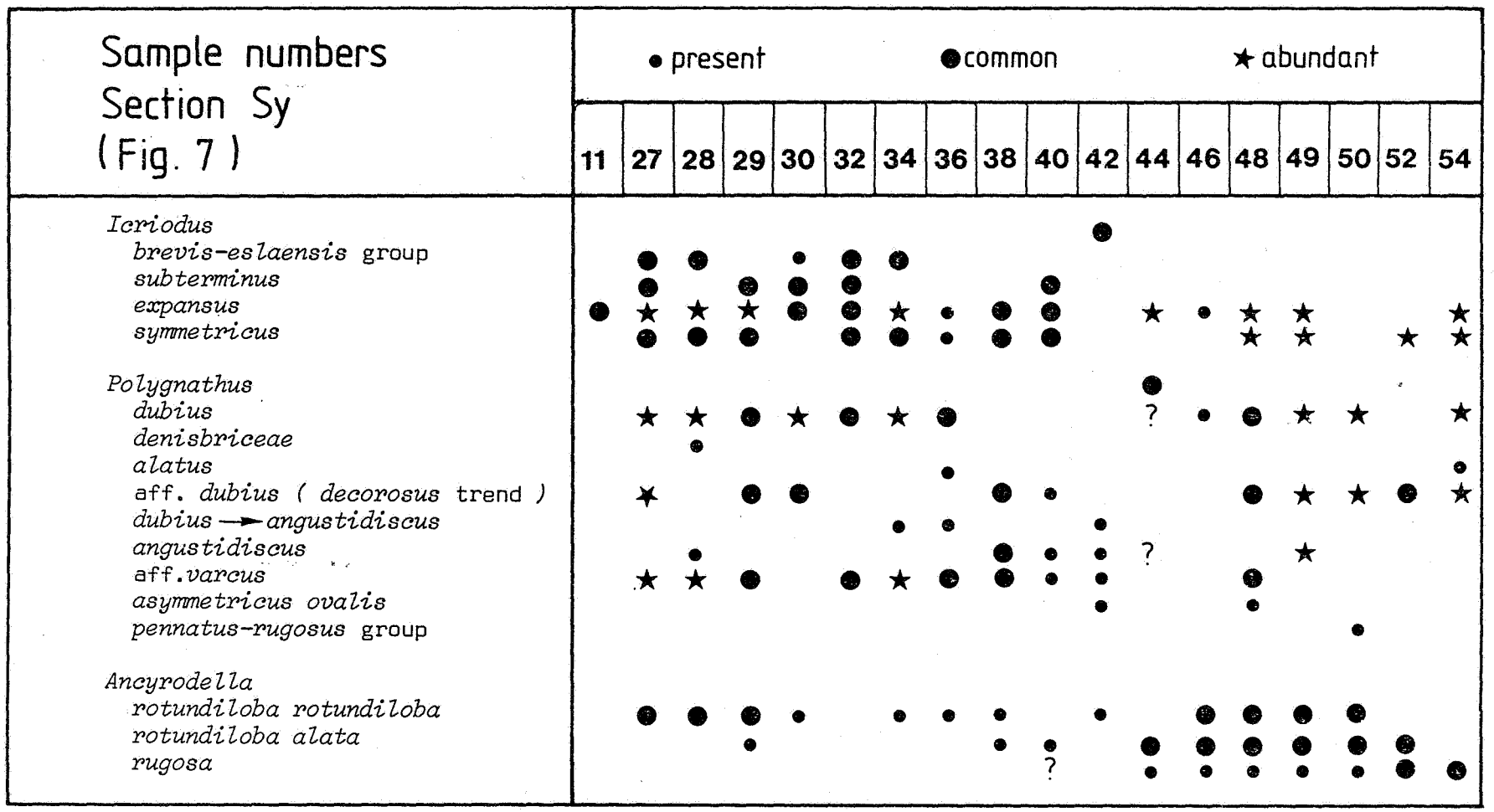


Table 3. From P. BULTYNCK & L. JACOBS, 1982, table 3.



the Upper *P. dengleri* Subzone can be identified by the occurrence of *Ozarkodina insita* (STAUFFER, C.R., 1940) and *Icriodus subterminus* YOUNGQUIST, W.L., 1947 below the earliest record of *Ancyrodella binodosa* (= *insitus* Fauna of G. KLAPPER *et al.*, 1971, p. 300) in the lower part of the Fort Hulobiet Member of the Fromelennes Formation at Sourd d'Ave. *Polygnathus dubius*, HINDE, G.J., 1879, *Schmidtognathus hermanni* ZIEGLER, W., 1965 ; and *Icriodus expansus* BRANSON, E.B. and MEHL, M.G., 1938 also occur initially in this part of the Fromelennes Formation. *Ozarkodina brevis* BISCHOFF, G. and ZIEGLER, W., 1957, is recorded from only the upper part of the Fort Hulobiet Member at Nismes, and indicates that the top of the Fromelennes Formation is probably older than the Lowermost *P. asymmetricus* Zone. According to J.G. JOHNSON, G. KLAPPER and W.R. TROJAN (1980, p. 95), the highest occurence of *O. brevis* in Nevada is in the Upper *P. dengleri* Subzone. G. KLAPPER and W. ZIEGLER (1979, p. 211) recorded the species from the Lower *P. varcus* Subzone to the top of the *S. hermanni* - *P. cristatus* Zone.

The Lowermost *P. asymmetricus* Zone

This Zone is not clearly evident in the Givet-Frasnes succession. The index species enters higher than normal (in the middle part of the Lower *asymmetricus* Zone and just below the entry of *Ancyrodella rotundiloba alata*). It is assumed that the "late entry" of *P. asymmetricus* is due to its rarity in the near-shore facies of the Givet-Frasnes succession and that the range of *Ancyrodella binodosa*, below the first occurrence of *A. rotundiloba rotundiloba*, represents at least the upper part of the Lowermost *P. asymmetricus* Zone. This assumption is based on the belief that *A. binodosa* is the direct ancestor of *A. rotundiloba rotundiloba*, which marks the base of the Lower *P. asymmetricus* Zone. In the sections at Nismes and Sourd d'Ave, *A. binodosa* enters at the base of the Nismes Formation. The *A. binodosa* Fauna is defined by the range of the nominate species below the first occurrence of *A. rotundiloba rotundiloba*. *Ozarkodina* sp. A. BULTYNCK, P. and JACOBS, L., 1982, *Polygnathus alatus* HUDDLE, J.W., 1934 and P. webbi STAUFFER, C.R., 1938 have their lowest occurrence in this Fauna ; *Icriodus* aff. *subterminus*, known from the Mont d'Haurs Formation (middle Givetian of the same area), has its last occurrence. *Ozarkodina* sp. A and intermediate forms assigned to *O.* aff. adventa and *O.* aff. *proxima* are considered to comprise the ancestral lineage of *A. binodosa*.

The Lower *P. asymmetricus* Zone

As already mentioned, the base of this Zone is identifiable in the auxiliary boundary stratotype at Nismes (bed 41) and Sourd d'Ave (bed 20) by the entry of *A. rotundiloba rotundiloba*. G. KLAPPER and W. ZIEGLER (1979, p. 211) reported the simultaneous first occurrence of *A. rotundiloba rotundiloba*, *A. rotundiloba alata*, and *A. rugosa* at the base of the Lower *P. asymmetricus* Zone. In the sections at Nismes, Sourd d'Ave, and Sy, these three taxa enter at slightly different stratigraphic levels, *A. rotundiloba rotundiloba* being the earliest species and *A. rugosa* the latest. The earliest occurrences of each of the three taxa mark the respective bases of the three faunas comprising the Lower *asymmetricus* Zone.

In the lower part of the *A. rotundiloba rotundiloba* Fauna, the nominate conodont is accompanied by *A. binodosa* and forms transitional to *A. rotundiloba rotundiloba*. Forms intermediate between *Ozarkodina* sp. A. and *A. binodosa* are also restricted to this lower part *I.* aff. *symmetricus*, *Ozarkodina gradata* (YOUNGQUIST, W.L., 1945) and *P.* aff. *dubuis* (*decorosus* trend) have their lowest occurrences ; *Polygnathus xylus* disappears. *Icriodus symmetricus* BRANSON, E.B. and MEHL, M.G., 1934, *Polygnathus angustidiscus* YOUNGQUIST, W.L., 1947, and *P. asymmetricus ovalis* ZIEGLER, W. and KLAPPER, G., 1964 enter near the highest limit of the Fauna ; *Polygnathus denisbriceae* BULTYNCK, P., 1979, disappears within the range of the Fauna.

The base of the *A. rotundiloba alata* Fauna is identified in the sections at Nismes (bed 65), Sourd d'Ave (bed 29), and Sy (bed 29). The *Icriodus eslaensis* VAN ADRICHEM BOOGAERT, H.A., 1967 - *I. brevis* STAUFFER, C.R., 1940 group has not been recorded from higher strata.

The base of the *A. rugosa* Fauna is immediately above, in bed 66 at Nismes section, in bed 30 at Sourd d'Ave, and in bed 44 at Sy.

BRACHIOPODS

ATRYPIDAE (BRACHIOPODA) IN UPPER GIVETIAN TO LOWER FRASNIAN STRATA OF THE SOUTHERN AND SOUTHEASTERN BORDERS OF THE DINANT SYNCLINORIUM (BELGIUM)

by J. GODEFROID & L. JACOBS

In the vicinity of the Middle Upper Devonian boundary the strata in Belgium contain rich atrypid and spiriferid brachiopod faunas.

The spiriferids have recently been studied by P. SARTENAER (1982) and the atrypids by J. GODEFROID and L. JACOBS (1986).

The atrypids have been collected from five outcrops on the southern and southeastern borders of the Dinant Synclinorium. From west to east, these outcrops are at Nismes, Fromelennes, Martouzin, Sourd d'Ave and Sy.

Most of the atrypids belong to the genus *Desquamatia* ALEKSEEVA, R.E., 1960. Six species have been recognized and assigned to the subgenera *D. (Neatrypa)* STRUVE, W., 1964 and *D. (Seratrypa)* COPPER, P., 1967.

The spinatrypids are rare and not well enough preserved to be described precisely. They have been grouped here as *Spinatrypina* sp. They seem to be related to the species *Spinatrypina (? Spinatrypina) comitata* COPPER, P., 1967, from the "Oberer Plattenkalk" and the lower part of the Refrath beds of Germany.

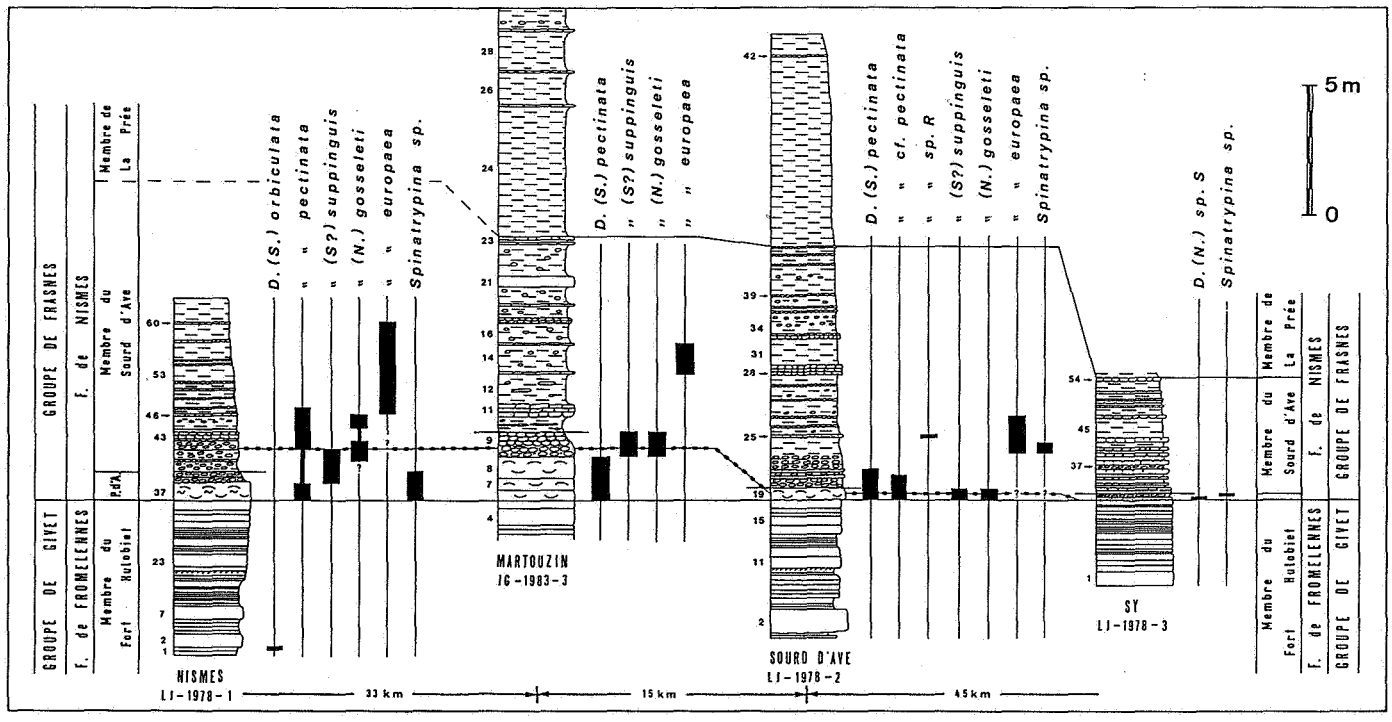


Figure - Distribution of the atrypid brachiopods in the Nismes, Martouzin, Sourd d'Ave and Sy sections [from : GODEFROID, J. & JACOBS, L., Atrypidae (Brachiopoda) de la Formation de Fromelennes (fin du Givetien) et de la partie inférieure de la Fromation de Nismes (début du Frasnien) aux bords sud et sud-est du Synclinorium de Dinant (Belgique) - Bull. Inst. r. Sci. nat. Belg. : Sciences de la Terre, 56, pp. 67-136].

The succession of the atrypids at the base of the Nismes Formation in these different outcrops displays from south to north-east, the diachronism of the base of the unit.

At Nismes and Martouzin, *Desquamatia (Seratrypa ?) suppinguis* and *D. (Neatrypa) gosseleti* occur for the first time in the Pont d'Avignon Member, above the base of the Nismes Formation and somewhat higher than the entry of *D. (Seratrypa) pectinata*.

In the Sourd d'Ave section, *D. (S.) pectinata, D. (S?) suppinguis* and *D. (Neatrypa) gosseleti* appear simultaneously at the base of the Nismes Formation.

In these three sections, *D. (N.) europea* is present in the Sourd d'Ave Member, clearly above the first occurence of *D. (N.) gosseleti* and of the *D. (Seratrypa)* species.

On that basis, beds 41-42 at Nismes are correlated biostratigraphically with bed 9 at Martouzin and bed 19 at the Sourd d'Ave.

None of the above considered species have been collected in the Sy section, but the occurence of *D. (Neatrypa)* sp. S, an unnamed species close to *D. (N.) europaea*, suggests that the base (bed 27) of the Nismes Formation at Sy, could be correlated biostratigraphically with the beds containing *D. (N.) europaea* in the Nismes, Martouzin and Sourd d'Ave sections.

THE STRATIGRAPHIC SIGNIFICANCE OF RHYNCHONELLID GENERA AT THE GIVETIAN/FRASNIAN BOUNDARY

by P. SARTENAER

A summary of the state of our knowledge of the rhynchonellid genera near the Givetian-Frasnian boundary on a global basis has been published in 1985 (Courier Forschungsinstitut Senckenberg, 75, pp. 311-318) (*see* table).

Sixteen genera are involved, of which nine actually cross the boundary. Unfortunately, most of them, including such critical world-wide genera as *Fitzroyella* VEEVERS, J.J. 1959, *Phlogoiderhynchus* SARTENAER P., 1970, *Platyterorhynchus* SARTENAER, P., 1970, are not present in Belgium.

On the other hand representatives of the genus *Globulirhynchia* BRICE, D., 1981 have been found by the author in the upper part of the Middle *Polygnathus asymmetricus* Zone at Boussu-en-Fagne, near Frasnes, and, possibly, in the upper part of the Lower *P. asymmetricus* Zone at Nismes. The author has also collected an undescribed species of the genus *Lorangerella* CRICKMAY, C.H., 1963 from the southern border of the Dinant Basin, in the middle part of the Lower *Polygnathus asymmetricus* Zone.

SPIRIFERIDS

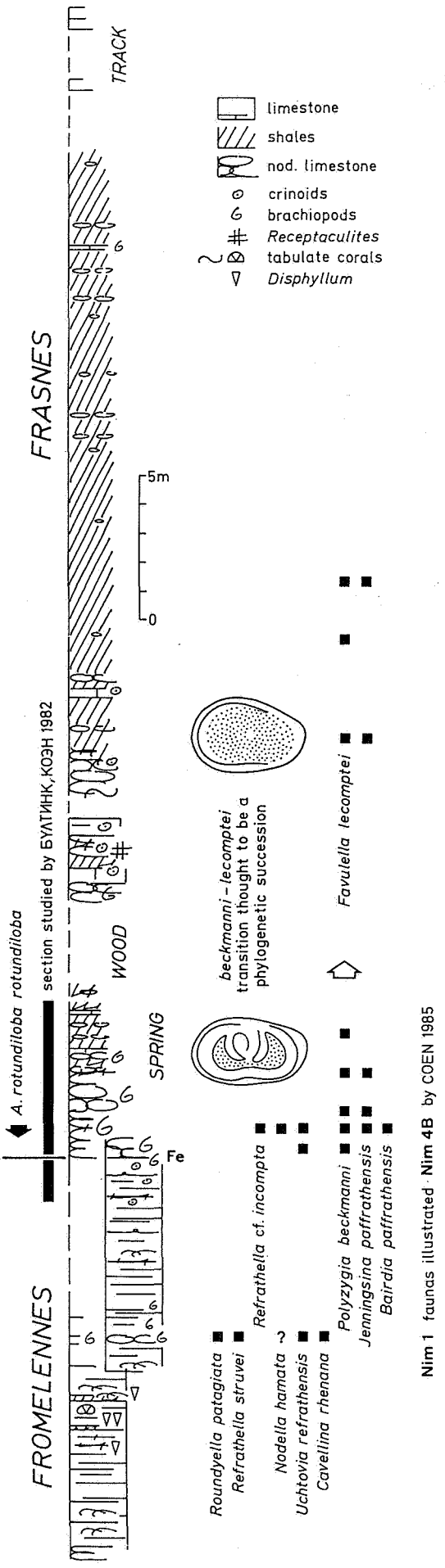
by P. SARTENAER

Many spiriferid species have been mentioned in the literature for a long time, both in the Givetian and in the Frasnian. Unfortunately they are either misidentified or too all-encompassing, and need to be re-examined, an very, often, recollected. This study is under way, and, some well redefined taxa are already of great biostratigraphical significance. Such are the genera *Eleutherokomma* CRICKMAY, C.H., 1950 and *Tecnocyrtina* JOHNSON, J.G. & NORRIS, A.W., 1972. These two genera straddle the Givetian-Frasnian boundary, and so does *Uchtospirifer* LIACHENKO, A.I., 1957, but the understanding of this genus is still unclear on account of the difficulty of access to the type collections ; also, the precise stratigraphic position of most of its species is unknown. This situation is regrettable, because, as the author has explained previously (1974), one or more species, described under the names *Spirifer orbelianus* ABICH, H., 1858, *Cyrtospirifer orbelianus* and *Cyrtiopsis orbeliana* in the uppermost Givetian and lowermost Frasnian beds of the Dinant Basin belong to *Uchtospirifer* or to related genera.

Some early Frasnian spiriferids, with restricted stratigraphic range, have been discussed by the author (1982) : *Geminisulcispirifer bisinus* (LE HON, H., 1870), type species of the subgenus *Geminisulcispirifer* SARTENAER, P., 1982 and *Subquadriangulispirifer malaisi* (GOSSELET, J., 1894), type species of the genus *Subquadriangulispirifer* SARTENAER, P., 1982, from the Dinant Basin (Belgium and France), Massif de la Vesdre (Belgium), and Aachen region (Germany) ; *Eodmitria oblivialis* SARTENAER, P., 1982 and *E. oblivialis grandis* SARTENAER, P., 1982 belonging to the genus *Eodmitria* BRICE, D., 1982 and collected in Belgium (Namur Basin, Dinant Basin, Massif de la Vesdre) and Germany (Aachen region).

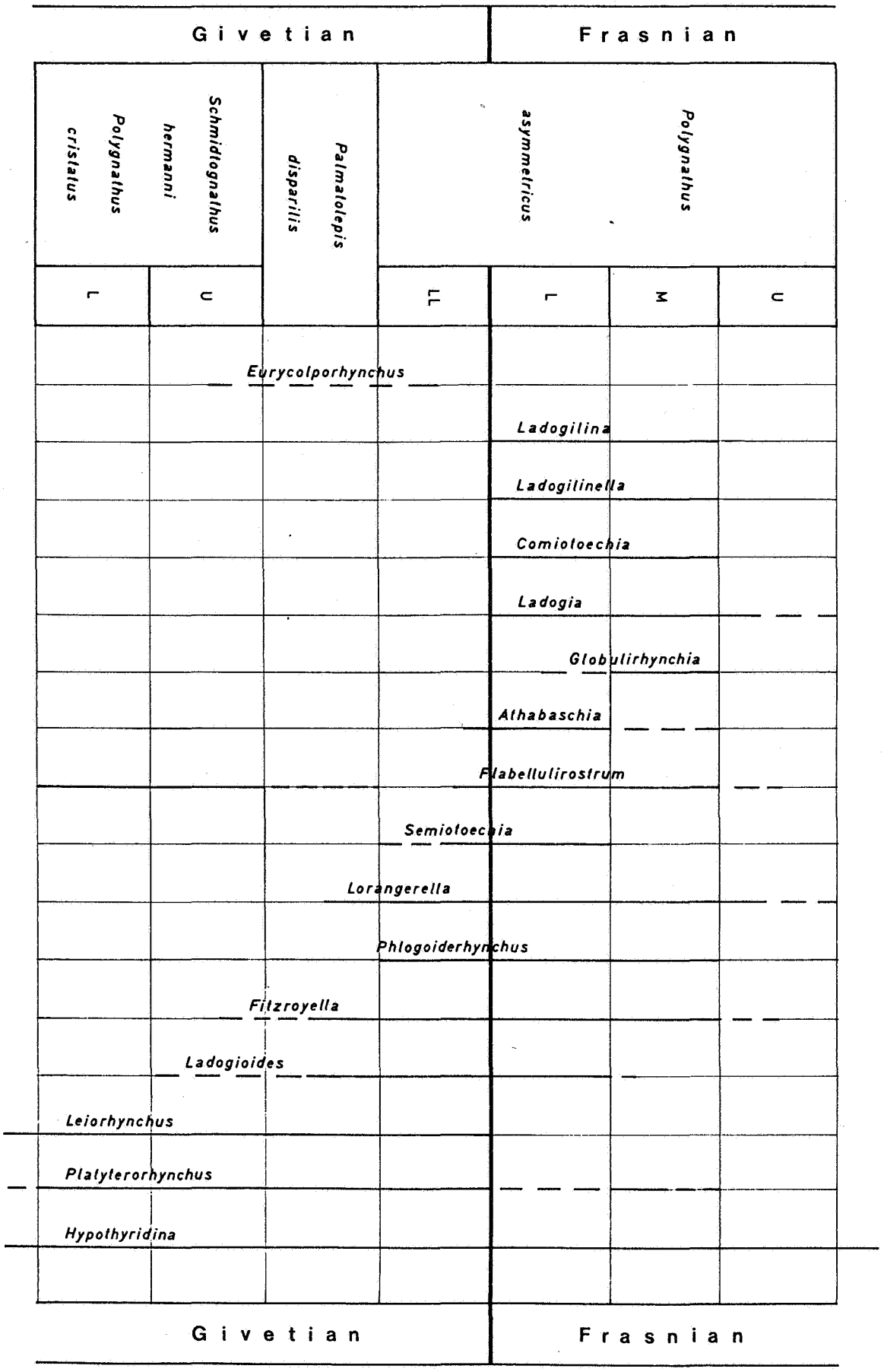
The stratigraphic position of the taxa mentioned in this note are indicated on the following table.

OSTRACODS OF THE NISMES SECTION by M. COEN



General log and ostracodes distribution in the section at Nismes (M. COEN).

Table.


Givetian
Frasnian
Schmidtognathus hermanni Polygnathus cristatus
Palmatolepis disparilis
Polygnathus asymmetricus
L
U
LL
L
M
U
Eurycolporhynchus
Ladogilina
Ladogilinella
Comiotoechia
Ladogia
Globulirhynchia
Athabaschia
Flabellulirostrum
Semiotoechia
Lorangerella
Phlogoiderhynchus
Fitzroyella
Ladogioides
Leiorhynchus
Platyterorhynchus
Hypothyridina
Givetian
Frasnian

OSTRACODS OF THE SOURD D'AVE SECTION

by J.-G. CASIER

The Sourd d'Ave section is located at the intersection of the Dinant-Neufchâteau (N48) and Wellin-Han-sur-Lesse (N35)roads (Fig. 1).

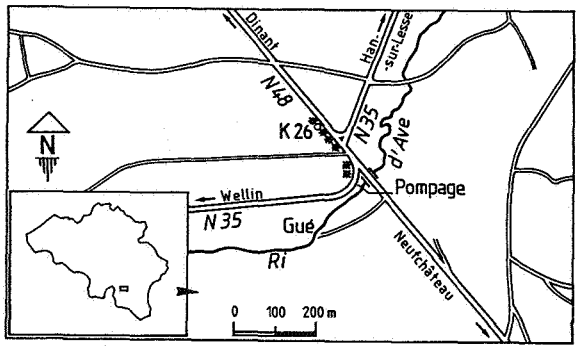


Figure 1. Sourd d'Ave section : locality map.

Ostracods from the Givet Group in the Sourd d'Ave section have been studied by B. MILHAU (1983) and these from the Frasnes Group by J.-G. CASIER (1979a, 1987a).

Ostracods occur infrequently in the upper member of the Fromelennes Formation and according to B. MILHAU (1983, tabl. 2, p. 353), the following species are present in this member : *Healdianella* sp. 1 ?, *Bythocypris ?* sp. G1' MAGNE 1964, *Birdsalella ?* sp. indet. ?, *Microcheilinella* cf. *clava* (KEGEL 1932), *Cryptophyllus* sp. 3 MAGNE 1964, *Acratia* sp. 1, *Bairdiocypris* cf. *rauffi* KRÖMMELBEIN 1952, *Cavellina* sp. 1, *Cytherellina* sp. 1, *Cytherellina* cf. *perlonga* (KUMMEROW, 1953), *Cytherellina* sp. 2, *Eridoconcha ?* sp. 1, *Knoxiella* sp. 1, *Polyzygia neodevonica* (MATERN, 1929), *Uchtovia ?* sp. 1, *Sulcella (P.) abundans* (POKORNY 1950), *Samarella* aff. *crassa* POLENOVA 1952, *Cavellina* cf. sp. II GROOS 1969, *Bairdia (R.)* sp. 1, *Silenites ?* sp. G. MAGNE 1964 ?, *Evlanella* sp. 1, *Evlanella* cf. *sulcellina ?* BECKER 1964, *Macrocypris ?* sp. G MAGNE 1964, *Sulcella ?* sp. 3, *Sulcella (S.) speculaea* BECKER 1965, *Evlanella* sp. 2, *Nodella* sp. 1, *Quasillitacea* gen. indet. sp. B. *Bairdia (R.) paffrathensis* KUMMEROW 1953 is also present in this member.

Starting with the only bed representing the Pont d'Avignon Member and containing the first *Ancyrodella binodosa*, the ostracod fauna becomes rich and diversified. The figures 2 and 3 present the recorded ranges of the ostracod species in the Frasnes Group.

BIOSTRATIGRAPHY

The *Polyzygia beckmanni beckmanni* Zone, *Polyzygia beckmanni beckmanni/Favulella lecomptei* Interval-zone and base of the *Favulella lecomptei* Zone are recognized in the Sourd d'Ave section. These zones are part of the zonal sequence established on the Metacopida by F. LETHIERS (1974) and J.-G. CASIER (1979b, pp. 5-6) (Fig. 4). The *Polyzygia beckmanni beckmanni* Zone is 4,7 m thick and begins at the base of the Frasnes Group. The *Favulella lecomptei* Zone begins 1,5 m below the limit between the Sourd d'Ave and the la Prée Members. The *Polyzygia beckmanni beckmanni/Favulella lecomptei* Interval-zone is 3,2 m thick in the Sourd d'Ave section.

The occurence of *Ungerella* in the upper part of the Nismes Formation indicates that the zonal sequence established on the Entomozoacea can be extend to the lower Frasnian of Belgium. This occurence would also indicate that the top of the Nismes Formation is still in the Lower *Polygnathus asymmetricus* Zone of the zonal sequence established on the Conodonts.

PALEOECOLOGY

Figure 5 presents the distribution of the ostracod ecozones in the Frasnian of the Paleotéthys. The following ecozones are recognized (J.-G. CASIER, 1987b) :

- Ecozone I : restricted environment rich in Platycopida and with some Podocopida.
- Ecozone II : shallow marine environment with thick shelled Podocopida.
- Ecozone III : marginal basin environment in which all the Ostracods orders can be present. In this ecozone, the number of species belonging to the Podocopida, Platycopida and Eridostraca decreases and the number of species belonging to the Metacopida increases with the deepening.
- Ecozone IV : deeper basin environment with spinous Metacopida and Podocopida (= Thuringe ecozone).
- Ecozone V : dysaerobic environment with Myodocopida (Entomozoacea) and some Palaeocopida.

The upper member of the Fromelennes Formation is lagoonal (absence of Ostracods), sometimes marine restricted (presence of ecozone I) and rarely open marine (presence of a shallow ecozone III at the base of the Member).

The Ostracods distribution indicates the transition from a lagoonal, restricted environment to an open marine environment at the Givet Group-Frasnes Group boundary and also a progressive deepening of the sea floor at the base of the Frasnian (presence of ecozone III with an increasing number of Metacopida species and a decreasing number of Podocopida and Platycopida species in the Nismes Formation and probably presence of ecozone IV at the base of the overlaying formation).

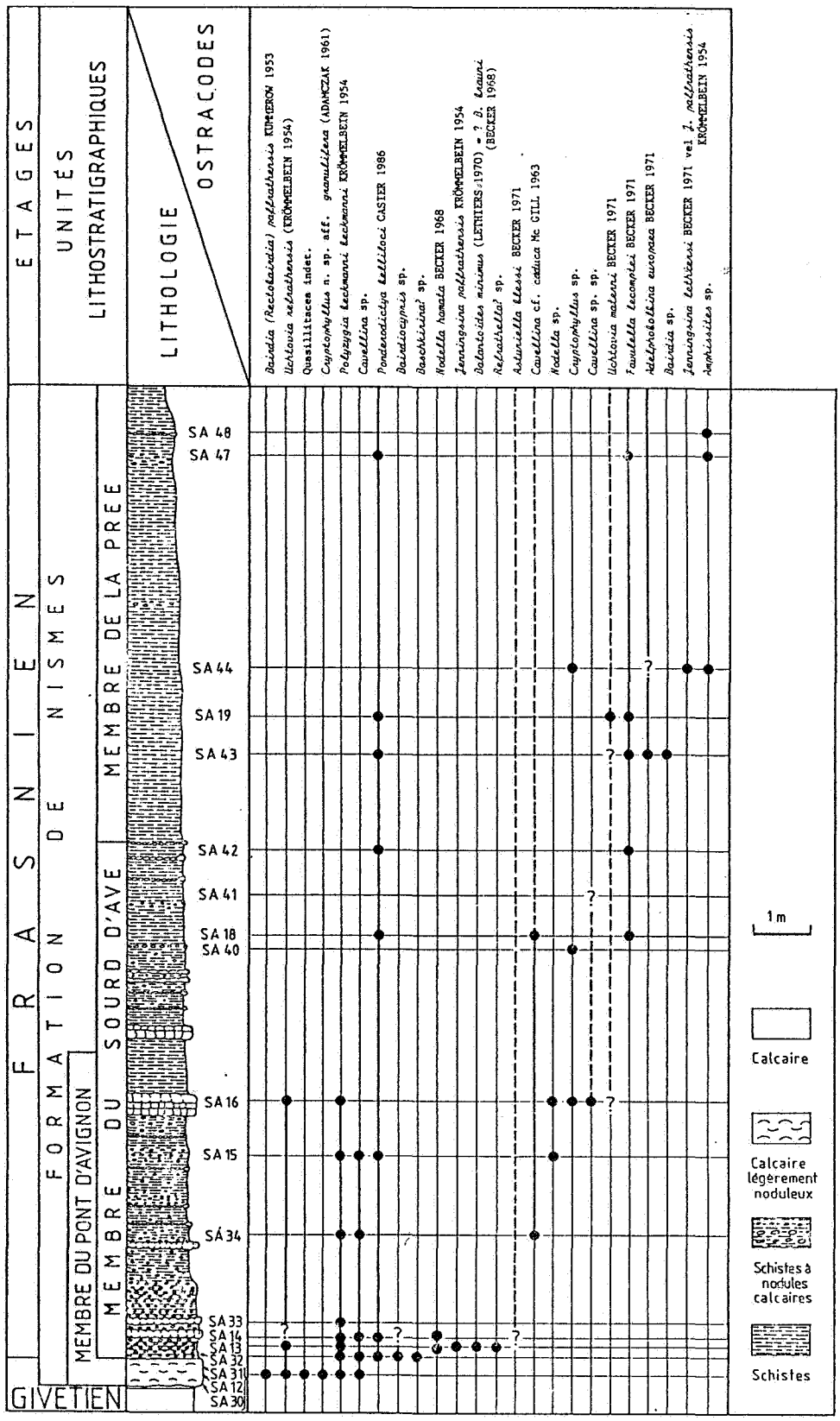


Figure 2. Recorded ranges of ostracod species in the Pont d'Avignon Member, in the Sourd d'Ave Member and in the base of the la Prée Member. Lithological column according to P. BULTYNCK & L. JACOBS, 1982 (J.-G. CASIER, 1987a, fig. 2, p. 25).

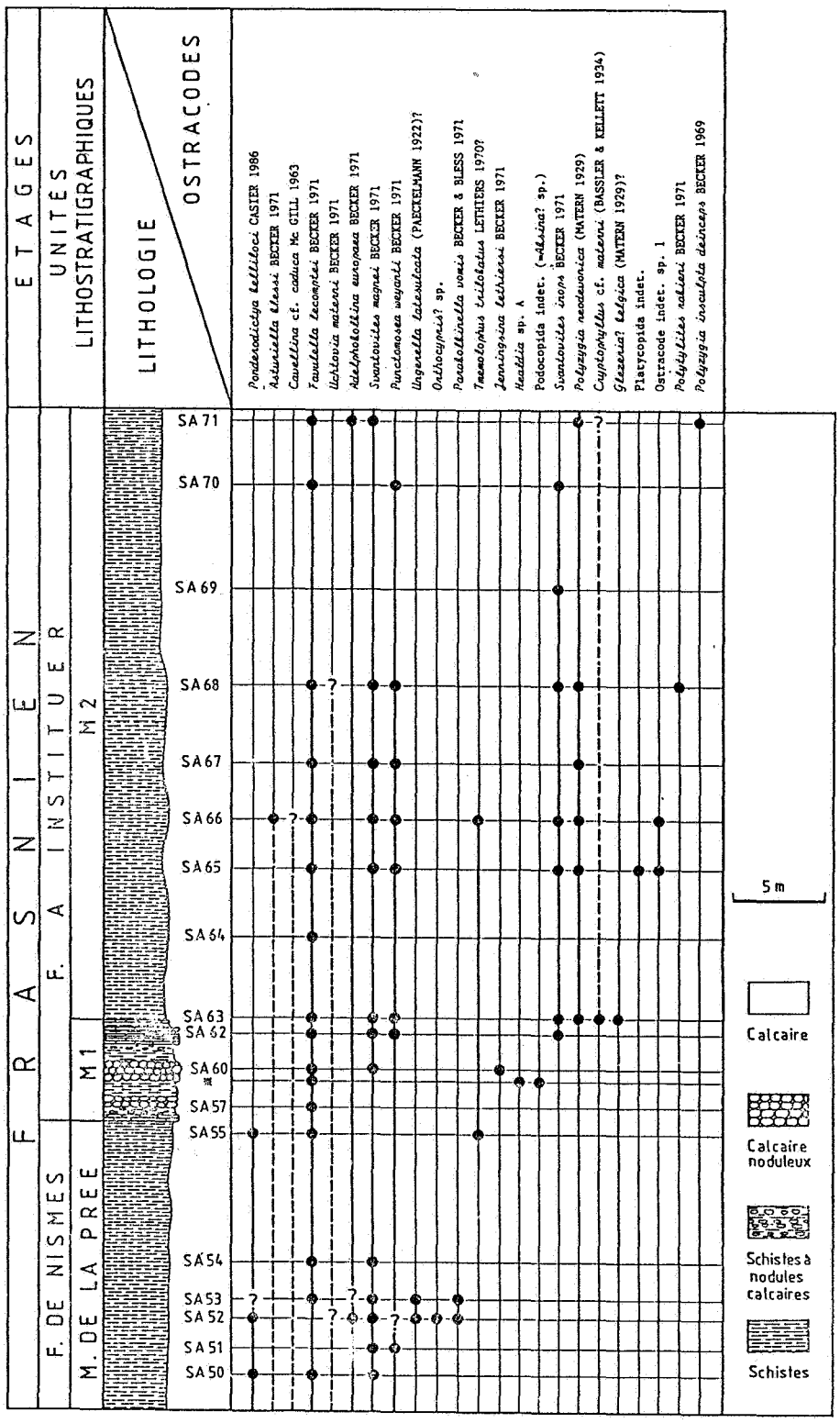


Figure 3. Recorded ranges of ostracod species in the upper part of the La Prée Member and in the basal part of the overlaying formation (J.-G. CASIER, 1987a, fig. 3, p. 26).

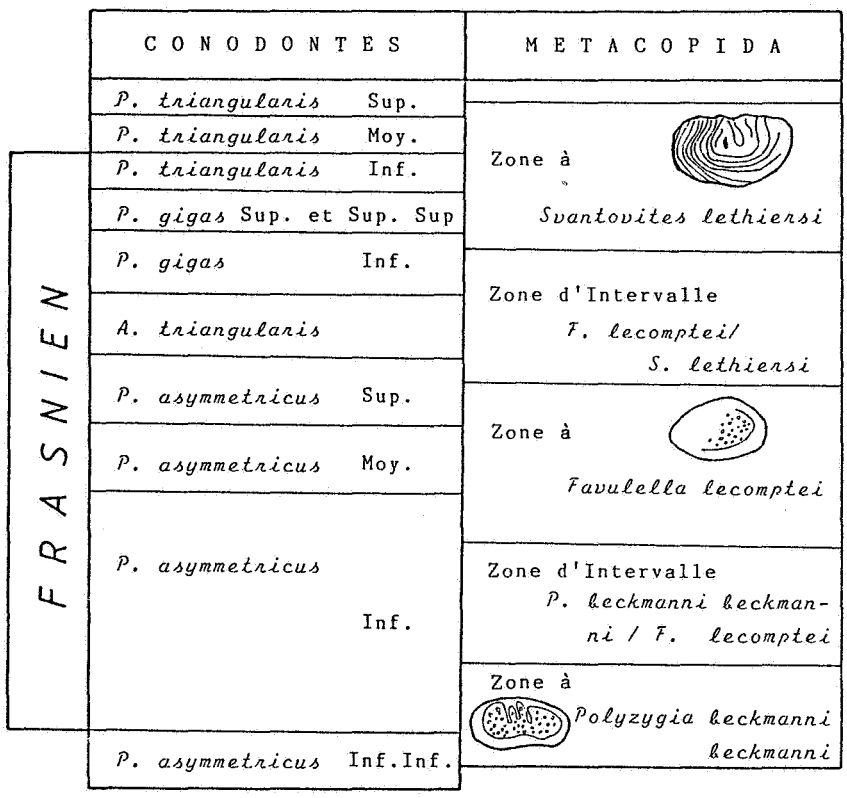


Figure 4. Zonal sequence established on the Metacopida and correlations with the biostratigraphic zonation based on the Conodonts (for the Entomozoacea : *see* J.-G. CASIER, 1983, tabl. 1, p. 199).

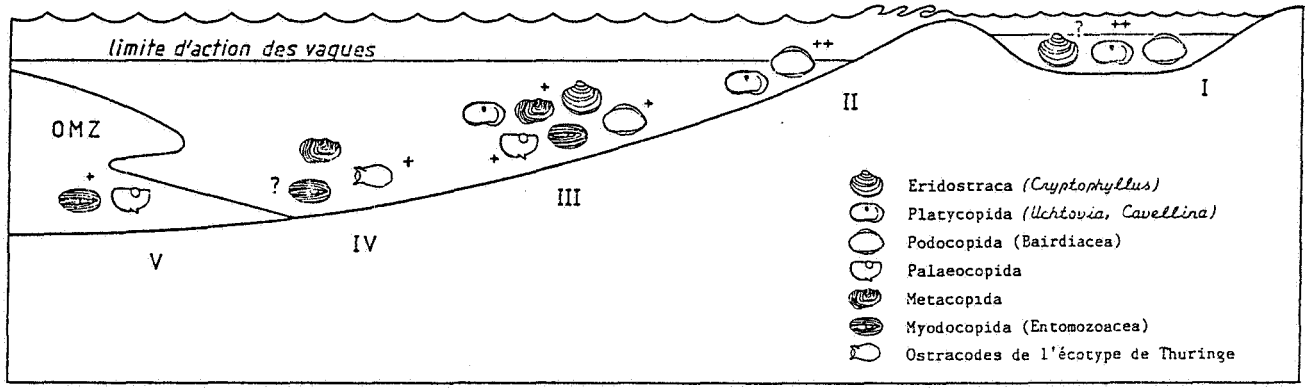


Figure 5. Distribution of the ostracod ecozones in the Frasnian of the Paleotéthys (J.-G. CASIER, 1987b, fig. 4).

RUGOSE CORALS by M. COEN-AUBERT

In the Nismes section, the Fort Hulobiet Member of the Fromelennes Formation is represented by 13,5 metres of fine stratified limestone which is sometimes a little bioclastic with small shells or brachiopods ; fragments of crinoids appear just below the Nismes Formation. Between 8 and 9,75 metres under the base of this lithostratigraphic unit, there are three thin layers rich in corallites of *Disphyllum virgatum* (HINDE, G.J., 1890) ; in the second one, these rugose corals are associated with some *Alveolites* and *Thamnopora*. All this sequence with the beds of *D. virgatum* is exposed in the upper level of the Nismes section.

D. virgatum has been found in the same facies and in the same stratigraphic position as in Nismes, in the Vaucelle quarry of Frasnes-lez-Couvin, at the Haute Roche of Dourbes and at the Fort de Charlemont of Givet. The first two sections have been described by M. COEN & M. COEN-AUBERT (1971), the third one by M. ERRERA, B. MAMET & P. SARTENAER (1972).

D. virgatum also occurs at the Sourd d'Ave section near Wellin, but here the upper part of the Fort Hulobiet Member consists of an alternation of fine limestone and layers with massive and dendroid stromatoporoids. These accumulations of rolled reef buiding organisms sometimes contain corallites of *D. virgatum* and rare fragments of *Alveolites* ; some thin beds of shale are also present.

Thus all these occurrences of *D. virgatum* from the southern border of the Dinant Synclinorium characterize the upper part of the Fort Hulobiet Member ; they belong to the Upper *Polygnathus dengleri* Subzone before the entry of *Ancyrodella binodosa* at the base of the Nismes Formation.

MIOSPORES NEAR THE GIVETIAN-FRASNIAN BOUNDARY

by M. STREEL & S. LOBOZIAK

Accurate miospore-based correlations of the Givetian-Frasnian boundary (the Middel-Upper Devonian boundary) cannot be achieved starting from the Global Stratotype Section exposed at Col du Puech de la Suque in the southern Montagne Noire, France, nor from the Auxiliary Stratotype at Nismes. Miospores are not known in these two sections where the limit is drawn at te base of lower *asymmetricus* conodont Zone.

However, miospores occur with conodonts of the Givetian-Frasnian transitional beds in the Ferques railroad section in the Boulonnais area, north of France.

The conodont zonation was demonstrated there by BULTYNCK (*in* BRICE *et al.*, 1979). We refer here (fig. 1) to his table III emended by observations made by COEN (*in* BRICE *et al.*, 1981).

In the Membre de Couderousse of the Formation de Blacourt, faunas IV and V correspond to the middle and upper *varcus* Zones (BULTYNCK *in* BRICE, 1987). The basal beds of the succeeding Formation de Beaulieu are not present in this section but a few meters above the first shales of the Membre de Cambresèque occurs the fauna IX with *Ancyrodella rotundiloba alata* (BRICE *et al.*, 1979) which has a rather early occurrence within the lower *asymmetricus* Zone. The first occurrence of *Ancyrodella gigas* noted by COEN (*in* BRICE *et al.*, 1981) in the Membre des Noces of the Formation de Beaulieu corresponds to the base of the middle *asymmetricus* Zone.

Three successive Oppel Zones of miospores (TA Zone, TCo Zone, BJ Zone) are present in the range of these conodont Zones in this section. They are described by LOBOZIAK & STREEL (1980, 1981) and STREEL *et al.* (1987). RICHARDSON & Mc GREGOR (1986) described two Assemblage-Zones (*optivus-triangulatus* Zone, *ovalis-bulliferus* Zone) in about the same timespan, around the old Red Sandstone Continent. The limit between these Assemblage-Zones is taken by RICHARDSON & Mc GREGOR (1986), in the Ferques section, at the limit between the TCo Zone and the BJ Zone. The *optivus-triangulatus* Zone probably includes both TA and TCo Zones as its base is characterized by the first appearance of miospores with prominent development of zona in the radial regions (*Samarisporites triangulatus*).

The Givetian-Frasnian boundary occurs within the TCo Zone. On fig. 1, we have selected a few species which might help to delineate this boundary. They are *Verrucosisporites premnus*, *Ancyrospora ancyrea* var. *ancyrea* and *Rhabdosporites langii* (the last-one not met in this section but only in the Tournai borehole). The last occurrences of these species are known within lower parts of the TCo Zone limits in many regions of the O.R.S. Continent and adjacent areas (Mc GREGOR, 1981 ; RICHARDSON & Mc GREGOR, 1986). The informal interval zone between these last occurrences and the first appearence of *Chelinospora concinna* and *Cirratriradites jekhowskyi* is, for the time being, the best miospore-marker available to approach the Givetian-Frasnian boundary.

These criteria have been recently applied to correlations between the Boulonnais area and three boreholes made in Belgium, two in the Namur Syncline (Nieuwkerke and Tournai), south of the Brabant Massif and one in the Campine (Booischot), north of the Brabant Massif.

In the Booischot borehole (STREEL & LOBOZIAK, 1987) the lower part (1037-1078 m) of the continental green conglomerates, despite the absence of *Ch. concinna*, might well belong to the informal interval zone described below the Givetian-Frasnian boundary in the Boulonnais area. If confirmed, this correlation would date the lower range of *Archaeopteris fimbriata* known in this borehole, of the Givetian age.

In the Tournai borehole the upper part (939 - 944 m) of the Formation d'Alvaux (COEN-AUBERT *et al.*, 1981) obviously belongs to this informal interval zone of Uppermost Givetian age (LOBOZIAK & STREEL, unedited). This is confirmed here by the occurrence of *Ancyrodella rotundiloba* near the base of the overwhelming Formation de Bovesse (COEN-AUBERT *et al.*,