Rivista Italiana di Paleontologia e Stratigrafia | volume 111 | no. 2 | 4 pls. | pp. 197-214 | July 2005

NEW AND REVISED TOURNAISIAN (EARLY MISSISSIPPIAN) FORAMINIFERAL TAXA FROM BELGIUM

PAUL L. BRENCKLE [1] & LUC HANCE [2]

Received: June 26, 2004; accepted: February 9, 2005

Key words: Foraminifers, Belgium, Mississippian, Carboniferous, Tournaisian, Hastarian, Ivorian, Biostratigraphy, Taxonomy.

Abstract. Hastarian formations in southern Belgium contain previously undescribed or unfigured foraminiferal taxa that provide a link to better known early Tournaisian faunas from eastern Europe. Characteristic specimens are illustrated, and selected elements are formally described as part of continuing research to reorganize Belgian Mississippian foraminiferal zones. Taxonomic discussions include description of the new genus *Crassiseptella,* emendation of the genera *Spinochernella* and *Condrustella* and reevaluation of the genus *Granuliferelloides*.

Riassunto. Le formazioni del sottopiano Hastariano (Tournesiano inferiore) del Belgio meridionale contengono una fauna a foraminiferi con taxa in precedenza non figurati o non descritti. Questi forniscono una connessione verso le faune dell'Europa orientale, meglio conosciute. Sono illustrati esemplari caratteristici, ed elementi selezionati sono descritti formalmente, nell'ambito di una ricerca in progresso dedicata a riorganizzare la zonazione a Foraminiferi del Missippiano del Belgio. Le discussioni tassonomiche comprendono la descrizione del nuovo genere *Crassiseptella,* l'emendamento dei generi *Spinochernella* e *Condrustella,* nonché una rivalutazione del genere *Granuliferelloides*.

Introduction

Gilissen (1986) described Hastarian (early Tournaisian) foraminifers from the Namur-Dinant Basin (Fig. 1) in a master's thesis that Raphaël Conil was editing for publication at the time of his death in 1990. Stratigraphic units within the study area included the Hastière, Landelies and lower Yvoir formations of southern Belgium and the Avesnelles Formation of northern France (Fig. 2). The foraminiferal diversity in those beds rivals that of similar-age faunas from classic localities on the Russian Platform (e. g., Brazhnikova & Vdovenko 1971; Makhlina et al. 1993) and in the Middle Urals (e.g., Lipina 1955, 1960; Malakhova 1956, 1959; Shcherbakov et al. 1979; Brenckle 1997), and represents one of the best developed early Tournaisian foraminiferal assemblages recovered from the western end of the Paleotethys.

Because of the importance to Eurasian biostratigraphic synthesis, we decided to revise identifications from the unpublished Conil & Gilissen manuscript, illustrate pertinent specimens in this paper (Pls. 1-4), and correlate them to the Tournaisian foraminiferal zonation and chronostratigraphic scheme outlined in Conil et al. (1991; Fig. 2). Taxa common to the Tournaisian of the Russian Platform-Urals but previously unreported or unfigured from the Namur-Dinant Basin include *Granuliferelloides nalivkini*, *Inflatoendothyra* spp., *Prochernyshinella disputabilis*, *Septabrunsiina minuta*, *Spinochernella paraukrainica*, and *Uviella aborigena*. Other common elements illustrated herein are *Chernyshinella glomiformis*, *C. paucicamerata*, *Endospiroplectammina nana*, *Laxoendothyra parakosvensis*, *Palaeospiroplectammina tchernyshinensis*, *Septabrunsiina kingirica*, *Septatournayella segmentata*, *Spinochernella brencklei*, *Tournayella* cf. *vespaeformis*, and *Tournayellina beata*. The overall aspect of the Belgian fauna suggests that the Hastarian can be no younger than the Cherepetsky or, possibly, early Kizelovsky horizons of European Russia (Reitlinger et al. 1996; Brenckle 1997, fig. 2).

In addition, application of sequence stratigraphic principles (Hance et al. 2001) since Conil's death has led to reappraisal of previously accepted (Paproth et al.

1 Whistler Point Road, Westport, MA 02790 (USA). E-mail: saltwaterfarm1@cs.com
2 Carmeuse Group, Boulevard de Lauzelle 65, B-1348 Louvain-la-Neuve (Belgium). E-mail: luc.hance@skynet.be

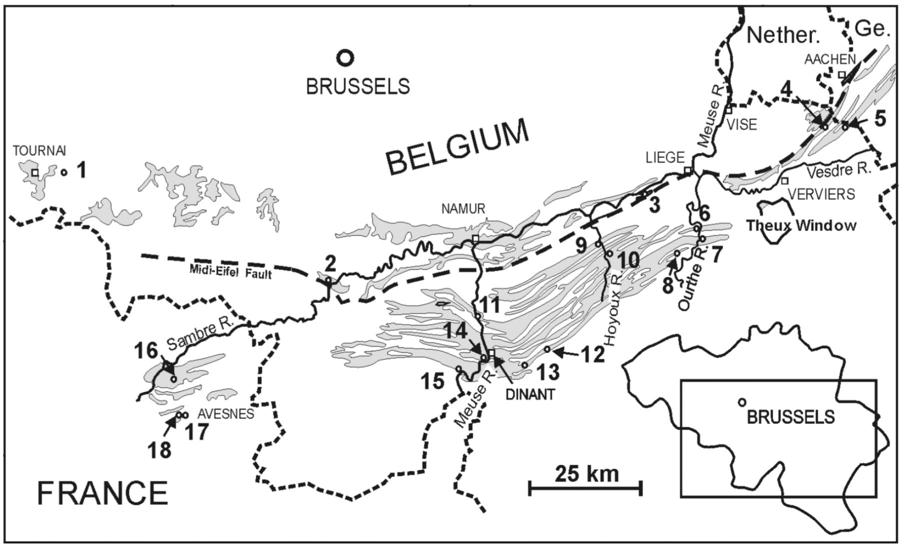


Fig. 1 - Distribution of Tournaisian-Visean deposits (shaded areas) in the Namur-Dinant Basin of southern Belgium and northern France (Avesnois) and localities of the illustrated foraminifers. Notations between parentheses are the outcrops numbers of the Geological Survey of Belgium: 1. Tournai, CCB Drillhole (125W280); 2. Landelies, Sambre River Section (153W91); 3. Engihoul Quarry; 4. Dolhain Railroad Section; 5. Welkenraedt Bridge; 6. Chanxhe, access road to Richopé Quarry; 7. Rivage Railroad Section (147E318); 8. Comblain-Fairon Roadcut Section; 9. Royseux Railroad Section (146W2); 10. Modave, Huy Road Section (157W51); 11. Yvoir Station (166E306); 12. Leignon Station Quarry; 13. Gendron-Celles Station (175E311); 14. Anseremme Railway Bridge Section; 15. Insémont Quarry (175W334); 16. Beaufort Section (Avesnois); 17. Camp de César Quarry (Avesnois); 18. Saint-Hilaire Railroad Section (Avesnois). Ge. = Germany; Nether. = The Netherlands.

1983) Dinantian bio- and lithostratigraphic correlations across Belgium. The foraminiferal succession along with conodont and megafossil occurrences plays a key role in facilitating realignment of these correlations. Ongoing revision of the definition and regional extent of Belgian Tournaisian foraminiferal zones by L. Hance and F. X. Devuyst will rely on a precise taxonomy that in part is updated in this paper through creation of *Crassiseptella* n. gen., emendations of *Spinochernella* and *Condrustella*, and reevaluation of *Granuliferelloides*.

The early Tournaisian depositional setting in the Namur-Dinant Basin was a south-facing homoclinal ramp. Similar facies are found across the basin, but formations are thinner with increasing depositional gaps northward (Hance et al. 2001; Poty et al. 2001). Dominant facies within the Hastière, Landelies and Yvoir formations are crinoidal packstones to rudstones, which generally yield sparse and undiversified foraminiferal associations. The last zonation published by Conil et al. (1991) reflects this relative poverty whereas latest Tournaisian and Visean associations are more diversified. As illustrated in this report, the best assemblages of Hastarian plurilocular foraminifers are found in the middle and upper members of the Hastière Formation, upper part of the Landelies Formation and lower part of the Yvoir Formation in southern Belgium, and in the Avesnelles Formation of northern France (Avesnes South Sedimentation Area of Hance et al. 2001; Conil & Lys 1970). Much of the material illustrated and discussed in this paper comes from the lowermost part of the Yvoir Formation at the Royseux Railroad Section (Fig. 1).

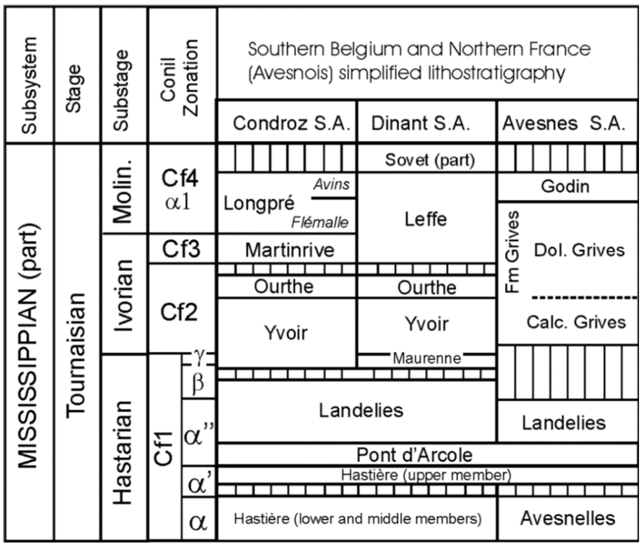


Fig. 2 - Correlation of the Conil foraminiferal zonation (in Conil et al. 1991) to Tournaisian substages and formations from southern Belgium and northern France (Avesnois). Regional stratigraphic scheme based on Hance et al. (2001) and Poty et al. (2001). In this paper we follow Conil & Lys's (1970) traditional foraminiferal correlation of the Avesnelles Formation to the earliest Tournaisian, although there is credible conodont data in Conil et al. (1986) to suggest that the formation may need to be reassigned to the latest Devonian. Molin. = early Moliniacian; S. A. = sedimentation areas outlined in Hance et al. (2001).

Selected foraminiferal taxonomy

Figured specimens are reposited in the Raphaël Conil (RC, MG) thin section collection, Geology Department, University of Liège, Liège, Belgium; in the United States National Museum (USNM), Washington, D. C., U. S. A.; in the Paleontology Repository (SUI), Department of Geoscience, University of Iowa, Iowa City, Iowa, U. S. A.; in the All-Russian Petroleum Scientific Research and Geological Exploration Institute (VNIGRI), St. Petersburg, Russia; and in the Micropaleontology Laboratory of the Kazakhstancaspishelf Company (KCS), Atyrau, Kazakhstan.

Class **Foraminifera** d'Orbigny, 1826

Order **Fusulinida** Wedekind, 1937

Family Endothyridae Brady, 1884

Genus *Spinochernella* Conil & Lys, 1977, emend. herein

Type species: *Spinochernella brencklei* Conil & Lys, 1977

Description. Coiling skew, tending to be planispiral in last volution. Chambers inflated; periphery lobate. Septa curved and at low angle to wall. Secondary deposits consist of unconnected, curved or hooked ridges (spines in sagittal section) secreted between septa on the floor of the outer volution(s). Wall dark, fine-grained with intercalated larger and lighter-colored grains, differentiated and of variable thickness.

Remarks. In their description of *Spinochernella*, Conil & Lys (1977) emphasized the chernyshinellid morphology of the initial volutions as the distinguishing characteristic of this genus that otherwise resembles *Spinoendothyra* Lipina in Rauzer-Chernousova, 1963. Mamet et al. (1986) rejected this feature as a taxonomic indicator and suppressed *Spinochernella* within *Spinoendothyra.* Hance (1996) in agreement remarked that specimens of *Spinochernella* should be reassigned to *Spinoendothyra* or *Tuberendothyra* Skipp, 1969, depending on the shape of the basal deposits.

PLATE 1

Magnifications X75. Thin section catalogue numbers (RC, MG) are in parentheses.
Correlation of Conil foraminiferal zones is shown in Fig. 2

Fig. 1-3 - *Chernyshinella paucicamerata* Lipina, 1955, sagittal and near-sagittal sections, Landelies Formation, late Hastarian (foraminiferal zone Cf1β). Fig. 1 - Royseux Railroad Section, spl. 48h (RC 23248); Fig. 2 - Rivage Railroad Section, spl. 202 (RC 23260); Fig. 3 - Camp de César Quarry, spl. 56 (RC 6203).

Fig. 4 - *Chernyshinella glomiformis* (Lipina, 1948), sagittal section, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), Rivage Railroad Section, spl. 238 (RC 3897).

Fig. 5 - P*rochernyshinella disputabilis* (Dain, 1958), near-sagittal section, Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Rivage Railroad Section, spl. 203 (RC 23262).

Fig. 6-8 - *Septabrunsiina kingirica* (Reitlinger, 1961), sagittal sections. Reitlinger (1961) questionably assigned this species to *Septaglomospiranella* and Lipina (1965) transferred it to *Septabrunsiina*. The coiling is intermediate between the two genera in that the slightly oscillating outer volutions are not planispiral as in typical *Septabrunsiina* nor highly skewed as in *Septaglomospiranella*. The morphology closely approaches that of *Septabrunsiina krainica* (Lipina, 1948). Fig. 6 - Landelies, Sambre River Section, spl. 24 (RC 23767), and Fig. 8, Landelies, Sambre River Section, spl. 25b (RC 23674), both from Hastière Formation, early Hastarian (foraminiferal zone Cf1α′); Fig. 7 - Avesnelles Formation, early Hastarian (foraminiferal zone Cf1α), Saint-Hilaire Railroad Section, spl. 29a (RC 22820).

Fig. 9 - *Chernyshinella yvoiri* Conil and Lys, 1964 [?=*Endochernyshinella gelida* (Durkina, 1959)], partly crushed sagittal section, Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Leignon Station Quarry, spl. 1 (RC 417).

Fig. 10 - *Chernyshinella*? *gutta* Conil and Lys, 1970, near-sagittal section, Avesnelles Formation, early Hastarian (foraminiferal zone Cf1α), Beaufort Section (MG 1551).

Fig. 11-19 - *Septabrunsiina minuta* (Lipina, 1948), sagittal and near-sagittal sections except as noted. Fig. 11 - Comblain-Fairon Roadcut Section, spl. 41b (RC 23457), Fig. 12 - Royseux Railroad Section, spl. 64 (RC 23370), Fig. 13 - Royseux Railroad Section, spl. 64 (RC 23158), Fig. 16 - Royseux Railroad Section, spl. 64 (RC 23162), Fig. 17 - Royseux Railroad Section, spl. 64 (RC 23160), and Fig. 18 - Royseux Railroad Section, spl. 63h (RC 23213), all from the lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ); Fig. 14 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Gendron-Celles Station, spl. 141 (RC 23297); Fig. 15 - Insémont Quarry, spl. 112 (RC20612), and Fig. 19 - near-axial section, Chanxhe on access road to Richopé Quarry, spl. 9 (RC20733), both from the Hastière Formation, early Hastarian (foraminiferal zone Cf1α′).

Fig. 20-22 - aff. *Inflatoendothyra* sp., Hastière Formation, early Hastarian (foraminiferal zone Cf1α′). Fig. 20 - near-sagittal section, Modave, Huy Road Section, spl. 74 (RC 20702); Fig. 21 - sagittal section, Chanxhe on access road to Richopé Quarry, spl. 14 (RC 20619); Fig. 22 - near-sagittal section, Anseremme Railway Bridge Section, spl. 221 (RC 20635).

Fig 23-25 - *Septaglomospiranella rudis* (Conil and Lys, 1964), sagittal and near-sagittal sections, Hastière Formation, early Hastarian (foraminiferal zone Cf1α′). Fig. 23 - Dolhain Railroad Section (RC 21117); Fig. 24 -Welkenraedt Bridge, spl. 15 (RC 3664-4880); Fig. 25 - Yvoir Station, spl. 40 (RC 20645).

Fig. 26-28 - *Septaglomospiranella* aff. *S. bouckaerti* Conil and Lys, 1970, sagittal sections, Landelies Formation, late Hastarian (foraminiferal zone Cf1β). Fig. 26 - Royseux Railroad Section, spl. 19 (RC 22858); Fig. 27 - Gendron-Celles Station, spl. 128h (RC 23282); Fig. 28 - Royseux Railroad Section, spl. 9 (RC 22960).

Fig. 29 - *Chernyshinella* sp., sagittal section, Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Royseux Railroad Section, spl.18 (RC 22847).


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29

Spinochernella has a lobate periphery and relatively low-angled, curved septa that produce a rounded, endothyrin chamber shape. This feature contrasts with the morphology of typical spinoendothyrins such as *Spinoendothyra media* (Vdovenko, 1954), *Spinoendothyra costifera* (Lipina, 1955) and *Spinoendothyra recta* (Lipina, 1955) in which chambers are subquadratic because of the smooth periphery and straight, nearly perpendicular septa. In fact, *Spinochernella* has the same chamber morphology and secondary deposits as *Endothyra spinosa* Chernysheva, 1940, that was included in the original description of *Spinoendothyra* (in Rauzer-Chernousova 1963). Lipina (1985) in her discussion of spinoendothyrin evolution, however, pointedly excluded *E. spinosa* from *Spinoendothyra* because its volution height and septation resembled those of the endothyrins. She felt that many *spinosa*-type forms from the literature were related to *Plectogyra trachida* Zeller, 1957, that, like *E. spinosa*, we would assign to *Spinochernella*. According to Lipina (1985), *Spinoendothyra s. s.* evolved from *Inflatoendothyra* Brazhnikova & Vdovenko in Vdovenko 1972, a taxon with a smooth periphery, numerous straight, perpendicular septa and no significant basal deposits. *Spinochernella*, on the other hand, may have evolved from *Tuberendothyra* that shares many morphological features with *Spinochernella* except for mound- or club-shaped basal deposits. Lipina (1985) implied the same relationship by saying that specimens of the *Plectogyra trachida* group were morphologically closer to the tuberendothyrins than to the spinoendothyrins.

Diagnostic features of *Spinochernella* are the skew-coiling, rounded chambers, curved septa and unconnected, spinose floor deposits. The shape of the initial chambers is not considered a critical feature for recognition. Constituent species include *Spinochernella brencklei* Conil & Lys, 1977, *S. spinosa* (Chernysheva, 1940), *S. paraukrainica* (sensu Lipina, 1955), and *S. trachida* (Zeller, 1957).

Occurrence. Late early Tournaisian to earliest Visean of the central and western United States, western Canada, western and eastern Europe, Siberia, Turkey, Kazakhstan and South China.

Spinochernella brencklei Conil & Lys, 1977

Pl. 2, figs 1-3

1969 *Endothyra* (*Tuberendothyra*) *tuberculata* (Lipina) - Skipp, part, p. 213-214, pl. 19, figs. 20, 21, pl. 20, figs. 19?, 25.

1977 *Spinochernella brencklei* Conil & Lys, p. 30, pl. 4, fig. 71.

1986 *Spinoendothyra spinosa spinosa* (Chernysheva) - Mamet et al., p. 15-16, pl. 4, figs. 1-8.

1986 *Spinoendothyra spinosa crassitheca* Mamet et al., p. 16, pl. 4, figs. 9-12, pl. 5, figs. 1-4.

1987 *Spinoendothyra* aff. *S. spinosa* (Chernysheva)-Brenckle & Groves, fig. 10,12.

1997 *Spinoendothyra spinosa* "*magna*" (Lipina)-Brenckle, fig. 2, no. 44.

Dimensions. Volutions: 3 ½ -4 ½; diameter: 600-800 μm; chambers, last volution: 6-8; interior diameter,

---

PLATE 2

Magnifications X75 except as noted. Thin section catalogue numbers (RC, VNIGRI) are in parentheses. Correlation of Conil foraminiferal zones is shown in Fig. 2

Fig. 1-3 - *Spinochernella brencklei* Conil and Lys, 1977, near-sagittal sections, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ). Fig. 1 - Royseux Railroad Section, spl. 64 (RC 23411); Fig. 2 - Comblain-Fairon Roadcut Section, spl. 41b (RC 23457); Fig. 3 - Royseux Railroad Section, spl. 64 (RC 23396).

Fig. 4, 11 - Holotype of *Granuliferelloides posneri* (Ganelina, 1966), type species of *Corrigotubella* Ganelina, 1966 that is a subjective synonym of *Granuliferelloides* McKay & Green, 1963. Fig. 4 - close-up of terminal chambers showing non-cribrate apertures clogged with a calcisphere and other debris, X100; Fig. 11 - near-sagittal section, reillustration of Ganelina (1966, pl. 9, fig. 3), Dobryansky District, Permskaya Oblast', Russia, Lukovskaya 11 field, well 7, Kizelovsky Horizon, spl. 714, depth: 1959.0-1960.5 m (VNIGRI 544/51).

Fig. 5-7 - *Spinochernella paraukrainica* (sensu Lipina, 1955), sagittal and near-sagittal sections, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ). Fig. 5 - Royseux Railroad Section, spl. 64 (RC 23205); Fig. 6 - Royseux Railroad Section, spl. 64 (RC 23151); Fig. 7 - Royseux Railroad Section, spl. 63h (RC 23210).

Fig. 8-10 - *Laxoendothyra beruinae* (Conil *in* Kimpe and others 1978), Landelies Formation, late Hastarian (foraminiferal zone Cf1β). Fig. 8 - oblique section, Gendron-Celles Station, spl. 151 (RC 23386); Fig. 9 - axial section, Royseux Railroad Section, spl. 9 (RC 22960; Fig. 10 - sagittal section, Gendron-Celles Station, spl. 151 (RC 23312).

Fig. 12, 15-17- *Granuliferelloides nalivkini* (Malakhova, 1956). Fig. 12 - oblique section, reillustration of paratype of *Corrigotubella posneri* Ganelina, 1966 (pl. 9, fig. 4), showing noncribrate, debris-filled terminal aperture, same morphology as *G. nalivkini*, Dobryansky District, Permskaya Oblast', Russia, Lukovskaya 11 field, well 2, Kizelovsky Horizon, depth: 1979.5-1980.0 m (VNIGRI 544/52); Fig. 15 - near-sagittal section, Royseux Railroad Section, spl. 63h (RC 23213), Fig. 16 - sagittal section, Royseux Railroad Section, spl. 64 (RC 23164), and Fig. 17 - oblique-sagittal section, Royseux Railroad Section, spl. 63h (RC 23204), all from lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ).

Fig. 13 - *Laxoendothyra parakosvensis* (Lipina, 1955), sagittal section, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), Royseux Railroad Section, spl. 64 (RC 23377).

Fig. 14 - *Tournayella* cf. *T. vespaeformis* Malakhova, 1956, near-axial section, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), Royseux Railroad Section, spl. 64 (RC 23397).


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

proloculus: up to 60μm; wall thickness, last volution: 20-30μm.

Description. Coiling, periphery and chamber shape the same as for the genus with a loosely coiled outer volution. Septa long, anteriorly directed. Basal deposits consist of long hooks or thickened curved spines. Wall has outer, dark, thin dense layer and an inner thicker, less dense, microgranular layer that may include lighter (recrystallized?), coarser grains.

Remarks. The above description and dimensions are based on material listed in the synonymy and on specimens illustrated from the lower Yvoir Formation in this paper. No axially oriented specimens have been identified unequivocally and dimensions from that orientation are not known.

S. brencklei differs from *S. spinosa* (Chernysheva) in its fewer chambers (8-10 in the last volution of *S. spinosa*), thicker wall, larger size and more rapid inflation of the last volution. *S. paraukrainica* has a chamber count (5-8 in the last volution) similar to *S. brencklei* but a thinner wall, smaller size and shorter basal spines. *S. trachida* has about the same size and wall thickness as *S. brencklei* but more chambers (generally 9-10 in the last volution), shorter and stouter basal spines, and septa thickened at the join.

Mamet et al. (1986) included Lipina's (1955) *Endothyra spinosa* form *magna* within their subspecies *Spinoendothyra spinosa crassitheca*, which we synonymize with *S. brencklei.* The holotype of Lipina's form has 10 chambers in the last volution and a relatively thin wall (10-20 μm in last volution). It does not belong within *S. brencklei* but possibly is related to *Spinoendothyra paracostifera* (Lipina, 1955) or another spinoendothyrin. Lipina (1951) previously used the name *Endothyra spinosa* var. *magna* for an entity whose holotype resembles a large *Tuberendothyra tuberculata*. Neither of Lipina's taxa is valid because the name *magna* is preoccupied by *Endothyra similis magna* Rauzer-Chernousova, 1948.

Occurrence. Specimens assignable to the species have been reported from the western United States in the early Osagean (late Tournaisian) part of the Redwall Limestone in Arizona (Skipp 1969), Leadville Limestone in Colorado (Conil & Lys 1977; Mamet et al. 1986) and Humboldt Oolite in Iowa (Brenckle & Groves 1987); from western Canada in the Osagean (late Tournaisian-earliest Visean) Shunda and Turner Valley formations of British Columbia (Mamet et al. 1986); from the Kizelovsky and Kosvinsky horizons (late Tournaisian) of the Middle Urals in Russia (Brenckle 1997) and from the late Hastarian (late early Tournaisian) lower Yvoir Formation in Belgium (Fig. 2).

Family Endothyranopsidae Reitlinger, 1958, *nom. trans.* Reitlinger, 1966

Genus *Granuliferelloides* McKay & Green, 1963

Type species: *Granuliferelloides jasperensis* McKay & Green, 1963

1965 *Rectochernyshinella* Lipina, p. 88, not Lipina, 1960
1966 *Corrigotubella* Ganelina, p. 98-99.
1985 *Lipinellina* Loeblich & Tappan, p. 92, new name for *Rectochernyshinella* Lipina, 1965.

Description. Bimorphic test; initially skew-coiled and septate, followed by erect uniserial chambers. Periphery of coiled portion smooth to slightly lobate. Septa of medium length, pointed forward, and characteristically wedge-shaped because of secondary thickenings at the join. Aperture in coiled portion basal and simple. Erect chambers quadrate, slightly bulging along sides and penetrated by a single, central aperture. Wall single-layered and granular/agglutinated.

Remarks. This genus is closely related to *Granuliferella*, differing only in the terminal rectilinear growth stage (Woodland 1958). Specimens of *Granuliferelloides*, however, have generally been assigned to other genera because their evolution or morphology has been misinterpreted or the genus overlooked. In North America, for example, Mamet & Skipp (1970), Mamet in Armstrong & Mamet (1977) and Brenckle & Groves (1987) placed this morphology in *Rectoseptaglomospiranella* Reitlinger, 1961. The two genera are similar but unrelated as they evolved from different stock.

Ganelina (1966) established *Corrigotubella* on the species *C. posneri* that is identical to *Granuliferelloides* except for a purported terminal cribrate aperture. Examination of the type specimens by the senior author (unpublished observation, Brenckle 1994) in St. Petersburg showed that the terminal apertures contained extraneous debris (calcisphere and shell fragments or peloids) and were not cribrate (see Pl. 2, fig. 4, 11, 12 in this paper). *Corrigotubella* is the same as *Granuliferelloides* and its reclassification as a subgenus of cribrate *Haplophragmella* (Rauzer-Chernousova et al. 1996) is not justified.

The distinguishing features of the bimorphic subgenus *Rectochernyshinella* Lipina, 1965, are the chernyshinellid coiling and pseudoseptation of the initial part of the test that Lipina (1965) claimed separated the type species *Chernyshinella* (*Rectochernyshinella*) *kinelensis* Lipina, 1965, from *Granuliferelloides nalivkini* (Malakhova, 1956). These features are not obvious in the type illustrations of *R. kinelensis* and Rauzer-Chernousova et al. (1996, p. 22) later synonymized that species with *G. nalivkini*. Loeblich & Tappan (1985) pointed out that Lipina's 1965 subgenus was a junior homonym of another genus that Lipina had named in 1960. They proposed the replacement name *Lipinellina* for *Rectochernyshinella* Lipina, 1965. Because this new genus is based on C. (*R.*) *kinelensis*, it too becomes a subjective synonym of *Granuliferelloides*. The bimorphic genus *Rectogranuliferella* Conil & Lys in Mansy et al. (1989) differs from *Granuliferelloides* in that the rectilinear portion is biserial.

Granuliferelloides can be divided into two morphologic types. The first is exemplified by *G. jasperensis* in which the diameter of the coiled portion in sagittal section is relatively small and approximates the width of the rectilinear chambers. That species may be synonymous with *G. gloriosa* (Grozdilova & Lebedeva, 1954), although the holotype of the latter is a slightly oblique, tangential section that hinders the precise determination of the size of the coiled portion. The second morphology includes forms with relatively large diameter skew-coiled portions that exceed the width of the uniserial chambers. *G. nalivkini* and the synonymous *G. granulella* (Woodland, 1958) belong in this group as well as *G. posneri*. This morphology is found within the lower Yvoir Formation in Belgium and described in the following write-up on *G. nalivkini*.

Occurrence. Late early to late Tournaisian beds of the western and central contiguous United States, Alaska, western Canada, and western and eastern Europe.

Granuliferelloides nalivkini (Malakhova, 1956)

Pl. 2, figs 12, 15-17

1956 *Ammobaculites nalivkini* Malakhova, p. 101, pl. 6, figs. 7, 11, not 6.

1958 *Granuliferella*? *granulella* Woodland, p. 797, pl. 99, figs. 9, 10, 13?, 18?, not 11, pl. 103, fig. 10.

1965 *Chernyshinella* (*Rectochernyshinella*) *kinelensis* Lipina, p. 88, pl. 20, figs. 7, 8.

1966 *Corrigotubella posneri* Ganelina, p. 99, pl. 9, fig. 4, not 3.

1977 *Rectoseptaglomospiranella nalivkini* (Malakhova)-Mamet *in* Armstrong & Mamet, p. 46, pl. 28, fig. 3.

1977 *Endothyranella* sp. -Mamet *in* Armstrong & Mamet, p. 54, pl. 29, figs. 11, 12.

1978 cf. *Eotextularia* sp. -Kimpe et al., pl. 8, fig. 22.

1987 "*Rectoseptaglomospiranella*" *granulella* (Woodland)-Brenckle & Groves, figs. 9.1-9.3, 9.7, not fig. 8.27.

Dimensions. Maximum observed length: 1800 µm; volutions, coiled portion: 3-4; diameter, coiled portion: 350-500 µm; chambers, last volution: 5-7; interior diameter, proloculus (one specimen): 40 µm; wall thickness, last volution: 15-40 µm; maximum observed number, uniserial chambers: 6; width, uniserial portion: 200-400 µm; wall thickness, uniserial chambers: 30-50 µm.

Description. See that for the genus.

Remarks. The dimensions are based on specimens listed in the synonymy and illustrated from the lower Yvoir Formation in this paper as well as from material described in Woodson's (1993) unpublished doctoral thesis on foraminifers from the lower member of the Gilmore City Formation of Iowa. That member along with the overlying Humboldt Oolite Member (Brenckle & Groves 1987) contains an exceptionally abundant and well preserved assemblage of granuliferellins and associated forms.

Granuliferelloides nalivkini is characterized by a relatively wide coiled portion and a thick wall that differentiate it from the narrower coil and thinner wall of *G. jasperensis*/*G. gloriosa*. In her original description of the species Malakhova (1956) reported that the coiled portion of *G. nalivkini* varied from 220-280 µm in diameter, although the magnifications given for the figured specimens indicated higher values. At our request R. M. Ivanova of the Institute of Geology and Geochemistry, Ekaterinburg, remeasured the holotype (Malakhova 1956, pl. 6, fig. 7) and one of the paratypes (Malakhova 1956, pl. 6, fig. 11) that have coiled diameters of 400 µm and 410 µm, respectively (written communication to Brenckle, October 21, 1998). These values are consistent with specimens assigned to Woodland's (1958) later-named species *G*? *granulella*. Malakhova's other paratype (1956, pl. 6, fig. 6) is more compact and thin-walled; it most likely should be reassigned to *G. jasperensis* or *G. gloriosa*.

Granuliferelloides posneri (Ganelina, 1966) is more massive than *G. nalivkini* with the diameter of the coiled portion being about 1 ½-2 times larger. This same morphology has also been found in both members of the Gilmore City Formation (Brenckle & Groves 1987, fig. 8.27; Woodson 1993). Woodson (1993) recommended that these larger forms be kept separate from *G. nalivkini* and his position is followed herein. The dimensions of the Iowa specimens are close to the holotype of *G. posneri* illustrated on Pl. 2, fig. 11 in this paper. Ganelina's paratype (1966, pl. 9, fig. 4) has a much smaller coiled portion and it is reassigned to *G. nalivkini* (see Pl. 2, fig. 12 in this paper).

Occurrence. Late Kinderhookian (late early Tournaisian) upper Gardner (Upper Fitchville) Limestone of central Utah (Woodland 1958), and lower member of the Gilmore City Limestone in Iowa (Woodson 1993); early Osagean (late Tournaisian) Humboldt Oolite Member of the Gilmore City Formation in Iowa (Brenckle & Groves 1987) and lower Wachsmuth Limestone in northern Alaska (Mamet in Armstrong & Mamet 1977); Chikmansky Horizon (= upper Cherepetsky or late early Tournaisian) of the Middle Urals (Malakhova 1956); Kizelovsky Horizon (late Tournaisian) of the Russian Platform (Lipina 1965) and Middle Urals (Ganelina 1966); and the late Hastarian (late early Tournaisian) "Tn2" Limestone (Kimpe et al. 1978) and lower Yvoir Formation (Fig. 2) in Belgium.

Family Uncertain

Crassiseptella n. gen.

Type species: *Plectogyra inflata* Zeller, 1957

Description. Coiling is initially skew and varies from skew to planispiral in the outer volutions. Septa have an inverted triangle or teardrop shape formed by massive secondary deposits along the posterior sides. Secondary deposits also form at the septal join but none are secreted on the chamber floor. Wall is composed of a thin, dark, microgranular layer covering a thicker, lighter-colored granular layer. A thin, interior microgranular layer may also be present. Aperture is a simple, basal opening.

Remarks. *Crassiseptella*, named for its characteristically enlarged septa, includes *C. inflata* (Zeller, 1957) and *C. tumesepta* (Zeller, 1957). Lipina (1977) assigned both species to *Laxoendothyra* along with *Plectogyra bulbisepta* Conil & Lys, 1964, now a synonym of *C. inflata*. The relationship between the genera is indeed close. *Laxoendothyra* appeared in the late Famennian of the Paleotethys and gave rise to *Crassiseptella* in the early Tournaisian, primarily through development of posterior septal thickenings. Conil et al. (1980) noted that specimens now referred to *Crassiseptella* characterize certain early Tournaisian foraminiferal assemblages of the Dinant Basin in Belgium, and they represent the bulbiseptal stage of endothyrid foraminiferal evolution (Gilissen 1988; Conil et al. 1988, 1991) that we consider to be widespread throughout the Northern Hemisphere at that time.

Plectogyrina Reitlinger in Voloshinova & Reitlinger (1959) may be related to *Crassiseptella*. Its type species *Endothyra*? *fomichaensis* Lebedeva, 1954, from late Tournaisian-early Visean beds of the Kuznets Basin in western Siberia has a similar differentiated wall and some septa with posterior thickenings. There also appear to be small deposits on the chamber floors. Reitlinger distinguished *Plectogyrina* by its coiling pattern that is initially planispiral and evolute, followed by an involute terminal volution rotated 90° to the interior. In other respects the genus is poorly understood and it is rarely cited in the literature. That coiling pattern is not seen in *Crassiseptella,* which contains heavier and more consistent posterior septal thickenings and no floor deposits.

The differentiated wall in *Crassiseptella* separates it from *Plectogyranopsis* Vachard, 1978, some species of which have similar coiling, chamber inflation and posterior septal deposits but only a single-layered granular wall. Specimens of *Latiendothyranopsis* Lipina, 1977, may also resemble *Crassiseptella* but the former have a mostly undifferentiated granular wall and septa that are thickened primarily at the septal joins not along the posterior sides.

Occurrence. Late early Tournaisian of the western United States, Belgium, western Kazakhstan, far eastern Russia, and South China.

PLATE 3

Magnifications X75, except as noted. Thin section catalogue numbers (RC, USNM, SUI, KCS) are in parentheses.
Correlation of Conil foraminiferal zones is shown in Fig. 2

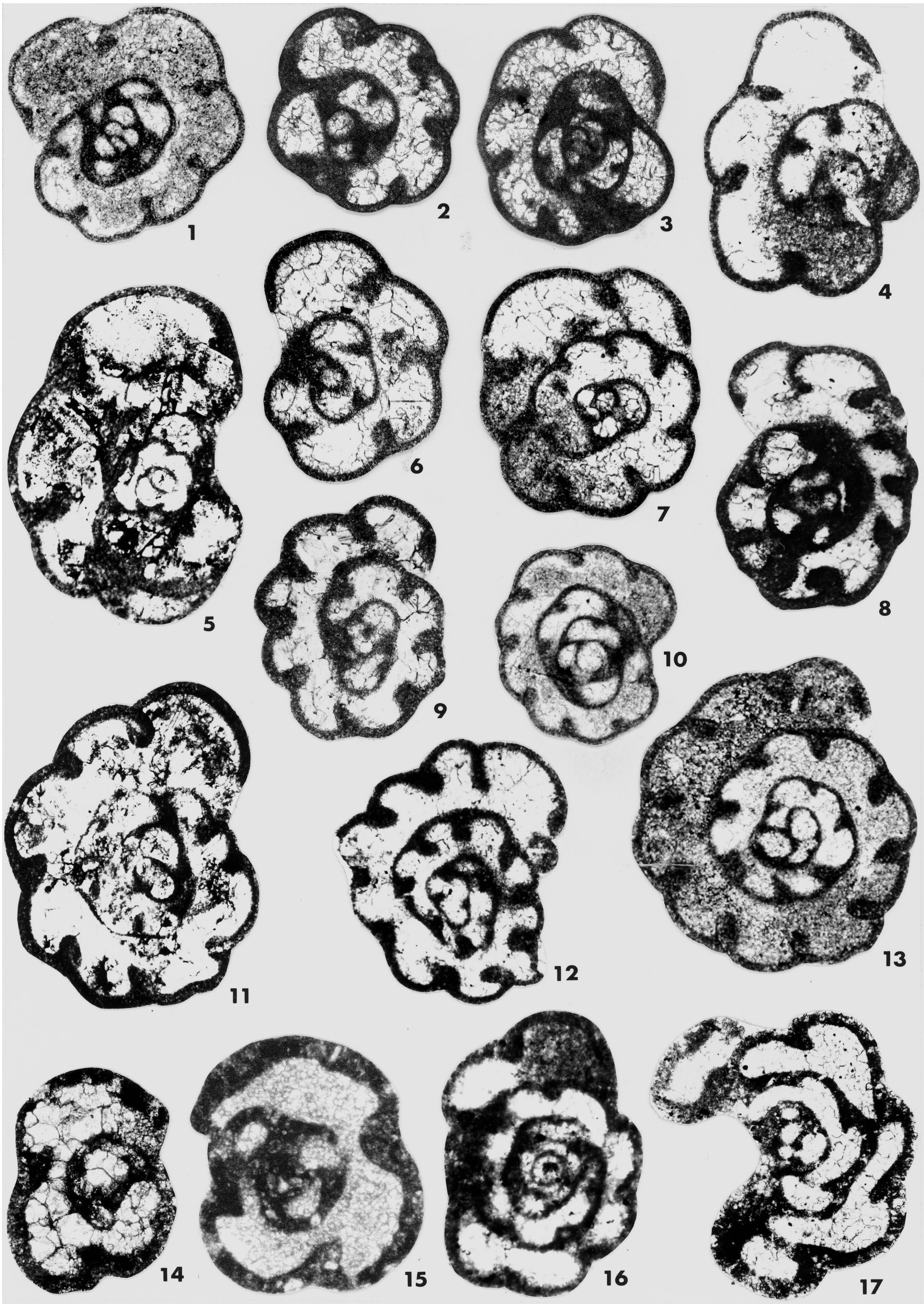
Fig. 1, 2?, 3-7- *Crassiseptella inflata* (Zeller, 1957), near-sagittal sections. Fig. 1 - reillustration of holotype from Zeller (1957, pl. 79, fig. 18), Blacksmith Fork Canyon section, Cache County, Utah, USA, Madison Limestone, Early Osagean, Bed 36 (USNM 186273); Fig. 2 - Tengiz Platform, Pricaspian Basin, western Kazakhstan, T-5857 well, Cherepetsky Horizon, depth: 5089.56-5089.61 m (KCS 5857-5089-1); Fig. 3 - Same locality, age and depth as fig. 2 (KCS 5857-5089-2); Fig. 4 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Rivage Railroad Section, spl. 221h (RC 23278); Fig. 5 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Gendron-Celles Station, spl. 151 (RC 23311); Fig. 6 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Rivage Railroad Section, spl. 223 (RC 2718), reillustration of *Endothyra parakosvensis clavaesepta* forma *minima* from Conil & Lys (1968, pl. 10, fig. 93); Fig. 7 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Rivage Railroad Section, spl. 223 (RC 3339), reillustration of the holotype of *Endothyra parakosvensis clavaesepta* from Conil and Lys (1967, pl. 2, fig. 18), X60.

Fig. 8-13 - *Crassiseptella tumesepta* (Zeller, 1957), sagittal and near-sagittal sections. Fig. 8 - lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), Royseux Railroad Section, spl. 64 (RC 23158); Fig. 9 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Comblain-Fairon Roadcut Section, spl. 33 (RC 1598); Fig. 10 - reillustration of paratype (Zeller, 1957, pl. 79, fig. 17), an immature specimen showing proloculus and initial coiling, Blacksmith Fork Canyon section, Cache County, Utah, USA, Madison Limestone, Early Osagean, Bed 36 (USNM 186272); Fig. 11 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Gendron-Celles Station, spl. 151 (RC 23312); Fig. 12 - Landelies Limestone, late Hastarian (foraminiferal zone Cf1β), Rivage Railroad Section, spl. 221h (RC 23226); Fig. 13 - reillustration of holotype (Zeller, 1957, pl. 79, fig. 16; USNM 186271), locality and age same as fig. 10.

Fig. 14, 15 - *Condrustella modavensis* (Conil and Lys, 1967), emend. herein, near-sagittal sections, Kosva Quarry near Shirokovsky settlement, Permskaya Oblast', Russia, Kosvinsky Horizon. Fig. 14 - spl. 11 (SUI 97953); Fig. 15 - spl. 18 (SUI 97954).

Fig. 16 - *Septatournayella segmentata* (Dain, 1953), sagittal section, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), Royseux Railroad Section, spl. 64 (RC23414).

Fig. 17 - *Uviella aborigena* Ganelina, 1966, incomplete near-sagittal section, Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Tournai, CCB Drillhole, spl. 809 (RC 16431).


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

Crassiseptella inflata (Zeller, 1957)
Pl. 3, figs 1, 2?, 3-7

1957 *Plectogyra inflata* Zeller, p. 699-700, pl. 79, fig. 18.
1964 *Plectogyra bulbisepta* Conil & Lys, p. 171, pl. 25, fig. 500.
1964 *Plectogyra parakosvensis* var. *struniana* Conil & Lys, p. 202-203, pl. 34, fig. 664 only.
1967 *Plectogyra parakosvensis* subsp. *clavaesepta* Conil & Lys, p. B405-B406, pl. 1, fig. 6, pl. 2, figs. 18, 19.
1968 *Endothyra skippae* Armstrong, new name for *Plectogyra inflata* Zeller, 1957, p. 54.
1968 Not *Endothyra skippae* Armstrong, p. 54, pl. 8, figs. 6, 9.
1968 *Endothyra parakosvensis* subsp. *clavaesepta* forma *minima* Conil & Lys, p. 519-520, pl. 10, figs. 93-95.
1973 *Latiendothyra* of the group *L. parakosvensis* (Lipina) - Verville et al., pl. 3, fig. 9.
1973 *Endothyra parakosvensis* subsp. *clavaesepta* (Conil & Lys) - Chabot, pl. 1, fig. 1?

Dimensions. Volutions: 3 ½-5; diameter: 500-1000 µm; chambers, last volution: 5-7; wall thickness, last volution: 15-30 µm; maximum septal thickness, last volution: 55 µm.

Dimensions of holotype (Zeller 1957, pl. 79, fig. 18). Volutions: about 4 ½; diameter: 610 µm; chambers, last volution: 6; wall thickness, last volution: 15 µm; maximum septal thickness, last volution: 45 µm.

Description. Test interior skew-coiled followed by one to two nearly planispiral, evolute to partly evolute, rapidly expanding, final volutions. Chambers inflated; periphery lobate. Septa high-angled, medium length and greatly thickened on posterior ends. Small deposits also fill septal join. Wall differentiated as in genus but can be altered to single-layered structure.

Remarks. The morphology of this species closely resembles that of *Laxoendothyra parakosvensis* (Lipina, 1955) with which specimens of *C. inflata* have often been associated. Although both species share a similar stratigraphic range, *L. parakosvensis* has short septa devoid of the posterior thickenings found in *C. inflata*. Comparisons between *C. inflata* and *C. tumesepta* are given in the remarks about the latter species. The holotype of *C. inflata* is reillustrated and its dimensions are given herein because the originally reported diameter and plate magnification are incorrect (Pohl & Zeller 1973). Chabot (1973) assigned an anomalously large and thick-walled foraminifer to *Endothyra parakosvensis clavaesepta* that is herein considered a junior synonym of *C. inflata*. That specimen is queried in the synonymy but its dimensions and stratigraphic occurrence are not included in the description. The identification of the specimen on Pl. 3, fig. 2, is also qualified because the coiling of the last volution is tighter than in typical *C. inflata*, although it may be an incomplete or immature example.

Mississippian foraminiferal specialists have generally considered *Plectogyra* Zeller, 1950, to be a subjective synonym of *Endothyra* following an ICZN ruling (China 1965) on the status of the latter genus. Armstrong (1968) proposed the replacement name *Endothyra skippae* for *P. inflata* Zeller, 1957, because the trivial name was preoccupied by *E. inflata* Lipina, 1955 (also by *E. inflata* Morozova, 1949). As neither of these *inflata* species is included within *Crassiseptella*, Zeller's species name remains available for use with that genus.

Occurrence. The species is known from the late Kinderhookian Series (late early Tournaisian) in the Madison Limestone of Utah and Wyoming, western United States (Zeller 1957; Verville et al. 1973); the upper part of the Hastarian Stage (late early Tournaisian) in the Landelies Formation of Belgium (Conil & Lys 1964, 1967; Conil et al. 1991; Fig. 2); and the Cherepetsky Horizon (late early Tournaisian) in the Pricaspian region of Kazakhstan (this paper; Brenckle, unpublished information).

Crassiseptella tumesepta (Zeller, 1957)
Pl. 3, figs 8-13

1957 *Plectogyra tumesepta* Zeller, p. 698, pl. 79, figs. 16, 17.
1957 *Granuliferella tumida* Zeller, p. 696-697, pl. 77, fig. 22 only.
1984 *Endothyra parakosvensis septima* Malakhova-Conil *in* Shilo et al., pl. 20, figs. 98, 99. [According to Conil (personal communication to senior author, 1984) these specimens were intended to be identified as *Endothyra parakosvensis* aff. *claveseptata* (Conil & Lys), but the names were transposed in the plate caption.]

Dimensions. Volutions: about 4-5; diameter: 600-1100 µm; chambers, last volution: 8-10; interior diameter, proloculus: up to 55 µm; wall thickness, last volution: 15-30 µm; maximum septal thickness, last volution: 40-80 µm.

Dimensions of holotype (Zeller 1957, pl. 79, fig. 16). Volutions: >3; diameter: 800 µm; chambers, last volution: about 10; wall thickness, last volution: 20-25 µm; septal thickness, last volution: 45-60 µm.

Description. Initial volutions skew coiled; at least the last two are planispiral. Coil expansion steady and moderate. Chambers mildly inflated; periphery smooth to slightly lobate. Septa short to medium in length and at moderately high angle to wall. Massive secondary deposits cover posterior ends of septa and smaller but well developed deposits fill the septal joins. Wall structure and aperture as in *C. inflata*.

Remarks. This species differs from *C. inflata* in having less coiling distortion in the outer volutions, more chambers in the last volution, a slower rate of coiling expansion, smoother periphery and more massive septal deposits. The holotype is reillustrated and its dimensions are given herein because Zeller (1957) incorrectly reported the size and magnification (Pohl & Zeller 1973). The paratype is also figured to show the morphology of the innermost chambers. Both it and the specimen listed under *Granuliferella tumida* in the synonymy are considered to be immature. Because axial sections of *C. tumespta* have not yet been identified, the coiling profile in that orientation is unknown.

"*Septatournayella*" *recta* Lebedeva, 1954, resembles *C. tumesepta* except for fewer chambers (7-8) in the last volution and a completely planispiral coil. The differentiated wall structure and posterior septal deposits distinguish it from true *Septatournayella* but the species cannot be accomodated within *Crassiseptella* which is nonplanispiral. "*S.*" *recta* occurs in late Tournaisian beds of the Kuznets Basin in western Siberia.

Occurrence. *Crassiseptella tumesepta* comes from the late Kinderhookian Series (late early Tournaisian) in the Madison and Joana limestones of Utah, western United States (Zeller 1957); the Mol Suite (late early Tournaisian) of far eastern Russia (Shilo et al. 1984); and the upper part of the Hastarian Stage (late early Tournaisian) in the Landelies and lower Yvoir formations of Belgium (Fig. 2).

Family Forschiidae Dain, 1953, *nom. trans.* Grozdilova & Lebedeva, 1954

Genus *Condrustella* Conil & Longerstaey in Conil & Lys, 1977, emend. herein

Type species: "*Mstinia*" *modavensis* Conil & Lys, 1967

1989 *Eomstinia* Lipina, p. 42.

Description. Initial coiling tight and skew, followed by 1-1 ½ rapidly expanding, involute, planispiral volutions. Few chambers asymmetrical or teardrop-shaped as in the chernyshinellins; rapidly inflated at the join and flattened toward the end of the septum. No secondary deposits. Wall thick, agglutinated with a thin, inner microgranular layer. Aperture a simple basal opening.

Remarks. This genus is an important element in transitional Tournaisian-Visean foraminiferal assemblages but its potential for regional correlation has not been realized because the morphology has been misunderstood. "*Mstinia*" *modavensis,* the type species of *Condrustella*, was originally described as cribrate (Conil & Lys 1967) and that feature was incorporated into Conil and Longerstaey's description of the genus. In a later publication Conil et al. (1980) redescribed *Condrustella* with a simple rather than cribrate aperture without explaining the reason for the change in diagnosis, and Loeblich & Tappan (1987) incorporated that change also without comment in their description of the genus. The type specimens of *C. modavensis* occur in the peloidal- and crinoidal-rich limestone of the Flémalle Member of the Longpré Formation in Belgium. Cribration in these specimens consists of two openings in the apertural face not the multiple openings associated with typically cribrate forms. Because the fortuitous entrapment of peloids or shell debris in the apertural opening could account for the observed morphology and because cribration does not occur in *Condrustella* from other localities, we reject a cribrate aperture as characteristic of the genus and emend its description to include forms with simple, basal apertures. Other

PLATE 4

Magnifications X75. Thin section catalogue numbers (RC) are in parentheses.
Correlation of Conil foraminiferal zones is shown in Fig. 2

Fig. 1-5 - *Uviella aborigena* Ganelina, 1966, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), all from Royseux Railroad Section, spl. 64 except as noted. Fig. 1 - sagittal section (RC 23151); Fig. 2 - sagittal section (RC 23389); Fig. 3 - near-sagittal section, Modave, Huy Road Section, spl. 124 (RC 21190); Fig. 4 - near-axial section (RC 23423); Fig. 5 - near-axial section (RC 23387).

Fig. 6, 8, 9, 13 - *Palaeospiroplectammina tchernyshinensis* (Lipina, 1948), sagittal and near-sagittal sections. Fig. 6 - Royseux Railroad Section, spl. 64 (RC 23193), Fig. 9 - Royseux Railroad Section, spl. 64 (RC23422), and Fig. 13 - Royseux Railroad Section, spl. 63h (RC 23210), all from lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ); Fig. 8 - Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Gendron-Celles Station, spl. 140 (RC 23308).

Fig. 7 - *Palaeospiroplectammina globata* Lipina, 1965, tangential-sagittal section, Landelies Formation, late Hastarian (foraminiferal zone Cf1β), Gendron-Celles Station, spl. 150 (RC 23297).

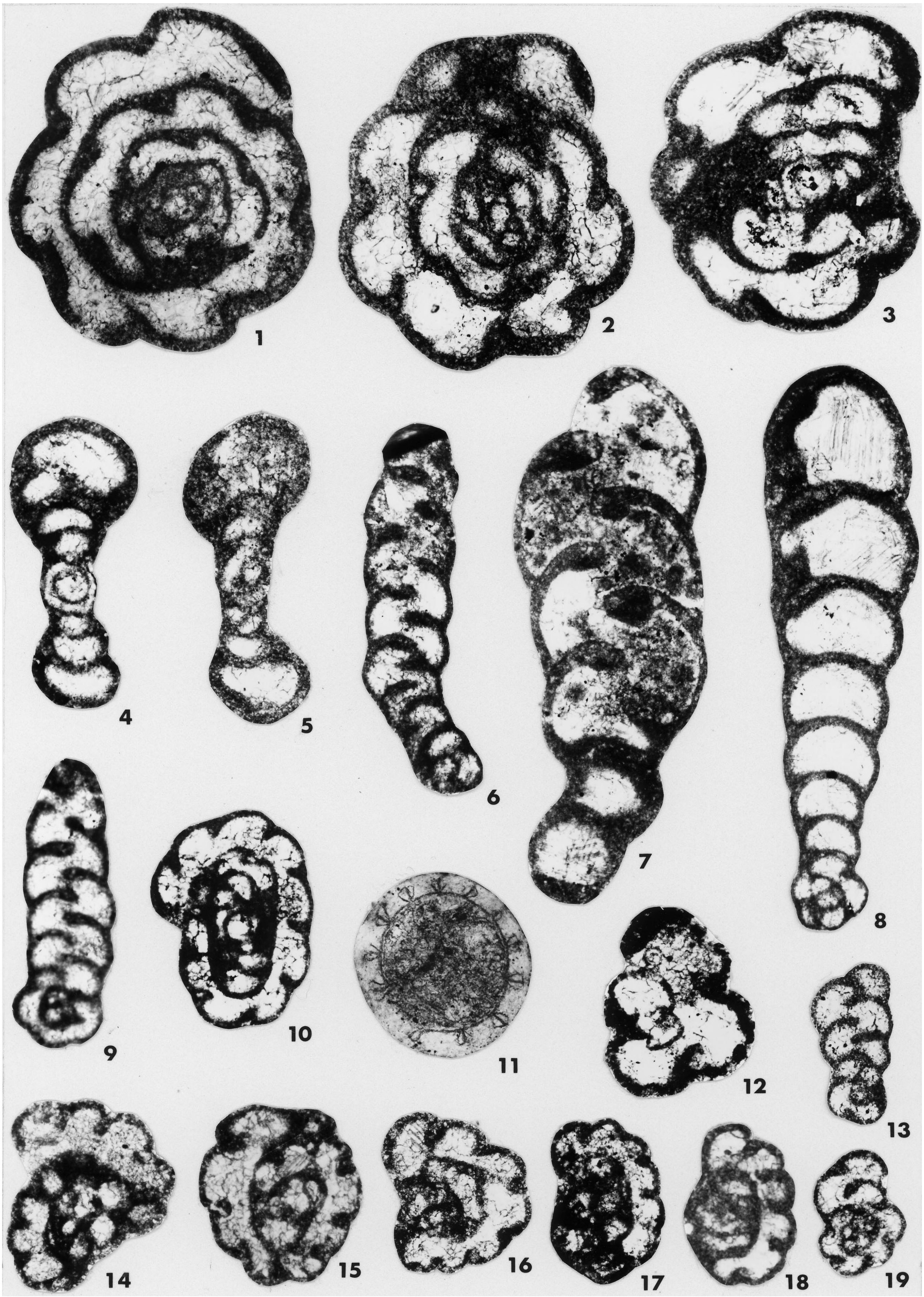
Fig. 10 - *Septaglomospiranella* sp., sagittal section, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), Royseux Railroad Section, spl. 65 (RC 23218).

Fig. 11 - *Sphaerinvia piai* Vachard, 1980, *incertae sedis*, random section, Landelies Formation, late Hastarian (foraminiferal zone Cf1α''), Leignon Station Quarry, spl. 1 (RC 417).

Fig. 12 - *Tournayellina beata* (Malakhova, 1956), near-sagittal section, Hastière Formation, early Hastarian (foraminiferal zone Cf1α'), Engihoul Quarry, spl. 3b (RC 24152).

Fig. 14-18 - *Inflatoendothyra* sp., near-sagittal sections, Hastière Formation, early Hastarian (foraminiferal zone Cf1α'). Fig. 14 - Rivage Railroad Section, spl.184c (RC 20510), Fig. 15 - Dolhain Railroad Section, spl. 3/8, (RC 1506), Fig. 16 - Dolhain Railroad Section, spl. 6c (RC 20688), Fig. 17 - Royseux Railroad Section, spl.146 (RC 20488), Fig. 18 - Rivage Railroad Section, spl. 184b (RC 20535).

Fig. 19 - *Endospiroplectammina nana* (sensu Lipina, 1955), near-sagittal section, lower Yvoir Formation, late Hastarian (foraminiferal zone Cf1γ), Royseux Railroad Section, spl. 65 (RC 23201).


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

species within *Condrustella* include *C. chusovensis* (Lipina 1989).

Lipina (1989) established the genus *Eomstinia* for specimens that resemble *Condrustella* but have simple apertures. Because *Condrustella* was originally described as cribrate, she reclassified it as a subgenus within *Mstinia* Dain, 1953, and the combination *Mstinia* (*Condrustella*) has been adopted in the latest Russian classification scheme for Mississippian foraminifers (Rauzer-Chernousova et al. 1996). We, however, prefer to synonymize *Eomstinia* under *Condrustella* because the type species of the genera, *E. shirokensis* and *C. modavensis*, have identical morphologies, wall structures and stratigraphic ranges. It seems illogical to separate the two genera based only on the spurious cribration of *Condrustella*.

Because of the teardrop chamber shape *Condrustella* was classified within the Subfamily Chernyshinellinae of the Family Tournayellidae (Conil et al. 1980) and *Eomstinia* within the same subfamily but as part of the Chernyshinellidae (Lipina 1989; Rauzer-Chernousova et al. 1996). These associations overlook the fact that the wall structure of *Condrustella* is thick, granular/agglutinated, more like that of the Forschiidae than the microgranular wall of typical chernyshinellins. The ancestry of *Condrustella* possibly can be traced to *Eochernyshinella* (sensu Lipina, 1965), a taxon that was considered a subgenus of *Chernyshinella* but has a thick, granular wall. Lipina (1989) created the Subfamily Mstiniinae to include supposedly cribrate *Condrustella*. That subfamily may be appropriate for *Condrustella* as emended herein but it should be shifted to the Forschiidae from the Chernyshinellidae in which it is now placed (Rauzer-Chernousova et al. 1996). In fact the classification of "tournayellids" s. l. needs to be reevaluated to reflect similarities in wall structures that are now combined in disparate suprageneric groupings (see remarks about *Carbotarima* in Brenckle 2004).

Occurrence. Late Tournaisian to Early Visean beds in Belgium, France, Middle and North Urals, far eastern Russia, Ukraine, northern Iran, and South China.

Condrustella modavensis (Conil & Lys, 1967), emend. herein

Pl. 3, figs 14, 15

1967 "*Mstinia*" *modavensis* Conil & Lys, p. B398-B399, pl. 2, figs. 10-13.

1973 "*Mstinia*" *modavensis* Conil & Lys - Bozorgnia, p. 61-62, pl. 8, figs. 4, 5.

1977 *Condrustella modavensis* (Conil and Lys)-Conil & Lys, pl. 5, figs. 85 (=Conil and Lys 1967, pl. 2, fig. 10), 86?

1981 *Condrustella modavensis* (Conil and Lys)-Conil et al., pl. 2, fig. 33.

1982 *Condrustella modavensis* (Conil and Lys)-Groessens et al., pl. 12, figs. 19, 20? 21? (=Conil and Lys 1977, pl. 5, fig. 86).

1984 *Condrustella modavensis* (Conil and Lys)-Shilo et al., pl. 23, figs. 154-157.

1989 *Condrustella modavensis* (Conil and Lys)-Mansy et al., pl. 7, fig. 28.

1989 *Condrustella modavensis* (Conil and Lys)-Conil et al., pl. 2, figs. 30?, 31?, 38-40.

1991 *Condrustella modavensis* (Conil and Lys)-Pelhate et al., pl. 3, figs. 21-24.

1989 *Eomstinia shirokensis* Lipina, p. 42, pl. 3, figs. 1-8.

Dimensions. Volutions: about 3-3 ½; diameter: 450-950 μm; width (one specimen): 430 μm; width/diameter (one specimen): 0.67; chambers, last volution: 3-5; wall thickness, last volution: 25-90 μm (generally around 50 μm).

Description. See that for the genus.

Remarks. *C. chusovensis* (Lipina, 1989) differs in its greater chamber count (5-7 in the last volution), more irregularly shaped chambers and generally thinner wall. Some specimens assigned to *C. modavensis* in Conil and Lys (1977), Groessens et al. (1982) and Conil et al. (1989) have larger diameters than typical forms or are evolutely coiled. They are queried in the synonymy and their dimensions and stratigraphic occurrences are not included in the description. These specimens have thicker walls and more regularly shaped chambers than *C. chusovensis*.

Malakhova (1954) described the species *Haplophragmella didona* from the Late Tournaisian of the Middle Urals. Although *Haplophragmella* is rectilinear and cribrate in the adult stage, she chose a coiled specimen, presumably a juvenile, as holotype. This specimen closely resembles *C. modavensis*. It could have priority but on the material available it is impossible to tell if the holotype of *H. didona* represents a mature *Condrustella* or juvenile bimorphic form. A paratype of another Late Tournaisian species, *Haplophragmella arctica* Malakhova, 1956 (pl. 8, fig. 1), also looks like *C. modavensis* except that the septa are not as well developed. It may better be assigned to the coiled, pseudoseptate genus *Eocribrella* Lipina, 1989. Brazhnikova & Vdovenko (1973, pl. 10, fig. 3) illustrated an *Endothyrina modavensis* (Conil & Lys) from beds equivalent to the Tulsky Horizon (early late Visean) in the Dneipr-Donets Basin of Ukraine. This is an unusually young occurrence for the species, suggesting that the specimen may be the immature portion of a bimorphic test belonging to *Haplophragmella* or a lituotubellid.

Occurrence. Ivoirian and early Moliniacian (Late Tournaisian) Martinrive, Longpré, Waulsort and Lens formations in Belgium (Conil & Lys 1967, 1977; Groessens et al. 1982; Conil et al. 1989; Mansy et al. 1989; Fig. 2); Viosne Limestone of the Laval Basin, France (Pelhate et al. 1991), and the Grives and Godin formations at Avesnois, France (Conil et al. 1981); Kizelovsky to

Pester'kovsky (=Radaevsky) horizons (late Tournaisian-early Visean) of the Middle and North Urals (Lipina 1989; Brenckle 1997); late Tournaisian Sikambr suite, Elergetkhyn area, far eastern Russia (Shilo et al. 1984); and early Visean Mobarak Formation, Gaduk section, Alborz Mountains, Iran (Bozorgnia 1973). The species may also occur in the Yintang and Baping formations (late Tournaisian-early Visean) in the Guangxi Autonomous Region of South China (Hance, unpublished information).

Acknowledgements. We thank Nilyufer Gibshman for commenting on an earlier version of the manuscript and for constructive journal reviews by Daniel Vachard and Bernard Mamet. The Kazakhstancaspishelf Company permitted illustration of the *Crassiseptella* specimens from Tengiz.

REFERENCES

Armstrong A. K. (1968) - Biostratigraphy and carbonate facies of the Mississippian Arroyo Peñasco Formation, north-central New Mexico. *State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology Memoir*, 20: 1-79, Socorro. [imprinted 1967].

Armstrong A. K. & Mamet B. L. (1977) - Carboniferous microfacies, microfossils and corals, Lisburne Group, Arctic Alaska. *U. S. Geological Survey. Professional Paper*, 849: 1-144, Washington.

Bozorgnia F. (1973) - Paleozoic foraminiferal biostratigraphy of central and east Alborz Mountains, Iran. *National Iranian Oil Company, Geological Laboratories Publication*, 4: 1-185, Tehran.

Brady H. B. (1884) - Report on the Foraminifera dredged by *HMS Challenger* during the years 1873-1876: Report of Scientific Results, Exploration Voyage HMS Challenger. *Zoology*, 9: 1-814, London.

Brazhnikova N. E. & Vdovenko M. V. (1971) - Foraminifera. In: Aizenverg, D. E. (ed.), Atlas of fauna in Tournaisian deposits of the Donets Basin (with a description of new species): *Akademiya Nauk Ukrainskoy SSR, Institut Geologicheskikh Nauk, "Naukova Dumka"*: 21-64 (in Russian), Kiev.

Brazhnikova N. E. & Vdovenko M. V. (1973) - Early Visean foraminifers of the Ukraine. *Vidavnitstvo "Naukova Dumka"*: 1-296 (in Ukrainian), Kiev.

Brenckle P. L. (1997) - Late Tournaisian (Lower Carboniferous) foraminifers from the Middle Urals and their use in Russian horizon definition. In: Ross C. A., Ross J. R. P. & Brenckle P. L. (eds.) - Late Paleozoic Foraminifera: Their Biostratigraphy, Evolution, and Paleoecology and the Mid-Carboniferous Boundary. *Cushman Found. Foram. Research, Sp. Publ.*, 36: 5-9, Washington.

Brenckle P. L. (2004) - Late Visean (Mississippian) calcareous microfossils from the Tarim Basin of Western China: *J. Foram. Res.*, 34 (2): 144-164, Washington.

Brenckle P. L. & Groves J. R. (1987) - Calcareous foraminifers from the Humboldt Oolite of Iowa: Key to Early Osagean (Mississippian) correlations between eastern and western North America. *Palaios*, 1: 561-581, Tulsa. [imprinted 1986].

Chabot A. G. (1973) - Stratigraphie du Tournaisien aux environs de Ciney. *Bull. Soc. belge Géol., Paléontol., Hydrol.*, 82 (1): 181-200, Brussels.

Chernysheva N. E. (1940) - On the stratigraphy of the Lower Carboniferous foraminifers in the Makarovsky district of the South Urals. *Byulleten' moskovskogo obshchestva ispytateley prirody, otdel. geologii*, 18 (5-6): 113-135 (in Russian), Moscow.

China W. E. (1965) Opinion 724-*Endothyra bowmani* Phillips, [1846] (Foraminifera): validated under the plenary powers. *Bull. Zool. Nomen.*, 22 (1): 37-39, London.

Conil R., De Putter Th., Hou H.-F., Wei J.-Y. & Wu X.-H. (1988) - Contribution à l'étude des foraminifères du Strunien et du Dinantien de la Chine sud-orientale. *Bull. Soc. belge Géol.*, 97 (1): 47-62, Brussels.

Conil R., Dreesen R., Lentz M.-A., Lys M. & Plodowski G. (1986) - The Devono-Carboniferous transition in the Franco-Belgian basin, with reference to Foraminifera and brachiopods. *Ann. Soc. géol. Belgique*, 109 (1): 19-26, Brussels.

Conil R., Groessens E., Laloux M. & Poty E. (1989) - La limite Tournaisien/Viséen dans la région-type. *Ann. Soc. géol. Belgique*, 112 (1): 177-189, Brussels.

Conil R., Groessens E., Laloux M., Poty E. & Tourneur, F. (1991) - Carboniferous guide Foraminifera, corals and conodonts in the Franco-Belgian and Campine basins: Their potential for widespread correlation. In: Brenckle P. L. & Manger W. L. (eds.) - Intercontinental Correlation and Division of the Carboniferous System. *Cour. Forsch.-Inst. Senckenberg*, 130: 65-78, Frankfurt. [imprinted 1990].

Conil R., Longerstaey P. J. & Ramsbottom W. H. C. (1980) - Matériaux pour l'étude micropaléontologique du Dinantien de Grande-Bretagne. *Mém. Inst. géol. Univ. Louvain*, 30: 1-187, Louvain-la-Neuve. [imprinted 1979].

Conil R. & Lys M. (1964) - Matériaux pour l'étude micropaléontologique du Dinantien de la Belgique et de la France (Avesnois): Partie 1, algues et foraminifères, et partie 2, foraminifères: *Mém. Inst. géol. Univ. Louvain*, 23: 1-296, Louvain.

Conil R. & Lys M. (1967) - Aperçu sur les associations de foraminifères endothyroïdes du Dinantien de la Belgique. *Ann. Soc. géol. Belgique*, 90 (4): B395-B412, Brussels.

Conil R. & Lys M. (1968) - Utilisation stratigraphique des foraminifères du Dinantien. *Ann. Soc. géol. Belgique*, 91: 491-558, Brussels.

Conil R. & Lys M. (1970) - Données nouvelles sur les foraminifères du Tournaisien inférieur et des couchesde passage du Famennien au Tournaisien dans l'Avesnois. In: Streel M. & Wagner R. H. (eds.), Colloque sur la Stratigraphie du Carbonifère. *Congrès et Colloques Univ. Liège*, 55: 241-265, Liège.

Conil R. & Lys M. (1977) - Les transgressions dinantiennes et leur influence sur la dispersion et l'évolution des foraminifères. *Mém. Inst. géol. Univ. Louvain*, 29: 9-55, Louvain-la-Neuve.

Conil R., Lys M. & Ramsbottom W., with the collaboration of Naum C., Gerard R., Hance L. & Vieslet J.-L. (1981) - Contribution à l'étude des foraminifères du Dinantien d'Europe occidentale. *Mém. Inst. géol. Univ. Louvain*, 31: 255-275, Louvain-la-Neuve.

Dain L. G. (1953) - Tournayellidae. In: Dain L. G. & Grozdilova L. P. - Fossil Foraminifers of the USSR, Tournayellidae and Archaediscidae. *Trudy VNIGRI, New Ser.*, 74: 5-65 (in Russian), Leningrad.

Dain L.G. (1958) - *Chernyshinella disputabilis* Dain n. sp. In: Bykova N. K. et al. - New Genera and Species of Foraminifers. *Trudy VNIGRI, Mikrofauna SSSR, Sbornik*, 9 (115): 18-19 (in Russian), Leningrad.

Durkina A. V. (1959) - Foraminifers of the Lower Carboniferous deposits of the Timan-Pechora Province. *Trudy VNIGRI, Mikrofauna SSSR, Sbornik*, 10 (115): 132-389 (in Russian), Leningrad.

Ganelina R. A. (1966) - Foraminifers of the Tournaisian and Lower Visean deposits of some regions of the Kamsk-Kinel Basin. *Trudy VNIGRI, Mikrofauna SSSR, Sbornik*, 14 (250): 64-175 (in Russian), Leningrad.

Gilissen E. (1986) - Contribution à l'étude des foraminifères de l'Hastarien dans le Bassin franco-belge. *Unpublished master's thesis, Univ. Louvain*: 1-106, Louvain-la-Neuve.

Gilissen E. (1988) - Étude de l'Hastarien, premier étage du Carbonifère dans le Bassin franco-belge. Biozonation par foraminifères et parallélisme avec l'Amérique du Nord et l'Extrême-Orient. *C. r. Acad. Sci. Paris*, 306 (2): 1297-1300, Paris.

Groessens E., Conil R. & Hennebert M. (1982) - Le Dinantien du sondage de Saint-Ghislain, stratigraphie et paléontologie. *Service géol. Belgique, Mém.*, 22: 1-137, Brussels. [imprinted 1979].

Grozdilova L. P. & Lebedeva N. S. (1954) - Foraminifers of the Lower Carboniferous and Bashkirian Stage of the Middle Carboniferous of the Kolvo-Vishera region. *Trudy VNIGRI, Mikrofauna SSSR, Sbornik*, 7 (81): 4-235 (in Russian), Leningrad.

Hance L. (1996) - Foraminiferal biostratigraphy of the Devonian-Carboniferous boundary and Tournaisian strata in central Hunan Province, South China. In: Coen M., Hance L. & Hou H. F. (eds.) - Papers on the Devonian-Carboniferous Transition Beds of Central Hunan, South China. *Mém. Inst. géol. Univ. Louvain*, 36: 29-54, Louvain-la-Neuve.

Hance L., Poty E. & Devuyst F.-X. (2001) - Stratigraphie séquentielle du Dinantien type (Belgique) et corrélation avec le Nord de la France (Boulonnais, Avesnois). *Bull. Soc. géol. France*, 172 (4): 411-426, Paris.

Kimpe W. F. M., Bless M. J. M., Bouckaert J., Conil R., Groessens E., Meessen J. P. M. Th., Poty E., Streel M., Thorez J. & Vanguestaine V. (1978) - Paleozoic deposits east of the Brabant Massif in Belgium and the Netherland. *Mededelingen Rijks Geologische Dienst*, 30-2: 37-103, Roermond.

Lebedeva N. S. (1954) - Lower Carboniferous foraminifers of the Kuznets Basin. *Trudy VNIGRI, Mikrofauna SSSR, Sbornik*, 7 (81): 237-319 (in Russian), Leningrad.

Lipina O. A. (1948) - Foraminifers of the Chernyshinsk suite of the Lower Carboniferous Tournaisian stage near Moscow. *Akad. Nauk SSSR, Trudy Inst. Geol. Nauk*, 62 (19): 251-259 (in Russian), Moscow.

Lipina O. A. (1951) - Foraminifers of the Tournaisian stage and presumed Devonian beds of Nordvik (Yurung-Tumus Peninsula). *Trudy Nauch.-Issled. Inst. Geol. Arktiki Glavsermorputi*, 17 (1): 92-125 (in Russian), Leningrad.

Lipina O. A. (1955) - Foraminifers from the Tournaisian stage and upper part of the Devonian of the Volgo-Ural'sk area and western slope of the Middle Urals. *Akad. Nauk SSSR, Trudy Inst. Geol. Nauk*, 70 (163): 1-96 (in Russian), Moscow.

Lipina O. A. (1960) - Foraminifers of Tournaisian deposits of the Russian Platform and Urals. In: Menner V. V. (responsible ed.) - Pre-Quaternary Micropaleontology. *Internat. Geol. Cong., Session 21, Report of Soviet Geologists, Problem 6, Akad. Nauk SSSR*: 48-55 (in Russian), Moscow.

Lipina O. A. (1965) - Systematics of the Tournayellidae: *Akad. Nauk SSSR, Trudy Geol. Inst., Izdatel. "Nauka"*, 130: 1-115 (in Russian), Moscow.

Lipina O. A. (1977) - The systematics and evolution of Lower Carboniferous endothyrids. *Akad. Nauk SSSR, Geol. Inst., Vopros. Mikropaleont.*, 20: 3-20 (in Russian), Moscow.

Lipina O. A. (1985) - Systematics and evolution of the loeblichiids and spinoendothyrids. *Akad. Nauk SSSR, Geol. Inst., Vopros. Mikropaleont.*, 27: 33-46 (in Russian). Moscow.

Lipina O. A. (1989) - Some changes to the systematics of the tournayellids. *Akad. Nauk SSSR, Geol. Inst., Vopros. Mikropaleont.*, 30: 30-47 (in Russian), Moscow.

Loeblich A. R., Jr. & Tappan H. (1985) - *Lipinellina*, new name for *Rectochernyshinella* Lipina 1965 (Foraminiferida), non *Rectochernyshinella* Lipina 1960. *Micropaleont.*, 31 (1): 92-93, New York.

Makhlina M. Kh., Vdovenko M. V., Alekseev A. S., Byvsheva T. V., Donakova L. M., Zhulitova V. E., Kononova L. I., Umnova N. I. & Shik E. M. (1993) - Lower Carboniferous of the Moscow Sineclise and Voronezh Anteclise: *Ross. Akad. Nauk, "Nauka"*: 1-224 (in Russian), Moscow.

Malakhova N. P. (1954) - Foraminifers of the Kizelovsky Limestone of the western slope of the Urals: *Byulleten' moskovskogo obshchestva ispytateley prirody, otdel. geologii*, 29 (1): 49-60 (in Russian), Moscow.

Malakhova N. P. (1956) - Upper Tournaisian foraminifers from the western slope of the North and Middle Urals. *Akad. Nauk SSSR, Ural. Fil., Trudy Gorno-Geol. Inst., Sbornik po Vopros. Strat. No. 3,* 24: 72-155 (in Russian), Moscow.

Malakhova N. P. (1959) -The Tournaisian Stage of the northern and middle Urals: *Akad. Nauk SSSR, Ural. Fil., Trudy Gorno-Geol. Inst*., 38: 1-104 (in Russian), Sverdlovsk.

Mamet B. L., Bamber E. W. & Macqueen R. W. (1986) - Microfacies of the Lower Carboniferous Banff Formation and Rundle Group, Monkman Pass map area, northeastern British Columbia. *Geol. Surv. Canada, Bulletin*, 353: 1- 93, Ottawa.

Mamet B. & Skipp B. (1970) - Lower Carboniferous calcareous Foraminifera: Preliminary zonation and stratigraphic implications for the Mississippian of North America. *6th Internat. Cong., Carb. Strat. and Geol., Sheffield 1967, C. r.*, 3: 1129-1146.

Mansy J. L., Conil R., Meilliez F., Khatir A., Delcambre B., Groessens E., Lys M., Poty E., Swennen R., Trentesaux A. & Weyant M. (1989) - Nouvelles données stratigraphiques et structurales sur le Dinantien dans l'Avesnois. *Ann. Soc. géol. Nord*, 108: 125-142, Lille.

McKay W. & Green R. (1963) - Mississippian Foraminifera of the southern Canadian Rocky Mountains, Alberta. *Res. Coun. Alberta, Bull.*, 10: 1-77, Edmonton.

Morozova V. G. (1949) - Representatives of the families Lituolidae and Textulariidae from the Upper Carboniferous and Artinskian deposits of the Priurals in Bashkiria. *Akad. Nauk SSSR, Trudy Inst. Geol. Nauk*, 35 (105): 244-275 (in Russian), Moscow.

Orbigny A. D. d' (1826) - Tableau méthodique de la classe des Céphalopodes. *Ann. Sci. Natur.*, ser. 1, 7: 245-314, Paris.

Paproth E., Conil R., Bless M. J. M., Boonen P., Bouckaert J., Carpentier N., Coen M., Delcambre B., Deprijck Ch., Deuzon S., Dreesen R., Groessens E., Hance L., Hennebert M., Hibo D., Hahn G., Hahn R., Hislaire O., Kasig W., Laloux M., Lauwers A., Lees A., Lys M., Op de Beek K., Overlau P., Pirlet H., Poty E., Ramsbottom W., Streel M., Swennen R., Thorez J., Vanguestaine M., van Steenwinkel M. & Vieslet J. L. (1983) - Bio- and lithostratigraphic subdivisions of the Dinantian in Belgium, a review. *Ann. Soc. géol. Belgique*, 106: 185-239, Brussels.

Pelhate A., Conil R., Vuillemin C. & Meilliez F. (1991) - Les calcaires de la Viosne (Mayenne): Un milieu endémique en terminaison occidentale du Bassin de Laval (Massif Armoricain, France) au Moliniacien (Viséen inférieur). *Ann. Soc. géol. Nord*, 109: 237-244, Lille.

Pohl E. R. & Zeller, E. J. (1973) - Mississippian endothyroid Foraminifera-a correction. *J. Paleont*., 47(6): 1077-1080, Tulsa.

Poty E., Hance L., Lees A. & Hennebert M. (2001) - Dinantian lithostratigraphic units (Belgium). In: Bultynck P. & Dejonghe L. (eds.) - Guide to a revised lithostratigraphic scale of Belgium. *Geologica Belgica*, 4 (1-2): 69-94, Brussels.

Rauzer-Chernousova D. M. (1948) - On some endothyrids of the group *Endothyra bradyi* Mikhailov. *Akad. Nauk SSSR, Trudy Inst. Geol. Nauk*, 19 (62): 176-181 (in Russian), Moscow.

Rauzer-Chernousova D. M. (ed.) (1963) - Resolutions on the systematics of endothyrid foraminifers of the 2nd colloquium organized by the Micropaleontological Commission (Moscow, April 1962). *Akad. Nauk SSSR, Geol. Inst., Vopros. Mikropaleont.*, 7: 223-227 (in Russian), Moscow.

Rauzer-Chernousova D. M., Bensh F. R., Vdovenko M. V., Gibshman N. B., Leven E. Ya., Lipina O. A., Reitlinger E. A., Solov'eva M. N. & Chediya I. O. (1996) - Reference book on the systematics of Paleozoic foraminifers (Endothyroida, Fusulinoida). *Ross. Akad. Nauk, Geol. Inst., Moskva "Nauka"*: 1-207 (in Russian).

Reitlinger E. A. (1958) - On the question of the systematics and phylogeny of the Superfamily Endothyridea. *Akad. Nauk SSSR, Geol. Inst., Vopros. Mikropaleont.*, 2: 53-73 (in Russian), Moscow.

Reitlinger E. A. (1961) - Some questions on the systematics of the quasiendothyrids. *Akad. Nauk SSSR, Geol. Inst., Vopros. Mikropaleont.*, 5: 31-68 (in Russian), Moscow.

Reitlinger E. A. (1966) - Some questions on the classification and evolution of endothyrins and primitive fusulinins. *Akad. Nauk SSSR, Geol. Inst., Vopros. Mikropaleont.*, 10: 39-67 (in Russian), Moscow.

Reitlinger E. A., Vdovenko M. V., Gubareva V. S. & Shcherbakov O. A. (1996) -European part of the USSR-Lower Carboniferous. In: Wagner R. H., Winkler Prins C. F. & Granados, L. F. (eds.) - The Carboniferous of the World, III. *Int. Union Geol. Sci. Publ. No. 33, Instituto Tecnológico GeoMinero de España and Nationaal Natuurhistorisch Museum:* 23-54, Madrid.

Shcherbakov O. A., Garan' I. M., Postoyalko M. V., Kitaev P. M. & Stepanaytys N. E. (1979) - Stratigraphy of Tournaisian deposits in the Kosaya Rechka section on the Vizhay River. In: Papulov G. N. & Pakhomov I. V. (eds.) - Supporting Sections of the Carboniferous of the Urals. *Akad. Nauk SSSR, Ural. Nauch. Tsentr, Trudy Inst. Geol. Geokhim., Sbornik po Vopros. Strat. No. 26*, 141: 5-10 (in Russian), Sverdlovsk.

Shilo N. A., Bouckaert J., Afanasjeva G. A., Bless M. J. M., Conil R., Erlanger O. A., Gagiev M. H., Lazarev S. S., Onoprienko Yu. I., Poty E., Razina T. P., Simakov K. V., Smirnova L. V., Streel M. & Swennen R. (1984) - Sedimentological and Paleontological atlas of the Late Famennian and Tournaisian deposits in the Omolon region (NE-USSR). *Ann. Soc. Géol. Belgique,* 107: 137-247, Brussels.

Skipp B. (1969) - Chapter V-Foraminifera. In: McKee E. D. & Gutschick R. C. (eds.) - History of the Redwall Limestone of Northern Arizona. *Geol. Soc. America, Mem*., 114: 173-255, Boulder.

Vachard D. (1978) - Étude stratigraphique et micropaléontologique (algues et foraminifères) du Viséen de la Montagne Noire (Hérault, France). *Mém. Inst. géol. Univ. Louvain*, 29: 111-195, Louvain-la-Neuve. [imprinted 1977].

Vachard D. (1980) - Téthys et Gondwana au Paléozoïque supérieur, les données afghanes: Biostratigraphie, micropaléontologie, paléogéographie. *Documents et Travaux Inst. Géol. Albert de Lapparent*, 2: 1- 463, Paris.

Vdovenko M. V. (1954) - Some new foraminiferal species from the lower Visean deposits of the Donets Basin. *Kiiv. Derzhav. Univ., Geol. Zbirnik*, 5: 63-76 (in Ukrainian), Kiev.

Vdovenko M. V. (1972) - New subgenera of *Endothyra* and *Globoendothyra*. *Dopov. Akad. Nauk Ukrain. RSR, Okrem. Vidbitok, Kiiv*: 106-109 (in Ukrainian), Kiev.

Verville G. J., Sanderson G. A., Brenckle P. L. & Lane H. R. (1973) - Upper Paleozoic biozonation in the Unit No. 19 Well, Church Buttes Field, Uinta County, Wyoming. *25th Field Conf., Wyoming Geol. Assoc. Guidebook*: 165-171, Casper.

Voloshinova, N. A. & Reitlinger E. A. (1959) - Order Endothyrida. In: Rauzer-Chernousova D. M. & Fursenko A. V. (eds.) - Fundamentals of Paleontology, General Part, Protozoa. *Izdatel. Akad. Nauk SSSR*: 190-201 (in Russian), Moscow.

Wedekind P. R. (1937) - Einführung in die Grundlagen der historischen Geologie, Band II. Mikrobiostratigraphie die Korallen-und Foraminiferenzeit. *Ferdinand Enke*: 1-136, Stuttgart.

Woodland R. B. (1958) - Stratigraphic significance of Mississippian endothyroid Foraminifera in central Utah. *Jour. Paleont*., 32 (5): 791-814, Tulsa.

Woodson F. J. (1993) - Early Mississippian calcareous Foraminifera from the lower part of the Gilmore City Formation, north-central Iowa. *Unpublished Ph. D. thesis, University of Iowa*: 1-83, Iowa City.

Zeller E. J. (1950) - Stratigraphic significance of Mississippian endothyroid Foraminifera. *Univ. Kansas, Paleont. Contrib.*, 4: 1-23, Lawrence.

Zeller E. J. (1957) - Mississippian endothyrid Foraminifera from the Cordilleran Geosyncline. *J. Paleont*., 31 (4): 679-704, Tulsa.