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# STRATIGRAPHIC INTERPRETATION OF THE TOHOGNE BOREHOLE (PROVINCE OF LUXEMBOURG). DEVONIAN - CARBONIFEROUS TRANSITION (*)

by

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**ABSTRACT.-** The Tohogne borehole section, from the Lower Tournaisian into the Upper Famennian, has a remarkable micropalaeontological content (conodonts, foraminifers, spores) which enabled a detailed subdivision of these strata. New data in biostratigraphy and systematic palaeontology and palaeogeographic implications are presented, as well as correlations with reference sections.

**RESUME.-** Le sondage de Tohogne traverse les unités lithostratigraphiques du contact Famennien - Tournaisien. Il a livré une microfaune et une microflore remarquable (conodontes, foraminifères, spores), permettant ainsi une subdivision détaillée des couches. Il en ressort des données nouvelles de biostratigraphie et de paléontologie systématique, ainsi que certaines implications de paléogéographie. Une corrélation plus précise entre les différentes coupes de référence a été rendue possible.

## INTRODUCTION

The Tohogne borehole (sheet Hamoir, 158 W 93) was drilled as part of a stratigraphic research project, aimed at the elucidation of problems concerning the Devonian - Carboniferous system limit. It is situated on the north-side of a large syncline centred at Houmart, a hamlet of Tohogne, 5 km south-west of Hamoir.

This is the southernmost syncline on the eastern border of the Dinant synclinorium, containing Lower Carboniferous limestones. It lies north of the Durbuy Massif, an uplift area with Upper and Middle Devonian limestones. The Xhoris thrust fault separates the two parts of the Dinant synclironium.

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In this respect, the Tohogne borehole is the southern prolongation of a series of classical sections through the Famennian and Tournaisian formations in the Ourthe valley.

A detailed lithological description of the borehole with its microfaunal content and exact situation is published as Professional Paper 1976 - 8 of the Belgian Geological Survey (with 4 photographic plates on conodonts). The borehole started in the basal beds of the Landelies Formation, and continued to a depth of 173 m near the base of a trangressive serie overlying a formation comparable to the Montfort Formation. The relationships with older formations and the facies changes of the "Strunian" deposits in the neighbouring areas will be dealt with in a forthcoming paper by Dusar.

## LITHOSTRATIGRAPHY

Lithostratigraphical Formations found :

- Landelies Formation ("Tn2b") basal beds only.
- Pont d'Arcole Shales ("Tn2a") also named Shales with *Spiriferellina peracuta* ; thickness 13 m.

- Hastière Limestone (" Tn1b ") ; thickness 22.5 m
  - upper member (" $\gamma$ ") shale and nodular limestone ; 3.5 m
  - middle member (" $\beta$ ") sorted limestone ; 7 m
  - lower member (" $\alpha$ ") sorted limestone with 3 shaley intercalations, oolitic limestone at the base ; 12 m.
- Etroeungt Limestone " sensu lato " (Tn1a sensu Conil et *al.* 1971) shaley nodular limestone ; thickness 20 m.
- Shaley and sandy " Strunian " (" Strunian " in the lithological sense, meaning a new transgressive formation over regressive Famennian formations, and starting here somewhat before the appearance of *S. lepidophytus*) ; tickness 76 m.

  Composed of different sequences :
  - " Ensemble schisto-gréseux de l'Ourthe " with coral beds ; 13 m
  - Second biostrome (with corals only) 3.5 m
  - Straticulated shales : 8.5 m
  - first biostrome (with corals) 3 m
  - Straticulated shales ; 10.5 m
  - " Rythms with small *Girvanella* " ; 9.5 m
  - Shales alternating with well-layered sandstones, sometimes slumped, and sandy limestone ; 28 m to the base of the borehole.

## BIOSTRATIGRAPHY

The micropaleontological content (conodonts, foraminifera, spores) is particularly rich, permitting a detailed biostratigraphic subdivision and giving new data in systematic paleontology. A combination of litho- and biostratigraphy also gives some insight into the paleogeographic situation.

### A.- MAJOR SUBDIVISIONS

Two major subdivisions were found.

- Limit between the sporozones VU (*versabilis - uncatus*) and PL (*pusillites - lepidophytus*) characterizing the base of the Fa2d in the Rivage section. This limit occurs near the base of the borehole.
- Limit at the base of the *Quasiendothyra kobeitusana* - Zone, found more than 25 m below the base of the Etroeungt Limestone in the Avesnois (CONIL et LYS, 1971). This limit occurs within the first biostrome in the Tohogne borehole whereas it is only recognized in the second biostrome in other sections further north along the Ourthe valley (fig. 1)
  Limits based on the standard conodont biozonation cannot be applied. The limit at the base of the *Siphonodella*-Zone is questionned because facies-bounded.

### B.- THE " STRUNIAN "

The beds belonging to the VU - and PL-Zones (top Fa2c, Fa2d, and " lower " Tn1a) are thicker, less coastal-bound and finer grained than in Comblain-au-Pont. Paleontological data give an indication for the more marine facies of these beds in Tohogne. The Fa2c beds contain an association of conodonts and *Umbellina* without *Girvanella nicholsoni*, with abundant and well-preserved spores, whereas the corresponding beds in Comblain do not contain any conodonts but exclusively an *Umbellina - Girvanella nicholsoni* association.

The Fa2d beds contain well-developed plurilocular foraminifera and conodonts, whereas the corresponding fauna in Comblain in extremely poor.

The level yielded *Avesnella* as in the Avesnois region. They have been found at the same level in Barvaux-en-Condroz by R. DREESEN (personal communication), on a place indicated as Fa2a (facies de Souverain-Pré on the geological map : sheet Maffe, 168 W).

*Polygnathus streeli* DREESEN, DUSAR and GROESSENS, 1976 is confined to the basal layers of the borehole (VU-Zone) whereas it rises into younger strata in regions with a more sandy facies. 3 new conodont species described by BOUCKAERT and GROESSENS, 1976, *Pseudopolygnathus conili, Ps. graulichi* and *Polygnathus paprothae* are fairly abundant in the Tohogne borehole, especially in the oolitic basal beds of the Hastière Limestone where they are probably reworked from underlying Etroeungt Limestone beds. They are more evenly distributed in the Strunian deposits : *Pseudopolygnathus conili* which evolved form *P. vogesi* is found from the second biostrome upwards ; *Pseudopolygnathus graulichi* from the top of the " Ensemble schisto-gréseux de l'Ourthe " upwards, and *Polygnathus paprothae* from the basal beds of the Etroeungt Limestone upwards.

The Tn1a foraminifera are generally better preserved. Plurilocular foraminifera are fairly abundant in the Tn1b beds of Tohogne but are very rare in the Tn1b of Comblain.

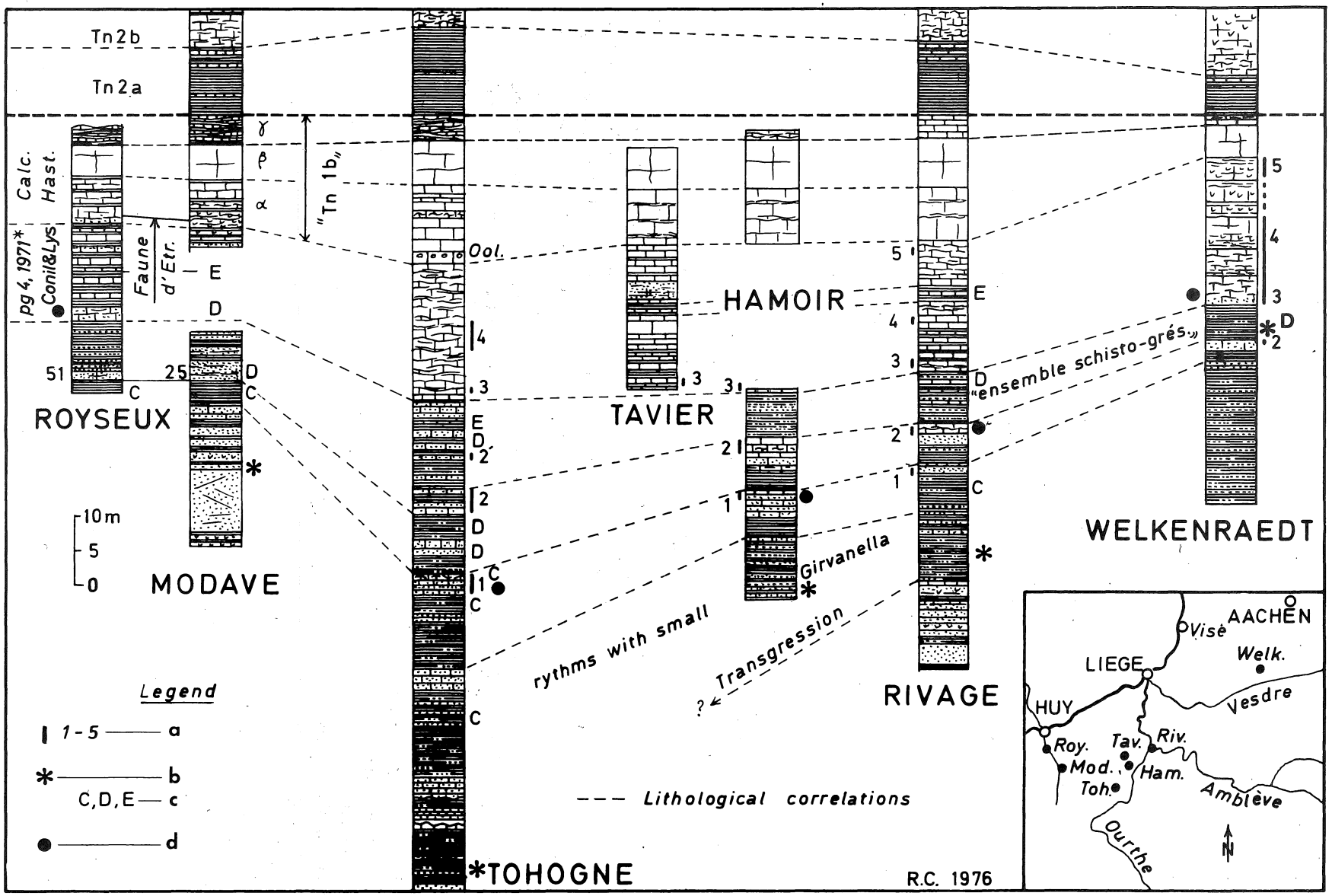



*FIGURE 1.*- Correlation between Modave - Tohogne - Tavier, Hamoir - Rivage (Ourthe valley) - Welkenraedt.
a. "biostromes" with corals and stromatopores. b. *S. lepidophytus*, first occurrence (Not studied below at Welkenraedt and Hamoir).
c. biometric zones, STREEL 1966. d. *Quasiendothyra kobeitusana*, first occurrence.

As a result, we can state that the facies becomes deeper towards the south in the synclines of the eastern border of the Dinant synclinorium. The depth probably also increases from west to east, compared with the central part of the Dinant synclinorium. This is discernible in the finer grading of the clastic sediments. In this way, the facies in Tohogne is close to the corresponding facies in the Avesnois region (western border of the Dinant synclinorium). In both places, the "Strunian" trangression starts well below the base of the PL-Zone, whereas it starts immediately before this base in Comblain.

## C.- THE LOWER TOURNAISIAN

The acrozone of *Chernyshinella glomiformis* is interrupted in Western Europe by a zone with unilocular foraminifera, or more generally by an interval which, for ecological reasons, has no guides (interpreted as a general regression by CONIL). This interruption ends the lifetime of Famennian-type *Quasiendothyra*. It is succeeded by the acme-zone of the *Chernyshinella* widespread in the world. The Tohogne borehole gives the opportunity of studying the only known well-preserved association of plurilocular foraminifera at the top of this interval ("Tn1bγ").

Only rare foraminifera were known from this level (CONIL and LYS, 1964, figs. 620, 722-724). The association is dominated by the Tournayellidae ; neither *Quasiendothyra* nor *Chernyshinella glomiformis* is present.

The interval between the base of the Hastière Limestone and the upper part of the Pont d'Arcole Shales is practically devoid of conodonts and the foraminifera are very rare, except in the Tn1bγ, although the oosparitic base of the Hastière Limestone contains an unusual and probably reworked conodont association consisting essentialy of *Pseudopolygnathus graulichi*. Any conodont succession which might be excepted in this important interval cannot be detected. The limit at the base of the *Siphonodella*-Zone (with *Siphonodella cooperi*), occurring in the upper part of the Pont d'Arcole is also the limit between a facies unfavorable to conodonts and a facies with a regular distribution of conodonts. It cannot be used for biostratigraphic correlation.

## D.- CORRELATIONS

The Avesnois region with many calcareous levels shows an elaborate evolution of plurilocular foraminifera, but its facies are unfavorable to spores. The opposite situation is true in Comblain, which made an exact correlation between the type-regions of the Avesnois and the Ourthe valley difficult to realize. The Tohogne borehole, rich in conodonts, foraminifera and spores provides an excellent link. This is illustrated by the first occurrence of *Quasiendothyra kobeitusana* in the upper part of the Lower PL-Zone (in the biometric zone "C" of *S. lepidophytus*) and not at its top as in Comblain. There is also a hint of diachronism in the lithofacies : *Quasiendothyra kobeitusana* appears in the first biostrome in Tohogne but only in the second biostrome in Comblain where the fauna is far to be so abundant. The miospore flora (see fig. 2) is abundant, varied and well-preserved. A complete biometric succession of *S. lepidophytus* was found (base at depth 161.9 m). The thickness of the strata containing different steps in *S. lepidophytus* changes of size is twice that of corresponding strata in Chanxhe. This increase in thickness is evenly distributed among all steps. The first *S. lepidophytus* found were very rare (6 in 3000 miospores observed) ; then its numbers increase only slowly towards higher levels.

A limit based on this first appearance is considered very sure, because lower samples (at 166 m) were rather rich (12000 miospores have been observed). In Chanxhe, the spore flora is not so abundant because of worse preservation conditions, and *S. lepidophytus* is better represented proportionally (1 in 127 miospores observed at the first appearance), and its increases more rapidly than in Tohogne. The beds below are not as rich in miospores as those of Tohogne, and it might be possible to find some earlier specimen of *S. lepidophytus*. The correlation between the two sections however is believed to be rather exact because of the gradual thinning of all beds from south to north throughout the "Strunian", up to the D/E step limit at or just below the base of the Etroeungt Limestone.

## E.- SYSTEMATIC PALAEONTOLOGY (R. CONIL)

### FORAMINIFERIDA

*Bisphaera* BIRINA

(pl. II, fig. 40 ; pl. III, figs. 57, 58)

*Bisphaera* have fixed species (figs. 57, 58). This character, the nature and the constrictions of the wall make it very similar to *Disonella* CONIL & LYS, 1964. Therefore, the general shape of the test appears as an uncertain character for the systematic of the Bisphaera. As *Bisphaera*, we consider *Disonella* as a genus of the Usloniinae BYKOVA, 1963.

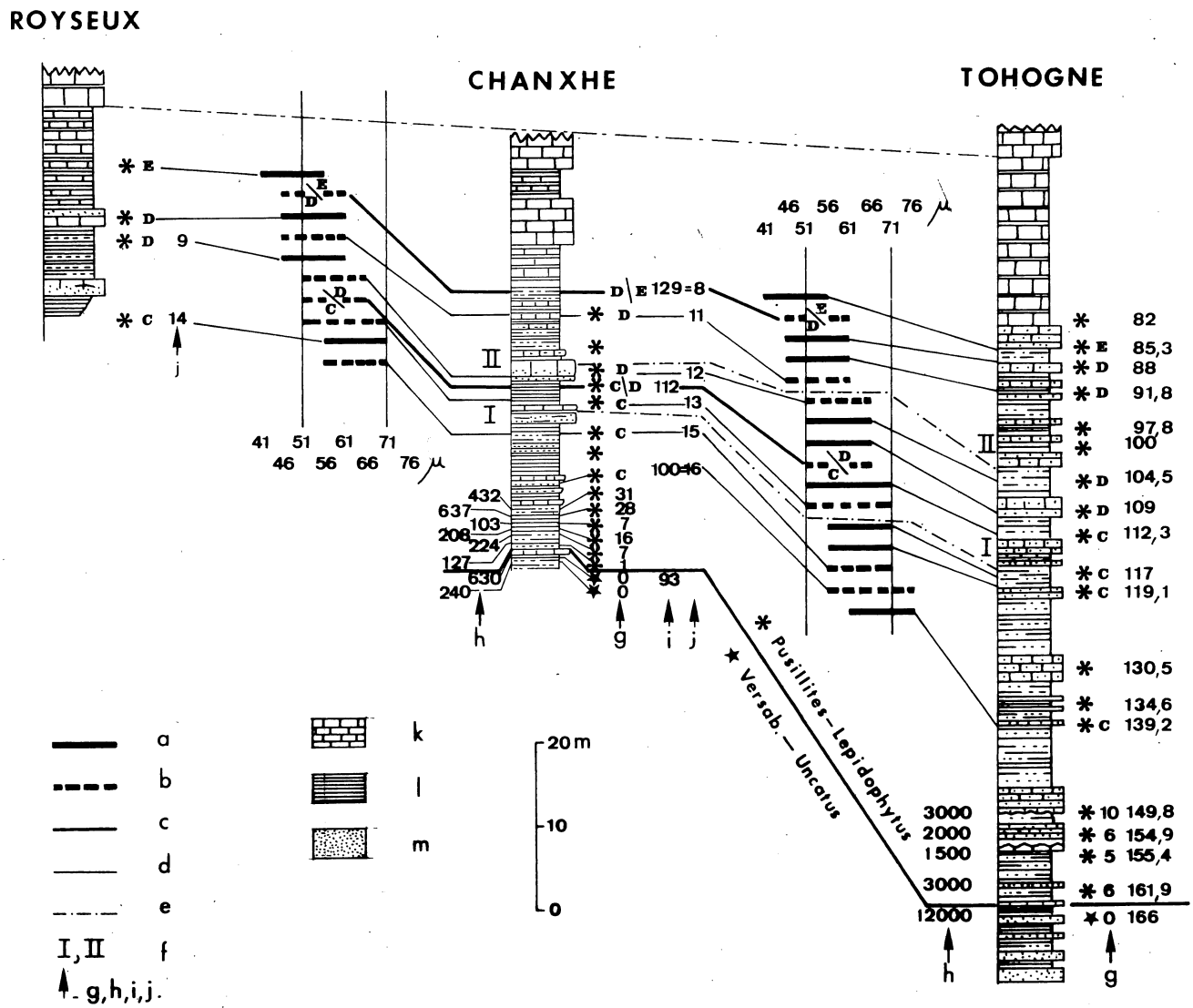



*FIGURE 2.*– Correlations between Tohogne – Chanxhe (Ourthe valley) and Royseux (Hoyoux valley) using biometric criteria of *S. lepidophytus*.

a & b : Interquartile range of the maximum diameters in the *S. lepidophytus* population
  a : Tohogne and Royseux
  b : Reference section of Chanxhe.
c : Biostratigraphic correlation line.
d : Location of biometric data.
e : Lithostratigraphic correlation line.
f : Biostrome.
g : Amount of *S. lepidophytus* observed (letter C to E : see definition in STREEL 1966).
h : Amount of miospores observed.
i : Sample of miospores in STREEL 1966, numbers of beds after CONIL 1964.
j : Sample numbers in STREEL 1969.
k : Limestone.
l : Shale.
m : Sandstone.

*Septabrunsiina rudis* (CONIL & LYS, 1964)

Pl. I, figs. 10–12 ; pl. II, figs. 21–27)

1964. *Plectogyra (?) rudis* CONIL & LYS - CONIL & LYS, p. 213, pl. XXXV, figs. 722–724.

1971. *Septaglomospiranella (Neoseptaglomospiranella) karakubensis* BRAZHNIKOVA & VDOVENKO - BRAZHNIKOVA & VDOVENKO, pp. 30–32 ; pl. XVII, figs. 1–31 ; pl. XVIII, figs. 1–6.

DIAGNOSIS

Test : irregular, with prominent initial portion.

Coiling : strong distorsion ; initial portion glomospiral ; - 1 1/4 terminal volution more or less aligned.

Whorls : 2 1/2 – 3 initial whorls dense and complex ; last whorls clearly higher.

Chambers : 7–8 (9), irregular, well separated by sutures.

Supplementary deposits : no basal supplementary deposits.

Diameter : 330 – 490 $\mu$.

Wall : relatively thick : 15–20 $\mu$, granular to agglutinated with clear grains of calcite. Tends to develop a fine and dark inner layer in some specimens.

The distinctive characters of this species are the irregular coiling, the irregular shape of the chambers and the wall usually fairly coarse.

COMPARISONS

This species resembles to *Septaglomospiranella kazakhstanica* REITLINGER, especially in equatorial sections. The divisions of *S. rudis* are more developed in the last volution and also in the preceding one which is usually more expanded and less obscure. *S. rudis* seems to be related to *S. kazakhstanica* but is more advanced in evolution.

STRATIGRAPHIC RANGE

Belgium : Tn1a – Tn2b, essentially Tn1bγ

URSS (Donetz) : C1td (V1b-V2a)

*Baelenia* gen. nov.

Derivatio nominis ; Baelen, village in the NE of Limbourg, Belgium.

Type species : *Septaglomospiranella (?) gosseleti* CONIL, 1967 ; pp. 169–170 ; pl. IV, figs. 40–42.

DIAGNOSIS

Test : discoidal, broad, with rounded periphery and umbilical regions more or less depressed.

Coiling : irregular with terminal part evolute.

Supplementary deposits : floor-lining fairly thick, corner filling.

Chambers : well developed in the terminal portion. Initial portion more or less tubular or divided in pseudochambers.

Wall : microgranular to granular, undifferenciated.

COMPARISONS

Differs from *Septabrunsiina* by the presence of floor lining. This character seems to have been developed when the primitive *Quasiendothyra* were differentiated from the *Septabrunsiina* ; therefore it has another meaning that the nodosities and projections which appear in more advanced forms (*Spinotournayella* MAMET, 1970).

STRATIGRAPHIC RANGE

Belgium : Fa2a, Tn1bγ

## BIBLIOGRAPHIE

BECKER, G., BLESS, M., STREEL, M. & THOREZ, J. - 1974 - Palynology and ostracode distribution in the Upper-Devonian and basal Dinantian of Belgium and their dependence on sedimentary facies. Med. Rijksgeol. Dienst., Nieuwe Serie. 25, 2, p. 9–99.

BLESS, M. *et al* - 1974 - Intern. Symp. belgian micropaleontological limits. Namur. Guidebook. Excursion D. Ed. BOUCKAERT, J. & STREEL, M. Brussels.

BOUCKAERT, J., CONIL, R. & THOREZ, J. - 1967 - Position stratigraphique de quelques gîtes famenniens à Foraminifères. Bull. Soc. belge Géol. LXXV, pp. 159–175.

BOUCKAERT, J., STREEL, M. & THOREZ, J. - 1968 - Schéma biostratigraphique et coupes de référence du Famennien belge. Ann. Soc. Géol. Belg. 91, 3, p. 317–336.

BOUCKAERT, J., CONIL, R., DELMER, A., GROESSENS, E., MORTELMANS, G., PIRLET, H., STREEL, M. & THOREZ, J., 1971 - Aperçu géologique des formations du Carbonifère belge. Serv. géol. Belg. Prof. Paper n° 2.

BOUCKAERT, J. et DUSAR, M. - 1976 - Description géologique du sondage de Tohogne. Serv. géol. Belg. Prof. Paper n° 8. 56 p.

BOUCKAERT, J. & GROESSENS, E. - 1976 - Polygnathus paprothae, Pseudopolygnathus conili, Pseudopolygnathus graulichi : espèces nouvelles à la limite Dévonien-Carbonifère. Ann. Soc. géol. Belg. T. 99, pp. 65–67.

BRAZHNIKOVA, N.E. & VDOVENKO, M.V. - 1971 - Foraminifera in AIZENVERG, D.E., Atlas of the Tournaisian fauna in the Donetz Besin. Acad. Sciences Ukrain. S.S.R., Inst. geol. Sc., Naukova Dumka, Kiev.

CONIL, R. & LYS, M. – 1964 – Matériaux pour l'étude micropaléontologique du Dinantien de la Belgique et de la France (Avesnois). Mém. Inst. Géol. Univ. Louvain, XXIII.

CONIL, R. & GRAULICH, J.-M. – 1970 – Les sondages d'étude et d'injection du viaduc 62 (Welkenraedt) de l'autoroute E5. Serv. géol. Belg. Prof. Paper n° 4.

DREESEN, R., DUSAR, M. & GROESSENS, E., 1976 – Biostratigraphy of the Yves-Gomezée Road Section (Uppermost Famennian). Serv. Géol. Belg. Prof. Paper n° 6, 20 p.

DUSAR, M. – 1976 – Devonian–Carboniferous transition beds in the region of Hamoir-sur-Ourthe. Ann. Soc. Géol. Belg. (in press).

STREEL, M. – 1966 – Critères palynologiques pour une stratigraphie détaillée du Tn1a dans les Bassins Ardenno-Rhénans. Ann. Soc. Géol. Belg. 89, p. 65–96.

STREEL, M. – 1969 – Corrélations palynologiques entre les sédiments de transition dévonien/dinantien dans les bassins ardenno-rhénans. Compte Rendu 6e Congr. Intern. Strat. Géol. Carbonif., Sheffield 1967, vol. I–, p. 3–18.

STREEL, M. – 1970 – Distribution stratigraphique et géographique d'H. lepidophytus Kedo, d'H. pusillites Kedo et des assemblages tournaisiens. Congrès et Colloques Univ. de Liège, 55, p. 121–147.

ZIEGLER, W. – 1971 – Conodont stratigraphy of the European Devonian. Geol. Soc. America. Memoir 127, p. 227–284.

## PLANCHE I.-

All figures x 75

**Tn2b**

*Septabrunsiina* sp.

Fig. 1. 5,32 m. (12.188)

*Chernyshinella glomiformis* (LIPINA, 1948)

Fig. 2. 7,30 m. (12.330)

*Septabrunsiina* sp.

Fig. 3. 8,9-9,50 m. (12.184)
Fig. 4. 8,9-9,50 m. (12.185)
Fig. 5. 9,8 m. (12.182)

*Septabrunsiina* sp.

Fig. 6. 4,24 m. (12.189)

*Endochernella* sp.

Fig. 7. 5,32 m. (12.189)

**Tn1bγ**

*Baelenia* cf. *gosseleti* (CONIL, 1967)

Fig. 8. 32,8 m. (11.997)
Fig. 9. 32,8 m. (11.992)

*Septabrunsiina rudis* (CONIL & LYS, 1964)

Fig. 10. 34,99-35,19 m. (12.006)
Fig. 11. 31,80 m. (12.015)
Fig. 12. 31,80 m. (12.014)

*Septabrunsiina* sp. 1

Fig. 13. 33,80 m. (11.991)

*Septabrunsiina* sp. 2

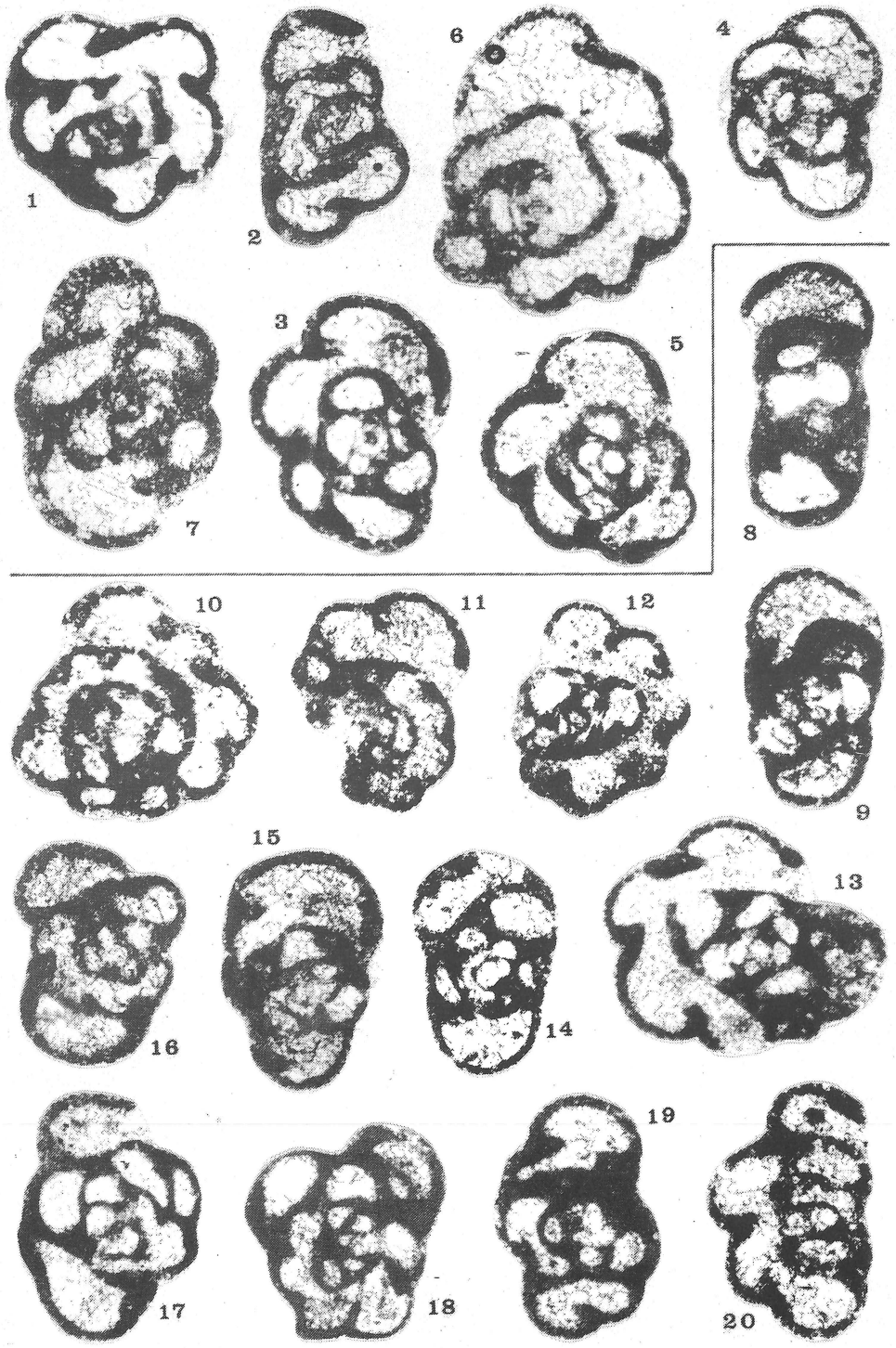
Fig. 14. 32,8 m. (12.008)
Fig. 15. 34 m. (12.017)

*Septabrunsiina* sp. 3

Fig. 16. 34,99-35,19 m. (11.986)
Fig. 17. 32,60 m. (12.005)
Fig. 18. 33,80 m. (11.989)
Fig. 19. 33,80 m. (11.988)

*Septabrunsiina* sp.

Fig. 20. 35,90 m. (12.012)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## PLANCHE II.-

All figures x 75

**Tn1bγ**

*Septabrunsiina rudis* (CONIL & LYS, 1964)

Fig. 21. 34 m. (12.016)
Fig. 22. 34,99-35,19 m. (11.984)
Fig. 23. 32,8 m. (11.995)
Fig. 24. 33,8 m. (11.987)
Fig. 25. 34,99-35,19 m. (11.985)
Fig. 26. 32,8 m. (11.996)
Fig. 27. 33,80 m. (11.990)

*Septabrunsiina* sp.

Fig. 28. 33,8 m. (11.990)

*Septabrunsiina* sp.

Fig. 29. 32,8 m. (11.994)

*Septabrunsiina* sp.

Fig. 30. 34,99-35,19 m. (12.007)
Fig. 31. 35,9 m. (12.010)
Fig. 32. 32,8 m. (11.993)

*Rectochernyshinella* sp.

Fig. 33. 37,75 m. (12.013)

*Septabrunsiina* sp.

Fig. 34. 32,6 m. (12.003)

*Baelenia ?*

Fig. 35. 35,9 m. (11.998)

*Septabrunsiina* sp.

Fig. 36. 32,6 m. (11.983)

*Septabrunsiina* sp.

Fig. 37. 31,8 m. (12.014)

*Tournayellidae*

Fig. 38. 35,75 m. (11.999)

**Tn1bα**

cf. *Glomospiranella* sp.

Fig. 39. 58,25 m. (12.002)

*Bisphaera variabilis* subsp. *variabilis* CONIL & LYS, 1964

Fig. 40. 58,25 m. (12.197)

**Tn1a**

*Septabrunsiina* sp.

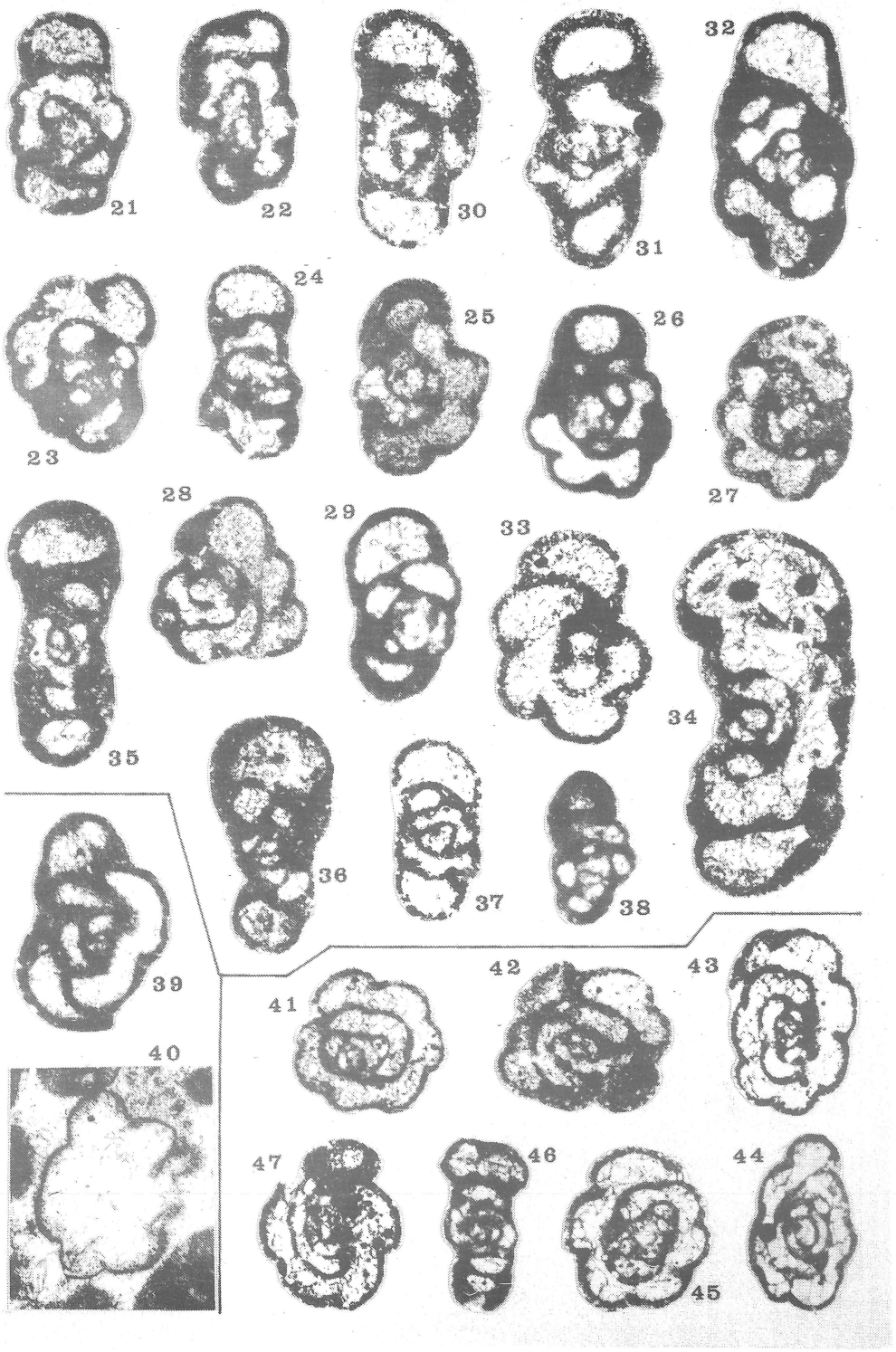
Fig. 41. 61,80 m. (12.214)
Fig. 42. 81,25 m. (12.207)
Fig. 43. 69,91 m. (12.024)
Fig. 44. 60,88 m. (12.218)

*Septabrunsiina bouckaerti* (CONIL & LYS, 1970)

Fig. 45. 77,70 m. (12.210)

*Septabrunsiina* sp.

Fig. 46. 67,22 m. (12.202)
Fig. 47. 69,91 m. (12.025)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## PLANCHE III.-

All figures x 75

**Tn1a**

*Septatournayella rauserae* (LIPINA, 1955) subsp. *potensa* DURKINA, 1959

Fig. 48. 73,21 m. (12.198)
Fig. 49. 65,39 m. (12.217)
Fig. 50. 79,20 m. (12,215)
Fig. 51. 73,21 m. (12.200)
Fig. 52. 69,91 m. (12.023)

*Septabrunsiina* (espèces différentes)

Fig. 53. 60,3 m-1 (12.175)
Fig. 54. 67,50 m. (12.209)
Fig. 55. 60,30 m-2 (12.178)

*Paracaligelloides florennensis* (CONIL & LYS, 1964)

Fig. 56. 74,09 m. (12.209)

*Bisphaera* sp. (formes fixées)

Fig. 57. 63 m. (12.205)
Fig. 58. 68,50 m. (12.208)

cf. *Septabrunsiina*

Fig. 59. 60,30 m. (12.180)

*Septabrunsiina* aff. *bouckaerti* (CONIL & LYS, 1970)

Fig. 60. 67,70 m. (12.206)

*Septabrunsiina*

Fig. 61. 67,22 m. (12.201)

*Septabrunsiina comblaini* CONIL & LYS, 1964

Fig. 62. 84,6 m. (12.001)
Fig. 63. 65,39 m. (13.089)

*Septabrunsiina bouckaerti* (CONIL & LYS, 1970)

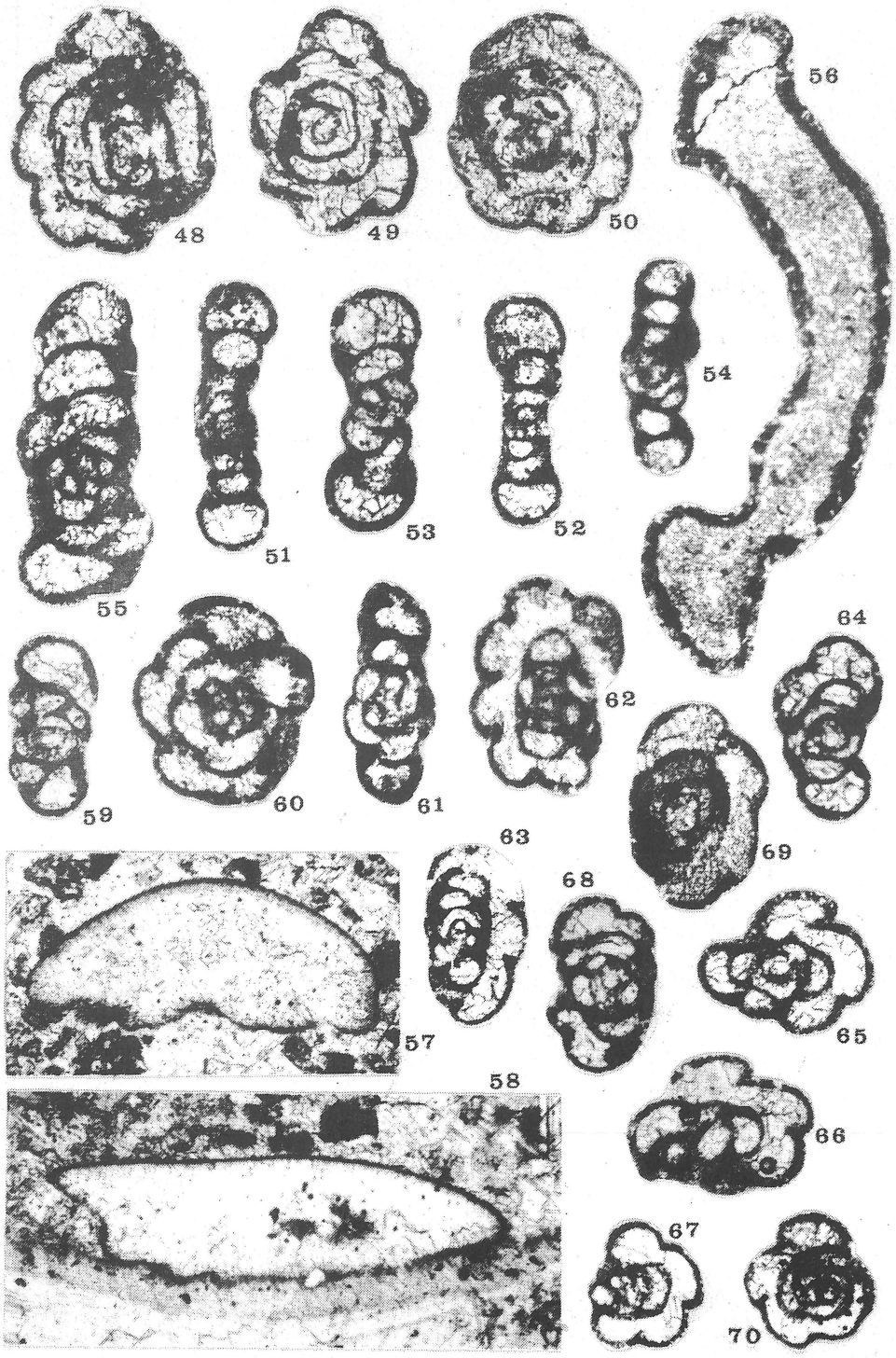
Fig. 64. 60,30 m-1 (12.177)
Fig. 65. 77,25 m. (12.204)
Fig. 66. 60,3 m-1 (12.176)
Fig. 67. 75,75 m. (12.019)
Fig. 68. 60,30 m-2 (12.179)

*Septatournayella* sp.

Fig. 69. 69,91 m. (13.068)

*Septatournayella* sp.

Fig. 70. 69,06 m. (12.203)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## PLANCHE IV.-

All figures x 75

**Tn1a**

*Quasiendothyra regularis* (LIPINA, 1955)

Fig. 71. 61,80 m. (12.213)
Fig. 72. 75,75 m. (12.018)
Fig. 73. 98 m. (12.020)

*Quasiendothyra communis* (RAUSER, 1948) *radiata*

Fig. 74. 65,39 m. (12.216)

*Quasiendothyra* aff. *kobeitusana* (RAUSER, 1948)

Fig. 75. 73 m. (12.211)
Fig. 76. 98 m. (12.021)

*Quasiendothyra* ex gr. *communis* (RAUSER, 1948)

Fig. 77. 73,21 m. (12.199)

*Quasiendothyra* sp.

Fig. 78. 82 m. (12.000)

*Quasiendothyra communis* (RAUSER, 1948)

Fig. 79 69,91 m. (12.022)

**Tn1a**

**Tn1a**

1er biostrome

*Quasiendothyra regularis* (LIPINA, 1955)

Fig. 80. 112,7 m. (12.169)

*Septabrunsiina* aff.*bouckaerti* (CONIL & LYS, 1970)

Fig. 81.114,48 m. (12.172)

*Quasiendothyra* ex gr. *kobeitusana* (RAUSER, 1948)

Fig. 82. 107 m-2. (12.166)
Fig. 83. 112,73 m. (12.170)
Fig. 84. 107,20 m. (12.165)
Fig. 85. 107 m-2. (12.164)

*Quasiendothyra kobeitusana* (RAUSER) subsp. *substricta* CONIL & LYS, 1964

Fig. 86. 113,5 m. (12.167)

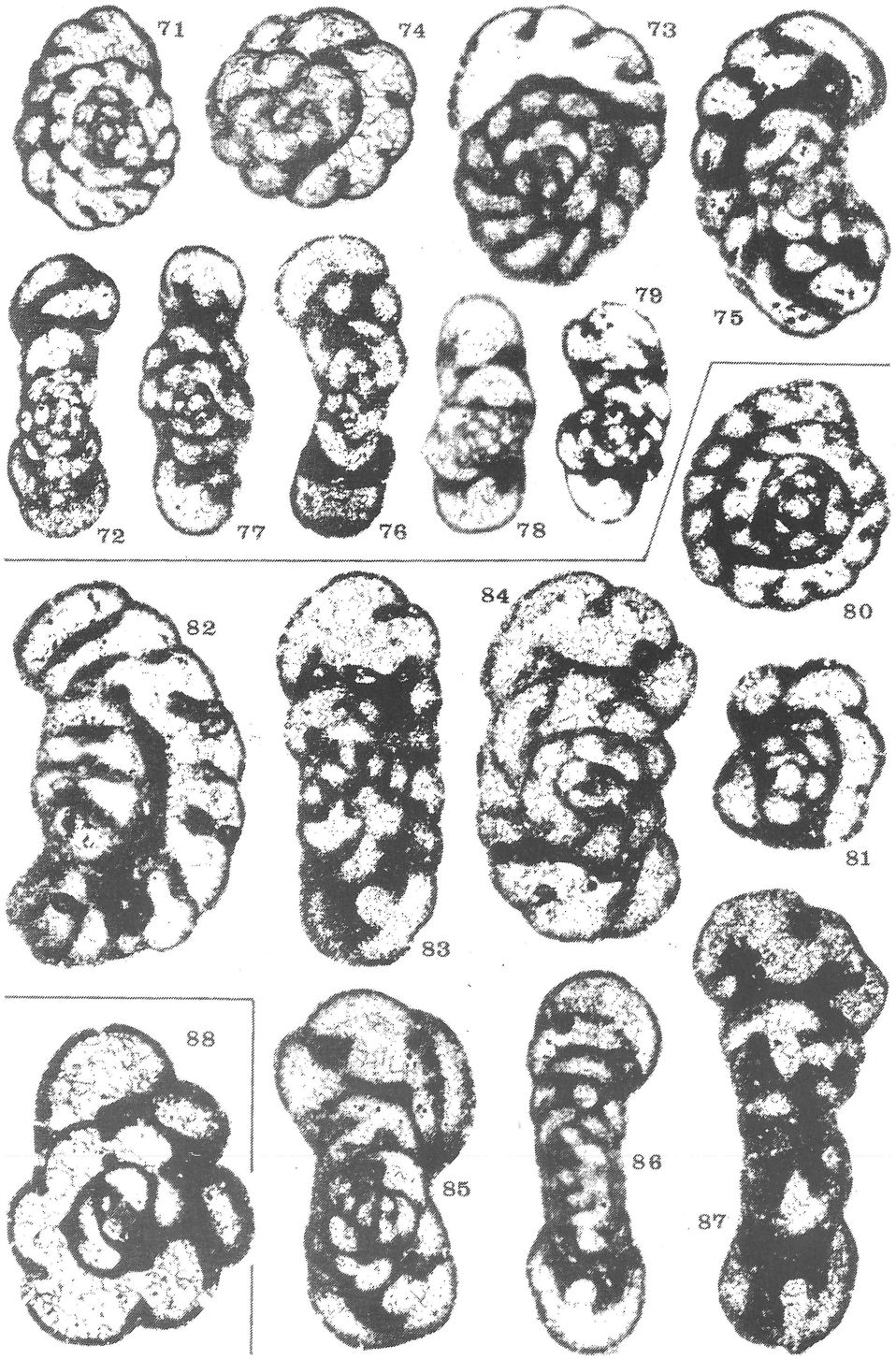
*Quasiendothyra kobeitusana* (RAUSER, 1948)

Fig. 87. 112.73 m. (12.168)

**Fa2d**

*Avesnella streeli* CONIL & LYS, 1970

Fig. 88. 130,54 m. (12.163).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