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PAPER 70-21

CARBONATE MICROFACIES OF THE WINDSOR GROUP (CARBONIFEROUS), NOVA SCOTIA AND NEW BRUNSWICK

(Report, 16 figures and 19 plates)

Bernard L. Mamet

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ABSTRACT

The carbonate microfacies of the Windsor Group (Carboniferous System) are described in Nova Scotia and New Brunswick. The microfauna and algal microflora which abound in these marine platform carbonates are divisible into the following four assemblage zones (from oldest to youngest):

1) *Archaediscus krestovnikovi-Biseriammina?* sp. - *Endothyranopsis crassa-Eoendothyranopsis* sp. - *Koninckopora* sp.
2) *Archaediscus krestovnikovi-Biseriammina?* sp. - *Endothyranopsis crassa*-primitive *Neoarchaediscus* sp.
3) *Biseriammina?* sp. - *Endothyranopsis crassa*, abundant *Neoarchaediscus incertus-Planospirodiscus* sp.
4) *Asteroarchaediscus* sp. - *Asteroarchaediscus baschkiricus-Endothyranopsis crassa-Endothyranopsis sphaerica-Neoarchaediscus* sp. - *Neoarchaediscus incertus-Planospirodiscus* sp.

These zones are recognizable in the Windsor type section as well as in the Antigonish, Port Hood, and Sydney regions; although there are some minor discrepancies between the ages indicated by the microfossils and the generally accepted megafaunal ages, the microfauna generally confirms the chronostratigraphic value of the brachiopod-coral assemblages within the Windsor "Basin". In addition, the microfauna can readily be related to the Tethian and Arctic zonal schemes, and suggests correlation of the Windsor Group with the late Visean-earliest Namurian of Western Europe (zone 15 to zone 17).

Characterization of chronostratigraphic horizons by biostratigraphic means must always be coupled with paleoecological analysis, because foraminifers and *incertae sedis* are dependent on environment, and in particular on salinity. Archaediscidae are practically restricted to open marine facies, Tetrataxidae flourish in peri- "reefoid" environment and calcisphaerids thrive in back-reef lagoons. Biseriamminidae, Earlandiidae and Endothyridae are widespread in most carbonates and are present even in hypersaline starved intertidal flats.

The Windsor microfauna shows obvious paleobiological affinities to the Arctic fauna, and less pronounced affinities to the Cordilleran, Mid-continent and Appalachian faunas. Similarities to the European Tethian realm are minimal, although the Windsor shares enough common elements with the classical Visean-Namurian fauna of Belgium and England to allow direct biostratigraphic correlations.

RÉSUMÉ

Ce mémoire est consacré à la description des microfaciès calcaires du Groupe de Windsor (Système Carbonifère) en Nouvelle-Écosse et au Nouveau-Brunswick.

La microfaune des Foraminifères et la microflore qui abondent dans les faciès marins francs de ce Groupe, permet d'y reconnaître quatre zones, qui, de la plus ancienne à la plus jeune, se caractérisent par les assemblages de:

1) *Archaediscus krestovnikovi-Biseriammina?* sp. - *Endothyranopsis crassa-Eoendothyranopsis* sp. - *Koninckopora* sp.
2) *Archaediscus krestovnikovi-Biseriammina?* sp. - *Endothyranopsis crassa-Neoarchaediscus* sp. primitifs
3) *Biseriammina?* sp. - *Endothyranopsis crassa-Neoarchaediscus* sp. abondants *Neoarchaediscus incertus-Planospirodiscus* sp.
4) *Asteroarchaediscus* sp. - *Asteroarchaediscus bachkiricus - Endothyranopsis crassa-Endothyranopsis sphaerica-Neoarchaediscus incertus-Planospirodiscus* sp.

Ces zones s'observent non seulement dans la section-type du Windsor, mais également dans la région d'Antigonish, de Port-Hood et de Sydney. Dans toute l'étendue du "Bassin" de Windsor, ces zones confirment donc la valeur chronostratigraphique des assemblages de Brachiopodes-Polypiers établis antérieurement; seules, quelques différences minimes s'observent avec la zonation par macrofaune. De plus, ces assemblages de microfaune du Carbonifère des provinces Maritimes se comparent aisément avec les assemblages des domaines téthysiens et arctiques. Cette comparaison permet d'établir l'âge du Groupe, âge qui va du Viséen supérieur au Namurien inférieur (zone 15 à zone 17) (St. Geneviève à Glen Dean, de la zonation mississipienne de Midcontinent Nord-Américain).

La répartition de ces Foraminifères et *incertae sedis* montrent d'importantes variations avec l'environnement; la salinité étant le facteur primordial contrôlant cette répartition. Les Archaediscidae sont restreints aux faciès à salinité normale; les Tetrataxidae sont particulièrement nombreux dans les faciès péri-récifaux; les Calciphères pullulent dans les arrières-récifs alors que les Biseriamminidae, les Earlandiidae et les Endothyridae s'accomodent à l'hypersalinité. Il est donc impérieux, pour obtenir une zonation chronostratigraphiquement valable, d'associer la paléoécologie à la biostratigraphie.

Enfin, les affinités paléobiologiques de la microfaune sont évidentes avec le Domaine Arctique et moins prononcées avec les Corillères et les Appalaches. Elles sont relativement faibles avec le Midcontinent Américain et avec la faune téthysienne d'Europe. Toutefois, le Windsor possède suffisamment d'éléments en commun avec le Viséen-Namurien classique de Belgique et d'Angleterre pour permettre des corrélations stratigraphiques directes entre les deux continents.

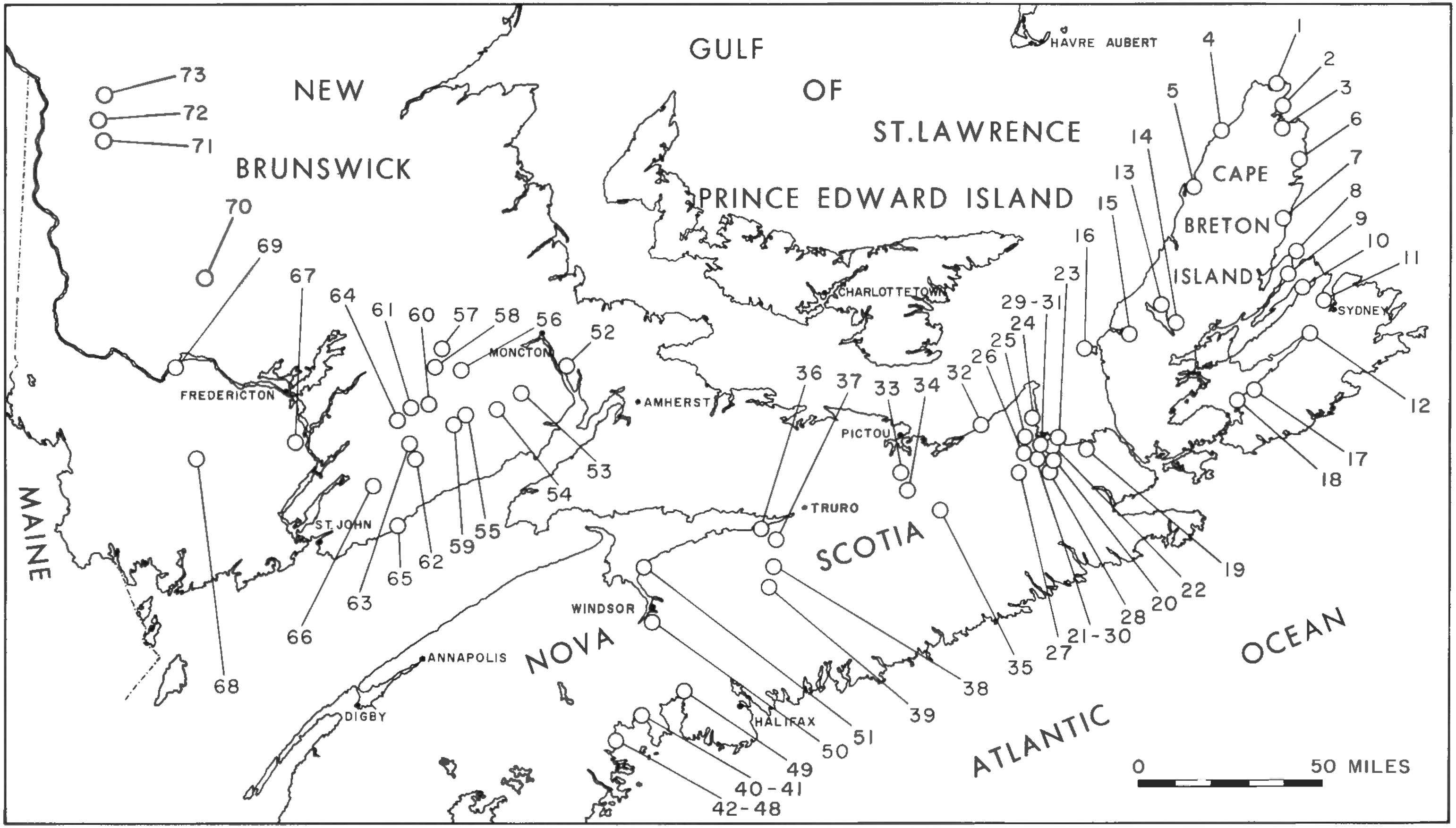

Figure 1. Geographic setting of the Windsor Group. Numbers refer to localities described in the Appendix.

CARBONATE MICROFACIES OF THE WINDSOR GROUP (CARBONIFEROUS), NOVA SCOTIA AND NEW BRUNSWICK

INTRODUCTION

Purpose and Outline of the Study

Nearly a hundred years ago the usefulness of microfacies for paleoecological and stratigraphic research was fully demonstrated in the early comprehensive studies of Carboniferous foraminiferal microfacies of Brady (1876) and von Möller (1878-1879). From 1879 to 1940, however, interest in this approach has dwindled, and the bulk of microfacies research has been concerned with Mesozoic and Cenozoic rocks. More recently the U.S.S.R. Academy of Sciences micropaleontological school (Rauzer-Chernoussova, Reitlinger, Lipina, 1948) "rediscovered" Brady's and von Möller's pioneering work and in less than twenty years has established a reliable and detailed biostratigraphic scheme based on small foraminifers for the Upper Paleozoic of the Soviet Union. Cummings (1958) demonstrated the potential of this approach in the classical Carboniferous regions of England and this method is now widely used in Western Europe.

Oddly enough, Lower Carboniferous studies are just beginning in North America; there are no more than a dozen comprehensive foraminiferal studies in existence for the entire continent and most of these were written a decade ago (see Toomey and Mamet, 1967, 1968, for discussion). This situation is anomalous, because rocks of Early Carboniferous age are widespread, rich in Foraminifera, and economically important in this continent. It is therefore hoped that this contribution will serve to stimulate future research in this field by demonstrating the usefulness of the microfacies approach in the study of the Windsor carbonate sequences.

It is shown that the combined petrologic and micropaleontologic thin-section studies permit possible recognition of four biostratigraphic units; these units, when considered in the light of paleoecological and environmental factors constitute a reliable chronostratigraphic scheme. The microfacies, i.e. the petrology, the foraminiferal fauna and algal flora of the Windsor Group, is described. A biostratigraphic framework is established based on the distribution of foraminiferal assemblages and paleoecological conclusions are drawn from the relationship between these assemblages and the lithofacies. The foraminiferal zonation is compared with lithostratigraphic and megafaunal correlations and the overall paleogeography of the Windsor Group is reconstructed from the integration of all of the above factors. Finally, the paleobiological affinities of the Windsor microfauna with that of Europe, Asia and North America is discussed.

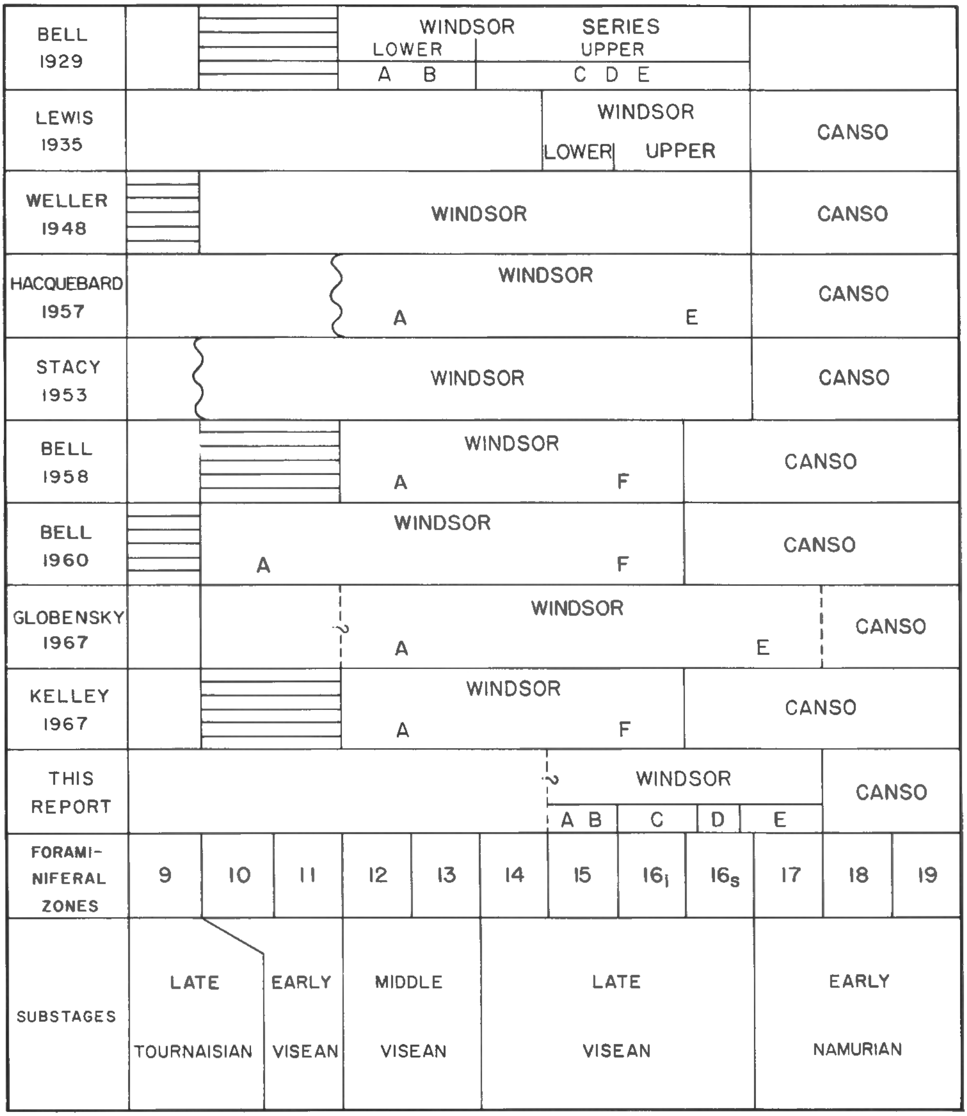

Figure 2. Stratigraphic position of the Windsor Group.

Geographic Setting

The Windsor Group occurs extensively from 68° Long. E to 59° Long. E and from 44° Lat. N to 47° Lat. N – an area approximately 400 miles long and 150 miles wide (Fig. 1). It is composed of thick successions of shale, carbonate, gypsum, salt, and rare arenite. Carbonate rocks are present throughout the column and therefore the entire Windsor "Basin" of Nova Scotia and New Brunswick will be investigated here.

Due to the high susceptibility of these rocks (gypsum, salt) to weathering, outcrops are usually poor. Exposures along the sea-shore are fairly good, although even there, sections generally are only 50 per cent exposed.

Inland, sections are usually restricted to man-made exposures (quarries, road-cuts). Fortunately the carbonate beds, the subject of this study, are conspicuously more resistant to alteration and have long been used as "marker-beds" for lithostratigraphic correlations (Bell, 1929a, b; Sage, 1954, Schenk, 1967).

Previous Stratigraphic Work

The Carboniferous Windsor Series was originally described as Permian in 1843 by Murchison, and for three-quarters of a century its stratigraphic position was subject to wide fluctuation (see Bell, 1929b; for the historical development).

The first precise correlations with the international chronostratigraphic standard scheme were made by Bell (1929a; see Fig. 2), who subdivided the Windsor Series in two zones and five subzones, on brachiopod and coral evidence. The Lower Zone (Zone of Composita dawsoni with an unfossiliferous "subzone" A and "subzone" B with Diodoceras avonensis) was assigned to the Middle Visean Upper Seminula (S_2) zone of the Bristol type-area (Vaughan, 1905). The Upper Zone (Zone of Martinia galeata with subzone C characterized by Dibunophyllum lambii, subzone D with Productus semicubiculus, and subzone E with Caninia dawsoni) was correlated with the Late Visean Dibunophyllum zone. The youngest subzone was correlated with the D_2 zone of Bristol.

Lewis (1935) studied the Windsor corals and concluded that the base of the group was not older than the Dibunophyllum (Upper Visean) zone of England.

Weller et al. (1948) considered the Windsor as the exact equivalent of the Viséan stage. Hacquebard (1957) did not assign a definite age to the base of the Windsor and placed the Windsor-Canso boundary at the Viséan-Namurian transition. Conclusions identical to these were reached by Stacy (1953).

Bell, in 1958, slightly modified his original views by proposing an additional subzone F for the Gigantoproductus assemblage (see Fig. 4), but he considered the base of the Canso Series to be latest Visean in age (this zonation was also followed by Kelley, 1967). Subsequently, Bell (1960, p. 17) considered the base of the Windsor to be older and assigned it to the Early Viséan.

Globensky (1967) made an extensive study of the Windsor conodont microfauna; the base of the Group was tentatively correlated with the upper Meramec and the Upper Windsor was shown to straddle the Viséan-Namurian boundary.

Present Work

In the present work it is shown that the Lower Windsor is Late Viséan in age, and that Bell's subzone B correlates well with foraminiferal zone 15 (Middle Late Viséan) of the standard European succession (see Fig. 2). It is also suggested that "subzone" A should be established as a formation or as a member. This "subzone", characterized by an absence of megafauna,

Figure 3. Stratigraphic Distribution of the Microfauna and Microflora within the Windsor Group (very scarce forms, such as Ammovertella sp., have been omitted).

1) Archaediscus sp.
2) Archaediscus of the group A. krestovnikovi Rauzer-Chernoussova (see Pl. IV, Figs. 3,4; Pl. VII, Figs. 1-6; Pl. XI, Fig. 3; Pl. XII, Fig. 1; Pl. XVIII, Fig. 3).
3) Archaediscus krestovnikovi Rauzer-Chernoussova (see Pl. VII, Figs. 1,2; Pl. VII, Figs. 5,6).
4) Archaediscus of the group A. moelleri Rauzer-Chernoussova.
5) Archaediscus of the group A. chernoussovensis Mamet.
6) Asteroarchaediscus sp. (see Pl. VII, Figs. 19,20).
7) Asteroarchaediscus baschkiricus (Krestovnikov and Teodorovitch) (see Pl. VII, Fig. 20).
8) Biseriammina? sp.
9) Biseriammina? windsorensis sp. nov. (see Pl. I, Figs. 1-4,6,11; Pl. II, Figs. 1,5,8; Pl. IV, Fig. 12; Pl. VIII, Fig. 1; Pl. X, Fig. 3; Pl. XI, Fig. 2).
10) Brunsia sp.
11) Calcisphaera sp.
12) Calcisphaera laevis Williamson (see Pl. XII, Fig. 2; Pl. XVIII, Fig. 3).
13) Calcisphaera pachysphaerica (Pronina) (see Pl. IV, Fig. 1).
14) Climacammina of the group C. patula (Brady) (see Pl. XIV, Fig. 2).
15) Climacammina of the group C. prisca (Lipina) (see Pl. XVIII, Fig. 2).
16) Cornuspira sp. (see Pl. III, Figs. 1,2; Pl. XI, Fig. 1; Pl. XII, Fig. 2).
17) Cribrostonum and Koskinotextularia sp. (see Pl. IV, Figs. 11,13).
18) Diplosphaerina sp. (see Pl. IV, Fig. 6,7).
19) Earlandia of the group E. clavatula (Howchin) (see Pl. IV, Fig. 2; Pl. XII, Fig. 2).
20) Earlandia of the group E. elegans (Rauzer-Chernoussova) (see Pl. III, Fig. 4).
21) Earlandia of the group E. vulgaris (Rauzer-Chernoussova and Reitlinger).
22) Endothyra sp.
23) Endothyra of the group E. bowmani Phillips in Brown emend Brady (see Pl. V, Figs. 4,5; Pl. II, Fig. 8; Pl. IV, Fig. 3; Pl. XVIII, Figs. 1-3).
24) Endothyra of the group E. prisca Rauzer-Chernoussova and Reitlinger (see Pl. I, Fig. 1; Pl. II, Fig. 8; Pl. IV, Figs. 15-18; Pl. V, Fig. 8).
25) Endothyra of the group E. similis Rauzer-Chernoussova and Reitlinger (see Pl. VI; Figs. 6,8).
26) Endothyranella sp. (see Pl. I, Figs. 9,10).
27) Endothyranopsis compressa (Rauzer-Chernoussova and Reitlinger).
28) Endothyranopsis crassa (Brady) (see Pl. V, Fig. 3; Pl. XV, Fig. 3).
29) Endothyranopsis sphaerica (Rauzer-Chernoussova and Reitlinger).
30) Eoendothyranopsis sp.
31) Eostaffella sp.
32) Eostaffella of the group E.? discoidea Girty (see Pl. V, Fig. 6; Pl. VI, Figs. 7,9-12; Pl. XI, Fig. 3; Pl. XVIII, Fig. 2).
33) Eostaffella of the group E. radiata (Brady) (see Pl. III, Fig. 10; Pl. V, Fig. 2).
34) Globoendothyra sp. (see Pl. V, Fig. 1).
35) Globendothyra of the group G. globulus d'Eichwald.
36) Haplophragmella? and Haplophragmina? sp.
37) Pseudoglomospira? sp. (see Pl. X, Fig. 1; Pl. XIX, Fig. 3).
38) Irregularina sp.
39) Koninckopora sp. (see Pl. IX, Fig. 3).
40) Mikhailovella sp. (see Pl. V, Fig. 7; Pl. XVIII, Fig. 1).
41) Neoarchaediscus sp.
42) Neoarchaediscus of the group N. incertus (Grozdilova and Lebedeva) (see Pl. VII, Figs. 7,8,12).
43) Neoarchaediscus parvus regularis (Suleimanov) (see Pl. VII, Figs. 7,8).
44) Palaeotextularia sp.
45) Palaeotextularia of the group P. consobrina Lipina (see Pl. III, Figs. 5-7; Pl. XV, Fig. 3; Pl. XVIII, Fig. 3).
46) Palaeotextularia of the group P. longiseptata Lipina.
47) Palaeotextularia asper (Cooper) (see Pl. III, Figs. 5-7).
48) Parathurammina sp. (see Pl. VIII, Fig. 1).
49) Parathurammina of the group P. dagmarae (Suleimanov).
50) Planospirodiscus of the group P. gregorii (Dain) (see Pl. VII, Figs. 9-11,13,14).
51) Planospirodiscus of the group P. minimus (Grozdilova and Lebedeva) (see Pl. VII, Figs. 15-18; Pl. XII, Fig. 1).
52) Pseudoendothyra of the group P. ornata (Brady) (see Pl. V, Fig. 9).
53) Radiosphaera sp.
54) Saccaminopsis sp.
55) Stacheia and Stacheoides sp.
56) Tetrataxis of the group T. angusta Vissarionova.
57) Tetrataxis of the group T. conica Ehrenberg emend von Möller (see Pl. IV, Figs. 8,9; Pl. XIV, Fig. 1; Pl. XII, Fig. 3).
58) Tetrataxis? of the group T.? eominima Rauzer-Chernoussova (see Pl. IV, Figs. 10,14; Pl. XVII, Fig. 1).
59) Tetrataxis of the group T. maxima Schellwien.
60) Trepeilopsis sp.
61) Tuberitina sp. (see Pl. XVII, Fig. 3).
62) Vicinesphaera sp.

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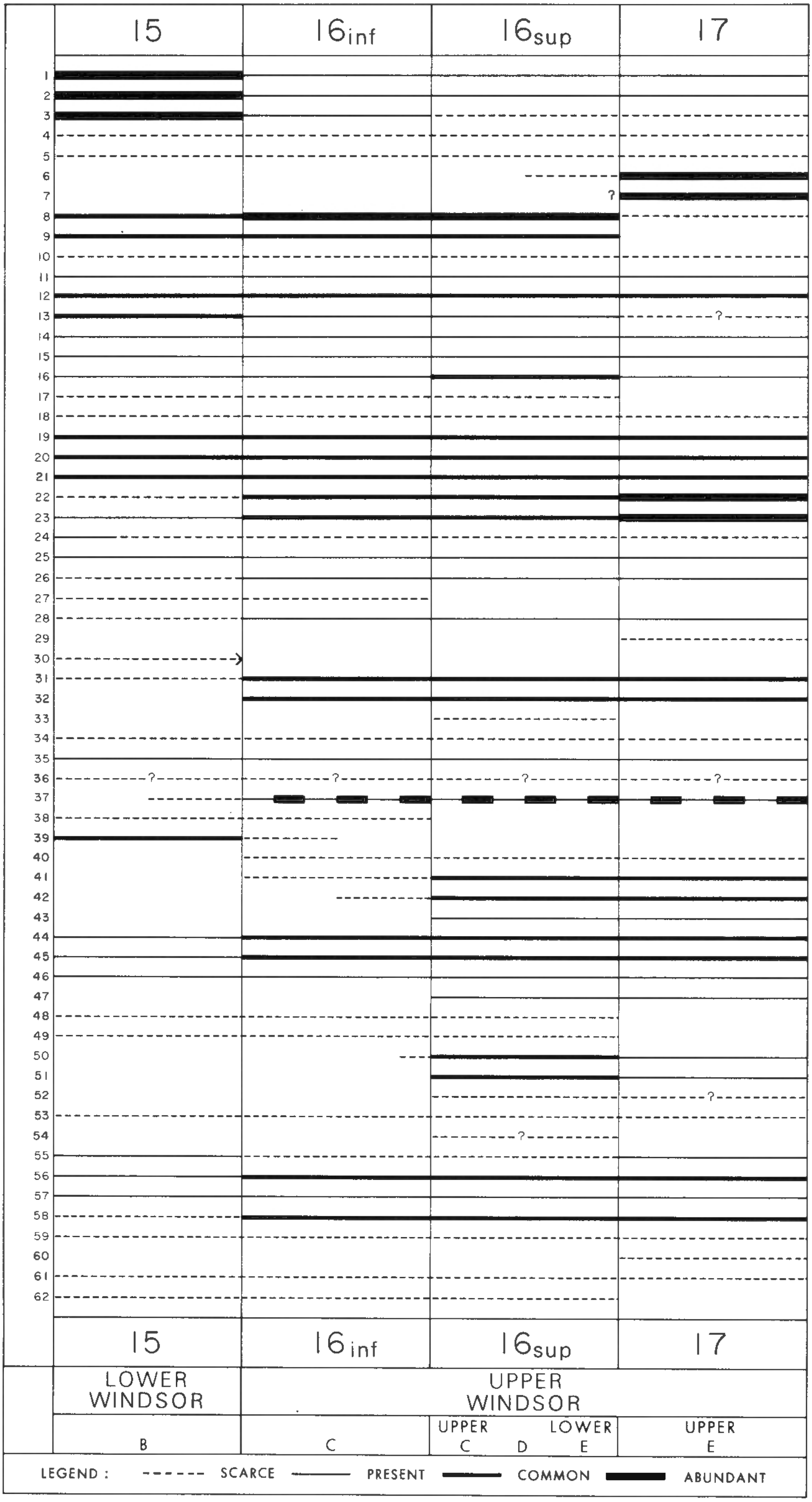
by V.N. Rampton and J. Ross Mackay

The captions for Figures 3 and 4 should read as follows:

Figure 3. Percentage of shot holes that encountered massive ice at given depths based on the number of holes that did encounter massive ice at any depth.

Figure 4. Percentage of shot holes that encountered icy sediments at given depths based on the number of holes that did encounter icy sediments at any depth.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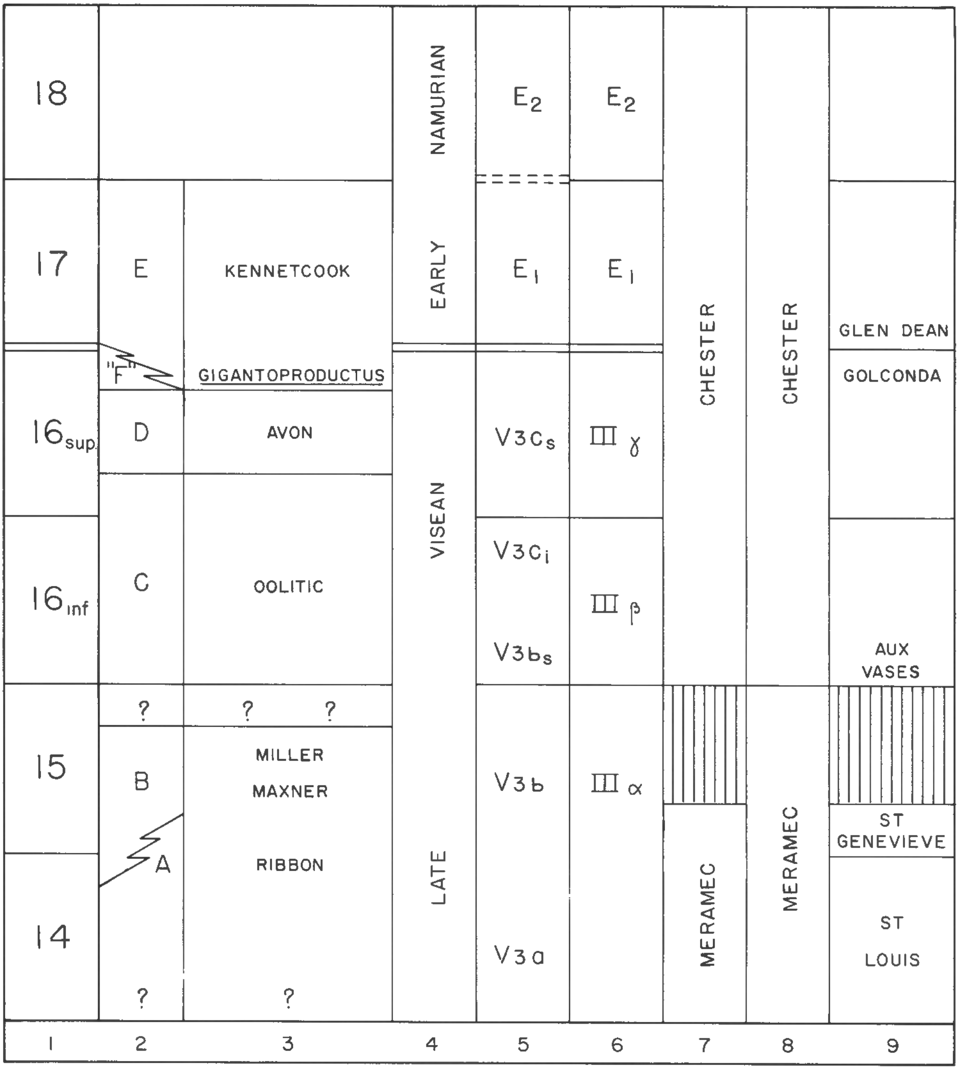

Figure 4. Comparison of the Windsor and the standard Carboniferous and Mississippian zonations.

1) Foraminiferal assemblage-zones.
2) Macrofaunal zones of Bell (1929).
3) Lithostratigraphic units in the Windsor region.
4) Substages.
5) Stratigraphic division of the Late Visean and Early Namurian in their type region (Belgium and England).
6) Ammonoid zonation (Germany).
7) Meramec-Chester boundary in its type locality.
8) Position of the Meramec-Chester boundary in this report.
9) Stratigraphic position of selected Meramecian and Chesterian formations of the American midcontinent (type locality).

contains sparse microfauna of Late Viséan age. It is also shown that subzones C and D are late Viséan. Finally, the original hypothesis of Bell (1929) concerning subzone E is confirmed; the base of this subzone is latest Viséan. However, the uppermost part of subzone E contains the first Namurian foraminiferal elements. "Subzone F" is found to be the time-equivalent of subzone E, for a slightly different facies.

Acknowledgments

The author wishes to acknowledge the kind co-operation of Dr. N. Sage (Massachusetts Institute of Technology), Dr. Y. Globensky (Département des Richesses Naturelles du Québec) and Dr. R. Moore (Acadia University), who made their personal collections available and furnished valuable unpublished field observations, enabling the writer to gain a rapid overall knowledge of the Carboniferous problems in the Maritime Provinces. The writer is also indebted to Drs. E. W. Bamber, M. Copeland, H. R. Greiner, D. J. Kelley and the late Dr. W. A. Bell for advice and discussion.

MICROFACIES BIOSTRATIGRAPHY

Stratigraphic Distribution of the Microfauna and Microflora with some Taxonomic Notes

Although macrofaunal zonation has been used for a century in the Windsor Group, no extensive use has been made of either microfauna or microflora for correlation purposes. The only microfossil repeatedly reported from the succession is *Nodosinella* which, as will be shown, is not a protozoan.

Sage (1954), however, reported a rich assemblage of ten foraminiferal taxa: *Textularia* (considered here as *Palaeotextularia*), *Climacammina* (*Climacammina*, *Cribrostomum*, *Koskinotextularia*, *Koskinobigenerina*), *Ammodiscus* (*Cornuspira*), *Glomospira* (*Pseudoglomospira*?), *Tetrataxis* (probably *Archaediscus*), *Haplophragmium* (*Mikhailovella*), *Plectogyra* (*Endothyra*), *Millerella* (probably *Eostaffella*?), *Endothyra* and *Ammovertella*: unfortunately, he made no attempt to use these taxa for correlations.

As stated above, microfossils are abundant in the Windsor Group. The stratigraphic distribution of fifty-five foraminiferal taxa, five *incertae sedis* and two algae is outlined in Figure 3. The chart does not include the lowermost Windsor A which has a microfauna restricted to a few monocular foraminifers (Earlandiidae) and scattered *incertae sedis* (*Calcisphaera laevis* Williamson, *C. pachysphaerica* (Pronina)). The distribution of each taxon follows, numbers in parentheses refer to Figure 3.

Archaediscus spp. (1-5)

Archaediscus sp. (1) is widespread throughout the section, in particular in the open marine micrites and biomicrites. It is characteristically abundant in the lower part of the Windsor (subzone B and lower part of subzone C), where the three main groups of the genus are present.

Archaediscus of the group *A. krestovnikovi* Rauzer-Chernoussova (2) has the same distribution within the Windsor as *Archaediscus* sp. (1). Other representatives of the group include *Archaediscus koktjubensis* Rauzer-Chernoussova and *Archaediscus infantis* Schlykova, but these are rare. *Archaediscus krestovnikovi sensu stricto* (3) is the most abundant species present; it is common in the *Koninckopora* bank facies of subzone B, and is present in subzones C, D, and E.

Archaediscus of the group *A. moelleri* Rauzer-Chernoussova (4), characterized by the constant deflection of the spire, and the erratically coiled *Archaediscus* of the group *A. chernoussovensis* Mamet (5) are rare. Their wide distribution and their scarcity preclude their use for stratigraphic zonation.

Asteroarchaediscus spp. (6-7)

Coalescence of the tubular chamber characterized *Asteroarchaediscus* sp. (6) and is observed for the first time in uppermost subzone D. The genus is very widespread in the middle and upper part of subzone E. *Asteroarchaediscus baschkiricus* (Krestovnikov and Teodorovitch) (7) is the most abundant species of this genus: one specimen, questionably referable to this taxon, is observed in uppermost subzone D; the outburst of the species characterizes the middle and upper part of subzone E.

Biseriammina? spp. (8-9)

The genus *Biseriammina?* is common throughout the Windsor and is characteristically abundant in subzones B, C and D. It dies out in subzone E. The oolitic *Koninckopora* banks and the *Pseudoglomospira?* - spongiostromid algal association are the most favourable environment for this genus. It is probably represented by two species, although only one of them, *Biseriammina? windsorensis* n. sp. (9) is known with certainty and is therefore described below.

Biseriammina? windsorensis sp. nov.

Pl. I, Figs. 1-4, 6, 11; Pl. II, Figs. 1-5, 8; Pl. IV, Fig. 12

Derivatio nominis	Windsor, Nova Scotia: type locality of the Windsor Group.
Type specimens	Holotype GSC No. 24874, paratypes GSC Nos. 24869-24873, 24880-24885, 24911.
Stratigraphic interval of the original material	Windsor Group, Subzone B, foraminiferal zone 15.
Age of the type	Middle Late Visean.

Diagnosis Wall calcareous, secreted, of dense, fine-grained micrite, embodying agglutinated particles. Test free. Proloculus followed by a closely-coiled, involute, double endothyroid spiral; the chambers alternate, in two series. Septa anteriorly curved, not fluted. Aperture narrow, slit like, at the base of the apertural face.

Dimensions of the holotype.

Diameter: 540 µ.
Number of whorls: two.
Total number of chambers: twice six.
Number of chambers in the last whorl: twice four.
Thickness of the spirotheca: 42-45 µ.
Thickness of the septa: 45 µ.
Inside diameter of the proloculus: approximately 60 µ.

Extreme dimensions of adult forms.

Diameter: 410 - 630 µ.
Width: 340 - 550 µ.
Number of whorls: one and a half to two.
Number of chambers: twice five to twice seven.
Number of chambers in the last whorl: twice three to twice four.
Thickness of the spirotheca: 38 to 65 µ.
Thickness of the septa: 35 to 65 µ.
Inside diameter of the proloculus: 40 to 55 µ.

Comparison and affinities.

The genus Biseriammina Chernysheva was introduced for double spiral alternating endothyroids. The genus is the direct ancestor of primitive Globivalvulina? from which it differs by lacking a trochoid spire and having partially agglutinated walls.

Biseriammina was monotypic (B. uralica from the Tournaisian of the Urals) and the name is rarely encountered in literature (Ganelina, 1966).

Biseriammina? windsorensis sp. nov. differs from B. vralica by its smaller number of chambers and the growth rate of the spirotheca; it is also found at a considerably higher stratigraphic level. It is conditionally assigned to Chernysheva's genus because the initial neanic coil is slightly trochoidal and, because of this character, this form is obviously transitional with primitive Globivalvulina?

B.? windsorensis is abundant in subzones B, C and D of the Windsor Group. It is presently known only from eastern North America.

Brunsia sp. (10)

Brunsia sp. (10) is known from scattered localities in the Maritime Provinces and appears to have no stratigraphic value in this region.

Calcisphaera spp. (11-13)

The incertae sedis Calcisphaera sp. (11), originally described as a calcareous "radiolarian" is probably related to the Chlorophyceae. The genus is ubiquitous, but its maximum spread is in lagoonal back-reef environments. Calcisphaera laevis Williamson (12), rather abundant in subzone B, gradually dies out in subzone E.

Climacammina spp. (14-15)

The cribrate palaeotextularid Climacammina is commonly represented by its two principal groups: two-layered Climacammina of the group C. patula (Brady) (14) and single-layered Climacammina of the group C. prisca (Lipina) (15). C. mississippiana Conkin which is present in the upper Windsor, belongs to the first group.

Cornuspira sp. (16)

Cornuspira sp. (16) has little stratigraphic value; the specific identification of this genus is unfeasible in thin sections and the genus appears to have a long range.

Cribrostomum sp. and Koskinotextularia sp. (17)

The uncommon Cribrostomum and Koskinotextularia sp. (17) are known from subzones B to lower E.

Diplosphaerina sp. (18)

Diplosphaerina (18) is scarce throughout the Windsor sequence.

Earlandia spp. (19-21)

Earlandia, and in particular Earlandia of the group E. clavatula (Howchin) (19), Earlandia of the group E. elegans (Rauzer-Chernoussova) (20), and Earlandia of the group E. vulgaris (Rauzer-Chernoussova and Reitlinger) (21), are common elements of subzones B to E.

Endothyra spp. (22-25) and Endothyranella sp. (26)

Endothyra sensu stricto (22) is scarce in the Lower Windsor and becomes increasingly common or abundant in zones C, D and E. This general increase is directly related to that of Endothyra of the group E. bowmani Phillips in Brown emend Brady (23) which abounds in subzone E (most prominent species of the group are Endothyra bowmani Phillips, Endothyra obsoleta Rauzer-Chernoussova and Endothyra excentralis Cooper).

Other endothyroids are poorly represented, mainly by minute Endothyra of the group E. prisca Rauzer-Chernoussova and Reitlinger (24) and scattered Endothyra of the group E. similis Rauzer-Chernoussova and Reitlinger (25). Endothyranella sp. (26) is present throughout the succession.

Endothyranopsis spp. (27-29)

The Windsor Group clearly displays the Endothyranopsis phylogeny: Endothyranopsis compressa (Rauzer-Chernoussova and Reitlinger) (27) is encountered in subzones B and C; Endothyranopsis crassa (Brady) (28) is rare in subzone B and moderately abundant in subzones C to E; Endothyranopsis sphaerica (Rauzer-Chernoussova and Reitlinger) (29) has been observed in subzone E.

Eoendothyranopsis sp. (30)

The very few specimens of Eoendothyranopsis sp. (30) are restricted to subzone B. These mainly include Eoendothyranopsis of the group E. pressa-E. rara (Grozdilova in Lebedeva), and Eoendothyranopsis of the group E. ermakiensis (Grozdilova in Lebedeva).

Eostaffella spp. (31-33)

As in most basins in North America, the extinction of Eoendothyranopsis (30) in the Windsor basin is concomittant with the outburst of Eostaffella sp. (31). A common taxon tentatively referable to Rauzer's genus is Eostaffella? discoidea Girty (32), which abounds in biomicrites and biosparites of subzones C, D and E. Another important group is that of Eostaffella radiata(Brady)(33) known in the upper C to lower E subzones of the Upper Windsor Group.

Globoendothyra spp. (34-35)

Globoendothyra (34) is, after Endothyra, the most common representative of the Endothyridae. The genus is present in most marine facies, but shows few evolutionary trends in the stratigraphic interval under consideration. The only group known is that of G. globulus d'Eichwald (35).

Haplophragmella? and Haplophragmina? sp. (36)

Reports of Haplophragmella? and Haplophragmina? sp. (36) are here tentative because no complete unequivocable thin section of these genera have been encountered; the forms could be crushed Palaeotextulariidae?.

Pseudoglomospira? sp. (37)

Pseudoglomospira? sp. (37) and Pseudoglomospira? infinitesima (Beede) are so widespread that they may form "Pseudoglomospira?" banks. However considerable difficulties are encountered in the determination of these sedentary, undivided, tubular foraminifers (Henbest, 1963). Conditionally, all calcareous secreted, randomly coiled, attached Cornuspiridae are referred in this work to Pseudoglomospira? . This point of view, however, definitely deserves future re-evaluation as Bykova's original illustrations of Pseudoglomospira (1955) are nondiagnostic.

In the literature, such forms are usually assigned to Glomospira, although the type specimen of Glomospira is a siliceous, agglutinated representative of the Ammodiscidae.

Irregularina sp. (38)

Irregularina sp. is rarely encountered in subzones B and C of the Windsor Group.

Koninckopora sp. (39)

Koninckopora sp. (39) apparently has the same stratigraphic range as Irregularina sp. but is extremely common in the late Visean oolites and algal bank facies of northeastern Nova Scotia (where it was previously reported by Wood in 1930). It is probable that this world-wide dasycladacean can be used as an indicator of Visean age; it appeared in late Early Visean time and died out in the late Visean. Thus, the ease of its identification, its wide distribution, and its comparatively short range, render this algal useful for biostratigraphy. However, it is not as useful as the foraminifers for accurate zonation; for example, Koninckopora undergoes a conspicuous decline at the 15/16 zonal boundary in North America, whereas it ranges well into the 16 sup. zone in Eurasia.

Mikhailovella sp. (40)

Mikhailovella sp. (40) is scarce in the Upper Windsor.

Neoarchaediscus spp. (41-43)

Neoarchaediscus sp. (41) appears in zone 16 inf. as does Neoarchaediscus incertus (Grozdilova and Lebedeva) (42). The genus "explodes" in zone 16 sup. and is abundant in all normal marine sediments of Windsor subzones D and E. Neoarchaediscus parvus regularis (Suleimanov) (43) is also characteristic of Windsor subzones D and E.

Palaeotextularia spp. (44-47)

The two characteristic Upper Visean groups of Palaeotextularia (44) have been observed: Palaeotextularia of the group P. longiseptata Lipina (46), and Palaeotextularia of the group P. consobrina Lipina (45). Palaeotextularia asper (Cooper) (47) belongs to the latter group. The presence of two-layered palaeotextulariids at the base of subzone B demonstrates that this subzone cannot be older than late Visean.

Parathurammina sp. (48-49)

Parathurammina sp. (48), and Parathurammina dagmarae Süleimanov (49) are poorly represented and usually associated with Calcisphaera.

Planospirodiscus spp. (50-51)

Planospirodiscus spp. (50, 51), notably Planospirodiscus gregorii (Dain) and P. minimus (Grozdilova and Lebedeva) abound in Windsor subzones upper C, D and lower E.

Pseudoendothyra sp. (52)

Pseudoendothyra of the group P. ornata (Brady) (52) is poorly represented and has been observed only in scattered outcrops of subzones upper C, D, and E.

Radiosphaera sp. (53)

Radiosphaera sp. (53) is present in the oolitic facies as well as in the biomicrites; the taxon is not known to have any stratigraphic value.

Saccaminopsis sp. (54)

Questionable specimens of Saccaminopsis sp. (54) are known from the gigantoproductid beds of Mahone Bay, Nova Scotia.

Stacheia sp. and Stacheoides sp. (55)

The author is inclined to consider Stacheia and Stacheoides sp. (55) as algae, although they were originally described as encrusting Foraminifera. These, with the Dasycladaceae, generally form an important part of the microflora of subzone B; they are also widespread in normal marine facies of subzone upper E.

Tetrataxis spp. (56-59)

The four main groups of Tetrataxis (Tetrataxis of the group T. angusta Vissarinova (56), T. of the group conica Ehrenberg emend von Möller (57), T.? of the group T.? eominima Rauzer-Chernoussova (58), and T. of the group T. maxima Schellwien (59) are observed throughout the Windsor Group.

Trepeilopsis sp. (60)

Trepeilopsis sp. (60) is confined to the uppermost Windsor, although, as in the case of Pseudoendothyra sp. (52) this is a local stratigraphic range, probably related to inadequate sampling.

Tuberitina sp. (61)

The attached Tuberitina sp. (61) and the incertae sedis Vicinesphaera sp. (62) are present, in limited quantity, throughout the Windsor.

To this list of foraminifers and algae could be added the taxon Palaeocrisidia? priscilla (Dawson), a bryozoan originally assigned to the Rhizopoda.

Palaeocrisidia? priscilla (Dawson), 1868

Pl. III, Fig. 3, Pl. X, Fig. 2.

Dentalina priscilla Dawson, 1868. Acadian Geology, 2nd ed., p. 285, Fig. 82.

Nodosinella priscilla (Dawson) in Brady (1876). Pal. Soc. Mem. 30, p. 105, Pl. VII, Figs. 8, 9, non 10.

Nodosinella clarkei Beede, 1910. N.Y. State Mus. Rep. Directors 1910, p. 175, unnumbered fig., p. 175.

Earlandinita priscilla (Dawson) in Cummings, 1955, Micropaleontology, vol. I, No. 3, p. 231, Pl. I, Figs. 5, 6, 17.

Types: Hypotype, GSC No. 24890.

Description: Stolon, rarely branching, with pyriform vesicles usually arranged in a nearly straight, and tapering manner. Wall calcareous, secreted, dark, microcristalline, composed of minute calcite crystals, conspicuously thin, 5-6 microns. Diameter of the vesicles: 100 to 1000 μ. Total length of the stolon: 2000 to 5000 μ.

Discussion: In the original description, Dawson expressed doubts about the systematic position of Dentalina priscilla ("I do not feel at all certain as to its affinities", p. 285). Beede seems to have had no doubt as to its foraminiferal nature, although he reported the branching nature of the test an uncommon feature among Protozoa. Cummings assigned the taxon with doubt to the newly erected genus Earlandinita in view of the presence of constrictions in the wall.

It seems, however, that *Dentalina priscilla* (Dawson) must be excluded from the Carboniferous Rhizopoda, because the reported existence of a secondary tubular chamber and of constrictions is a misinterpretation of a succession of vesicles bearing stolons. However, the exact systematic position of this bryozoan is not known; although it bears great affinities with *Palaeocrisidia* Cummings, 1966, which was described at a similar level from the same environment in the Scottish Carboniferous sequence, it could also be interpreted as a new genus of the *Ctenostomata.*

The separation of *Nodosinella clarkei* (Beede) from *Dentalina priscilla* (Dawson), based on a difference in diameter of the vesicles, is artificial, as the stolons taper.

Occurrence: Floods of *Palaeocrisidia? priscilla* (Dawson) are common in the middle part of the Windsor Group; they form "*Palaeocrisidia-bands*", very conspicuous on weathered surfaces. It must be noted, however, that many "*Nodosinella-bands*" reported in the Windsor are composed of accumulations of *Earlandiidae* (*Earlandia* and *Earlandinita*).

Foraminiferal Zonation

A precise and useful zonation must be based on abundant, short-ranging taxa. Only eleven such taxa are present in the microfossils described above; these are:

Archaediscus krestovnikovi Rauzer-Chernoussova
Asteroarchaediscus sp.
Asteroarchaediscus baschkiricus (Krestovnikov and Teodorovitch).
Biseriammina? sp.
Endothyranopsis crassa (Brady)
Koninckopora sp.
Neoarchaediscus sp.
Neoarchaediscus incertus (Grozdilova and Lebedeva)
Neoarchaediscus parvus regularis (Suleimanov)
Planospirodiscus minimus (Grozdilova and Lebedeva)
Planospirodiscus gregorii (Dain)

Endothyranopsis sphaerica (Rauzer-Chernoussova and Reitlinger) and *Eoendothyranopsis* sp. can also be used, although these forms are rare in the Windsor Group, because their distribution is well known in other North America basins.

The combination of the ranges of the 50 taxa produces four assemblage zones (in ascending order):

1) *Archaediscus krestovnikovi* - *Biseriammina?* sp. - *Endothyranopsis crassa* - *Eoendothyranopsis* sp. - *Koninckopora* sp.,

2) *Archaediscus krestovnikovi* - *Biseriammina?* sp. - *Endothyranopsis crassa* - primitive *Neoarchaediscus* sp.,

3) *Biseriammina?* sp. – *Endothyranopsis crassa* – abundant *Neoarchaediscus* sp. - *Neoarchaediscus incertus* - *Planospirodiscus minimus* - *Planospirodiscus gregorii.*

4) Asteroarchaediscus sp. - Asteroarchaediscus baschkiricus - Endothyranopsis crassa - Endothyranopsis sphaerica - Neoarchaediscus sp. - Neoarchaediscus incertus - Planospirodiscus minimus - Planospirodiscus gregorii.

In the Windsor type region, the first assemblage occurs in subzone B, the second in the lower part of subzone C, the third in subzone D and in the lower part of subzone E, and the fourth in the upper part of subzone E.

Comparison of the Windsor and the Standard Carboniferous Zonations

The Late Viséan and Early Namurian substages of Western Europe can be divided respectively into four and three foraminiferal zones numbered 14, 15, 16 inf., 16 sup.; and 17, 18, 19 (Mamet, Choubert, and Hottinger, 1966, Mamet, 1968; Mamet and Skipp, in press).

The early Late Viséan zone 14 retains many Middle Visean elements and represents the acme for Archaediscus krestovnikovi Rauzer-Chernoussova, Endothyranopsis compressa (Rauzer-Chernoussova and Reitlinger), Koninckopora sp., Omphalotis sp., and Mediocris sp.

The Middle Late Viséan zone 15 is characterized by the outburst of gigantic Archaediscidae (Archaediscus karreri), Endothyranopsis crassa (Brady), numerous two-layered Palaeotextularia (Palaeotextularia of the group P. consobrina Lipina), and Climacammina (C. of the group C. patula (Brady)) accompanied by Koninckopora sp. This coincides with the disappearance of Lituotubella; the Tetrataxidae are represented by widespread Valvulinella youngi (Brady) and Howchinia bradyina (Howchin).

The Late Viséan zone 16 inf. contains the previously mentioned assemblage from zone 15 with the addition of Bradyina rotula (d'Eichwald) and the first primitive Neoarchaediscus sp.; Koninckopora sp. is slowly eliminated.

The latest Viséan zone, zone 16 sup. contains the acme of Neoarchaediscus sp., and the appearance of numerous Planospirodiscus sp. Loeblichia sp. is also known at that level, mostly from shaly facies. Valvulinella sp. and Howchinia sp. abruptly disappear at the top of the zone.

The earliest Namurian assemblage, zone 17, is characterized by the acme of Asteroarchaediscus sp.; Endothyranopsis crassa (Brady) is present, along with Endothyranopsis sphaerica (Rauzer-Chernoussova and Reitlinger).

Zone 18, of Early Namurian age, contains Globivalvulina? parva (Chetnysheva) in addition to the microfaunal assemblage of zone 17.

These zones are well known in the classical Carboniferous regions of Great Britain and can readily be correlated with North Africa. Only minor modifications to this succession are observed in the Russian Platform sequence.

The correlation of these "European" faunal assemblages with the Maritime Provinces is fairly obvious. "Subzone" A, of the Windsor Group contains only scarce plurilocular Foraminifera, and is tentatively considered as an impoverished zone 15 time equivalent. The lowest reliable microfauna is found in subzone B which contains Endothyranopsis crassa (Brady) and two-layered palaeotextulariids. This microfauna is therefore definitely equivalent to zone 15. The archaediscids Archaediscus krestovnikovi Rauzer-Chernoussova mixed with Archaediscus of the group A. moelleri

Rauzer-Chernoussova, and A. chernoussovensis Mamet confirm this correlation. However, conspicuous "European" elements such as Archaediscus karreri (Brady) Lituotubella sp., Valvulinella sp. and Howchinia sp. are absent from the Windsor fauna.

The lower part of subzone C, in its type locality contains the first Neoarchaediscus sp. and is therefore assigned to zone 16 inf.

The upper part of subzone C, in its type locality, is unfortunately very poor in Foraminifera, but the upper part of subzone C in the Antigonish, Port Hood, and Cape Dauphin regions is rich in Neoarchaediscus sp. and Planospirodiscus sp. a fauna also encountered in subzone D; it is therefore equivalent to zone 16 sup. The main difference between the Windsor and the European fauna, is the absence of Loeblichia sp., Valvulinella sp. and Howchinia sp. in the former.

The lower part of subzone E belongs also to the latest Visean zone 16 sup. but the characteristic assemblage Asteroarchaediscus baschkiricus (Krestovnikov and Teodorovitch) - Endothyranopsis sphaerica (Rauzer-Chernoussova and Reitlinger) is present in the upper part of the subzone; therefore subzone E straddles the Visean-Namurian boundary, but is not equivalent to much of the early Namurian, in that no Globivalvulina? has been observed.

Comparison of the Windsor and the Mississippian Zonations of the American Midcontinent

The St. Genevieve Formation, in its type locality, is a very thin oolitic sequence of strata which straddles the boundary between zones 14 and 15 (Mamet and Skipp in press). It is overlain disconformably by the Aux Vases Sandstone the lowest formation of the Chester Group. In the type region the Aux Vases Sandstone contains small limestone stringers with rare primitive Neoarchaediscus and is therefore assigned to zone 16 inf.

The hiatus between the St. Genevieve Formation and the Chester Group disappears as the St. Genevieve thickens eastward from its type locality. The top of the formation is very clearly diachronous; it extends into zone 16 sup. in Illinois and Kentucky (the interval above the Rosiclare Member should therefore be considered as "Lower Chester").

The type localities of the Meramec and Chester Groups should therefore be emended but at present no formal neostratotype has been proposed by American geologists. In order to follow stratigraphic convention, the base of the Chester will be considered here to be the top of the hiatus, that is, at the base of zone 16 inf.

The Maxner and Miller microfauna of the Windsor Group (see Fig. 4) is equivalent to the highest part of the zone 15 (uppermost Meramec as stated above). The younger Oolitic, Avon, and Kennetcook Limestones are clearly equivalent to the lower and middle Chester. The Oolitic Limestone has the same Neoarchaediscus population as the Renault Limestones of the Midcontinent. The Gigantoproductus beds are the exact time-equivalent of the Golconda Limestones as they share the same Neoarchaediscus-Planospirodiscus populations mixed with the earliest forms referable to Asteroarchaediscus. The upper part of the Kennetcook Limestone contains the same Asteroarchaediscus assemblage as the Glen Dean Limestone. No

ZONES	WINDSOR TYPE SECTION	MAHONE-ST MARGARETS BAY	ANTIGONISH	PORT HOOD AND SOUTHWESTERN CAPE BRETON IS.	CAPE DAUPHIN AND NORTHEASTERN CAPE BRETON IS.	AGE
17	KENNETCOOK E		<u>SCHIZODUS</u> E	<u>SCHIZODUS</u> E	<u>SCHIZODUS</u> E	EARLIEST NAMURIAN
16_s	WALLACE POINT D MEANDER RIVER AVON	<u>GIGANTOPRODUCTUS</u> BEDS "F" ?	GIANT D RIPPLE	GIANT D RIPPLE	D	LATE LATE VISEAN
16_i	BROOKLIN STATION C OOLITIC HERBERT RIVER		THIRD ALGAL C SMALL ALGAL	THIRD ALGAL C SMALL ALGAL	C	
15	MILLER B MAXNER A?	B A?	FIRST AND SECOND B OOLITIC A?	FIRST AND SECOND B OOLITIC A?	B	MIDDLE LATE VISEAN

Figure 5. Comparison of the macro and microfaunal correlations within the Windsor Basin.

foraminiferal equivalent of the Upper Chester has been encountered in the Maritime Provinces, where most of the time-equivalent sediments of this subgroup are nonmarine (Canso Group).

Comparison of Macrofaunal and Microfaunal Correlations Within the Windsor "Basin"

It has been shown that the microfaunal and megafaunal limits do not always coincide in the Windsor. Subzone B is consistently restricted to microfaunal zone 15. But the top of subzone C, subzone D, and the lowermost part of subzone E, all fall within microfaunal zone 16 sup. Such a situation is to be expected in that there is not necessarily an a priori relationship between the rates of evolution in foraminifers and brachiopods. A complete correspondence in the positions of microfaunal and macrofaunal boundaries would certainly suggest the presence of concealed hiatus and such paleontological "boundaries" would indicate chronostratigraphic gaps.

To test the relative values of micro and macrofaunal assemblages, it is interesting to compare the microfaunal, macrofaunal, and lithostratigraphic correlations within the Windsor Group of Nova Scotia. Figure 5 gives the stratigraphic positions of the units and their macrofauna with respect to the foraminiferal zones for five regions of Nova Scotia.

The stratigraphic position of "Subzone" A remains obscure in all outcrops. It is probably a basal impoverished facies of subzone B.

The First and Second Oolitic Limestones are, on macrofaunal evidence, equivalent to the Maxner and Miller Limestones (subzone B). This correlation is substantiated by the Foraminifera and the stratigraphic interval is consistently Middle Late Viséan in age.

Subzone B of northeastern Cape Breton Island is equivalent to subzone B of the Windsor, with one exception, the Cape Dauphin succession. Hayes and Bell (1923), Stacy (1953), and Sage (1954) recorded a Miller fauna in the basal part of the Cape Dauphin section. Bell (1958) later questioned the correctness of his first identification and the microfauna definitely indicates an age younger than Middle Late Viséan. However, the discrepancy is not proof of diachronism because the subzone B outcrops surrounding Cape Dauphin fall consistently within zone 15. The writer is inclined to believe that the Cape Dauphin succession is faulted and that part of its macrofauna has been incorrectly assigned to subzone B. Moreover, in Nova Scotia, subzones C, D and E have consistent relationships with the microfaunal succession. Such consistency suggests that both the microfaunal and macrofaunal zones are reliable biostratigraphic units, and are not diachronous.

"Subzone F", with its characteristic Gigantoproductus assemblage is time-equivalent to the base of subzone E, in a coral-rich facies. This late addition of Bell's original zonation should therefore be discarded.

Schenk (1967) has recently suggested that the Windsor macrofaunal zonation was so facies sensitive, as to be diachronous. Kelley (1967) challenged this view and observed that no inversion of macrofaunal zones has been proved in the Windsor Group. This latter view is substantiated by this study. All fossils are facies sensitive. The basic criterion which allows selection of fossils for zonation is not a mythical independence of a given fossil group to its environment but rather the rapidity of its evolution. For instance, it will be shown that the Archaediscidae are facies sensitive but the astounding rapidity of their evolution with the successive appearance and disappearance of a dozen genera in a single Carboniferous stage makes them extremely useful.

The writer is inclined to believe that lithologic correlations are more precise than paleontological zonation for short distance correlations restricted to the Windsor basin. But at the scale considered in this report, Bell's zonation is a reliable tool; identification and interpretation inconsistencies may be responsible for miscorrelations in the Windsor Group but not for gross faunal diachronism.

PALEOECOLOGY AND PALEOGEOGRAPHY

Paleoecology

Four principal paleoenvironments can be distinguished in the Windsor Group (Fig. 6):

1) An open marine carbonate platform facies; its salinity was that of the Carboniferous oceans (if the CO_2 partial pressure was the same as today, salinity was around 40 parts per thousand). Bathymetry was variable, ranging up to 50 fathoms.

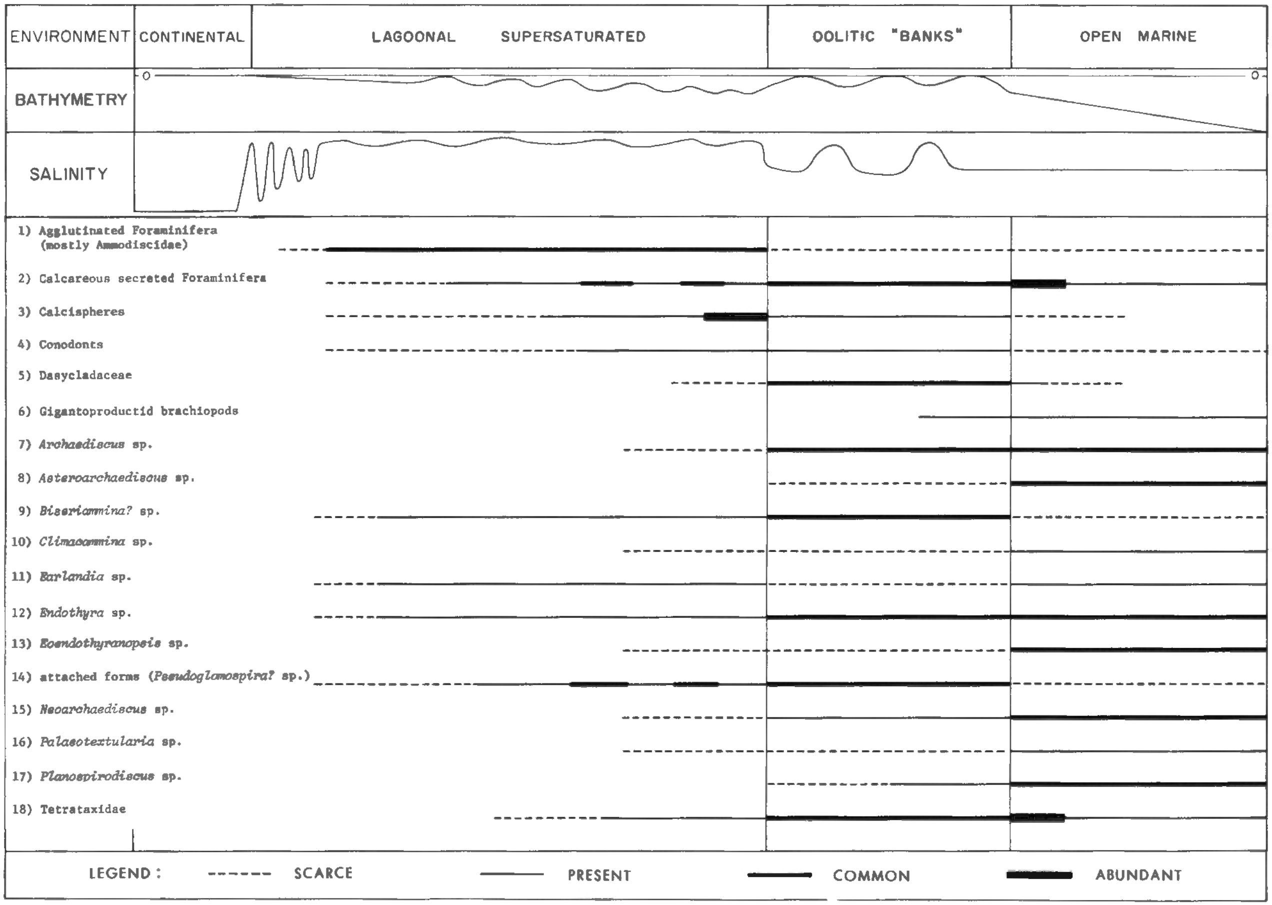

Figure 6. Paleoecology of the Windsor facies.

2) An oolitic and algal bank facies, restricted to a positive arch. This well-oxygenated facies was characterized by abrupt changes of turbulence, with very shallow waters prevailing. Salinity was normal to slightly supersaturated.

3) A shallow marine restricted, hypersaline facies grading to intertidal-supratidal flats.

4) A continental facies.

The plotting of microfacies distribution against these four main environments reveals the following information on the Carboniferous microfacies paleoecology.

Agglutinated Foraminifera (mostly Ammodiscidae) (1, on Fig. 6) are abundant in the penesaline and scattered in other marine environments. The family Ammodiscidae seems to be the most adaptable microfauna observed in this study in that they are present at the marine-continental facies boundary. In contrast, calcareous secreted Foraminifera (2) are widespread only in normal marine salinities. Calcispheres (3) are abundant in back-reef facies, a conclusion reached long ago for the Carboniferous of England (Williamson, 1881, Garwood, 1913) and confirmed by Ferguson (1962) and Mamet (1965). They are scattered in other facies, where they probably represent thanatocoenoses. Conodonts (4) are scarce but widespread in most marine facies. Dasycladaceans (Koninckopora) (5) are abundant in the turbulent facies and their accumulations form banks and biostromes. Gigantoproductid brachiopods (6) characterize normal salinites and are not observed in the highly saline environment.

Detailed study of the distribution of calcareous secreted foraminifers shows considerable ecologic differences among the various families.

The Archaediscidae are common in the normal facies and oolitic-bank facies; they are very sensitive to salinity changes and are absent from hypersaline facies (Archaediscus sp.-7, Asteroarchaediscus sp.-8, Neoarchaediscus sp.-15, Planospirodiscus sp.-17). Biseriamminidae (Biseriammina? sp.-9) seem to adapt to supersaturated waters although they are also abundant in the banks. The distribution of the Palaeotextulariidae is similar to that of the Archaediscidae (Climacammina sp.-10 , Palaeotextularia sp.-16). Earlandiidae and Endothyridae are widespread in all marine facies (Earlandia sp.-11, Endothyra sp.-12, Eoendothyranopsis sp.-13). Attached forms (14) flourish in shallow water environments and are well adapted to supersaturated conditions (Pseudoglomospira? sp.). Finally, Tetrataxidae (18) are characteristic of bank facies and are particularly abundant in the forereefs.

As previously suggested (Mamet and Skipp, in press), Carboniferous calcareous secreted foraminifers are quite different from present day Foraminifera, in that they are restricted to shallow water environments; no secreted Carboniferous Foraminifera are known in situ from deep water sediments and the abundant microfauna of deep water turbidites is believed to be completely allochthonous; in platform sedimentation, bathymetry is of minor importance in the faunal distribution, whereas salinity appears to be the most obvious parameter controlling foraminiferal ecology. Hence, great care must be taken in stratigraphic zonation when passing from an open, normal marine facies to a closed basin. This point was stressed by Mamet (1965) in the Early Visean zone 10 of Belgium, where the Archaediscidae are abundant in the basin carbonates, but are scarce or absent in the associated lagoonal sediments. An identical situation is observed here. The zonation based on Archaediscidae is useful in most of Nova Scotia for normal marine and bank facies; hence, it is not difficult to relate the Windsor type section with similar facies as distant as Western Europe. But this zonation is of little use when trying to relate the Windsor type section carbonates to the nearby supersaline intertidal-supratidal flats.

For the Late Viséan-Early Namurian, the four principal environments outlined above can be characterized by the following faunal associations:

1) Open normal marine; rich foraminiferal microfauna of Archaediscus-Asteroarchaediscus-Endothyra-Neoarchaediscus spp. The passage of the normal marine facies to the bank environment is characterized by this same faunal assemblage supplemented by abundant Tetrataxis sp.

2) Oolitic and algal banks; rich foraminiferal microfauna. Late Viséan time is characterized by Biseriammina? -Koninckopora-Tetrataxis spp.; in the latest Viséan and earliest Namurian, one observes Biseriammina? -Pseudoglomospira? -Tetrataxis spp. The back-reef facies of the banks is characterized by innumerable calcispherids.

3) Lagoonal supersaturated and intertidal-supratidal flats; scarce foraminiferal microfauna with Biseriammina? -Earlandia-Endothyra-Pseudoglomospira? spp. The transition from the hypersaline of the continental facies eliminates all calcareous secreted foraminifers and only agglutinated siliceous forms are observed.

4) Continental; no calcareous Foraminifera present.

Paleogeography

The paleogeography of the Windsor sea seems to follow a simple scheme. During all of Late Viséan time, most of peninsular Nova Scotia and Cape Breton Island formed a positive arch, which isolated a northeast-southwest penesaline lithotope, characterized by intertidal-supratidal flats. Isoliths were roughly parallel to the Appalachian trend. The sea transgressed and regressed on the platform which sank slowly in the southwest and more rapidly in the northeast. Most of these oscillations are marked by thin carbonate blankets.

Marine cycles started in subzone A (Fig. 7), but the greatest extent of the transgression occurred during subzone B time when marine carbonate sediments were spread as far as central New Brunswick (Fig. 8). Koninckopora oolitic banks developed on the Nova Scotia arch, isolating supersaturated flats characterized by dolomite, gypsum, and halite.

Marine oscillations continued during the time represented by subzones C and D (Fig. 9). Paleogeographic trends were not modified during this time; the direction of the isoliths is practically identical to that of the preceding subzone, although the extent of marine encroachments on the platform was gradually reduced. The banks were still located on the Nova Scotia positive arch; Koninckopora banks were completely eliminated and replaced by Pseudoglomospira? -spongiostromid banks. This barrier still isolated narrow, northeast-southwest starved flats. Each marine transgression

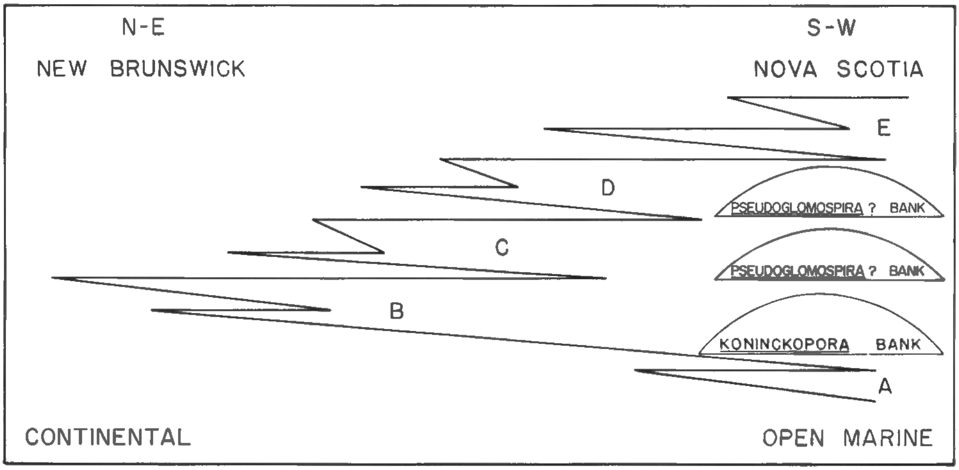

Figure 7. Distribution of the marine oscillations in the Windsor Basin (diagrammatic).

brought an ample supply of brine, and the restriction persisted until the latest Viséan with the formation of dolomite, gypsum, and salt.

The last marine oscillations occurred early in the Namurian (Fig. 10); they corresponded with the disappearance of the starved flats and the slow elimination of the Nova Scotia Pseudoglomospira? banks, which were replaced by normal marine micrites. The shoreline continued to withdraw to the southeast.

Paleoecological observations plotted on the lithofacies maps, give the following results.

Subzone B - Late Viséan (Fig. 11)

The extreme limit of the Ammodiscidae is coincident with the continental hypersaline facies break. The extreme limits of Biseriammina? sp. and the Archaediscidae are coincident with the northern and southern boundaries of the hypersaline flats. The northern limit of Koninckopora sp. delineates the Nova Scotia positive arch, and give the northern extent of the bank-facies.

Subzones C and D - Latest Viséan (Fig. 12)

The extreme limit of the Ammodiscidae is not known with precision although it is not far from the Biseriammina? limit. General withdrawal of the sea toward the southeast and the proximity of the Biseriammina? - Archaediscus limits suggest a narrowing of the hypersaline flats. However, the position of the Nova Scotia arch does not change appreciably and the Pseudoglomospira? algal banks coincide with the Koninckopora oolitic facies of the preceding zone.

Subzone E - Earliest Namurian (Fig. 13)

The Nova Scotia arch and the hypersaline flats ceased to exist and are replaced by normal marine archaediscid-bearing micrites which became

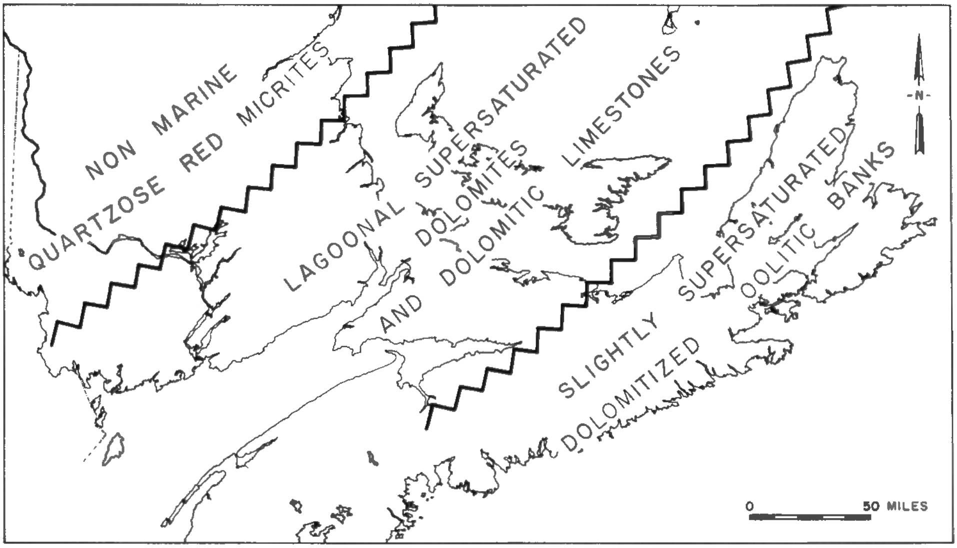

Figure 8. Paleogeography of the Windsor carbonates at the maximal spread of subzone B.

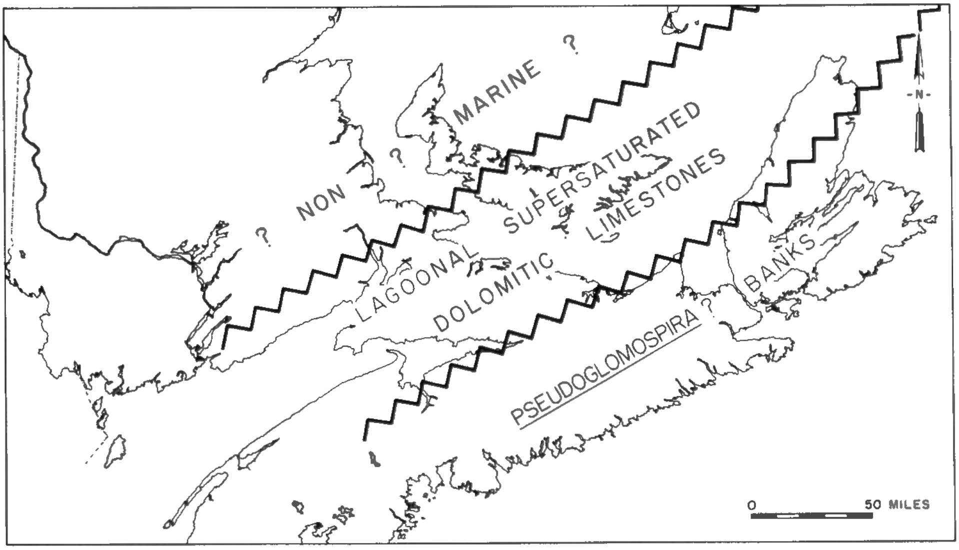

Figure 9. Paleogeography of the Windsor carbonates at the maximal spread of subzones C and D.

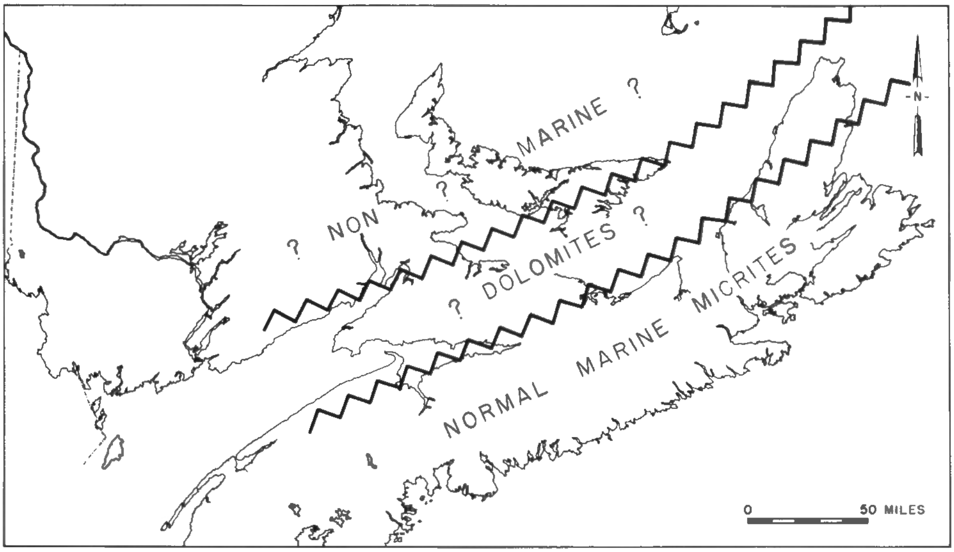

Figure 10. Paleogeography of the Windsor carbonates at the maximal spread of subzone E.

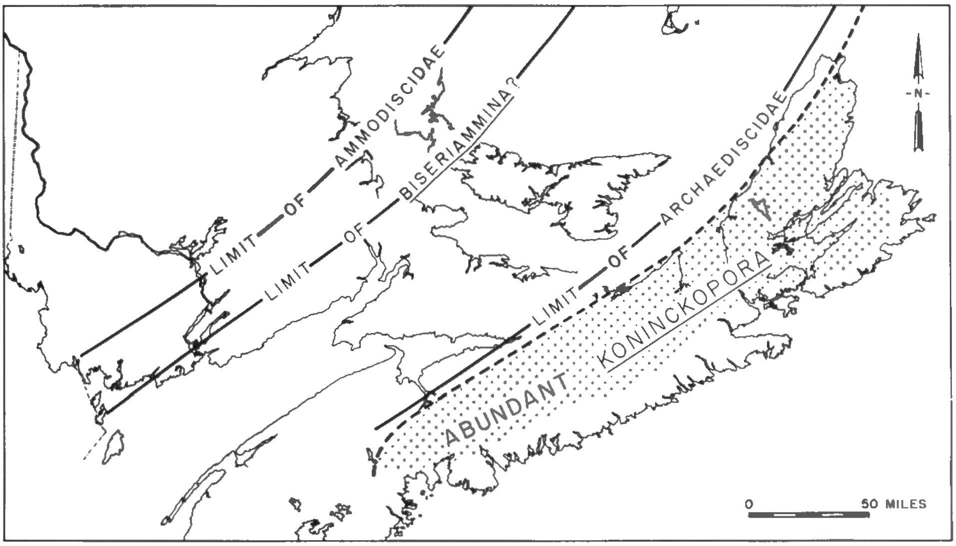

Figure 11. Windsor microfacies at the maximal spread of subzone B.

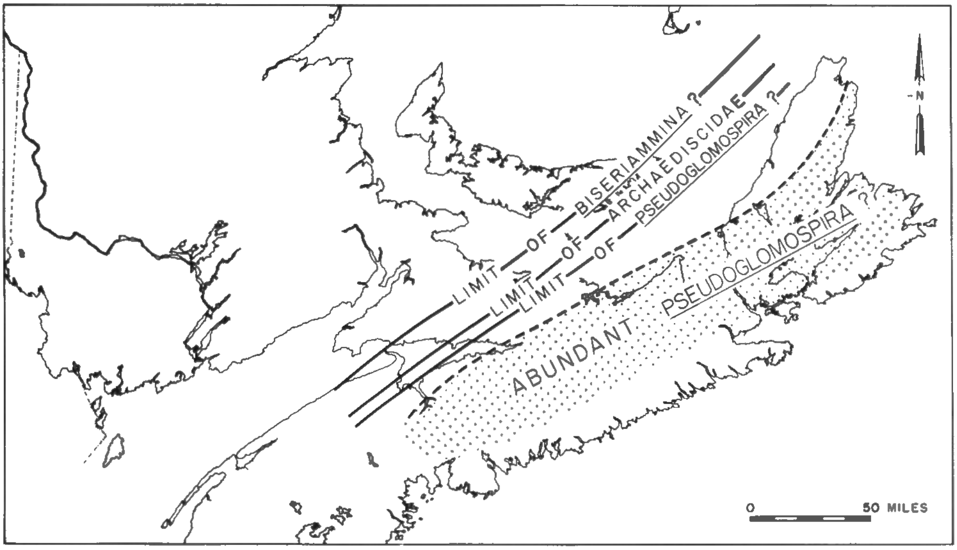

Figure 12. Windsor microfacies at the maximal spread of subzones C and D.

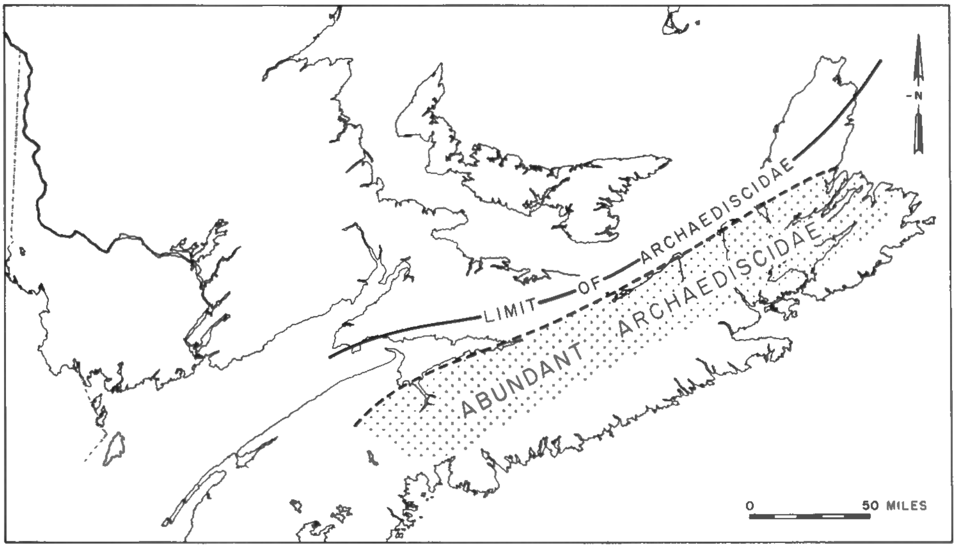

Figure 13. Windsor microfacies at the maximal spread of subzone E.

widespread over the remainder of the platform. The subzone E oscillations are the last marine invasions of the region and subzone E sediments are overlain, often with hiatus, by nonmarine beds.

PALEOBIOLOGICAL AFFINITIES OF THE WINDSOR MICROFAUNA

Paleogeographic Dispersion of the Microfauna in the Northern Hemisphere at the Viséan-Namurian Boundary

Investigations of the areal dispersion of living species is the customary procedure in biology. It permits recognition of migration patterns and delineation of biological realms. It is, however, a more difficult task in paleontology. Identification of a precise stratigraphic interval is not easy even in a basinal scale, and is always difficult on a continental scale. Moreover, modern biologists are able to observe ecologic conditions in great details; in contrast, in the study of Paleozoic microfacies, which is still in its infancy, even such a gross parameter as salinity can only be roughly assessed.

Despite these hindrances, an attempt at evaluation of paleogeographic dispersal will be attempted here; it will be restricted to the latest Viséan-earliest Namurian zones of the Windsor Group and their time equivalents in the Northern Hemisphere.

The premises on which this attempt is based are reasonably secure. The assemblage-zones under consideration are stratigraphically precise. Moreover to avoid circular reasoning, an independent parameter, macrofaunal dating is used to support the time-stratigraphic evaluation of the microfauna. In the Northern Hemisphere, Carboniferous zones 16 and 17 are widespread, and their faunal elements are exceptionally well documented. The facies to be taken into consideration are all of the shallow-marine, platform type; to make the comparisons uniform, only true open marine or slightly supersaturated environments will be discussed.

The paleobiological dispersion of the taxa will be reviewed here in alphabetical order (Fig. 14).

1) Archaediscus karreri Brady, 1873

This gigantic Archaediscus, originally described from the Late Viséan of England (Brady, 1873), is very common at that level in Western Europe (Morton, 1904; Cummings, 1961) and North Africa (Mamet, Choubert and Hottinger, 1966; Chanton, 1967, as Archaediscus moelleri gigas).

In the Russian Platform, the Donbass, and the Urals, the species is abundant in the Oka Series and its equivalents, but is usually reported as Archaediscus moelleri gigas Rauzer-Chernoussova (1948)[1].

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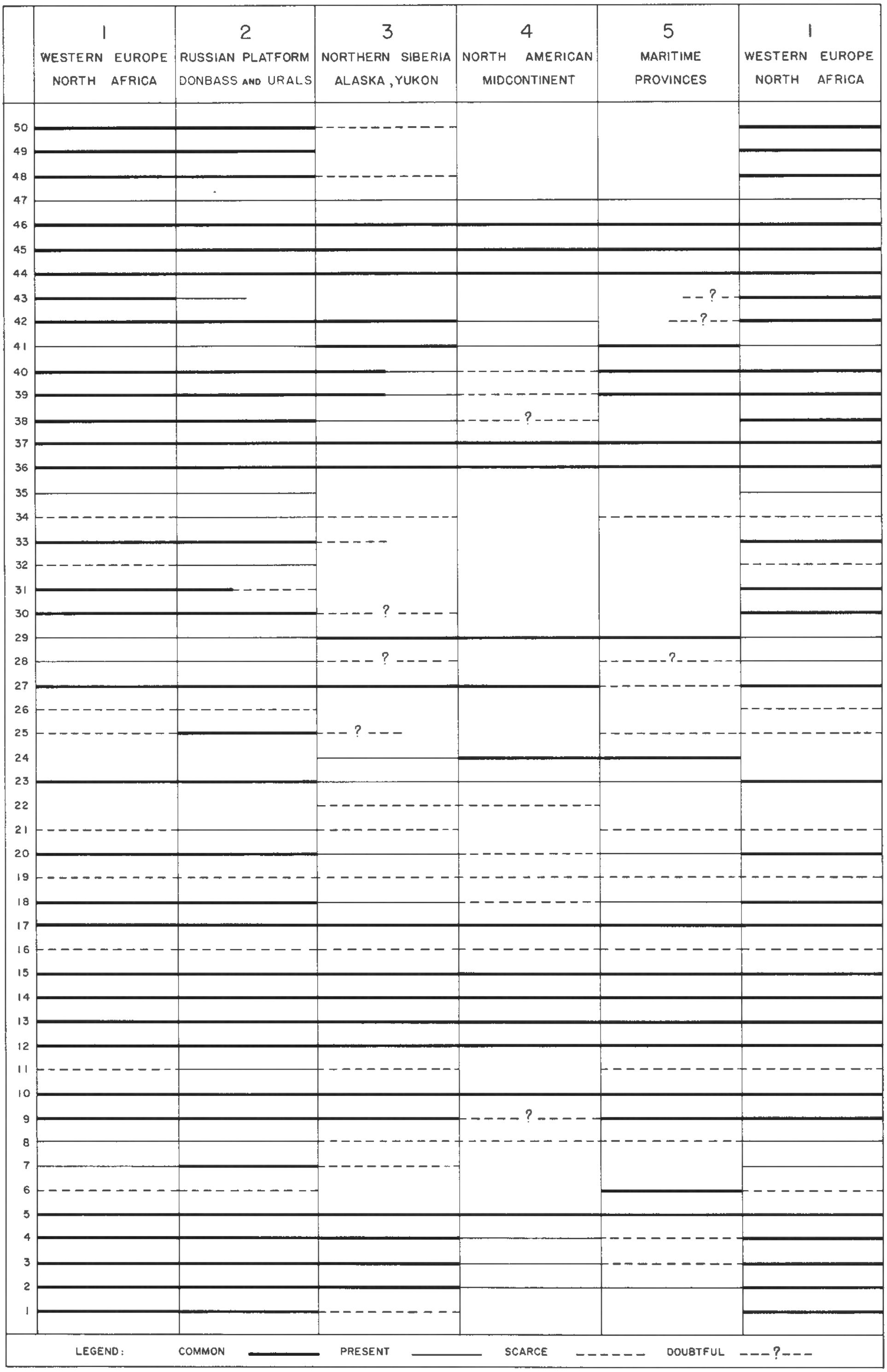
[1] Comparison of the type specimens in the British Museum (London) and the Institute of Geology, Akademia Nauk, Moscow, leaves no doubt as to the identity of the two taxa. Hence the numerous Russian references of Rauzer-Chernoussova's species (Rauzer-Chernoussova, 1948; Schlykova, 1951; Grozdilova, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Braznikhova, 1956; Lebedeva and Grozdilova, 1960; Pronin, 1960; Chukina, 1961) should be considered equivalent to the type of Archaediscus.

Figure 14. Paleobiological dispersion of the Late Viséan-Early Namurian foraminifers in the Northern Hemisphere.

50 – *Vissariotaxis* sp.
49 – *Valvulinella youngi* (Brady).
48 – *Valvulinella* sp.
47 – *Tuberitina* sp.
46 – *Tetrataxis* of the group *T? eominima* Rauzer-Chernoussova.
45 – *Tetrataxis* of the group *T. conica* Ehrenberg *emend* von Möller.
44 – *Tetrataxis* sp.
43 – *Saccaminopsis* sp.
42 – *Pseudoendothyra* sp.
41 – *Planospirodiscus* sp.
40 – *Palaeotextularia* of the group *P. longiseptata* Lipina.
39 – *Palaeotextularia* of the group *P. consobrina* Lipina.
38 – *Omphalotis* sp.
37 – *Neoarchaediscus* of the group *N. incertus* (Grozdilova and Lebedeva).
36 – *Neoarchaediscus* sp.
35 – *Monotaxinoides* sp.
34 – *Mikhailovella* sp.
33 – *Mediocris* sp.
32 – *Loeblichia* sp.
31 – *Howchinia bradyina* (Howchin).
30 – *Howchinia* sp.
29 – *Pseudoglomospira?* sp.
28 – *Haplophragmella* sp.
27 – *Globoendothyra* sp.
26 – *Forschia* sp. and *Forschiella* sp.
25 – *Eostaffella* of the group *E. radiata* (Brady).
24 – *Eostaffella? discoidea* (Girty).
23 – *Eostaffella* sp.
22 – *Eoendothyranopsis* sp.
21 – *Endothyranopsis sphaerica* (Rauzer-Chernoussova and Reitlinger).
20 – *Endothyranopsis crassa* (Brady).
19 – *Endothyranopsis compressa* (Rauzer-Chernoussova and Reitlinger).
18 – *Endothyranella* sp.
17 – *Endothyra* of the group *E. similis* Rauzer-Chernoussova and Reitlinger.
16 – *Endothyra* of the group *E. prisca* Rauzer-Chernoussova and Reitlinger.
15 – *Endothyra* of the group *E. bowmani* Phillips *in* Brown *emend* Brady.
14 – *Endothyra* sp.
13 – *Earlandia* of the group *E. vulgaris* (Rauzer-Chernoussova and Reitlinger).
12 – *Earlandia* of the group *E. clavatula* (Howchin).
11 – *Crisbrostomum* and *Coskinotextularia* sp.
10 – *Cornuspira* sp.
9 – *Climacammina* sp. and *Coskinobigenerina* sp.
8 – *Brunsia* sp.
7 – *Bradyina* sp.
6 – *Biseriammina* sp.
5 – *Asteroarchaediscus* of the group *A. baschkiricus* Krestovnikov and Teodorovitch.
4 – *Archaediscus* of the group *A. chernoussovensis* Mamet.
3 – *Archaediscus* of the group *A. moelleri* Rauzer-Chernoussova.
2 – *Archaediscus* of the group *A. krestovnikovi* Rauzer-Chernoussova.
1 – *Archaediscus karreri* Brady.


1 WESTERN EUROPE NORTH AFRICA
2 RUSSIAN PLATFORM DONBASS AND URALS
3 NORTHERN SIBERIA ALASKA, YUKON
4 NORTH AMERICAN MIDCONTINENT
5 MARITIME PROVINCES
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The form is known in the Timan-Petchora (Raznitsin, 1958), but is unreported from the Kunetz Basin, the Verkoyansk, or the Taimyr (Siberian Arctic).

The author has observed rare forms referable to *A. karreri* in Late Visean carbonates of northern British Columbia (Fort St. John region). However, the taxon has never been encountered in the southern Rocky Mountains, the North America Midcontinent, or the Canadian Maritime Provinces.

2) *Archaediscus* of the group *A. krestovnikovi* Rauzer-Chernoussova, 1948.

This taxon is cosmopolitan and is observed in the Northern as well as in the Southern Hemisphere[1]. It was originally described in Kazakhstan and is abundant in Western Europe (Cummings, 1961; Conil and Lys, 1964), in North Africa (Chanton, 1964; Mamet, Choubert, Hottinger, 1966) and in the U.S.S.R. (Rauzer-Chernoussova *in* Chernysheva, 1948; Schlykova, 1951; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Ilyna, 1953; Grozdilova 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Braznikhova, 1956; Durkina, 1959; Galitskaia-Glatchenko, 1958 and 1960; Pronin, 1960; Mikluko-Maklai, 1961; Einor and Vdovenko, 1963; Safarov and Kaptsan, 1964; Skvorzov, 1965). The fauna is also known from the Siberian Arctic (Chernyak and Dedock, 1959; Sossipatrova, 1962; Solomina, 1962; Ustritz, 1962; Bogush and Yuferev, 1966; Ustritz and Chernyak, 1967). It has been observed by the writer in practically all the Late Visean carbonate facies of Alaska (Brooks Range). British Columbia (Mamet and Mason, 1968) and of Alberta (Mamet, 1968). In the center of the Midcontinent the species is less conspicuous, although it is well represented in the St. Genevieve Formation and the Chester Group (Mamet and Skipp, in press). A similar distribution is known in the Maritime Provinces.

3) *Archaediscus* of the group *A. moelleri* Rauzer-Chernoussova, 1948.

The distribution of this taxon is similar to that of the *Archaediscus* described above. The type of this group, which was originally reported from the Russian Platform (von Möller, 1879), is abundant throughout Western Europe (Cummings, 1961; Conil and Lys, 1964; Mamet, 1969), North Africa (Mamet, Choubert and Hottinger, 1966) and most of Eurasia (Rauzer-Chernoussova, 1948; Schlykova, 1951; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Grozdilova, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Braznikhova, 1956; Malakhova, 1956; Braznikhova and Yartzeva, 1958; Galitskaia-Glachenko 1958; Durkina, 1959; Librovitch and Nalivkin, 1960; Chukina, 1961; Bogush and Yuferev, 1962; Einor and Vdovenko, 1963). The group has been reported from the Timan-Petchora (Raznitsin, 1958), and taxon is also present in the Late Viséan-Early Namurian of Alaska, Yukon, and northern British Columbia (Mamet and Gabrielse, 1969). It is observed in the American Midcontinent (Mamet and Skipp, in press) and in the Windsor Group of the Maritime Provinces.

4) *Archaediscus* of the group *A. chernoussovensis* Mamet *in* Mamet, Choubert and Hottinger, 1966.

This group has the same paleogeographic distribution as *A. krestovnikovi* and *A. moelleri*. It is reported by Mamet, Choubert and

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[1] Saurin (1960) reports it from Indochina, Mamet and Saurin (in press) from Vietnam, and Mamet and Belford (1968) from Australia.

Hottinger (1966) from Great Britain, Algeria and Morocco. Most of the Archaediscus karreri of the Soviet literature are to be assigned to this group (Rauzer-Chernoussova, 1948; Kireeva, 1949; Schlykova, 1951; Grozdilova, 1953; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Grozdilova and Lebedeva, 1954; Malakhova, 1956; Grozdilova and Lebedeva, 1960; Pronin, 1960). It is also known from the Taimyr Peninsula (Sossipatrova, 1962), and has been observed by the author in most of the North American Cordillera (Mamet and Mason, 1968; Mamet, 1968). These Archaediscidae are poorly represented in the North American Midcontinent (Mamet and Skipp, in press) and in the Maritime Provinces.

5) Asteroarchaediscus of the group A. baschkiricus (Krestovnikov and Teodorovitch, 1936).

This Archaediscidae; originally described from the Southern Urals, is widespread in most of the Northern Hemisphere. Although the recorded occurrences of this taxon are rare in Western Europe and North Africa (Cummings, 1961; Chanton, 1964; Mamet, Choubert and Hottinger, 1966), this group has been observed by the writer in practically all Namurian carbonates of Europe (Great Britain, Poland). In the Soviet Union, the taxon is reported by Krestovnikov and Teodorovitch, 1936; Chernysheva, 1948; Kireeva, 1949; Malakhova, 1950; Grozdilova, 1953; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Einor, 1953; Grozdilova and Lebedeva, 1954; Braznikhova, 1956; Malakhova, 1956; Mikluko-Maklai, 1956; Aizenberg and Yartzeva, 1958; Galitskaia-Glachenko, 1958; Librovitch and Nalivkin, 1960; Grozdilova and Lebedeva, 1960; Pronin, 1960; Chukina, 1961; Mikluko-Maklai, 1961; Bogush and Yuferev, 1962; Einor and Vdovenko, 1963). Reports of this taxon are numerous for Northern Siberia (Shvedov, Ustritz, Chernyak, Gerke and Sossipatrova, 1961; Ustritz, 1962; Sosnina, Jamonda, Sokolov, et al., 1964; Egiasaroi, et al., 1965; Bogush and Yuferev, 1965; Sossipatrova, 1966; Betektina, Bogush and Yuferev, 1967). In the North American Cordillera, the sudden abrupt outburst of this group is highly characteristic of the beginning of the Namurian (Mamet and Mason, 1968; Mamet and Gabrielse, 1969). The same outburst is observed at the Golconda-Glen Dean contact in the type Chester region (Mamet and Skipp, in press). This sudden acme is observed in the Maritime Provinces, in the middle part of the "E brachiopod subzone".

6) Biseriammina Chernysheva, 1941.

The internal structure of Biseriammina, a genus proposed by Chernysheva for double spirally coiled Endothyridae, has been rather unclear in the past, since this form is very rare in Western Europe (Mamet, 1965) and in its original type region, the Southern Urals (Chernysheva, 1941; Lipina, 1959; Ganelina, 1966). Moreover, to the author's knowledge, the taxon has never been found in Siberia, the Cordilleran or the Midcontinent.

In contrast with this world-wide scarcity, very evolved Biseriammina? is abundant in the Late Viséan of Nova Scotia. Consequently, it is possible to test Chernysheva's theory regarding an ancestral link between Biseriammina and primitive Globivalvulina?

7) Bradyina von Möller, 1878.

This characteristic genus can be recognized in thin section on a mere fragment of its wall; hence its particular stratigraphic importance, since it first appears in the Late Viséan of Eurasia.

Bradyina, first described in the Russian Platform (von Möller, 1878), is known in Great Britain (Brady, 1876; Cummings, 1961), in Belgium and Germany[1] (Conil and Lys, 1964; Conil and Pirlet, 1964), in Southern France (Mamet, 1969), in North Africa (Chanton, 1964; Mamet, Choubert, Hottinger, 1966), and in the Soviet Union (d'Eichwald, 1860; Venukoff, 1889; Mikhailov, 1935 and 1939; Kalmiukova *in* Gorki *et al.*, 1936; Rauzer-Chernoussova and Reitlinger, 1940; Rauzer-Chernoussova, 1948; Malakhova, 1950; Schlykova, 1951; Einor, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Ganelina, 1956; Braznikhova, 1956; Malakhova, 1956; Golubsov, 1957; Braznikhova and Yartseva, 1958; Vissarionova, 1959; Durkina, 1959; Pronin, 1960; Grozdilova and Lebedeva, 1960; Galitskaia-Glatchenko, 1960; Chukina, 1961; Potievskaia, 1964). *Bradyina* is reported by Sosnina, *et al.*, (1964) from the Siberian Arctic.

In Alaska and Yukon Territory the genus is rare and scattered *Bradyina* have been observed in the Early Namurian Nizi Formation of northern British Columbia (Mamet and Gabrielse, 1969).

All reported occurrences of the genus in the American Midcontinent are Pennsylvanian in age (Harlton, 1927; Cushman and Waters, 1928; Harlton, 1930; Roth and Skinner, 1930; Plummer, 1945; St. Jean, 1957). Revision of the Chester microfauna in the Midcontinent confirms this heterochrony of the first appearance of *Bradyina* (Mamet and Skipp, in press). The genus has not been observed in the Maritime Provinces.

8) *Brunsia* Mikhailov, 1939.

The genus is very common in the Tournaisian and Early Visean, in most basins of the Northern Hemisphere. It dies out in the Late Visean-Early Namurian interval and is reported here as an ubiquitous but rare taxon.

Late Viséan *Brunsia* are known in Western Europe (Liebus, 1932, as *Hemigordius*; Cummings, 1961; Conil and Lys, 1964; Mamet, Choubert, Hottinger, 1966), and in the Soviet Union (Glebovshaia and Grozdilova, 1948; Rauzer-Chernoussova, 1948; Einor, 1955; Bogush and Yuferev, 1962). The taxon is also reported from the Verkoyansk (Bogush and Yuferev, 1966). It has been observed by the writer in most of the North American Cordillera region (Mamet and Mason, 1968; Mamet, 1968) in the American Midcontinent, and in the Maritime Provinces.

9) *Climacammina* Brady, 1873, and *Koskinobigenerina* Eickhof, 1968.

These evolved Palaeotextulariidae derive from the work of Brady (1873, 1876) in Scotland and of Eickhof (1968), in Germany. In addition to being observed in numerous Western European basins (Liebus, 1932; Cummings, 1956, 1961; Ferguson, 1962) and in North Africa (Termier and Termier, 1950; Chanton, 1964; Mamet, Choubert, and Hottinger, 1966), these genera are also often reported from Eastern Europe (von Möller, 1879; Lipina, 1948; Rauzer-Chernoussova, 1948; Schlykova, 1951; Aizenberg, Braznikhova and Yartzeva, 1958; Durkina, 1959; Grozdilova and Lebedeva, 1960; Pronin, 1960) and in Siberia (Bogush and Yuferev, 1962; Sosnina, *et al.*, 1964; Egiasaroi, *et al.*, 1965).

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[1] The foraminifers reported by Liebus (1932) as *Bradyina grandis* from Waldeck, should be referred to *Endothyranopsis crassa* Brady, and those reported by him as *Bradyina nautiliformis* from the Etroeungt of Cromford, belong to *Latiendothyra*.

In the North American Cordillera, *Climacammina* and *Koskinobigenerina* are abundant in the Nizi Formation (Mamet and Gabrielse, 1969) and in the Etherington Formation (Mamet, 1968).

In the North American Midcontinent, all reported occurrences of the genus are Pennsylvanian in age (Harlton, 1928; Cushman and Waters, 1928; Roth and Skinner, 1930), although the writer has observed abundant *Climacammina* in the upper Chesterian Kinkaid Formation. The genus seems rare in the middle Chester.

The only reported Chesterian occurrences in North America are from the Appalachians (Flowers, 1956; Conkin, 1961). *Climacammina* and *Koskinobigenerina* are abundant in the Upper Windsor Group of the Maritime Provinces.

10) *Cornuspira* Schultze, 1854.

Cornuspira (*Cyclogyra* sp?) is a widespread genus throughout the Visean and Namurian of Western Europe (Simpson, 1954; Cummings, 1961; Conil and Lys, 1964; Mamet, Choubert and Hottinger, 1966, Mamet, 1968) and Eastern Europe (Grozdilova and Lebedeva, 1951; Schlykova, 1955; Ganelina, 1956; Malakhova, 1963). Moreover, many of the forms assigned to *Ammodiscus* in the Russian literature have calcareous secreted tests and should be regarded as *Cornuspira* (Rauzer-Chernoussova, 1948; Malakhova, 1956; Braznikhova, 1956; Golubsov, 1957; Durkina, 1959; Skvorzov, 1965). The genus is present in the Siberian Arctic (Sossipatrova, 1966) and the writer has observed abundant *Cornuspira* in Alaska (Brooks Range), British Columbia (Mamet and Gabrielse, 1969) and Alberta (Mamet and Mason, 1968).

Cornuspira has occasionally been illustrated in the American literature (as *Ammodiscus* by Woodland, 1957, or by McKay and Green, 1963), and is scattered through most Meramec and Chester carbonate facies of the Midcontinent (Mamet and Skipp, in press). It is also present to abundant in the Maritime Provinces.

11) *Cribrostomum* von Möller, 1879, and *Koskinotextularia* Eickhof, 1968.

The paleogeographic distribution of *Cribrostomum* and *Koskinotextularia* closely follows that of *Climacammina* and *Koskinobigenerina*. These genera, originally described from the Russian Platform (von Möller, 1879, 1880), and Germany (Eickhof, 1968), are also present in Western Europe (Simpson, 1954; Cummings, 1956, 1961), North Africa (Chanton, 1964; Mamet, Choubert and Hottinger, 1966), the Russian Platform, the Urals, and Arctic Siberia (Mikhailov, 1935; Lipina, 1948 *partim*; Braznikhova, 1956 *partim*; Braznikhova and Yartzeva, 1958; Pronin, 1960; Bogush and Yuferev, 1962; Sosnina *et al.*, 1964). However, most of *Cribrostomum* of the Russian literature should be transferred to *Climacammina* (*see* Cummings, 1956 for discussion). The same is true for all reported Pennsylvanian *Cribrostomum* (Harlton, 1927; Plummer, 1945).

12) *Earlandia* of the group *E. clavatula* (Howchin, 1888).

This group, based on a Late Viséan English taxon (Howchin, 1888), is characterized by calcareous secreted walls and moderate dimensions (diameter of the cylindrical chamber around 200 microns)[1].

This ubiquitous group is widespread in all territories constituting the U.S.S.R., including the Soviet Arctic (Rauzer-Chernoussova, 1948;

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[1] *Hyperammina vulgaris minor* Rauzer-Chernoussova of the Russian literature is here regarded as conspecific with Howchin's species.

Grozdilova and Lebedeva, 1954; Malakhova, 1956; Golubsov, 1957; Durkina, 1959; Malakhova, 1959; Bogush and Yuferev, 1962; Pronin, 1963; Sosnina *et al.*, 1964; Bogush and Yuferev, 1966) and has been observed in North America, by the writer, in Alaska, British Columbia (Mamet and Mason, 1968; Mamet and Gabrielse, 1969), Alberta (Mamet, 1968), the Midcontinent (Mamet and Skipp, in press) and the Maritime Provinces.

13) *Earlandia* of the group *E. vulgaris* (Rauzer-Chernoussova and Reitlinger, 1937).

The taxon was originally described from Eastern Europe and the group is characterized by its gigantic dimensions. It is abundant in the Visean of Western Europe (Cummings, 1958; Lizka, 1958; Conil and Lys, 1964; Mamet, 1965) and of the Soviet Union (Kalmiukova *in* Gorki, 1940; Chernysheva, 1940; Rauzer-Chernoussova, 1948; Schlykova, 1951; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Ilyna, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Braznikhova, 1956; Durkina, 1959; Malakhova, 1959; Pronin, 1960; Grozdilova and Lebedeva, 1960; Bogush and Yuferev, 1962; Safarov and Kapstan, 1964). The group begins to die out in Early Namurian time. The writer has observed the group in Alaska, British Columbia (Mamet and Mason, 1968), Alberta (Mamet, 1968), the Midcontinent (Mamet and Skipp, in press), and in the Maritime Provinces.

14) and 15) *Endothyra* Phillips *in* Brown, *emend* Brady, *emend* ICZN, 1965, and *Endothyra* of the group *E. bowmani* Phillips *in* Brown *emend* Brady.

This controversial genus has undergone numerous and contradictory interpretations, but the recent designation of a neotype and the official emendation of the International Commission of Zoological Nomenclature have considerably restricted the limits of the taxon. Although it is to be suspected that Brady's species is by no means related to either Phillip's or Brown's original taxa, only confusion would result by perpetuating the argument and the official designation will be followed here.

The considerable range of *Endothyra* given in the literature is the result of the controversial taxonomy. All Devonian *Endothyra* should be assigned to *Quasiendothyra*, *Latiendothyra* or *Nanicella*. Most Tournaisian *Endothyra* are *Spinoendothyra*, *Tuberendothyra*, *Latiendothyra*, *Urbanella*, etc. The greatest majority of Visean *Endothyra* are *Eoendothyranopsis*, *Endothyranopsis*, *Globoendothyra*, *Dainella*, etc. Most of the Namurian *Endothyra* of literature, however, properly fit the ICZN description.

Endothyra is abundant in Western Europe where it was originally reported, and in all the territories of the U.S.S.R. However, from the 750 reports of this genus, not more than a hundred are consistent with the 1965 ICZN decision (Brady, 1876 *pars*; Liebus, 1932 *pars*; Cummings, 1961 *pars*; Mamet, 1965 *pars*). Some *Plectogyra* of Conil and Lys (1964) are *Endothyra* (e.g. *Plectogyra bradyi*). In the Soviet Union, the most important contributions to the study of the genus must be credited to von Möller (1878, 1879), Mikhailov (1935, 1939). Rauzer-Chernoussova and Reitlinger (1936), Rauzer-Chernoussova (1948), Braznikhova and Potievskaia (1952), Grozdilova and Lebedeva (1954), Braznikhova (1956), Durkina (1959), Bogush and Yuferev (1962), and Rozovskaia (1963). The genus is reported from the Siberian Arctic (Voizhekhovskaia, 1961; Sosnina *et al.*, 1964; Ustritz and Chernyak, 1965; Bogush and Yuferev, 1965) and has been observed by the writer in British Columbia (Mamet and Mason, 1968; Mamet and Gabrielse, 1969), Alberta (McKay and Green, 1963; Mamet, 1968) and in the Southern Cordilleran (Idaho, Utah, etc...). Some Plectogyra of Zeller, 1957, are true Endothyra, while none of his Endothyra are Endothyra in the ICZN's sense. In the North American Midcontinent literature are reported many forms of Endothyra (Cooper, 1947); all Chesterian Plectogyra of N. Zeller, 1953, are true Endothyra. Endothyra was reported by Sage (1954) from the Windsor and it has been observed in most of the Carboniferous localities in the Maritime Provinces.

16) Endothyra of the group E. prisca Rauzer-Chernoussova and Reitlinger, 1936.

Originally described from the Russian Arctic (Petchora), this group is widespread at the Tournaisian-Visean boundary and dies out progressively in Late Visean time.

It is reported from Western Europe (Conil and Lys, 1964; Mamet, 1969), North Africa (Mamet, Choubert and Hottinger, 1966) and Eastern Europe (Rauzer-Chernoussova and Reitlinger, 1936; Rauzer-Chernoussova, 1948; Schlykova, 1951; Ilyna, 1953; Grozdilova and Lebedeva, 1954; Lebedeva, 1954; Einor, 1955; Malakhova, 1956; Galitskaia-Glachenko, 1958; Vissarionova, 1959; Grozdilova and Lebedeva, 1960; Pronin, 1960; Rozovskaia, 1963; Safarov and Kapstan, 1964).

Described from the Siberian Arctic by Bogush and Yuferev (1966) and by Ustritz and Chernyak (1968) it is also recorded in the Etherington Formation of Alberta (Mamet, 1968). It is present in the Chester Group of the Midcontinent (Mamet and Skipp, in press) and in the Windsor Group of the Maritime Provinces.

17) Endothyra of the group E. similis. Rauzer-Chernoussova and Reitlinger, 1936.

Phylogenically linked to the group of Endothyra bowmani, the group Endothyra similis is very common in the Late Visean-Early Namurian interval of Western Europe (Conil and Lys, 1964, as Plectogyra; Mamet, 1969) and North Africa (Mamet, Choubert and Hottinger, 1966). Originally reported from the Russian Arctic, it is widespread in all basins of the Soviet Union (Rauzer-Chernoussova, 1948; Schlykova, 1951; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Ilyna, 1953; Malakhova, 1954; Grozdilova and Lebedeva, 1954; Lebedeva, 1954; Braznikhova, 1956; Reitlinger, 1958; Malakhova, 1959; Chernyak and Dedok, 1959; Vissarionova, 1959; Grozdilova and Lebedeva, 1960; Pronina, 1960; Bogush and Yuferev, 1962; Rozovskaia, 1963; Safarov and Kapstan, 1964; Bogush and Yuferev, 1966; Ustritz and Chernyak, 1967). The group is ubiquitous in Alaska, British Columbia (Mamet and Mason, 1968), Alberta, the Midcontinent (Mamet and Skipp, in press) and the Maritime Provinces.

18) Endothyranella Galloway and Harlton, 1930.

The genus appears in Visean time and develops mostly in Middle Carboniferous. It is observed in Western Europe (Brady, 1876, as Haplophragmium; Lizska, 1958; Cummings, 1961) and in the U.S.S.R. (Rauzer-Chernoussova, 1938; Reitlinger, 1950; Malakhova, 1957; Potievskaia, 1958; Lebedeva in Kalfina, 1962; Rozovskaia, 1963). Some Arctic Mikhailovella (Voizhekovskaia, 1962) are to be reported to Endothyranella.

The genus is present in the Canadian Arctic; very scarce in the upper Chester, it is unreported in the Midcontinent before the Pennsylvanian; it is present in the Maritime Provinces.

19-20-21) Endothyranopsis Cummings, 1955.

Cummings' genus is ubiquitous in the northern hemisphere and its three species, E. compressa, E. crassa and E. sphaerica are known in the five realms under consideration. Hence discussion of the paleogeographic spread of the taxon will be found in the next three paragraphs.

19) Endothyranopsis compressa (Rauzer-Chernoussova and Reitlinger, 1936).

As primitive root of the Endothyranopsis phylogeny, E. compressa appears in Middle Visean and reaches immediately its acme in Late Middle and Early Late Visean time. It dies out in Late Visean time; hence for the stratigraphic interval under consideration this microfauna is poorly represented.

It is found in the Late Visean of England (Cummings, 1961) and at the same level in Eastern Europe (Schlykova, 1951; Einor, 1955; Golubsov, 1957; Durkina, 1959; Rozovskaia, 1963). It is also reported by Voichekovskaia Voichekhovskaia (1961) and by Bogush and Yuferev (1966) from the Soviet Arctic. The author has reported the form from the Etherington Formation of Alberta (Mamet, 1968) and British Columbia (Mamet and Mason, 1968). It is very scarce in the Midcontinent (Mamet and Skipp, in press) and in the Maritime Provinces.

20) Endothyranopsis crassa (Brady, 1870)

Derived from the preceding taxon in Middle Late Visean time, Endothyranopsis crassa is a widespread and characteristic form of the Late Visean. Originally described from Scotland, Endothyranopsis crassa is abundant in Great Britain (Cummings, 1955, 1961; Ferguson, 1962), in Belgium (Conil and Pirlet, 1964), in Southern France (Mamet, 1969) in Germany (Liebus, 1932, as Bradyina grandis) and in North Africa (Mamet, Choubert and Hottinger, 1966). Numerous reports of the form are found in Eastern Europe and Siberia (von Möller, 1878, 1879; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Braznikhova, 1956; Fomina, 1958; Braznikhova and Yartzeva, 1958; Durkina, 1959; Grozdilova and Lebedeva, 1960; Pronin, 1960; Librovitch and Nalivkin, 1960; Mikluko-Maklai, 1961; Bogush and Yuferev, 1962; Rozovskaia, 1963; Safarov and Kapstan, 1964). The taxon is also reported by Voichekovskaia (1961) and Sosnina et al. (1964) from the Soviet Arctic. The form has been observed by the writer in the Carnarvon Member of the Mount-Head Formation of Alberta, in the Etherington Formation of Alberta (Mamet, 1968) and in the Nizi Formation of British Columbia (Mamet and Gabrielse, 1969). It is also present in the White Knob Limestone of Idaho, while it is scarce in the Chester of the Midcontinent (Mamet and Skipp, in press). Quite at the opposite, the open marine facies of the Windsor E zone is particularly rich in Edothyranopsis crassa.

21) Endothyranopsis sphaerica (Rauzer-Chernoussova and Reitlinger, 1936)

Originally described from the Early Namurian of the Russian Platform (Rauzer-Chernoussova and Reitlinger, 1936), this species is rare in Western Europe; indeed marine microfauna are exceptional or even absent in Great Britain, Belgium, France and Germany. The taxon has only been reported by Cummings (1961), from the Archerbeck borehole in Great Britain.

In the U.S.S.R., the taxon is also rather scarce; from Eastern Europe it is reported by Einor (1953 and 1955), Durkina (1959), Vissarionova (1959), Pronin (1960) and Rozovskaia (1963). The form is known from Siberia through Bogush and Yuferev (1962). Known in the Alaskan Arctic (Brook's Range), it has also been encountered by the writer in the Nizi Formation of British Columbia. The taxon is not known in the Midcontinent (Mamet and Skipp, in press), but two specimens have been encountered in the upper part of the E zone of the Windsor.

22) Eoendothyranopsis Reitlinger, 1965.

This genus is extremely abundant in the Early and Middle Visean of North America where it is reported as Endothyra by Zeller (e.g. Endothyra macra, Endothyra utahensis, Endothyra spiroides etc.: these taxa should be reported to Eoendothyranopsis Reitlinger, 1965). It is also observed at the same level in Siberia (Lebedeva, 1954, as Parastaffella, Bogush and Yuferev, 1965; Bogush and Yuferev, 1966; Solovieva, 1967) and in Western Europe (Mamet, 1965). The extinction of the genus being rather brutal at the 15/16 zonal boundary, very few Eoendothyranopsis are known from the Late Late Visean (lowermost part of the Etherington of Alberta, basal part of the Chester in the Midcontinent). No Eoendothyranopsis is known from the Late Late Visean, in Asia, Europe, or the Maritime Provinces.

23) Eostaffella Rauzer-Chernoussova, 1948.

The genus Eostaffella, first described from the Late Visean Gigantella beds of Russia, presents like Endothyra, numerous taxonomic problems. In the Visean stage, more than 80 species have been reported to this genus, a figure which obviously indicates specific duplication or lack of generic discrimination. For the Late Visean only, more than 150 references are known from European literature; hence only the most important reports, will be cited here.

Eostaffella is known in Europe (Cummings, 1961, as Paramillerella; Conil and Lys, 1964; Mamet, 1969, in North Africa (Mamet, Choubert, and Hottinger, 1966; Chanton, 1967) and in the U.S.S.R. (von Möller, 1879; Rauzer-Chernoussova and Reitlinger, 1936; Rauzer-Chernoussova, 1948; Vissarionova, 1948; Grozdilova and Lebedeva, 1950; Ganelina, 1951; Braznikhova, 1951; Grozdilova and Lebedeva, 1954; Braznikhova, 1956; Ganelina, 1956; Malakhova, 1956; Golubsov, 1957; Orlova, 1958; Durkina, 1959; Grozdilova and Lebedeva, 1960; Bogush and Yuferev, 1962; Rozovskaia, 1963; Potievskaia, 1964). It is reported from the Siberian Arctic (Ustritz, 1962; Sosnina et al., 1964; Egiasaroi, 1964; Ustritz and Chernyak, 1965 and Bogush and Yuferev, 1966). The genus has been observed by the writer in Alaska (Brook's Range), in the Yukon Territories, in British Columbia (Mamet and Mason, 1968; Mamet and Gabrielse, 1969) and in Alberta (Mamet, 1968). Eostaffella is common in the White Knob Limestone of Idaho.

In the North American Midcontinent, Eostaffella has been reported as Paramillerella (Paramillerella circuli, Thompson, 1951 pars.).

Eostaffella is present in the upper part of the Windsor Group.

24) Eostaffella? discoidea (Girty, 1915)

Girty's species, described from the Chester of Arkansas, is identical to Millerella tortula Zeller, 1953, and Millerella designata Zeller, 1953, which are regarded here as duplications.

The taxon is abundant in the Chester of the type region (Mamet and Skipp, 1969) and in the Maritime Provinces. It is also known in the White Knob Limestone of Idaho, in the Etherington Formation of Alberta (Mamet, 1968) and of British Columbia (Mamet and Mason, 1968) and in the Nizi Formation (Mamet and Gabrielse, 1969).

To the writer's knowledge, the taxon is endemic to North America, although it bears striking resemblance to *Endothyra parva* von Möller, 1879 (now *Endostaffella parva*). Equatorial sections of both taxa are nearly identical, but in axial section *Eostaffella? discoidea* has a less developed glomospiral coil and more concave umbilici.

25) *Eostaffella* of the group *E. radiata* (Brady, 1876)

Eostaffella radiata is originally described from the Early Namurian of Great Britain (Brady, 1876, as *Endothyra radiata*). It is usually reported in Europe or Asia as *Eostaffella mosquensis* (Vissarionova, 1948; Rauzer-Chernoussova, 1948; Ganelina, 1951; Braznikhova, 1956; Golubsov, 1957; Durkina, 1959; Bogush and Yuferev, 1962; Rozovskaia, 1963; Conil and Lys, 1964). The group is unknown in the Canadian Cordillera and in the American Midcontinent. It is present in the Maritime Provinces.

26) *Forschia* Mikhailov, 1939 and *Forschiella* Mikhailov, 1939.

The close-coiled *Forschia* and the uncoiled *Forschiella*, are very common elements of the Middle and Late Visean microfauna of the Russian Platform, from where they were originally described (von Möller, 1879; Mikhailov, 1935 and 1939; Rauzer-Chernoussova, 1948; Dain, 1953; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Ilyna, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Braznikhova, 1956; Ganelina, 1956; Durkina, 1959). They die out in latest Visean-earliest Namurian time where they are only known through scattered occurrences (Dain, 1953; Bogush and Yuferev, 1962). The same stratigraphic distribution is observed in Europe (Cummings, 1961) and in North Africa (Mamet, Choubert and Hottinger, 1966).

Only two references to these genera are known from the Siberian Arctic (Bogush and Yuferev, 1965, 1966) and this microfauna has never been encountered in the late Visean of the North American continent (Mamet and Skipp, 1969).

27) *Globoendothyra* Reitlinger, 1959.

The genus is widespread in the Northern Hemisphere. It is known from the Viséan-Namurian of Western Europe (Cummings, 1961; Conil and Lys, 1964), of North Africa (Chanton, 1964; Mamet, Choubert and Hottinger, 1966) and of the U.S.S.R. (usually as "*Endothyra*"; d'Eichwald, 1860; von Möller, 1879; Kalmiukova *in* Gorski *et al.*, 1939; Rauzer-Chernoussova, 1948; Chernysheva, 1948; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Ilyna, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Ganelina, 1956; Braznikhova and Yartseva, 1958; Durkina, 1959; Vissarionova, 1959; Reitlinger, 1959; Galitskaia-Glatchenko, 1960; Grozdilova and Lebedeva, 1960; Librovitch and Nalivkin, 1960; Lebedeva *in* Kalfina, 1962; Rozovskaia, 1963; Safarov and Kapstan, 1964; Ganelina, 1966).

Globoendothyra is known from the Russian Arctic (Voichekovskaia, 1961; Ustritz and Chernyak, 1965; Bogush and Yuferev, 1965, 1966; Ustritz and Chernyak, 1967). Innumerable *Globoendothyra* have been observed by the author along the Cordilleran from Alaska to New Mexico. The genus is particularly abundant in British Columbia (Mamet and Mason, 1968; Mamet and Gabrielse, 1969) and in Alberta (where it is erroneously reported as Endothyra omphalota by McKay and Green, 1963).

In the Midcontinent region, the oldest Carboniferous foraminifera taxon of North America, Rotalia baileyi Hall, 1856, is to be attributed to Globoendothyra[1].

Globoendothyra is abundant in the Salem, St. Louis, St. Genevieve and Chester of the Midcontinent. It is present in the Maritime Provinces.

28) Haplophragmella Rauzer-Chernoussova and Reitlinger, 1936.

This Forschidae is abundant from the Early to the Late Visean of the U.S.S.R., from which it was originally described (Rauzer-Chernoussova and Reitlinger, 1936; Rauzer-Chernoussova, 1948; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Malakhova, 1954; Braznikhova, 1956; Ganelina, 1956; Malakhova, 1956; Malakhova, 1959; Durkina, 1959; Grozdilova and Lebedeva, 1960; Pronina, 1963; Mikluko-Maklai, 1963; Ganelina, 1966). Haplophragmella becomes extinct in the latest Visean of the U.S.S.R. (Rauzer-Chernoussova, 1938; Schlykova, 1951) and of Southern France (Mamet, 1969). Unknown in the Russian Arctic, it has also never been observed in the Cordilleran or in the American Midcontinent. A few forms, questionably referable to Haplophragmella? are known from the Upper Windsor of the Maritime Provinces.

29) Pseudoglomospira? Bykova, 1954.

The taxonomic difficulties which render conditional the report of this genus have already been explained elsewhere in this report. These forms are known in Western Europe (Cummings, 1961; Conil and Lys, 1964), in North Africa (Chanton, 1964; Mamet, Choubert, and Hottinger, 1966) and the following Russian references to Glomospira belong to this group (Mikhailov, 1939; Grozdilova and Glebovskaia, 1948; Rauzer-Chernoussova, 1948; Malakhova, 1956; and Bogush and Yuferev, 1962).

Pseudoglomospira? sp. is very common all along the Cordilleran (Mamet and Mason, 1968; Mamet, 1968; Mamet and Gabrielse, 1969, as Hedraites?. In the Midcontinent, Glomospira disca Cooper should be referred to this taxon. The form is abundant in the Chester Group (Mamet and Skipp, in press) and in the Windsor Group of the Maritime Provinces.

30) Howchinia Cushman, 1927.

This highly characteristic Tetrataxidae is abundant in the uppermost Visean of Western Europe (Howchin, 1888; Davies, 1951 and 1945; Cummings, 1961; Ferguson, 1962; Conil and Lys, 1964) and North Africa (Mamet, Choubert and Hottinger, 1966; Chanton, 1967).

In the Russian literature, Howchinia is usually reported as Monotaxis (OBJ) although this preoccupied taxon seems also to include Vissariotaxis. The form is abundant in Eastern Europe and in particular in the Donetz Basin

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[1] Plectogyra plectogyra Zeller, 1950 the type species of Plectogyra could be related to Globoendothyra, however Zeller's original description of the wall structure is inadequate and re-examination for the type-material discloses that the genotype has a completely recrystallized wall structure. Since Zeller himself used Plectogyra to include taxa as varied as Septaglomospiranella, Septabrunsiina, Spinoendothyra, Tuberendothyra, Latiendothyra, and Globoendothyra it seems preferable to consider this genus as an "unrecognizable taxon".

(Aizenberg, Braznikhova, Ishenko and Novik, 1953; Braznikhova, 1956; Golubsov, 1957; Braznikhova and Yartseva, 1958; Vdovenko, 1960; Einor and Vdovenko, 1963). It is known in Siberia (Bogush and Yuferev, 1962), in the Siberian Arctic (Sosnina et al., 1964) and has been observed by the author in the Northern Cordilleran (Yukon Territory). It is unknown in the rest of North America.

31) Howchinia bradyina (Howchin, 1888)

The type of the genus previously described, is known in the British Isles (Howchin, 1888; Davies, 1951; Cummings, 1961; Ferguson, 1962), from Belgium (Conil and Lys, 1964), from Southern France (Mamet, 1969), from the Sahara (Mamet, Choubert, and Hottinger, 1966) and from the European part of the U.S.S.R. (as Monotaxis gibba longa, Reitlinger, 1956; Braznikhova, 1956).

The species is unknown in Siberia and in the totality of North America.

32) Loeblichia Cummings, 1955.

This rare genus was erected by Cummings on English specimens of Brady's collection. It is present in the Late Visean-Early Namurian of Great Britain (Cummings, 1961; Ferguson, 1962), of Belgium (Conil and Lys, 1964) and of North Africa (Mamet, Choubert, Hottinger, 1966). It appears to be rather widespread in the Ukraine (Aizenberg, Braznikhova, Ishenko, and Novik, 1953; Braznikhova, 1956; Golubsov, 1956; Dain, 1958; Braznikhova, 1959). All other occurrences in the U.S.S.R. (such as Devonian "Loeblichia" which have to be transferred to Nanicella) should be assigned to other taxa.

The genus is unreported from Siberia, and has never been encountered by the writer in North America.

33) Mediocris Rozovkaia, 1961.

This Eostaffellidae characterized by umbilical axial fillings, was originally found to be widespread in the Eastern Russian Platform, the Urals and Baschkiria (Vissarionova, 1948). Additional reports of the genus are widespread (Ganelina, 1951; Aizenberg, Braznikhova, Ishenko, and Novik, 1953; Lebedeva, 1954; Grozdilova and Lebedeva, 1954; Einor, 1955; Malakhova, 1956; Braznikhova, 1956; Ganelina, 1956; Golubsov, 1957; Durkina, 1959; Galitskaia-Glatchenko, 1960; Pronin, 1960; Rozovskaia, 1961; and Safarov and Kapstan, 1964).

The genus is abundant in Western Europe and North Africa (Conil and Lys, 1964; Mamet, Choubert and Hottinger, 1966). It is present in Northern Siberia (Sosnina et al., 1964; Bogush and Yuferev, 1965, 1966), but the author has never encountered the genus in North America.

34) Mikhailovella Ganelina, 1956.

Mikhailovella was originally described from the latest Visean of the Russian Platform where it is a rather uncommon taxon (von Möller, 1879; Rauzer-Chernoussova, 1948; Ilyna, 1953; Braznikhova, 1956; Golubsov, 1957; Durkina, 1959; Fomina, 1960; Grozdilova and Lebedeva, 1960; Rozovskaia, 1962). Mikhailovella is unreported from Western Europe, although it was observed by the writer in the Upper Visean III γ zones of Germany and in the Dibunophyllum zone of Ireland (Galway).

It is also present in the Soviet Arctic (Voichekhovskaia, 1961) in Northern British Columbia (Mamet and Gabrielse, 1969) and in the Maritime Provinces. The microfauna has never been observed in the American Midcontinent.

35) *Monotaxinoides* Braznikhova and Yartzeva, 1956.

First described from the Namurian of the Donetz Basin, this transitional genus between *Howchinia* and *Eolasiodiscus* has a much wider distribution than its ancestor. Indeed, it is reported in the U. S. S. R. by Braznikhova and Yartzeva (1956), Reitlinger (1956), Braznikhova and Yartzeva (1958), Galitskaia-Glatchenko (1960), Chukina (1961), Pogrebniak (1964) and Safarov and Kapstan (1964). *Monotaxinoides* is present in Southern France (Mamet, 1969), Great Britain and North Africa (Mamet, Choubert and Hottinger, 1966). It was also reported by Chanton in Algeria (1967).

This taxon is not known from the Siberian Arctic, nor has it been observed in the Cordilleran. It is observed, however, in the Namurian Pitkin Limestone of Arkansas (Mamet and Skipp, in press). *Monotaxinoides* has not been observed in the Maritime Provinces.

36) *Neoarchaediscus* Mikluko-Maklai, 1956.

The genus is widespread in Western Europe (Conil and Lys, 1964; Mamet, Choubert and Hottinger, 1966), in North Africa (Mamet, Choubert, and Hottinger, 1966; Chanton, 1967, as *Arch. karreri*), and in all basins of the U. S. S. R. (Rauzer-Chernoussova, 1948; Dain *in* Grozdilova, 1953; Grozdilova and Lebedeva, 1954; Einor, 1953; Mikluko-Maklai, 1956; Braznikhova and Yartzeva, 1958; Grozdilova and Lebedeva, 1960; Mikluko-Maklai, 1961; Chukina, 1961; Bogush and Yuferev, 1962). Numerous reports of *Neoarchaediscus* are encountered in the Soviet Arctic (Shvedov, 1961; Solomina, 1962; Sossipatrova, 1962, 1966; Ustritz, 1962; Sosnina *et al.*, 1964; Ustritz and Chernyak, 1965; Bogush and Yuferev, 1965, 1966; Betekhtina, Bogush and Yuferev, 1967). One of the most prolific assemblages of *Neoarchaediscus* has been recently discovered by the writer from the Early Namurian of Ellesmere Island. The taxon is also abundant along the Cordilleran axis from Alaska to New Mexico. *Neoarchaediscus* is abundant in the Nizi type locality (British Columbia) (Mamet and Gabrielse, 1969) and in the Etherington Formation of Alberta (Mamet, 1968). It also has been observed in practically all Middle and Upper Chester formations of the Midcontinent (Mamet and Skipp, 1969) and in most outcrops of the Upper Windsor Group.

37) *Neoarchaediscus* of the group *N. incertus* (Grozdilova and Lebedeva, 1954).

This group is particularly abundant at the Viséan-Namurian boundary. It is known from Belgium (Conil and Lys, 1964), from Southern France (Mamet, 1969), from the U. S. S. R. (Grozdilova and Lebedeva, 1954; Mikluko-Maklai, 1956; Grozdilova and Lebedeva, 1960) and is abundant in the Arctic Taimyr and Verkoyansk (Solomina, 1962; Ustritz, 1962; Bogush and Yuferev, 1965). It has been observed by the writer, along the Cordilleran, in all localities previously mentioned for the genus *Neoarchaediscus*. It is also present in the Midcontinent (Mamet and Skipp, in press) and in the Maritime Provinces.

38) *Omphalotis* Mamet, 1969.

The earliest form referable to *Omphalotis* is *Endothyra circumplicata* Howchin, 1888, from the British Upper Visean. Other taxa (usually as *Endothyra* or *Plectogyra*) which should be attributed to this genus are described by Cummings (1961), Conil and Lys (1964) and Conil and Pirlet

(1964). The genus is observed in North Africa (Mamet, Choubert, and Hottinger, 1966; Chanton, 1967) in France (Mamet, 1969); and in the U.S.S.R. (Rauzer-Chernoussova and Reitlinger, 1936; Rauzer-Chernoussova, 1937; Rauzer-Chernoussova, Beljaev and Reitlinger, 1940; Rauzer-Chernoussova, 1948; Schlykova, 1951; Grozdilova and Lebedeva, 1954; Einor, 1955; Braznikhova, 1956; Golubsov, 1957; Reitlinger, 1958; Braznikhova and Yartzeva, 1958; Durkina, 1958; Vissarionova, 1959; Grozdilova and Lebedeva, 1960; Galitskaia-Glatchenko, 1960; Pronin, 1960; Rozovskaia, 1963; Rostovceva in Reitlinger, 1964). The form is erroneously reported by Okimura (1958) from Japan, but it is present in the Russian Arctic (Voichekovskaia, 1961). The genus is very poorly represented in the Northern Cordillera. References to Endothyra aff. omphalota in Alberta (McKay and Green, 1963) are erroneous and all the published material should be referred to Globoendothyra. Omphalotis is unknown in the Maritime Provinces.

39) Palaeotextularia of the group P. consobrina Lipina, 1948.

The characteristic feature of this group is the absence of a "radial hyaline" layer in the wall structure; further study will probably elevate this feature to generic rank. The group is exceptionally long-ranging, since it appears in Visean time and is still conspicuous in the Moscovian (Reitlinger, 1950).

This ubiquitous group is known from Great Britain (Cummings, 1956, 1961), Southern France (Mamet, 1969) and North Africa (Chanton, 1964 and 1967; Mamet, Choubert and Hottinger, 1966). Lipina has observed the group in most basins of the U.S.S.R. (1948), an extent confirmed by the works of Malakhova (1960), Schlykova (1951), Einor (1955), Braznikhova (1956), Golubsov (1957), Braznikhova and Yarzeva (1958), Durkina (1959) and Pronin (1960). It is also known from the Soviet Arctic (Voichekovskaia, 1961).

The group is present in the North American Cordillera and notably in the Nizi Formation of British Columbia (Mamet and Gabrielse, 1969) and the Etherington Formation of Alberta (Mamet, 1968). At the Visean-Namurian boundary, this taxon is scarce in the Midcontinent (Mamet and Skipp, in press), while it is abundant in the Maritime Provinces.

40) Palaeotextularia of the group P. longiseptata Lipina, 1948.

This bilayered Palaeotextularia has comparable paleogeographic distribution to the preceding taxon. Originally reported from the Russian Platform (Lipina, 1948), the group is widespread in England (Cummings, 1956), North Africa (Mamet, Choubert and Hottinger, 1966), and the U.S.S.R. (Schlykova, 1951; Golubsov, 1957; Durkina, 1959; Pronin, 1960). It is present in the Northern part of the Cordilleran (Nizi Formation, Etherington Formation, Mamet, 1968; Mamet and Gabrielse, 1969), but absent in the Midcontinent (first outburst of this group is in upper Chester (Mamet and Skipp, in press). The group is widespread in the Maritime Provinces.

41) Planospirodiscus Sossipatrova, 1962.

The taxon is originally defined from the Middle Carboniferous of the Siberian Arctic, but it appears as low as in the latest Visean. Although unreported from Western Europe, Planospirodiscus has been observed by the writer in most IIIγ limestones of Rhineland and Hesse. It is also present in the Yoredale Series of England (Five Yards, Three Yards, Underset and Main limestones). It is reported from the Kolvo-Vichera by Grozdilova and

Lebedeva (1954) and is very abundant in the Makarov and Tikhsink Series of the Siberian Arctic (Ustritz, 1962; Sossipatrova, 1962; Ustritz and Chernyak, 1965; Bogush and Yuferev, 1965 and 1966; Sossipatrova, 1966). The genus has often been observed by the writer in Alaska, Yukon and in the Lower Namurian of the Canadian Arctic (Ellesmere Island). Planospirodiscus is also present in the upper part of the Chester Group of the Midcontinent and in the Namurian Pitkin Limestone of Arkansas. It is well displayed in the upper part of the Windsor in Nova Scotia.

42) Pseudoendothyra Mikhailov, 1939.

Pseudoendothyra Mikhailov, 1939 and Parastaffella Rauzer-Chernoussova, 1948, are considered here as synonymous. First appearing in Visean time, the genus reaches its acme in Late Visean-Early Middle Carboniferous, where it is known from all basins of the Northern Hemisphere.

It is described from the Visean of Belgium (Conil and Lys, 1964) and of North Africa (Mamet, Choubert, and Hottinger, 1966). Forms referable to Pseudoendothyra are often signalled in the U. S. S. R. (von Möller, 1878, 1879; Vissarionova, 1948; Rauzer-Chernoussova, 1948; Grozdilova and Lebedeva, 1950; Schlykova, 1951; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Ilyna, 1953; Grozdilova and Lebedeva, 1954; Einor, 1955; Ganelina, 1956; Golubsov, 1957; Braznikhova and Yartzeva, 1958; Durkina, 1959; Vdovenko, 1960; Chukina, 1961; Rozovskaia, 1963; Skvorzov, 1965). The genus is reported from the Siberian Arctic by Sosnina et al. (1964) and Ustritz and Chernyak (1965). Pseudoendothyra is very abundant in the middle part of the Nizi Formation of Alberta (Mamet, 1968). In the Midcontinent, forms referable to Pseudoendothyra (Dunbar and Skinner, 1937; Thompson, 1947) are all Middle Carboniferous in age, but the genus is also present in middle and upper Chester (Mamet and Skipp, in press). Pseudoendothyra is uncommon in the Maritime Provinces.

43) Saccaminopsis Sollas, 1921.

Saccaminopsis is very abundant in Great Britain, where its accumulation forms the "Saccamina-bands" (McCoy, 1849; Brady, 1871, 1876; Chapman, 1898; Morton, 1904; Sollas, 1921; Cummings, 1961). The illustrated report of "Saccamina" in the German Carboniferous (Liebus, 1932) should be transferred to Calcisphaera, but the author has observed numerous Saccaminopsis in the $III_{\alpha-\gamma}$ zones of Western Germany. "Saccamina" is also reported by Conil and Lys from the Upper Visean of Belgium (1964) and it is known from North Africa (Mamet, Choubert and Hottinger, 1966). In Eastern Europe, Saccaminopsis is only present in the Donetz Basin (Braznikhova, 1956; Braznikhova and Yartzeva, 1958). No reports of the genus are known from the rest of the Soviet Union, and it is unknown in the Cordillera and the Midcontinent. Scarce Saccaminopsis are known from the "Gigantoproductus beds" of Nova Scotia.

44) Tetrataxis Ehrenberg, 1954, emend von Möller, 1879.

Tetrataxis is a common Visean genus observed throughout the Northern Hemisphere. Reported from Great Britain by Brady (1876), Cummings (1961) and Ferguson (1962), from Belgium by Conil and Lys (1964), from Germany by Liebus (1932), from Southern France by Mamet (1969), from North Africa by Termier and Termier (1950), Chanton (1964 and 1967) and Mamet, Choubert, and Hottinger (1966), it is also observed from all basins of the U.S.S.R. (von Möller, 1879; Mikhailov, 1939; Rauzer-Chernoussova, 1948; Vissarionova, 1948; Reitlinger, 1949; Schlykova, 1951; Braznikhova, 1951; Aizenberg, Braznikhova, Ishenko and Novik, 1953; Grozdilova and Lebedeva, 1954; Ganelina, 1956; Braznikhova, 1956; Malakhova, 1956; Golubsov, 1957; Durkina, 1959; Vissarionova, 1959; Grozdilova and Lebedeva, 1960; Lebedeva in Kalfina, 1962; Vdovenko, 1962; Bogush and Yuferev, 1962 and Einor and Vdovenko, 1963). It is found as well in the Siberian Arctic (Ustritz, 1962; Sosnina et al., 1964; Egiasaroi, 1965; Bogush and Yuferev, 1965, 1966). The genus is common in all the Cordilleran from Alaska to New Mexico and is reported from British Columbia (Mamet and Mason 1968; Mamet and Gabrielse, 1969) and from Alberta (McKay and Green, 1963; Mamet, 1968).

All reported occurrences of Tetrataxis in the North American Midcontinent are Middle Carboniferous in age (Spandel, 1901; Cushman and Waters, 1927; Galloway and Harlton, 1928; Galloway and Ryniker, 1930; Warthin, 1930; Roth and Skinner, 1930; Lehman, 1953; Mapple, 1955; St. Jean, 1957). However, Tetrataxis is widespread in all the Midcontinent carbonates from the Late Tournaisian Keokuk Formation through the Meramec and the Chester (Mamet and Skipp, in press). Tetrataxis is abundant in the Windsor, and was recorded by Stacy (1954).

45) Tetrataxis of the group T. conica, Ehrenberg, 1854, emend von Möller, 1879.

The group has the same paleogeographic distribution as the genus Tetrataxis. It is known from Ireland (Simpson, 1954), from Great Britain (Cummings, 1961; Ferguson, 1962) and from Belgium (where Tetrataxis compacta, Tetrataxis exornata, Tetrataxis media and Tetrataxis paraminima Conil and Lys, 1964, are all random sections of Tetrataxis conica Ehrenberg). The group is also known in Southern France (Mamet, 1969), Algeria and Morocco (Mamet, Choubert and Hottinger, 1966; Chanton, 1967) and in the U.S.S.R. (von Möller, 1879; Mikhailov, 1939; Rauzer-Chernoussova, 1948; Vissarionova, 1948; Schlykova, 1951; Grozdilova, 1954; Malakhova, 1956; Golubsov, 1957; Lebedeva in Kalfina, 1962; Bogush and Yuferev, 1962; Einor and Vdovenko, 1963). It is described from the Siberian Arctic by Bogush and Yuferev (1965, 1966) and known along all Cordilleran (Alberta, British Columbia, Idaho, New Mexico). In the Midcontinent, reports of T. conica (Cushman and Waters, 1930; Lehman, 1953) are all Middle Carboniferous in age, but the group has been observed by the author from the Upper Tournaisian Osage to the Pennsylvanian (Mamet and Skipp, in press). The group is observed in the Maritime Provinces.

46) Tetrataxis? of the group T. eominima Rauzer-Chernoussova, 1948.

These Tetrataxis?, characterized by a thin, dense, dark, monolayered wall, are transitional between the Biseriamminidae and the Tetrataxidae; they should probably be elevated to a generic status.

The group is observed in England (1961), in Belgium (Conil and Lys, 1964), in North Africa (Mamet, Choubert, and Hottinger, 1966; Chanton, 1967) and in most basins of the U.S.S.R. (Rauzer-Chernoussova, 1948; Schlykova, 1951; Grozdilova and Lebedeva, 1954; Malakhova, 1956; Golubsov, 1957; Pronin, 1960; Bogush and Yuferev, 1962; Vdovenko, 1962). It is recorded from the Siberian Arctic (Bogush and Yuferev, 1965).

The taxon is present in the Cordillerans (Mamet and Mason, 1968; Mamet, 1968; Mamet and Gabrielse, 1969), in the Midcontinent (Mamet and Skipp, in press) and in the Maritime Provinces.

47) Tuberitina Galloway and Harlton, 1928 (and Eotuberitina Mikluko-Maklai, 1958).

This very long ranging genus, known from the Devonian (Bykova, 1955) to the Late Carboniferous (Galloway and Harlton, 1928) has been reported in Western Europe (Cummings, 1961; Conil and Lys, 1964; Mamet, 1965), in the U.S.S.R. (Malakhova, 1956, pars; Mikluko-Maklai, 1958, pars; Poyarkov, 1961; pars; Bogush and Yuferev, 1962, pars) but most references have to be transferred to Diplosphaerina (Mikhailov, 1939; Suleimanov, 1948, etc...). All reports of Tuberitina in the American literature are of Middle Carboniferous age (Galloway and Harlton, 1928; Warthin, 1930; Cushman and Waters, 1930; Galloway and Ryniker, 1930). But the author has observed the genus in many Visean carbonate facies of the American Cordillera, Midcontinent and Appalachians.

48) Valvulinella Schlubert, 1908, non 1907.

This characteristic Tetrataxidae appears in Viséan time and dies out in latest Viséan; this sudden elimination can be relied upon to characterize the Visean-Namurian boundary in Western Europe. Upper Carboniferous and Permian "Valvulinella" (Cushman and Waters, 1928; Kochansky-Devide, 1964) are not related to Schubert's genus.

Valvulinella is known from Great Britain (Brady, 1876; Cummings, 1961; Ferguson, 1962), Belgium and Germany (Liebus, 1932; Conil and Lys, 1964; partim), Southern France (Mamet, 1969), Poland (Lizska, 1958) and North Africa (Mamet, Choubert and Hottinger, 1966; Chanton, 1967). In the U.S.S.R., it is abundant in the Donbass Basin (Braznikhova, 1956; Braznikhova and Yartzeva, 1958) and occasionally reported in other basins (Mikhailov, 1939; Grozdilova and Lebedeva, 1954; Fomina, 1960; Grozdilova and Lebedeva, 1960). It is present in the Siberian Arctic (Bogush and Yuferev, 1966), but has never been encountered by the writer in North America.

49) Valvulinella youngi (Brady, 1876).

Brady's species has the same paleogeographic distribution as Valvulinella. It is reported from Great Britain (Brady, 1876; Cummings, 1961; Ferguson, 1962), Southern France (Mamet, 1969), Poland (Lizska, 1958) and North Africa (Mamet, Choubert and Hottinger, 1966). It is present in the Donbass (Braznikhova, 1956; Dain, 1958) and recorded from the Arctic (Bogush and Yuferev, 1966).

50) Vissariotaxis Cummings, 1966.

Vissariotaxis exilis, the type of this genus, erected for monolayered, dense, Howchinia-like Tetrataxidae, was first described from the Stalinogorsk horizon of the Russian Platform (as Monotaxis exilis, Vissarionova, 1948). The genus is seldom recorded although present in England (Cummings, 1961), in Belgium (as Howchinia Conil and Lys, 1964), in North Africa (Mamet, Choubert, and Hottinger, 1966) and in the Donets (Braznikhova, 1956; Golubsov, 1957). The genus has therefore the same distribution as its parent form Howchinia, and seems restricted to Western Eurasia.

Figure 15. Comparison of the degree of similarity between the distribution of the Windsor microfauna with that of similar age and facies in Europe, the North American Midcontinent, and the Siberia-Alaska realm.

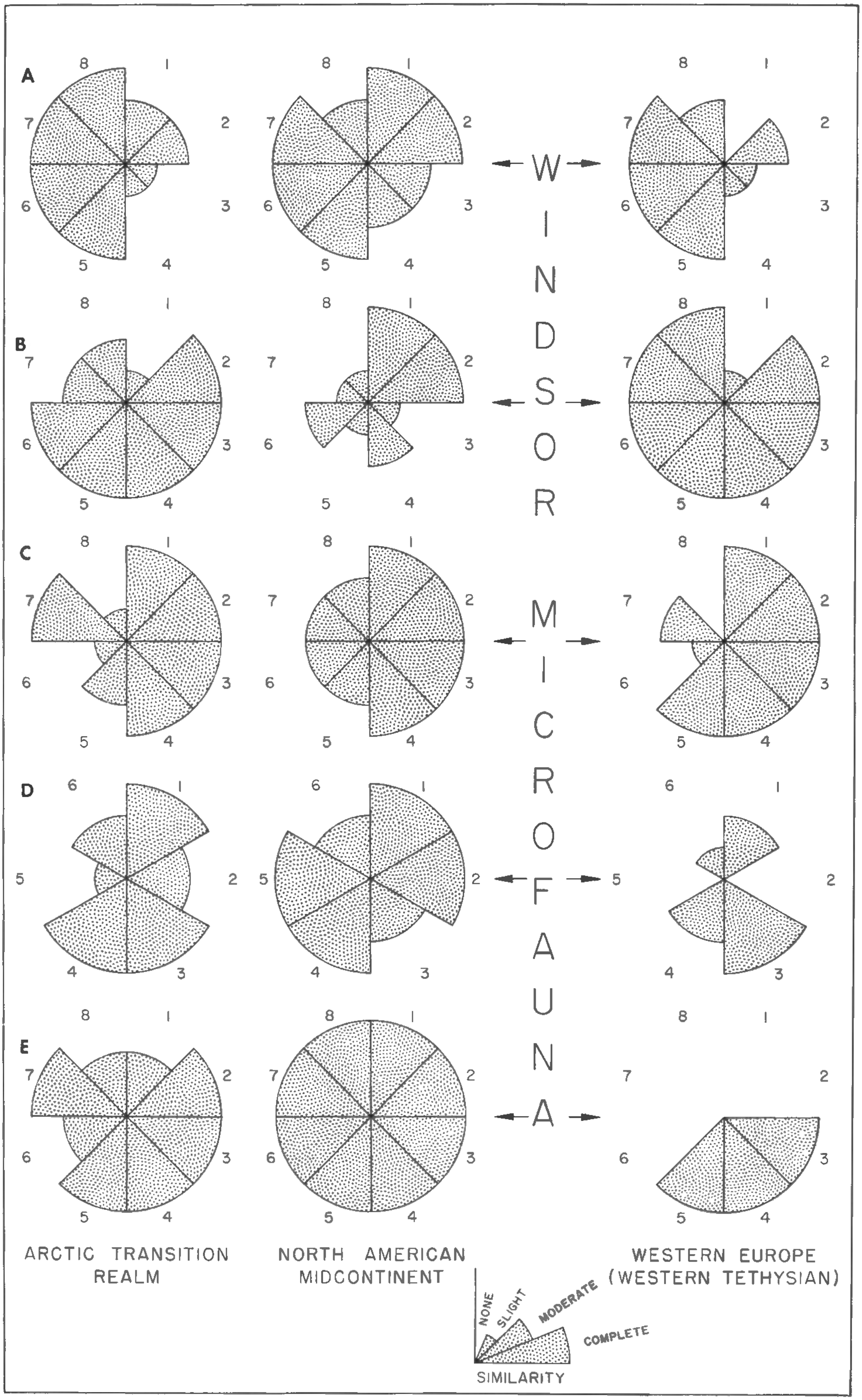
A - Archaediscidae.
1) *Archaediscus karreri* Brady.
2) *Archaediscus* of the group *A. krestovnikovi* Rauzer-Chernoussova.
3) *Archaediscus* of the group *A. moelleri* Rauzer-Chernoussova.
4) *Archaediscus* of the group *A. chernoussovensis* Mamet.
5) *Asteroarchaediscus* of the group *A. baschkiricus* (Krestovnikov and Teodorovitch).
6) *Neoarchaediscus* sp.
7) *Neoarchaediscus* of the group *N. incertus* (Grozdilova and Lebedeva).
8) *Planospirodicus* sp.

B - Primitive Bradyinidae and Palaeotextulariidae.
1) *Endothyranopsis* sp.
2) *Endothyranopsis compressa* (Rauzer-Chernoussova and Reitlinger).
3) *Endothyranopsis crassa* (Brady).
4) *Endothyranopsis sphaerica* (Rauzer-Chernoussova and Reitlinger).
5) *Cribrostomum* sp. and *Coskinotextularia* sp.
6) *Climacammina* and *Coskinobigenerina* sp.
7) *Paleotextularia* of the group *P. consobrina* Lipina.
8) *Palaeotextularia* of the group *P. longiseptata* Lipina.

C - Endothyridae.
1) *Endothyra* sp.
2) *Endothyra* of the group *E. bowmani* Phillips *in* Brown *emend* Brady.
3) *Endothyra* of the group *E. prisca* Rauzer-Chernoussova and Reitlinger.
4) *Endothyra* of the group *E. similis* Rauzer-Chernoussova and Reitlinger.
5) *Eoendothyranopsis* sp.
6) *Globoendothyra* sp.
7) *Globoendothyra* of the group *G. globulus* d'Eichwald.
8) *Omphalotis* sp.

D - Eostaffellidae and Pseudoenthyrydae.
1) *Eostaffella* sp.
2) *Eostaffella?* of the group *E. discoidea* (Girty).
3) *Eostaffella* of the group *E. radiata* (Brady).
4) *Loeblichia* sp.
5) *Mediocris* sp.
6) *Pseudoendothyra* sp.

E - Tetrataxidae.
1) *Howchinia* sp.
2) *Howchinia bradyina* (Howchin)
3) *Tetrataxis* sp.
4) *Tetrataxis* of the group *T. conica* Ehrenberg *emend* von Möller.
5) *Tetrataxis?* of the group *T?. eominima* Rauzer-Chernoussova.
6) *Valvulinella* sp.
7) *Valvulinella youngi* (Brady).
8) *Vissariotaxis* sp.


A
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1
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WINDSOR
MICROFAUNA
ARCTIC TRANSITION REALM
NORTH AMERICAN MIDCONTINENT
WESTERN EUROPE (WESTERN TETHYSIAN)
NONE
SLIGHT
MODERATE
COMPLETE
SIMILARITY

Faunal Realms of the Northern Hemisphere at the Visean-Namurian Boundary

After having reviewed the paleobiological dispersion of the Late Visean-Early Namurian Foraminifera, we are now able to distinguish three types of faunal distribution patterns:

1) Ubiquitous fauna dispersed over all of the Northern Hemisphere (cosmopolitan in the broad sense), e. g.
   Asteroarchaediscus of the group A. baschkiricus
   Endothyranopsis
   Neoarchaediscus, etc.

2) Tethian eurasiatic fauna usually in Europe, North Africa and Central Asia., e. g.
   Loeblichia
   Valvulinella

3) Fauna mainly abundant in North America, e. g.
   Eoendothyranopsis
   Eostaffella? discoidea, etc.

The existence of "cosmopolitan" forms proves that free communications existed among all Carboniferous basins of the Northern Hemisphere (Mamet, 1962). These free communications, coupled with extensive development of carbonate platforms, eliminated true provincialism and facilitated excellent dispersal of vagrant benthonic fauna. Hence, the zonation of Eurasia can be applied to North America and vice versa. Parts of the fauna are endemic, however, and allow recognition of three paleobiologic realms; a Tethyian realm, a North American realm, and a transitional Siberian-Alaskan realm. These realms can be further subdivided in subrealms (for instance the North American realm can be divided in Cordilleran, Midcontinent and Appalachian subrealms). However, all of these realms and subrealms are freely connected and the zonations of their basins are united by a single scheme. With this paleobiologic scheme in mind, we can now investigate the provenance of the Windsor fauna.

Origin and Affinities of the Windsor Microfauna

The similarity between the fauna of the Maritime Provinces and that of Northern Europe has already been stressed by Bell (1929) and Lewis (1935). Stacy (1954) proposed a similar distribution, but the resemblances of the Windsor to the Midcontinent were also pointed out. Identical conclusions were reached by Globensky (1967), who observed that the Windsor conodonts formed a "bridge" between the American Midcontinent and Europe.

Careful study of the calcareous Foraminifera of the Windsor however suggests a number of considerations which depart slightly from the preceding hypothesis. It is obvious that the Windsor Group fauna contains many microfaunal elements which were originally described from England, Belgium, or Germany, but this similarity does not imply that this fauna element migrated directly from Western Europe to the Maritimes or vice versa.

Moreover, it is important to recall that the basin from which a taxon was first described is not necessarily the basin from which the form originated[1]. Finally, our knowledge of biostratigraphy has been restricted up to now to that of highly populated, technologically advanced nations; recent advances in the stratigraphy of the Arctic, Northern Siberia, and Asia are modifying many of our concepts established for other basins. We must therefore re-evaluate the basis for our arguments.

As we have seen, most of the foraminifers common to Europe and the Maritimes are also found in the American Cordillera, in the Arctic Islands, Northern Siberia, and most of the U. S. S. R. Hence the similarity of the Maritimes with Western Europe is related to the unity of phylogeny observed in Eurasia-North America, but does not imply particularly easy communication through the palaeo-Atlantic.

Figure 15 compares, family by family and taxon by taxon, the Windsor microfauna to that known at the same stratigraphic level and in similar environment in Western Europe, the North American Midcontinent, and the Alaska-Siberian transitional realms. The similarity of distribution of a given taxon between the Windsor and these three regions is expressed as nil, slight or probable, moderate, and complete.

Fifteen rose-diagrams are presented for the seven most important families. The Windsor Endothyridae are equally similar to those of the Midcontinent, the Arctic or Western Europe. On the other hand the Windsor Archaediscidae, Eostaffellidae, Pseudoendothyridae and Tetrataxidae are obviously related to the Midcontinent and the Arctic and have little similarity with Europe. The Palaeotextularidae and Bradyinidae have a close resemblance with the Arctic and Europe, while they have little in common with the Midcontinent craton.

In conclusion, the Windsor microfacies is more similar to that of the Arctic and American realms than to that of the Western Tethysian realm, although comparison of the individual families gives a rather different picture.

Although it is conceivable that the families migrated separately, they are all phylogenically linked (the Tetrataxidae originated from the Endothyridae in Late Tournaisian time, the Eostaffellidae and Pseudoendothyridae in Early Visean, the Bradyinidae in Middle Viséan, etc.) and their order of appearance is fairly constant in all of the Northern Hemisphere. Therefore it seems plausible that the fauna should be treated as a single entity; if this view is correct, the Windsor fauna is more American or Arctic in character than it is European, and its similarity with the Tethyian realm is mainly due to the presence of cosmopolitan forms.

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[1] Most of the so-called "Western European" faunas are truly Central Eurasiatic in origin; see Mamet and Skipp, in press.

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APPENDIX

Figure 16. Distribution of microfauna and microflora by locality (see also Figs. 1 and 2).

	67 to 73	66	56 to 65	55	54	53	52	51	50	50	50	50	50	50	50	50	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	20	20	19	18	17	16	16	16	16	15	14	13	12	11	10	9	8	8	8	8	7	6	5	4	3	2	1		LOCALITY
	82305 to 82311	82304	82294 to 82303	82293	82292	82291	82290	82289	82288	82287	Ac.U. WP 1-2	Ac.U. MR 1-5	82286	Ac.U. DAN 1-4	82285	Ac.U. a	82284	82283	82282	82281	82280	27595	27594	27596	82279 to 27597	82278	82277	82276	82275	82274	82273	82272	82271	82270	82269	82268	82267	82266	82265	82264	82263	82262	82261	82260	82259	82258	82257	82256	82255	82254	82253	82252	82351	82313	82250	82249	82248	82247	82246	82245	82244	82312	82243	82242	82241	82240	82239	82238	82237	82236	82235	82234	82233	82232		
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59									×	×	×		×			×	×	×																										×		×															×						×							59	Vicinesphaera sp.

APPENDIX

Geological Survey of Canada locality register for collections indicated on Figure 1 (see Fig. 16).

1) GSC loc. 82232 (Bay St. Lawrence). East shore of Bay St. Lawrence, 3000 feet northeast of the wharf, Victoria Co., Cape Breton Island (Neale, 1956).

   Stratigraphic level: undetermined subzone.

   Microfacies: Four thin sections; quartz bearing, spongiostromid micrite with scattered biotite; Foraminifera, not observed; age, undetermined.

2) GSC loc. 82233 (Dingwall). Shore of Aspy Bay, at the end of the road from Dingwall, Victoria Co., Cape Breton Island (Stacy, 1953, p. 52).

   Stratigraphic level: undetermined subzone.

   Microfacies: Three thin sections; completely recrystallized, dolomitized, quartz bearing micrite; Foraminifera, not observed; age, undetermined.

3) GSC loc. 82234 (South Harbour). South Point, near YellowHead, Victoria Co., Cape Breton Island (Neale, 1955).

   Stratigraphic level: undetermined subzone.

   Microfacies: Seven thin sections; highly recrystallized, "reefoid" sparite; Foraminifera, very scarce, mostly as ghosts; age, undetermined Viséan zone.

4) GSC loc. 82235 (Pleasant Bay). Approximately 1000 feet southwest of the main wharf at Pleasant Bay, Inverness Co., Cape Breton Island (Neale, 1955; Globensky, 1967, p. 437).

   Stratigraphic level: C subzone.

   Microfacies: Three thin sections; fine-grained dolomitic limestone and recrystallized biopelsparite; Foraminifera, scarce; age, undetermined Visean zone.

5) GSC loc. 82236 (Belle Marche). Old gypsum quarry at Belle Marche, two miles east of Cheticamp, Inverness Co., Cape Breton Island (MacLaren, 1956; Globensky, 1967, p. 437).

   Stratigraphic level: undetermined subzone.

   Microfacies: Five thin sections; dolomitized, vuggy, pelmatozoan bearing sparite; Foraminifera, not observed; age, undetermined.

6) GSC loc. 82237 (Rocky Bay). Shore of Rocky Bay, two miles north of Ingonish, Victoria Co., Cape Breton Island (MacLaren, 1956).

   Stratigraphic level: undetermined subzone.

6) Microfacies: Six thin sections; dolomitized and recrystallized spongiostromid packstone; Foraminifera, very scarce, mostly as ghosts; age, undetermined Visean zone.

7) GSC loc. 82238 (Skir Dhu). Section between Briton Cove and Skir Dhu, Victoria Co., Cape Breton Island (Goudge, 1934, p. III; Globensky, 1967, p. 437).

Stratigraphic level: C or E subzone?

Microfacies: Eight thin sections; dolomitized sparite and dolomite; dolomitized spongiostromid biosparite; Foraminifera, scarce, mostly as ghosts; age, undetermined Visean zone.

8a) GSC loc. 82239 (Cape Dauphin). Section one mile to the north of Cape Dauphin village, Victoria Co., Cape Breton Island (Stacy, 1953, pp. 36-38; Sage, 1954, pp. 58-59; Bell, 1958, p. 151; Globensky, 1967, p. 137).

Stratigraphic level: Third Algal (this level was reported as "Lower Windsor" by Sage and Stacy, while Bell had doubts concerning the correctness of this identification. The microfacies points to a Late Windsor age).

Microfacies (Pl. IV, Fig. 7): Approximately seventy-five thin sections; dolomitized and recrystallized biomicrites, dolomitized "reefoid" fibrous sparite and recrystallized micrite; Foraminifera, scarce to present; age, Latest Visean (zone 16 sup.).

8b) GSC loc. 82240 (Cape Dauphin).

Stratigraphic level: Third Algal Limestone.

Microfacies: Approximately 30 thin sections; dolomitized recrystallized sparite and dolomite; Foraminifera, not observed; age, undetermined.

8c) GSC loc. 82241 (Cape Dauphin).

Stratigraphic level: Giant Ripple Limestone.

Microfacies (Pl. VII, Figs. 11, 13, 14): Approximately forty thin sections; dolomitized, recrystallized spongiostromid sparite and spongiostromid packstone; Foraminifera; present to abundant; age, Latest Visean (zone 16 sup.).

8d) GSC loc. 82242 (Cape Dauphin).

Stratigraphic level: Schizodus Limestone.

Microfacies (Pl. I, Figs. 5,7,9,10, Pl. III, Figs. 5,9, Pl. IV, Fig. 18, Pl. XIX, Figs. 1-3): Approximately fifty thin sections; gypsiferous dolomite, recrystallized and dolomitized biomicrite, scarce oolitic packstone; Foraminifera, present; age, Early Namurian (zone 17).

9) GSC loc. 82243 (Kelly Cove): Outcrop on the southern side of the road, at Kelley Cove, north of New Campbellton, Victoria Co., Cape Breton Island (Globensky, 1967, p. 437).

Stratigraphic level: Schizodus Limestone.

Microfacies (Pl. IV, Figs. 15-16): Approximately a dozen thin sections; quartz bearing spongiospomid biosparite and biomicrite; recrystallized pelsparite; Foraminifera, present; age, undetermined.

10) GSC loc. 82312 (Saunders Cove).

Stratigraphic level: C subzone.

Microfacies (Pl. I, Fig. 8): Ten thin sections; recrystallized spongiostromid packstone; Foraminifera, scarce; age, undetermined Visean zone.

11) GSC loc. 82244 (Edwardsville). Dominion Steel and Iron Corporation Quarry, Edwardsville, Cape Breton Island (Goudge, 1934, pp. 30-32; Wood, 1943, p. 221).

Stratigraphic level: Oolitic Limestone (B subzone).

Microfacies (Pl. I, Figs. 1-4, 6, 11, Pl. II, Figs. 1-5, 8, Pl. IV, Fig. 2, Pl. VII, Figs. 1-3, 5, 6, Pl. VIII, Fig. I, Pl. IX, Figs. 1-3, Pl. X, Figs. 1, 3): Sixty-six thin sections; oolitic, dasycladacean-bearing packstone, wackestone, grainstone and calcirudite; Foraminifera, present; age, Middle Late Visean (zone 15).

12) GSC loc. 82245 (East Bay). Outcrop on the East shore of Sydney River, three miles from Sydney Forks on the Meadows Road, Cape Breton Island (Goudge, 1934, p. 29).

Stratigraphic level: B subzone.

Microfacies: Approximately a dozen thin sections; slightly to highly recrystallized spongiostromid packstone with sparite cement; recrystallized "reefoid" algal packstone; Foraminifera, present; age, Middle Late Visean (zone 15).

13) GSC loc. 82246 (Doherty Cove). Doherty Cove, one mile west of Scotsville, Inverness Co., Cape Breton Island (Norman, 1935).

Stratigraphic level: Schizodus Limestone.

Microfacies (Pl. IV, Figs. 8-9): Fifteen thin sections; quartz bearing, recrystallized, biomicrite; Foraminifera, present; age, Earliest Namurian (zone 17).

14) GSC loc. 82247 (Lake Ainslie). Outcrop and quarry north of Twin Rock Valley Farm, Inverness Co., Cape Breton Island.

Stratigraphic level: Horton Group?

14) Microfacies: Forty thin sections; quartz bearing, intraclastic, oolitic packstone, with dolomitic, micritic and pelmatozoan debris; Foraminifera, extremely scarce; age, undetermined Visean zone.

15) GSC loc. 82248 (Mabou). Outcrop south of Mabou River Bridge, southwest of Mabou, Inverness Co., Cape Breton Island (Norman, 1935; Stacy, 1953, pp. 40-42).

Stratigraphic level: A subzone?

Microfacies (Pl. IV, Fig. 6): Three thin sections; algal micrite and recrystallized pelmatozoan biomicrite; Foraminifera, very scarce; age, Middle Late Visean? (zone 15).

16a) GSC loc. 82249 (Port Hood Island). Outcrop on the north shore of the Island (Stacy, 1953, pp. 31-36; Globensky, 1967, p. 438).

Stratigraphic level: First and Second Oolitic Limestone.

Microfacies: Sixteen thin sections; highly recrystallized, dolomitized oolitic packstone; Foraminifera, scarce, as ghosts; age, Middle Late Visean (zone 15).

16b) GSC loc. 82250 (Port Hood Island).

Stratigraphic level: Third Algal Limestone.

Microfacies (Pl. VII, Figs. 16,21): Approximately thirty thin sections; recrystallized biomicrite, spongiostromid biosparite and spongiostromid packstone; rare oolites; Foraminifera, present; age, latest Visean (zone 16 sup.).

16c) GSC loc. 82313 (Port Hood Island).

Stratigraphic level: Giant Ripple Limestone.

Microfacies (Pl. XII, Fig. 3, Pl. XIII, Figs. 1,2): Approximately twenty thin sections; recrystallized biosparite and oolitic packstone and grainstone; Foraminifera, present; age, latest Visean (zone 16 sup.).

16d) GSC loc. 82351 (Port Hood Island).

Stratigraphic level: Schizodus Limestone.

Microfacies (Pl. XVII, Fig. 3): Approximately fifty thin sections; recrystallized, dolomitized biomicrite; rare oolitic packstone, and grainstone; Foraminifera, present to common; age, Early Namurian (E 1 zone) (zone 17).

17) GSC loc. 82252 (Irish Cove). West shore of Bras d'Or Lake, at Irish Cove; in the bank of MacNeil Brook, east of the highway bridge (Bell and Goranson, 1938).

Stratigraphic level: B subzone.

17) Microfacies: Four thin sections; recrystallized and dolomitized, spongiostromid-brachiopod-algal "reefoid" biosparite; Foraminifera, scarce; age, undetermined late Visean zone.

18) GSC loc. 82253 (Johnstown Quarry). Johnstown village, on the south shore of Bras d'Or Lake, Richmond Co., Cape Breton Island (Stacy, 1953, pp. 39, 52; Globensky, 1967, p. 438).

Stratigraphic level: B subzone.

Microfacies: Nine thin sections; recrystallized, dolomitized "reefoid" biosparite; Foraminifera, scarce.

19) GSC loc. 82259 (Monastery Brook). Outcrops near the St. Augustine Monastery, along the Monastery Brook, Antigonish Co., Nova Scotia (Sage, 1954, pp. 55-57 and Fig. 11).

Stratigraphic level: B subzone.

Microfacies: Fifteen thin sections; dolomitized oolite and dolomite; Foraminifera, very scarce; age, undetermined.

20a) GSC loc. 82255 (Pomquet River). Outcrops along the Pomquet River, downstream of Meadow Green, Antigonish Co., Nova Scotia (Sage, 1953, pp. 51-55, Fig. 9).

Stratigraphic level: Canary Limestone.

Microfacies: Approximately twenty sections; slightly recrystallized, spongiostromid bearing micrite and biomicrite; Foraminifera, very scarce; age, undetermined late Visean zone (probably Middle Late Visean, zone 15?).

20b) GSC loc. 82256 (Pomquet River).

Stratigraphic level: Third Algal Limestone.

Microfacies: Six thin sections; recrystallized spongiostromid packstone; Foraminifera, very scarce, as ghosts; age, undetermined Visean zone.

20c) GSC loc. 82257 (Pomquet River).

Stratigraphic level: Schizodus Limestone.

Microfacies: Three thin sections; recrystallized biomicrite; Foraminifera, present; age, Early Namurian, zone 17.

21) GSC loc. 82258 (Williams Point I). Outcrop east of the Transcanadian Highway and Williams Point road intersection, Antigonish Co., Nova Scotia (Sage, 1953, Map 1).

Stratigraphic level: Schizodus Limestone.

Microfacies (Pl. III, Figs. 1,2,7, Pl. IV, Fig. 2, Pl. V, Figs. 4-7, Pl. VI, Figs. 1-12, Pl. VII, Figs. 4,7,8,12,19,22, Pl. XVI, Fig. 1, Pl. XVIII, Figs. 1-3). Three

21) thin sections; recrystallized biomicrite and quartz bearing, slightly recrystallized biomicrite; Foraminifera, abundant; age, Early Namurian, zone 17.

22) GSC loc. 82259 (Monk Pond). Outcrop west of Monk Pond, Antigonish Co., Nova Scotia (Sage, 1954, p. 48 and Map 1).

Stratigraphic level: Schizodus Limestone.

Microfacies: Four thin sections; dolomitized, recrystallized biomicrite; detrital quartz present; Foraminifera, rare; age, Early Namurian, zone 17.

23) GSC loc. 82260 (Monks Head). Outcrop along Monks Head Point, one mile north of Monks Head village, Antigonish Co., Nova Scotia (Sage, 1954, pp. 46-48, Fig. 7).

Stratigraphic level: Giant Ripple Limestone.

Microfacies (Pl. IV, Fig. 14, Pl. VII, Fig. 15): A dozen thin sections; recrystallized pelmatozoan biomicrite and oolitic packstone; Foraminifera, present; age, latest Visean; zone 16 sup.

24) GSC loc. 82261 (Crystal Cliffs). Outcrop one mile north of Crystal Cliffs village (Sage, 1954, pp. 39-40).

Stratigraphic level: Ribbon Limestone.

Microfacies: Three thin sections; spongiostromid bearing biomicrite; Foraminifera, very scarce; age, undetermined Visean zone.

25) GSC loc. 82262 (Fairmont road Quarry). Abandoned quarry, one and a half miles north of Antigonish, Antigonish Co., Nova Scotia (Sage, 1954, pp. 42-43).

Stratigraphic level: Ribbon Limestone.

Microfacies: Seven thin sections; recrystallized and dolomitized biomicrite; Foraminifera, not observed; age, undetermined.

26) GSC loc. 82263 (Milk Plant). Road-cut north of Antigonish Milk Plant, Antigonish Co., Nova Scotia (Sage, 1954, p. 41, Fig. 5).

Stratigraphic level: Schizodus Limestone.

Microfacies (Pl. V, Fig. 3, Pl. XVI, Figs. 2, 3). Approximately forty-five thin sections; quartz bearing recrystallized biomicrite; Foraminifera, abundant; age, earliest Namurian, zone 17.

27) GSC loc. 82264 (West River). Outcrops along a small stream tributary of the West River, one mile south of Antigonish, Antigonish Co., Nova Scotia (Sage, 1954, p. 37, Fig. 4).

Stratigraphic level: Giant Ripple Limestone.

27) Microfacies: Seven thin sections; dolomitized, recrystallized biosparite and dolomite; Foraminifera, not observed; age, undetermined.

28) GSC loc. 82265 (Pomquet River Drillhole). Drillhole between St. Andrews and Pomquet Fork, north of Pomquet River, Antigonish Co., Nova Scotia (Sage, 1954, Map 1).

Stratigraphic level: Unknown.

Microfacies: Approximately twenty-five thin sections; recrystallized algal, spongiostromid "reefoid" limestone; Foraminifera, very scarce; age, undetermined Visean zone.

29) GSC loc. 82266 (Southside). Outcrop at the hamlet of Southside, Antigonish Harbour, Antigonish Co., Nova Scotia (Sage, 1954, Map 1).

Stratigraphic level: Giant Ripple Limestone.

Microfacies: Two thin sections; bioclastic, oolitic packstone; Foraminifera, present; age, latest Visean, zone 16 sup.

30) GSC loc. 82267 (Williams Point II). Outcrop at a saddle, 0.4 mile east of point 21, Antigonish Co., Nova Scotia (Sage, 1954, Map 1).

Stratigraphic level: Oolitic Limestone.

Microfacies: Five thin sections; recrystallized "reefoid" fibrous sparite; Foraminifera, scarce; age, Middle Late Visean, zone 15.

31) GSC loc. 82268 (South River Station). Outcrop 0.9 mile north of South River Station, Antigonish Co., Nova Scotia (Sage, 1954, Map 1).

Stratigraphic level: Schizodus Limestone.

Microfacies: Four thin sections; recrystallized biomicrite; Foraminifera, present; age, Early Namurian, zone 17.

32) GSC loc. 82269 (Knoydart). Outcrop on the sea-coast at Knoydart village, Antigonish Co., Nova Scotia (Globensky, unpublished Ph. D. thesis).

Stratigraphic level: undetermined subzone.

Microfacies: Eight thin sections; recrystallized oolitic packstone; Foraminifera, present; age, latest Visean, zone 16.

33) GSC loc. 82270 (Eureka). Outcrop on the West Branch River, immediately south of Eureka bridge, Pictou Co., Nova Scotia (Goudge, 1934, p. 97).

Stratigraphic level: Schizodus Limestone.

Microfacies: (Pl. IV, Fig. 10, Pl. XVII, Figs. 1, 2).

34) GSC loc. 82271 (Springville). Abandoned quarry at Springville, Pictou Co., Nova Scotia (Goudge, 1934, p. 97).

34) Stratigraphic level: C subzone.

Microfacies (Pl. IV, Figs. 1,2,13,17, Pl. XI, Fig. 2): Twenty-three thin sections; recrystallized biomicrite and packstone; Foraminifera, present; age, Early Latest Visean, zone 16 inf.

35) GSC loc. 82272 (Sunnybrae). Exposure along East River, upstream from bridge at Sunnybrae, Pictou Co., Nova Scotia (Goudge, 1934, p. 98).

Stratigraphic level: C subzone?

Microfacies: Four thin sections; recrystallized and dolomitized, pelmatozoan biosparite; Foraminifera, not observed; age, undetermined.

36) GSC loc. 82273 (Black Rock). Outcrop at the mouth of the Shubenacadie River, near Black River village, Colchester Co., Nova Scotia (Stevenson, 1958, pp. 25-26).

Stratigraphic level: Contorted Beds, A subzone?

Microfacies: Two thin sections; recrystallized, dolomitized biosparite with pelmatozoan ghosts; Foraminifera, not observed; age, undetermined.

37) GSC loc. 82274 (Beaver Brook). Outcrop in Beaver Brook River, 0.5 mile east of Beaverbrook village, Colchester Co., Nova Scotia (Globensky, 1967, p. 438).

Stratigraphic level: B subzone.

Microfacies: Six thin sections; quartz bearing recrystallized, slightly dolomitized, argillaceous sparite; Foraminifera, not observed; age, undetermined.

38) GSC loc. 82275 (Admiral Rock). Wooded knoll, on the west bank of the Shubenacadie River, 1.5 miles south of Admiral Rock village, Hants Co., Nova Scotia (Stevenson, 1959, p. 24).

Stratigraphic level: B subzone.

Microfacies: Three thin sections; spongiostromid biomicrite, spongiostromid packstone and "reefoid" fibrous sparite; Foraminifera, very scarce; age, undetermined.

39) GSC loc. 82276 (Mill village). Exposure along the Micmac Road 200 feet from its junction with Mill village road, Hants Co., Nova Scotia (Globensky, 1967, p. 438).

Stratigraphic level: C subzone.

Microfacies: Two thin sections; recrystallized spongiostromid packstone; Foraminifera, scarce; age, undetermined.

40) GSC loc. 82277 (East River I): Abandoned quarry one mile south of East River Railroad Station, Lunenburg Co., Nova Scotia (Sage,1954, p. 29, Fig. 3).

40) Stratigraphic level: B subzone.

Microfacies: Three thin sections; recrystallized "reefoid" fibrous sparite; Foraminifera, present; age, undetermined.

41) GSC *loc.* 82278 (East River II). Abandoned quarry 0.9 mile southeast of East River Railway Station, Lunenburg Co., Nova Scotia (Sage, 1954, p. 29, Fig. 3).

Stratigraphic level: Maxner Limestone, B subzone.

Microfacies: Three thin sections; recrystallized "reefoid" fibrous sparite; Foraminifera, present; age, undetermined.

42) GSC *loc.* 82279, 16824 and 27597 (Sheep Island). Boulders along the shore of Sheep Island, Mahone Bay, Lunenburg Co., Nova Scotia (Sage, 1954).

Stratigraphic level: *Gigantroproductus* beds.

Microfacies (Pl. IV, Fig. 3, Pl. V, Figs. 2, 8, Pl. XIV, Fig. 1): A dozen thin sections; slightly recrystallized biomicrite; Foraminifera, abundant; age, latest Visean, zone 16 sup.

43) GSC *loc.* 27596 (Goat Island I). Boulder on the shore of Goat Island, Mahone Bay, Lunenburg Co., Nova Scotia.

Stratigraphic level: *Gigantoproductus* beds.

Microfacies (Pl. III, Fig. 8, Pl. IV, Figs. 4, 5): Seven thin sections; slightly recrystallized biomicrite; Foraminifera, abundant; age, latest Visean, zone 16 sup.

44) GSC *loc.* 27594 (Mahone Bay). Boulder on the shore of Mahone Bay, Lunenburg Co., Nova Scotia.

Stratigraphic level: *Gigantoproductus* beds.

Microfacies (Pl. V, Fig. 1, Pl. XIV, Fig. 2): Five thin sections; recrystallized biomicrite; Foraminifera, abundant; age, latest Visean, zone 16 sup.

45) GSC *loc.* 27595 (Seaboyer's). Boulder at Seaboyer's, south of Deep Cove, Lunenburg Co., Nova Scotia.

Stratigraphic level: *Gigantoproductus* beds.

Microfacies (Pl. III, Figs. 4, 6, 10, Pl. V, Fig. 9, Pl. XIV, Fig. 3, Pl. XV, Fig. 3): A dozen thin sections; slightly recrystallized biomicrite and impure packstone; Foraminifera, abundant; age, latest Visean, zone 16 sup.

46) GSC *loc.* 82280 (Gaetz Cove). Boulder at Gaetz Cove, east shore of Mahone Bay, Lunenburg Co., Nova Scotia (Sage, 1954).

Stratigraphic level: *Gigantoproductus* beds.

Microfacies: One thin section; recrystallized biomicrite; Foraminifera, abundant; age, latest Visean, zone 16 sup.

47) GSC loc. 82281 (Rouse Island). Boulder on the shore of Rouse Island, Mahone Bay, Lunenburg Co., Nova Scotia (Sage, 1954).

Stratigraphic level: Gigantoproductus beds.

Microfacies: Five thin sections; slightly recrystallized biomicrite; Foraminifera, abundant; age, latest Visean, zone 16 sup.

48) GSC loc. 82282 (Goat Island II). Boulder on the shore of Goat Island, Mahone Bay, Lunenburg Co., Nova Scotia (Sage, 1954).

Stratigraphic level: Gigantoproductus beds.

Microfacies: Six thin sections; recrystallized biomicrite; Foraminifera, abundant; age, latest Visean, zone 16 sup.

49) GSC loc. 82283 (Redman Hills). Outcrop at Redman Hills, St. Margaret's Bay, Lunenburg Co., Nova Scotia (Sage, 1954).

Stratigraphic level: B subzone.

Microfacies: Three thin sections; biomicrite and intrabiomicrite; Foraminifera, present; age, Middle Late Visean, zone 15.

50a) GSC loc. 82284 (Windsor). Type locality of the Windsor Group. Outcrops located along the Avon River, in the vicinity of Windsor, Hants Co., Nova Scotia (Bell, 1929, pp. 47-54; Bell, 1958, pp. 77-79, Globensky, 1967, p. 438; Moore, 1967, pp. 245-266).

Stratigraphic level: B subzone. Miller and Maxner Limestones (type locality).

Microfacies (Pl. VIII, Figs. 2, 3): A dozen thin sections; slightly recrystallized biomicrite "reefoid" brachiopod-bearing fibrous biosparite, and spongiostromid-brachiopod-palmatozoan packstone; Foraminifera, uncommon; age, Middle Late Visean, zone 15.

50b) Acadia University Collection. Avondale Quarry (Windsor).

Stratigraphic level: B subzone.

Microfacies: A dozen thin sections; recrystallized biopelmicrite and bioclastic grainstone; Foraminifera, scarce; age, Middle Late Visean, zone 15.

50c) GSC loc. 82285 (Windsor).

Stratigraphic level: Lower part of the C subzone. Herbert River Limestone (type locality).

Microfacies (Pl. XI, Figs. 1, 3): Approximately twenty-six thin sections; recrystallized biomicrite, biopelmicrite and oolitic packstone; Foraminifera, present; age, Early latest Visean, zone 16 inf.

50d) Acadia University Collection. Dan 1-4 (Windsor).

50d) Stratigraphic level: C subzone. Brooklin Station Limestone (type section).

Microfacies: A dozen thin sections; recrystallized to highly recrystallized, oolitic, packstone and grainstone; Foraminifera, very scarce; age, undetermined late Visean zone.

50e) GSC loc. 82286 (Windsor).

Stratigraphic level: Avon Limestone, subzone D.

Microfacies (Pl. VII, Figs. 9, 10, 17, Pl. XIII, Fig. 3, Pl. XII, Fig. 1): A dozen thin sections; biomicrite, pelmatozoan biosparite, spongiostromid bioclastic biosparite, and lump bearing oolitic packstone; Foraminifera, abundant; age, latest Visean, zone 16 sup.

50f) Acadia University Collection. MR 1-5 (Windsor).

Stratigraphic level: D subzone. Meander River Limestone (type section).

Microfacies: Approximately thirty thin sections; oolitic packstone and grainstone, biomicrite and recrystallized fibrous biomicrite sparite; Foraminifera, scarce; age, latest Visean; zone 16 sup.

50g) Acadia University Collection. WP 1-2 (Windsor).

Stratigraphic level: Subzone D. Wallace Point Limestone. Avon River.

Microfacies (Pl. XII, Fig. 2): Approximately 24 thin sections; recrystallized biomicrite and quartz bearing recrystallization biosparite and wackestone; Foraminifera, present; age, latest Visean, zone 16 sup.

50h) GSC loc. 82287 (Windsor).

Stratigraphic level: Basal part of the Kennetcook Limestone (basal E subzone).

Microfacies (Pl. XV, Figs. 1, 2): Approximately twenty thin sections; recrystallized biomicrite and sparitic packstone; Foraminifera, present to abundant; age, latest Visean, zone 16 sup.

50i) GSC loc. 82288 (Windsor).

Stratigraphic level: Upper part of the Kennetcook Limestone (upper E subzone).

Microfacies (Pl. VII, Fig. 20): Approximately a dozen thin sections; biomicrite and quartz bearing biomicrite; Foraminifera, present to abundant; age, earliest Namurian, zone 17.

51) GSC loc. 82289 (Cheverie). 0.3 mile west of the wharf at Cheverie, Hants Co., Nova Scotia (Bell, 1929, p. 46, 1958, p. 79).

51) Stratigraphic level: A or B subzone.

Microfacies: Two thin sections; recrystallized "reefoid" fibrous sparite; Foraminifera, not observed; age, undetermined.

52) GSC loc. 82290 (Hillsborough). Outcrop 8,000 feet south of Hillsborough along Highway 14, thence 1,500 feet west. Alberta Co., New Brunswick (Goudge, 1934, p. 127).

Stratigraphic level: B subzone?

Microfacies: Three thin sections; highly recrystallized biomicrite with occasional oolites; Foraminifera, not observed; age, undetermined.

53) GSC loc. 82291 (Berrytown). Cliff on the West Turtle Creek, one mile south of Berrytown, Albert Co., New Brunswick (Hamilton,1965, pp. 67-68).

Stratigraphic level: B subzone.

Microfacies: Three thin sections; recrystallized biomicrite and "reefoid" fibrous sparite; Foraminifera, very scarce; age, undetermined.

54) GSC loc. 82292 (Parkindale). Exposure in a field, east of the road, 1.25 miles south of Parkindale, Albert Co., New Brunswick (Hamilton, 1965, p. 68).

Stratigraphic level: B subzone.

Microfacies: Two thin sections; spongiostromid packstone and biopelsparite; Foraminifera, scarce; age, undetermined Visean zone.

55) GSC loc. 82293 (Upper Goshen). Exposure in the woods near Upper Goshen, 5.6 miles west of Church Creek, King's Co., New Brunswick (Hamilton, 1965, p. 69).

Stratigraphic level: B subzone.

Microfacies: One thin section; recrystallized biomicrite and "reefoid" fibrous sparite; Foraminifera, scarce; age, undetermined Visean zone.

56) GSC loc. 82294 (Petitcodiac). Hughes Quarry, northeast of Petitcodiac, King's Co., New Brunswick (Goudge, 1934, p. 177; Hamilton, 1965, p. 72).

Stratigraphic level: B subzone.

Microfacies: Three thin sections; fine-grained, completely recrystallized sparite; Foraminifera, not observed; age, undetermined.

57) GSC loc. 82295 (Havelock). Havelock Lime Ltd., quarry at Havelock, King's Co., New Brunswick (Goudge, 1934, pp. 140-141; Hamilton, 1965, pp. 71-72).

57) Stratigraphic level: B subzone.

Microfacies: One thin section; completely recrystallized dolomitic sparite; Foraminifera, not observed; age, undetermined.

58) GSC loc. 82296 (Samp Hill). Exposure at Samp Hill, 2.9 miles south-southeast of Havelock, King's Co., New Brunswick (Goudge, p. 142).

Stratigraphic level: B subzone.

Microfacies: Two thin sections; completely recrystallized algal micrite; Foraminifera, not observed; age, undetermined.

59) GSC loc. 82297 (Cedar Camp). Exposure on a steep hill 1,200 feet south of Waterford-Cedar Camp (Hayes, 1927, p. 130c; Hamilton, 1965, p. 69).

Stratigraphic level: B subzone.

Microfacies: Two thin sections; recrystallized algal micrite and "reefoid" fibrous sparite; Foraminifera, not observed; age, undetermined.

60) GSC loc. 82298 (Picadilly). 0.3 mile north-northeast of Albertite, King's Co., New Brunswick (Hamilton, 1965, p. 69).

Stratigraphic level: B subzone?

Microfacies: Four thin sections; completely recrystallized, dolomitized sparite; Foraminifera, not observed; age, undetermined.

61) GSC loc. 82299 (Smith Creek). Exposure in a field 300 feet west of Plumwesleep-Mount Pisgah road, King's Co., New Brunswick (Globensky, unpublished Ph.D. thesis).

Stratigraphic level: B subzone.

Microfacies: Eight thin sections; quartz bearing, recrystallized and dolomitized sparite; Foraminifera, not observed; age, undetermined.

62) GSC loc. 82300 (Markhamville). Markhamville Mine 2,000 feet northeast of Markhamville, King's Co., New Brunswick (Hayes, 1927, p. 129).

Stratigraphic level: B subzone.

Microfacies: One thin section; recrystallized, micrite and "reefoid" fibrous sparite; Foraminifera, not observed; age, undetermined.

63) GSC loc. 82301 (Walker Settlement). Globe Mine, one mile north of Walker Settlement, King's Co., New Brunswick (Globensky, unpublished Ph.D. thesis).

Stratigraphic level: B subzone.

Microfacies: One thin section; recrystallized algal biomicrite; Foraminifera, not observed; age, undetermined.

64) GSC loc. 82302 (Roachville). Section three miles northwest of Sussex, King's Co., New Brunswick (Globensky, unpublished Ph. D. thesis).

Stratigraphic level: B subzone.

Microfacies: Three thin sections; recrystallized dolomite; Foraminifera, not observed; age, undetermined.

65) GSC loc. 82303 (Quaco Head). Exposure 1,500 feet north of Quaco Head Lighthouse, Saint John Co., New Brunswick (Hamilton, 1965, pp. 83-85).

Stratigraphic level: B subzone.

Microfacies: Three thin sections; recrystallized and dolomitic sparite with pelmatozoan ghosts; Foraminifera, not observed; age, undetermined.

66) GSC loc. 82304 (Upham). Outcrop at the Titusville-Upham and Branville-Upham road junction. King's Co., New Brunswick (Globensky, unpublished Ph. D. thesis).

Stratigraphic level: B subzone.

Microfacies: Three thin sections; recrystallized "reefoid" fibrous sparite; Foraminifera, scarce; age, undetermined Visean zone.

67) GSC loc. 82305 (Queenstown). Road cut one mile south of Queenstown, Queen's Co., New Brunswick (Goudge, 1934, p. 144).

Stratigraphic level: B subzone.

Microfacies: One thin section; recrystallized, spongiostromid bearing, "reefoid" sparite; Foraminifera, not observed; age, undetermined.

68) GSC loc. 82306 (Shin Creek). Exposure in the banks of Shin Creek, at German Settlement, Sunbury Co., New Brunswick (Globensky, unpublished Ph. D. thesis).

Stratigraphic level: B subzone.

Microfacies: Four thin sections; completely recrystallized dolomite; Foraminifera, not observed; age, undetermined.

69) GSC loc. 82307 (Mactaquac). Road-cut on Highway 2, at Mactaquac, York Co., New Brunswick (Anderson and Poole, 1959).

Stratigraphic level: Undetermined Windsor; probably equivalent to the B subzone?

Microfacies: Five thin sections; nonmarine quartz bearing micrite; age, undetermined.

70) GSC loc. 82308 (Stanley). Road-cut highway 25 A, 3 miles from Stanley village, York Co., New Brunswick (Anderson and Poole, 1959).

Stratigraphic level: Undetermined Windsor; probably equivalent to the B subzone?

70) Microfacies: One thin section; nonmarine calcareous arkose; age, undetermined.

71) GSC loc. 82309 (Waspke). John Day Quarry at Waspke, Victoria Co., New Brunswick (Goudge, 1934, p. 175).

Stratigraphic level: Undetermined Windsor; probably equivalent to the B subzone?

Microfacies: Five thin sections; nonmarine quartz bearing micrite; age, undetermined.

72) GSC loc. 82310 (Plaster Rock). Outcrop on the Tolique River, north of Plaster Rock Bridge (Goudge, 1934, p. 175; Hamilton, 1965, pp. 17-22).

Stratigraphic interval: Undetermined Windsor; probably equivalent to the B subzone.

Microfacies: Ten thin sections; nonmarine, quartz bearing micrite and calcareous sandstone; age, undetermined.

73) GSC loc. 82311 (Oxbow). Alton Quarry, south of Oxbow Lake, Victoria Co., New Brunswick (Goudge, 1934, p. 175; Hamilton,1964, p. 22).

Stratigraphic level: Undetermined Windsor; probably equivalent to the B subzone.

Microfacies: Three thin sections; brackish, quartz bearing micrite; age, undetermined.

PLATES I-XIX

MICROFOSSIL AND MICROFACIES SLIDES DEPOSITED IN THE NATIONAL TYPE FOSSIL COLLECTION, GEOLOGICAL SURVEY OF CANADA, OTTAWA, UNLESS OTHERWISE SPECIFIED

PLATE I

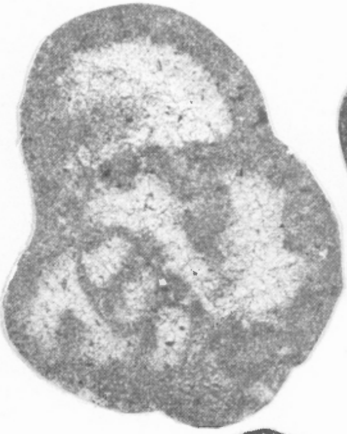
Figures 1-4, 6, 11	*Biseriammina? windsorensis* sp. nov.
Fig. 1	Paratype GSC No. 24869. High equatorial section, showing one coil.
Fig. 2	Paratype GSC No. 24870. Low, slightly oblique, equatorial section.
Fig. 3	Paratype GSC No. 24871. Oblique section showing one coil.
Fig. 4	Paratype GSC No. 24872. Oblique section showing the double coil.
Fig. 6	Paratype GSC No. 24873. Oblique axial section showing the double coil.
Fig. 11	Holotype. GSG No. 24874. Equatorial section showing the double row of four chambers in the last whorl.
	All figures from Edwardsville, subzone B, foraminiferal zone 15, GSC *loc.* 82244, 97 x.
Figure 5	Undetermined *Biseriamminidae.*
	Hypotype GSC No. 24875. One single axial section has been encountered of that form. The wall structure is that of *Biseriammina?* sp. but the fluted septa are characteristic of *Globivalvulina?* sp.
	Cape Dauphin, *Schizodus* Limestone subzone E, foraminiferal zone 17, GSC *loc.* 82242, 97 x.
Figure 7	*Endothyra* of the group *Endothyra prisca* Rauzer-Chernoussova and Reitlinger.
	Hypotype, GSC No. 24876. Equatorial section of a young specimen.
	Cape Dauphin, *Schizodus* Limestone, subzone E, foraminiferal zone 17, GSC *loc.* 82249, 97 x.
Figure 8	*Endothyra pseudobradyi* Braznikhova.
	Hypotype, GSC No. 24877. Slightly oblique equatorial section.
	Saunders Cove, subzone C, undetermined foraminiferal zone, GSC *loc.* 82312, 97 x.
Figures 9-10	*Endothyranella* sp.
Fig. 9	Hypotype, GSC No. 24878. Equatorial section.
Fig. 10	Hypotype, GSC No. 24879. Oblique, high equatorial section.
	Cape Dauphin, *Schizodus* Limestone, subzone E, foraminiferal zone 17, GSC *loc.* 82242, 97 x.

Plate I


1


2


3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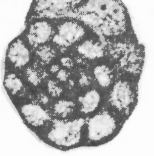
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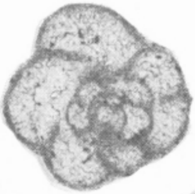
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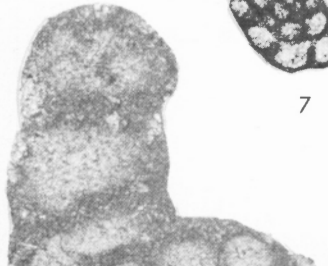
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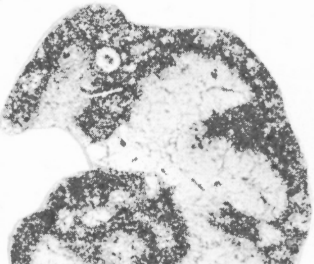
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PLATE II

Figures 1-5, 8	*Biseriammina? windsorensis* sp. nov.
Fig. 1	Paratype GSC No. 24880. High equatorial section.
Fig. 2	Paratype GSC No. 24881. Oblique axial section.
Fig. 3	Paratype GSC No. 24882. Very high equatorial section. Note the agglutination of a calcispherid in the wall.
Fig. 4	Paratype GSC No. 24883. Equatorial section.
Fig. 5	Paratype GSC No. 24884. Equatorial section.
Fig. 8	Paratype GSC No. 24885. Equatorial section of a young form.
	All material from Edwardsville, subzone B, foraminiferal zone 15, GSC *loc.* 82244, 21 x.
Figures 6, 7	Primitive *Globivalvulina?* sp.
	Hypotypes GSC No. 24886 and 24887. Axial and equatorial sections of primitive *Globivalvulina?* are included here for comparison with *Biseriammina?*. The axial section clearly shows the double trochoid spire and the fluted septa. The wall is secreted densely micritic and differs therefore from the typical Moscovian *Globivalvulina* sensu stricto.
	Ellesmere Island, foraminiferal zone 20, Namurian, courtesy of Dr. Thorsteinsson, 122 A, 148 x.

Plate II


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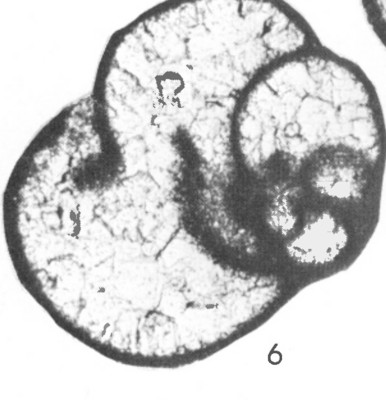
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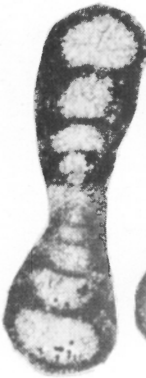
PLATE III

Figures 1, 2	*Cornuspira* sp.
Fig. 1	*Cornuspira* sp. Hypotype GSC No. 24888. Axial section. Williams Point, subzone E, foraminiferal zone 17, 1-69-a, Sage Collection, 121 x.
Fig. 2	*Cornuspira* sp. Hypotype GSC No. 24889. Axial section. Williams Point, subzone E, foraminiferal zone 17, 1-69-b, Sage Collection, 121 x.
Figure 3	*Palaeocrisidia* (?) *priscilla* (Dawson). Hypotype GSC No. 24890. West Bay, undetermined foraminiferal zone, 116-27, Bell Collection, 31 x.
Figure 4	*Earlandia* of the group *Earlandia elegans* (Rauzer-Chernoussova). Hypotype GSC No. 24891. Longitudinal section. Seaboyer's, "subzone F", foraminiferal zone 16s, GSC *loc.* 27595, 121 x.
Figures 5-7	*Palaeotextularia* of the group *Palaeotextularia consobrina*, Lipina.
Fig. 5	*Palaeotextularia asper* (Cooper). Hypotype GSC No. 24892. Longitudinal section. Williams Point, subzone E, foraminiferal zone 17, GSC *loc.* 82258, 121 x.
Fig. 6	*Palaeotextularia asper* (Cooper). Hypotype GSC No. 24893. Longitudinal section. Seaboyer's, "subzone F", foraminiferal zone 16s, GSC *loc.* 27595, 121 x.
Fig. 7	*Palaeotextularia asper* (Cooper). Hypotype GSC No. 24894. Longitudinal section. Cape Dauphin, subzone E, foraminiferal zone 17, GSC *loc.* 82242, 121 x.
Figure 8	*Endothyra* of the group *Endothyra prisca* Rauzer-Chernoussova and Reitlinger. Hypotype GSC No. 24895. Equatorial section. Goat Island, gigantoproductid beds, foraminiferal zone 16s, GSC *loc.* 27596, 121 x.
Figure 9	*Pseudoglomospira? infinitesima* (Beede). Hypotype GSC No. 24896. Random section. Cape Dauphin, subzone E, foraminiferal zone 17, GSC *loc.* 82242, 121 x.
Figure 10	*Eostaffella* of the group *Eostaffella radiata* (Brady). Hypotype GSC No. 24897. Equatorial section. Seaboyer's, "subzone F", foraminiferal zone 16s, GSC *loc.* 27595, 121 x.

Plate III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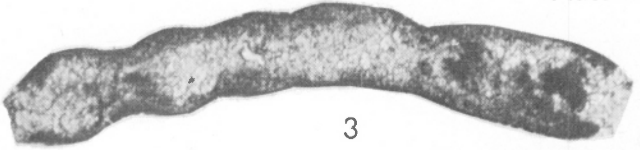
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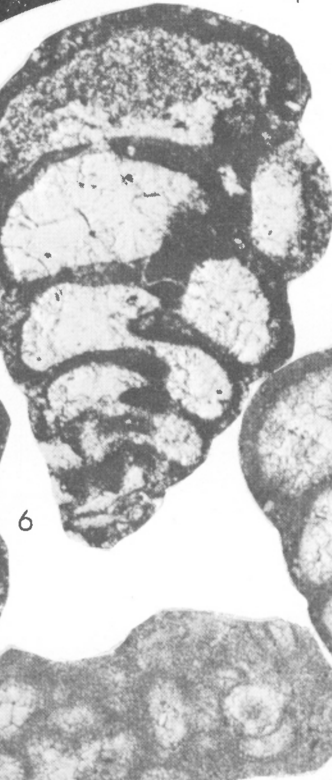
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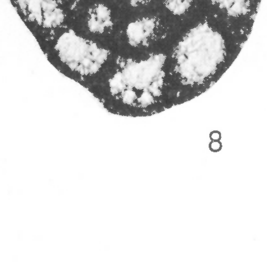
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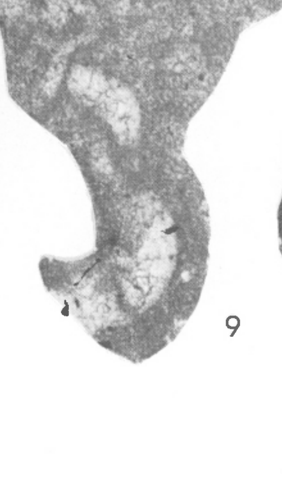
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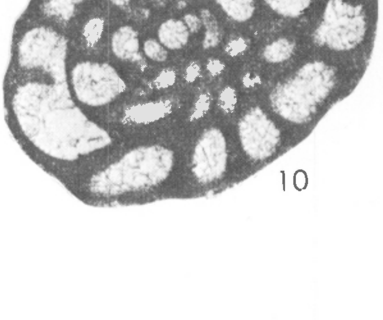
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PLATE IV

Figure 1 — *Calcisphaera pachysphaerica* (Pronina). Hypotype GSC No. 24898. Random section.
Springville, subzone C, foraminiferal assemblage 16i, GSC *loc.* 82271, 118 x.

Figure 2 — *Earlandia* of the group *Earlandia clavatula* (Howchin). Hypotype GSC No. 24899. Axial section.
Williams Point, subzone E, foraminiferal zone 17. GSC *loc.* 82258, 118 x.

Figures 3, 4 — *Archaediscus* of the group *Archaediscus krestovnikovi* Rauzer-Chernoussova.

Fig. 3 — *Archaediscus koktjubensis* Rauzer-Chernoussova. Hypotype GSC No. 24900. Oblique axial section.
Sheep Island, gigantoproductid beds, foraminiferal zone 16s, GSC *loc.* 16824, 118 x.

Fig. 4 — *Archaediscus* aff. *koktjubensis* Rauzer-Chernoussova. Hypotype GSC No. 24901. Axial section.
Goat Island, gigantoproductid beds, foraminiferal zone 16s, 27596, 160 x.

Figure 5 — Undetermined *Archaediscidae*. Hypotype GSC No. 24902. Axial section.
Goat Island, gigantoproductid beds, foraminiferal zone 16s, GSC *loc.* 27596, 118 x.

Figure 6 — *Diplosphaerina inaequalis* (Derville). Hypotype GSC No. 24903. Equatorial section.
Mabou, subzones A or B?, foraminiferal zone 15, GSC *loc.* 82248, 97 x.

Figure 7 — *Diplosphaerina maljavkini* (Mikhailov) (*non auct.*). Hypotype GSC No. 24904. Equatorial section.
Cape Dauphin, subzone D, foraminiferal zone 16s, GSC *loc.* 82239, 97 x.

Figures 8, 9 — *Tetrataxis* of the group *Tetrataxis conica* Ehrenberg *emend* von Möller.

Fig. 8 — *Tetrataxis* aff. *T. paraminima* Vissarionova. Hypotype GSC No. 24905. Oblique axial section.
Lake Ainslie, subzone E, foraminiferal zone 17, GSC *loc.* 82246, 97 x.

Fig. 9 — *Tetrataxis* of the group *Tetrataxis conica* Ehrenberg *emend* von Möller. Hypotype GSC No. 24906.
Lake Ainslie, subzone E, foraminiferal zone 17, GSC *loc.* 82246, 97 x.

Figures 10 and 14 — *Tetrataxis?* of the group *Tetrataxis? eominima* Rauzer-Chernoussova.

Fig. 10 — *Tetrataxis? eominima* Rauzer-Chernoussova. Hypotype GSC No. 24907. Oblique axial section.
Eureka, *Schizodus* Limestone, foraminiferal zone 17, GSC *loc.* 82270, 97 x.

Fig. 14 — *Tetrataxis?* of the group *Tetrataxis? eominima* Rauzer-Chernoussova. Hypotype GSC No. 24908. Axial section.
Monk's Head, Giant Ripple Limestone, foraminiferal zone 16s, GSC loc. 82260, 118 x.

Figures 11 and 13 — *Koskinotextularia* sp.

Fig. 11 — Hypotype GSC No. 24909. Oblique longitudinal section, missing the cribrate aperture. This form is certainly congeneric with Figure 13 and gives an example of the difficulties encountered in determining Palaeotextulariids in random section.
Springville, subzone C, foraminiferal zone 16i, GSC *loc.* 82271, 97 x.

Fig. 13 — *Koskinotextularia*. Hypotype GSC No. 24910. Slightly oblique longitudinal section.
Springville, subzone C, foraminiferal zone 16i, GSC *loc.* 82271, 91 x.

Fig. 12 — *Biseriammina? windsorensis* sp. nov. Paratype GSC No. 24911. High equatorial section.
Edwardsville, subzone B, foraminiferal zone 15, GSC *loc.* 82244.

Figures 15-18 — *Endothyra* of the group *Endothyra prisca* Rauzer-Chernoussova and Reitlinger.

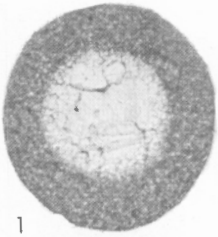
Fig. 15 — Hypotype GSC No. 24912. Oblique equatorial section.
Kelley Cove, *Schizodus* Limestone, foraminiferal zone undetermined GSC *loc.* 82243, 97 x.

Fig. 16 — Hypotype GSC No. 24913. Equatorial section.
Kelley Cove. *Schizodus* Limestone, undetermined foraminiferal zone, GSC *loc.* 82243, 97 x.

Fig. 17 — Hypotype GSC No. 24914. Oblique equatorial section.
Springville, subzone C, foraminiferal zone 16i, GSC *loc.* 82271, 97 x.

Fig. 18 — Hypotype GSC No. 24915. Equatorial section.
Cape Dauphin, subzone E, foraminiferal zone 17, GSC loc. 82242, 97 x.

Plate IV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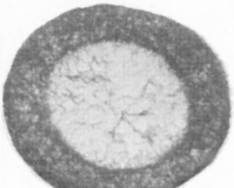
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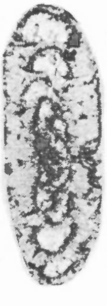
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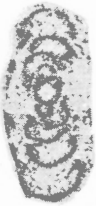
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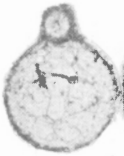
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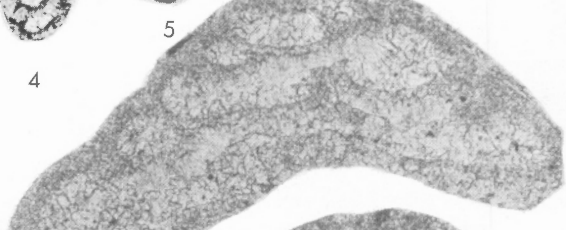
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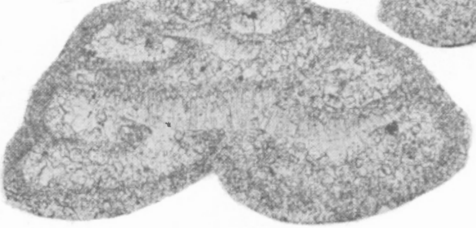
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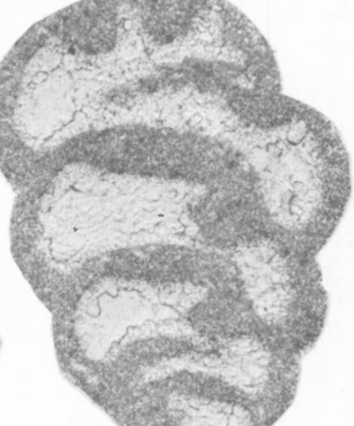
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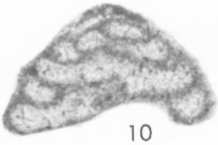
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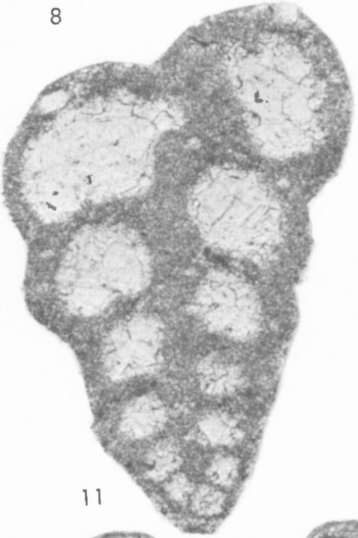
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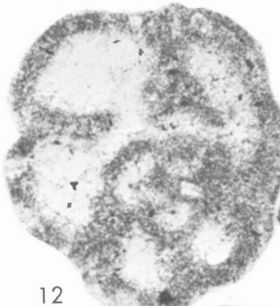
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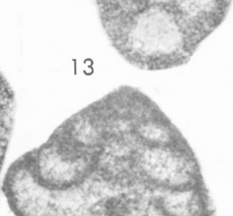
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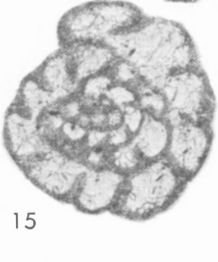
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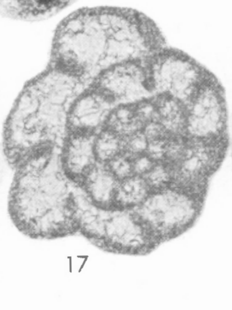
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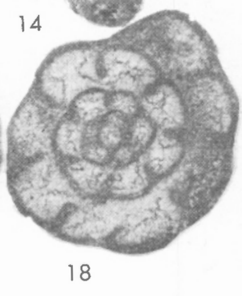
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PLATE V

Figure 1 *Globoendothyra* sp. Hypotype GSC No. 24916. Oblique, axial section.

Mahone Bay, gigantoproductid beds, foraminiferal zone 16s, C6, Sage Collection. 51 x.

Figure 2 *Eostaffella* of the group *Eostaffella radiata* (Brady). Hypotype GSC No. 24917. Oblique equatorial section.

Sheep Island, gigantoproductid beds, foraminiferal zone 16s, GSC *loc.* 16824, 121 x.

Figure 3 *Endothyranopsis crassa* (Brady). Hypotype GSC No. 24918. Equatorial section.

Milk Plant section, subzone E, foraminiferal zone 17, GSC *loc.* 82263, 51 x.

Figures 4, 5 *Endothyra* of the group *Endothyra bowmani* Phillips *in* Brown *emend* Brady.

Fig. 4 *Endothyra excentralis* Cooper. Hypotype GSC No. 24919. Equatorial section.

Williams Point, *Schizodus* Limestone, foraminiferal zone 17, GSC *loc.* 82258, 121 x.

Fig. 5 *Endothyra excentralis* Cooper. Hypotype GSC No. 24920. Equatorial section.

Williams Point, *Schizodus* Limestone, foraminiferal zone 17, 1-69-a, Sage Collection, 121 x.

Figure 6 *Eostaffella? discoidea* (Girty). Hypotype GSC No. 24921. Equatorial section of a young form.

Williams Point, *Schizodus* Limestone, foraminiferal zone 17, 1-69-a, Sage Collection, 121 x.

Figure 7 *Mikhailovella* sp. Hypotype GSC No. 24922.

Williams Point, *Schizodus* Limestone, foraminiferal zone 17, OW-I-I, Sage Collection, 121 x.

Figure 8 *Endothyra* of the group *Endothyra prisca* Rauzer-Chernoussova and Reitlinger. Hypotype GSC No. 24923. Equatorial section.

Figure 9 Sheep Island, gigantoproductid beds, foraminiferal zone 16s, GSC *loc.* 16824, 121 x. *Pseudoendothyra* of the group *Pseudoendothyra ornata* (Brady). Hypotype GSC No. 24924. High axial section.

Seaboyer's, gigantoproductid beds, foraminiferal zone 16s, GSC *loc.* 27595, 121 x.

Plate V


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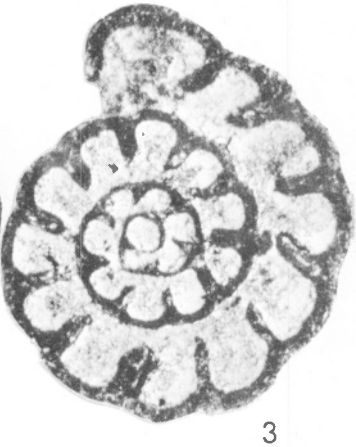
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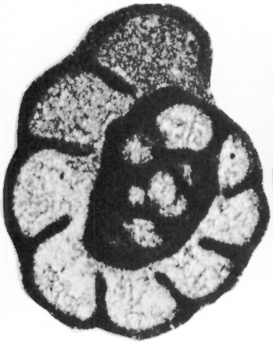
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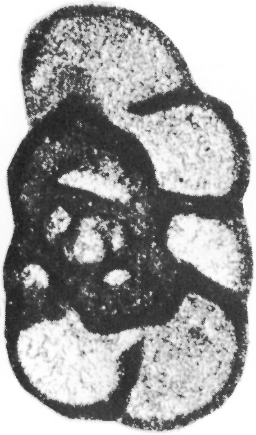
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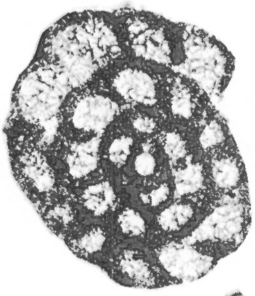
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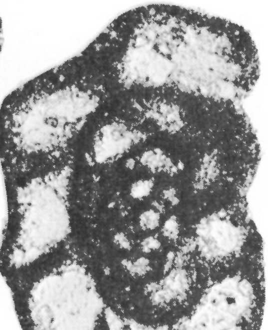
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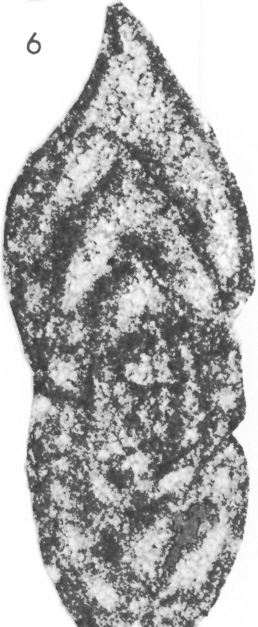
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PLATE VI

Figures 1-5 *Endothyra* of the group *Endothyra bowmani* Phillips *in* Brown *emend* Brady.
Fig. 1 *Endothyra bowmani* Phillips *in* Brown *emend* Brady. Hypotype GSC No. 24925. High equatorial section.
Williams Point, subzone E, foraminiferal assemblage 17, 1-60-c, Sage Collection, 97 x.

Fig. 2 *Endothyra* aff. *Eobsoleta* Rauzer-Chernoussova. Hypotype GSC No. 24926. Equatorial section.
Williams Point, subzone E, foraminiferal assemblage 17, 1-69-c, Sage Collection, 97 x.

Fig. 3 *Endothyra bowmani* Phillips *in* Brown *emend* Brady. Hypotype GSC No. 24927. High equatorial section.
Williams Point, subzone E, foraminiferal assemblage 17, OW 1-2, Sage Collection, 118 x.

Figs. 4, 5 *Endothyra excentralis* (Cooper). Hypotypes GSC No. 24928. 9 Equatorial sections.
Williams Point, subzone E, foraminiferal assemblage 17, 1-69-i, Sage Collection, 97 x.

Figures 6, 8 *Endothyra* of the group *Endothyra similis* Rauzer-Chernoussova and Reitlinger.
Figs. 6 and 8 Hypotypes GSC No. 24930 et 24931. Equatorial sections.
Williams Point, subzone E, foraminiferal assemblage 17, 1-69-1, Sage Collection, 97 x.

Figures 7, 9-12 *Eostaffella*? of the group *Eostaffella? discoidea* (Girty)
Fig. 7 *Eostaffella*? of the group *Eostaffella? discoidea* (Girty). Hypotype GSC No. 24932. Equatorial section.
Williams Point, subzone E, foraminiferal zone 17, 1-69-e, Sage Collection, 118 x.

Fig. 9 *Eostaffella? discoidea* (Girty). Hypotype GSC No. 24933. Equatorial section.
Williams Point, subzone E, foraminiferal zone 17, 1-69-e, Sage Collection, 97 x.

Figs. 10, 11 *Eostaffella? cooperi* (Zeller). Hypotypes GSC No. 24934 et 24935. Equatorial section (10) and high equatorial section (11).
Williams Point, subzone E, foraminiferal zone 17, 1-69-m (10) and 1-69-c (11); Sage Collection, 118 x.

Fig. 12 *Eostaffella? cooperi* (Zeller). Hypotype GSC No. 24936. Equatorial section.
Williams Point, subzone E, foraminiferal zone 17, 1-69-o, Sage Collection, 118 x.

Plate VI


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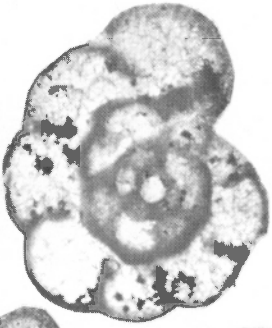
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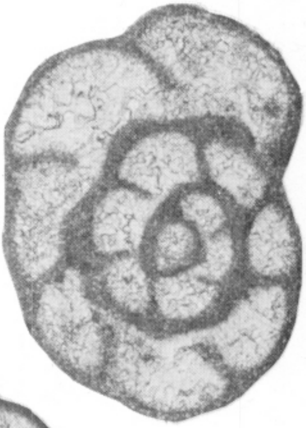
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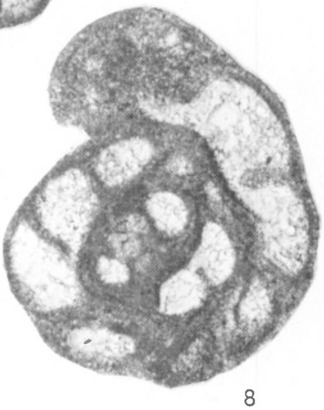
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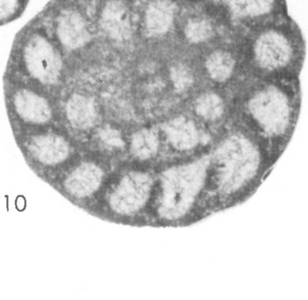
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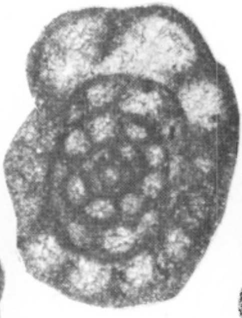
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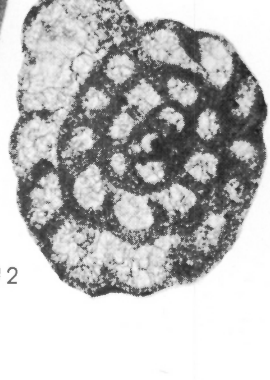
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PLATE VII

Figures 1-6 Archaediscus of the group Archaediscus krestovnikovi Rauzer-Chernoussova.
Fig. 1 Archaediscus krestovnikovi Rauzer-Chernoussova. Hypotype GSC No. 24936. Axial section.
Edwardsville, subzone B, foraminiferal zone 15, GSC loc. 82244, 121 x.

Fig. 2 Archaediscus krestovnikovi Rauzer-Chernoussova. Hypotype GSC No. 24938. Axial section.
Edwardsville, subzone B, foraminiferal zone 15, GSC loc. 82244, 121 x.

Fig. 3 Archaediscus koktjubensis Rauzer-Chernoussova. Hypotype GSC No. 24939. Axial section.
Edwardsville, subzone B, foraminiferal zone 15, GSC loc. 82244, 121 x.

Fig. 4 Archaediscus of the group A. krestovnikovi Rauzer-Chernoussova. Hypotype GSC No. 24940. Axial section.
Williams Point, subzone E, foraminiferal zone 17, OW 1-2, Sage Collection.

Fig. 5 Archaediscus krestovnikovi Rauzer-Chernoussova, Hypotype GSC No. 24941. High axial section.
Edwardsville, subzone B, foraminiferal zone 15, GSC 82244, 121 x.

Fig. 6 Archaediscus krestovnikovi Rauzer-Chernoussova. Hypotype GSC No. 24942. Axial section.
Edwardsville, subzone B, foraminiferal zone 15, GSC loc. 82244, 121 x.

Figures 7, 8, 12 Neoarchaediscus of the group Neoarchaediscus incertus Grozdilova and Lebedeva.
Fig. 7 Neoarchaediscus parvus regularis (Suleimanov). Hypotype GSC No. 24943. Axial section.
Williams Point, subzone E, foraminiferal zone 17, 1-69-e, Sage Collection, 148 x.

Fig. 8 Neoarchaediscus parvus regularis (Suleimanov). Hypotype GSC No. 24944. Axial section.
Williams Point, subzone E, foraminiferal zone 17, 1-69-i, Sage Collection, 148 x.

Fig. 12 Neoarchaediscus of the group Neoarchaediscus incertus. Hypotype GSC No. 24945. Axial section.
Williams Point, subzone E, foraminiferal zone 17, 1-69-c, Sage Collection, 148 x.

Figures 9-11, 13, 14 Planospirodiscus of the group Planospirodiscus gregorii (Dain).
Fig. 9 Planospirodiscus gregorii (Dain). Hypotype GSC No. 24946. Axial section.
Windsor, Avon Limestone, subzone D, foraminiferal zone 16s, GSC loc. 82286, 148 x.

Fig. 10 Planospirodiscus gregorii (Dain). Hypotype GSC No. 24947. Axial section.
Windsor, Avon Limestone, subzone D, foraminiferal zone 16s, GSC loc. 82286, 148 x.

Fig. 11 Planospirodiscus aff. gregorii (Dain). Hypotype GSC No. 24948. Axial section.
Cape Dauphin, subzone D, foraminiferal zone 16s, GSC loc. 82241, 148 x.

Fig. 13 Planospirodiscus of the group Planospirodiscus gregorii (Dain). Hypotype GSC No. 24949. High axial section.
Cape Dauphin, subzone D, foraminiferal zone 16s, GSC loc. 82241, 148 x.

Fig. 14 Planospirodiscus of the group Planospirodiscus gregorii (Dain). Hypotype GSC No. 24950. High axial section.
Cape Dauphin, subzone D, foraminiferal zone 16s, GSC loc. 82241, 148 x.

Figures 15-18 Planospirodiscus of the group Planospirodiscus minimus (Grozdilova and Lebedeva).
Fig. 15 Planospirodiscus minimus (Grozdilova and Lebedeva). Hypotype GSC No. 24951. Axial section.
Monks Head, Giant Ripple Limestone, foraminiferal zone 16s, GSC loc. 82260, 148 x.

Fig. 16 Planospirodiscus cf. minimus (Grozdilova and Lebedeva). Hypotype GSC No. 24952. High axial section.
Port Hood Island, Third Algal Limestone, foraminiferal zone 16s, GSC loc. 82250, 121 x.

Fig. 17 Planospirodiscus aff. minimus (Grozdilova and Lebedeva). Hypotype GSC No. 24953. High axial section.
Windsor, Avon Limestone, subzone D, foraminiferal assemblage 16s, GSC loc. 82286, 148 x.

Fig. 18 Planospirodiscus minimus (Grozdilova and Lebedeva). Hypotype GSC No. 24954. Axial section.
Cape Dauphin, subzone E, foraminiferal zone 17, GSC loc. 82242, 148 x.

Figures 19, 20 Asteroarchaediscus of the group Asteroarchaediscus baschkiricus (Krestovnikov and Teodorovitch)
Fig. 19 Asteroarchaediscus of the group Asteroarchaediscus baschkiricus (Krestovnikov and Teodorovitch). Hypotype GSC No. 24955. Axial section.
Williams Point, subzone E, foraminiferal assemblage 17, 1-69-i, Sage Collection, 148 x.

Fig. 20 Asteroarchaediscus baschkiricus (Krestovnikov and Teodorovitch). Hypotype GSC No. 24956. Axial section.
Windsor, Kennetcook Limestone, subzone E, foraminiferal assemblage 17, GSC loc. 82288, 148 x.

Figures 21, 22 Undetermined Planospirodiscus sp.
Fig. 21 cf. Planospirodiscus? sp. Hypotype GSC No. 24957. Axial section.
Port Hood Island, Third Algal Limestone, foraminiferal zone 16s, GSC loc. 82250, 148 x.

Fig. 22 Planospirodiscus sp. Hypotype GSC No. 24958. High axial section.
Williams Point, subzone E, foraminiferal zone 17, OW 1-2, Sage Collection, 148 x.

Plate VII


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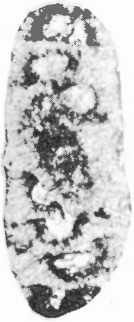
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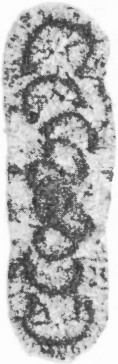
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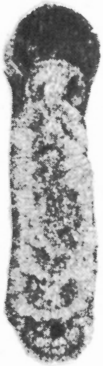
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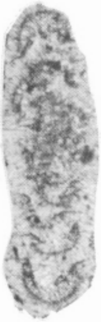
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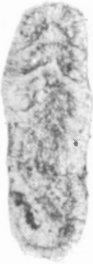
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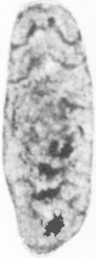
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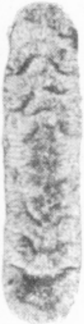
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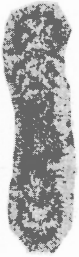
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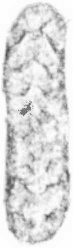
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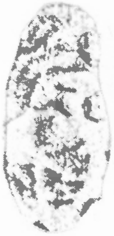
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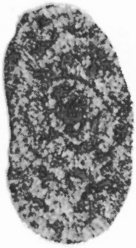
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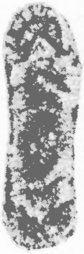
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PLATE VIII

Figures 1-3 Microfacies of subzone B, foraminiferal zone 15.

Fig. 1 Medium-grained pelmatozoan-spongiostromid grainstone with sparry calcite cement. Allochems are composed of ossicles and spongiostromids with additional lumps, microbreccias, calcispherids (*Calcisphaera* sp., *Parathurammina* sp.), and foraminifers (*Biseriammina? windsorensis* sp. *nov.*).

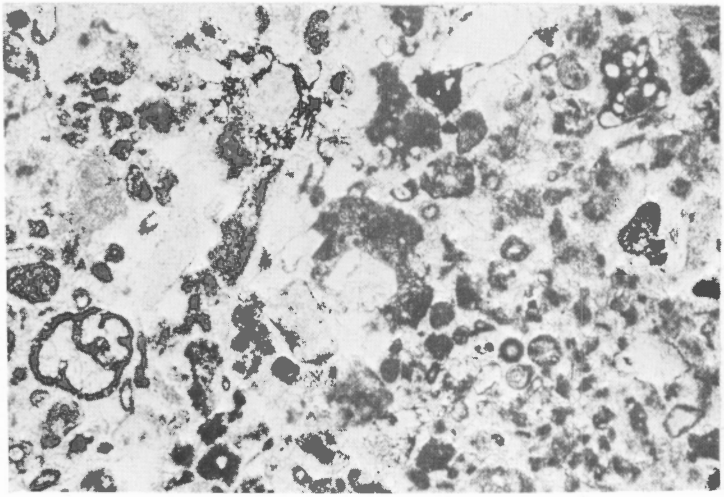
Edwardsville, GSC loc. 82244, 31 x.

Fig. 2 "Drusy fibrous calcite" (in Orme and Brown's sense) is often encountered in the Windsor carbonates. Spongiostromid "pellets" are here embedded in a recrystallized matrix, whereas the central druse is filled with oriented sparite. The facies is always unfavorable to foraminifers.

Windsor, Miller Limestone, NQ 2b, Moore Collection, Acadia University, 31 x.

Fig. 3 Same phenomenon as Fig. 2.

Windsor, Maxner Limestone, GSC loc. 82284, 121 x, crossed nicols.



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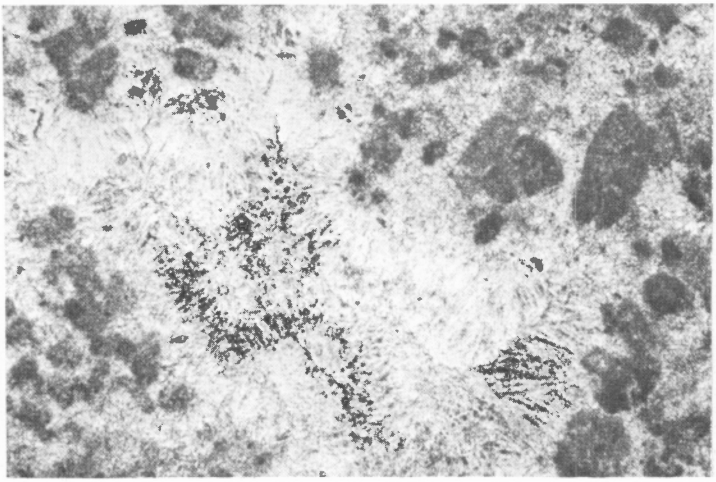

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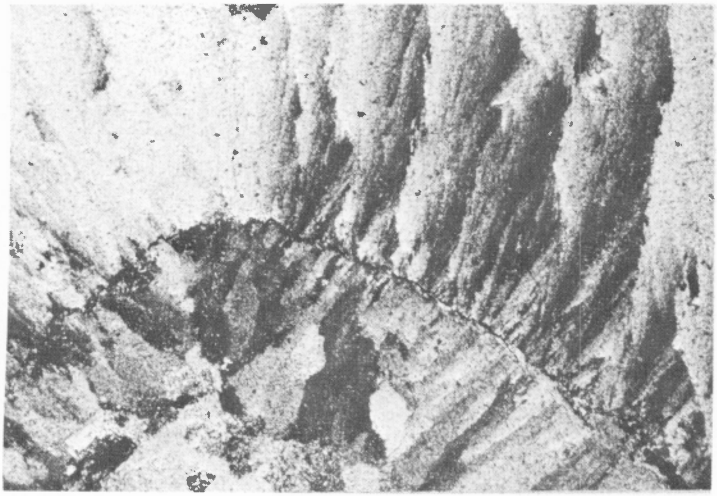

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PLATE IX

Figures 1-3 Microfacies of subzone B, foraminiferal zone 15.

Fig. 1 Oolitic calcirudite with sparry calcite void-filling cement. An accretion Spongiostromid bahamite shows incipient penecontemporaneous recrystallization of its matrix. Foraminifera are usually absent in such microfacies.

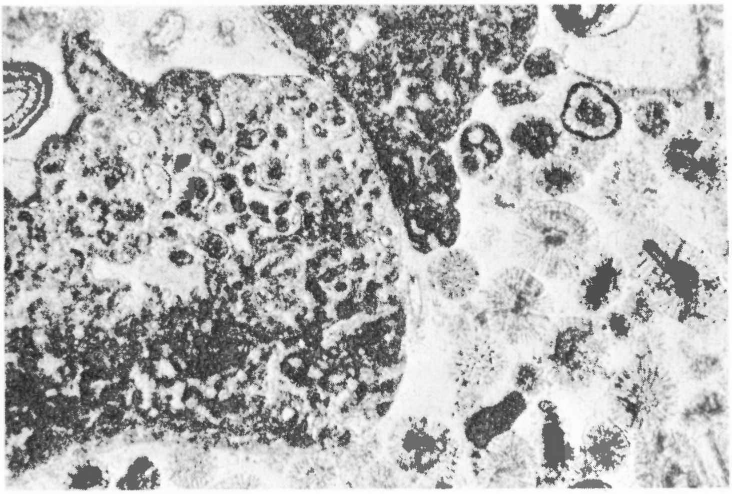
Edwardsville, GSC *loc.*, 82244, 31 x.

Fig. 2 Well sorted, coarse-grained oolitic grainstone with sparry calcite cement. All the particles (lumps, crinoids...) are oolitized and the size of the grains is remarkably homogeneous. Microfacies unfavourable to foraminifers.

Edwardsville, GSC *loc.* 82244, 31 x.

Fig. 3 Dasycladaceae bank. Poorly sorted, *Koninckopora* calcirudite with void-filling cement. Allochems are composed of large green-algae fragments, lumps, oolites, pelmatozoans and microbreccias.

Edwardsville, GSC *loc.* 8244, 31 x.



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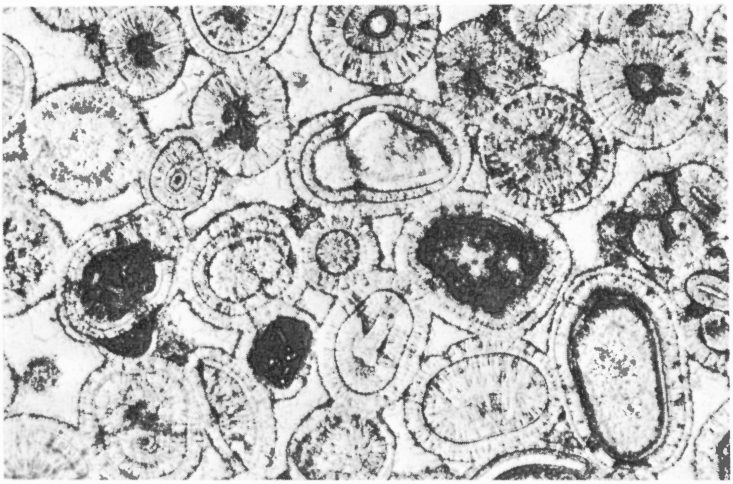

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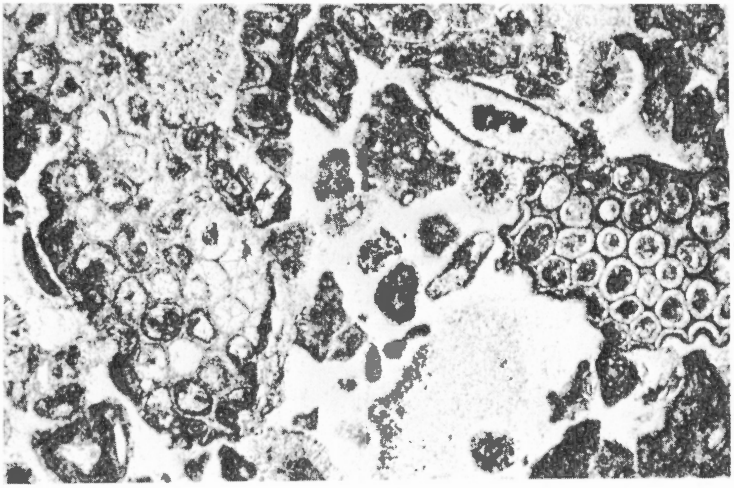

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PLATE X

Figures 1-3 Microfacies of subzone B, foraminiferal zone 15.

Fig. 1 Medium-grained, poorly sorted intrabiosparite (wackestone). Allochems composed of bahamite lumps (with recrystallized bipyramidated quartz). Spongiostromid "pellets", foraminifers (Earlandia sp., Pseudoglomospira? sp., Cornuspiridae) calcispherids (Calcisphaera sp.) and Bryozoans (Palaeocrisidia? sp.).

Edwardsville, GSC loc. 82244, 31 x.

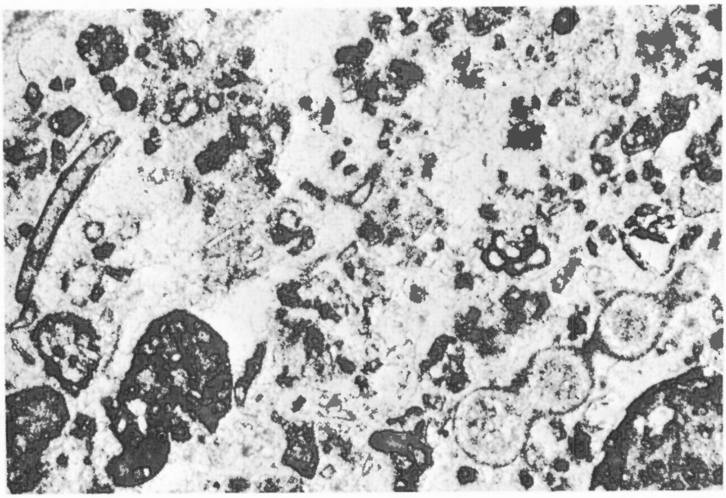
Fig. 2 Palaeocrisidia? priscilla band (Nodosinella band auctores). Mud-filled Palaeocrisidia? priscilla (Dawson) packstone with void-filling sparite. This taxon, erroneously reported as a Permian foraminiferal genus should probably be assigned to the Ctenostoma.

Riverdale, Bell Collection, WN 12-239, 31 x.

Fig. 3 Recrystallized, poorly sorted, medium-grained packstone with void-filling sparite. Intraclasts composed of weathered pelmatozoans, Spongiostromid accretion lumps, and scattered foraminifers (Biseriammina? windsorensis sp. nov. and Earlandia sp.).

Edwardsville, GSC loc. 82244, 31 x.

Plate X



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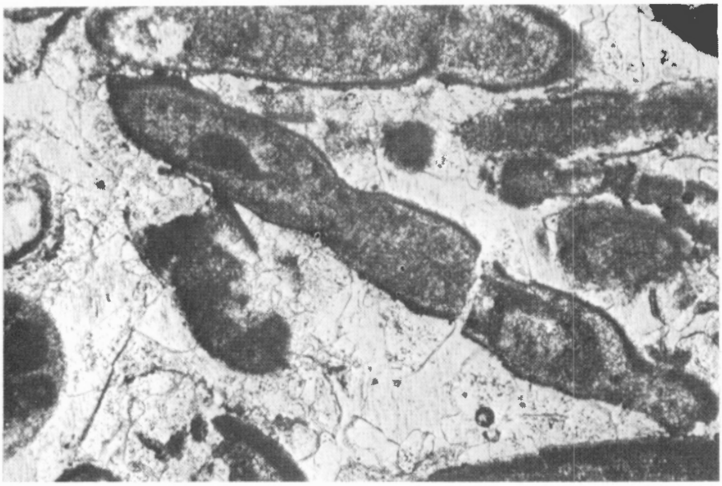

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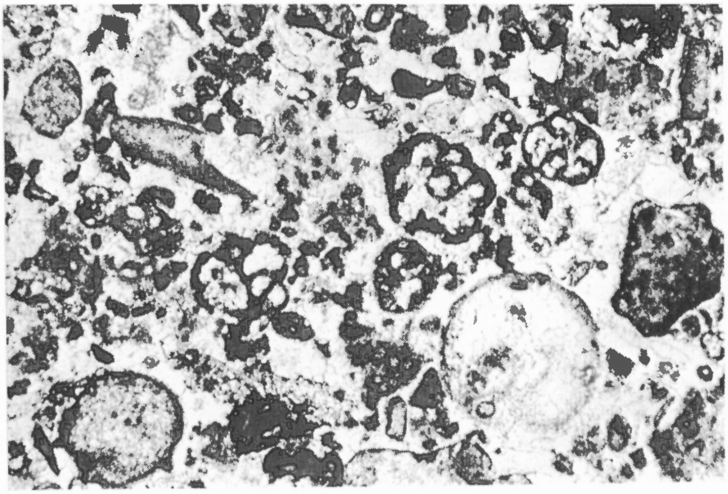

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PLATE XI

Figures 1-3 Microfacies of subzone C, foraminiferal zone 16 inf.

Fig. 1 Mud-supported, highly recrystallized biomicrite into microspar. The great abundance of *Cornuspira* sp. (more than 20 individuals are visible on 6 mm^2) and scattered *Earlandia* sp. suggest abnormal salinity.

Windsor, Herbert River Limestone, Avondale Quarry, Np 2, Moore Collection, 31 x.

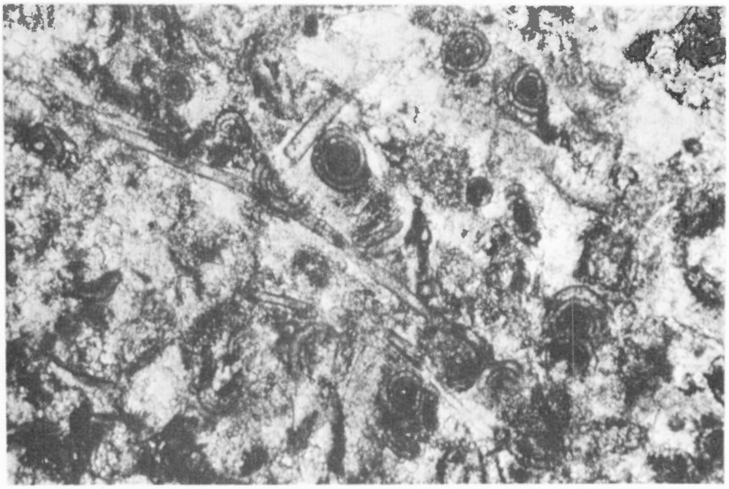
Fig. 2 Lump-bearing, sparitic packstone. Most of the sparite is from penecontemporaneous recrystallization of the micritic matrix, but some void-filling sparite is also present. Two high axial sections showing the double spiral of *Biseriammina? windsorensis* sp. nov., *Endothyra* sp., and calcispherids are also conspicuous.

Springville, GSC *loc.* 82272, 38 x.

Fig. 3 Slightly recrystallized, mud-supported biomicrite. Allochems are composed of reworked, weathered pelmatozoans and algal coated brachiopods and mollusks. Foraminifera are abundant *Endothyra* of the group *Endothyra bowmani* Phillips *in* Brown *emend* Brady, *Endothyra* of the group *Endothyra prisca* Rauzer-Chernoussova and Reitlinger, *Endothyra* sp., *Eostaffella* sp., *Eostaffella? discoidea* (Girty), and *Archaediscus* of the group *Archaediscus krestovnikovi* Rauzer-Chernoussova.

Windsor, Herbert River Limestone, GSC *loc.* 82285, 31 x.

Plate XI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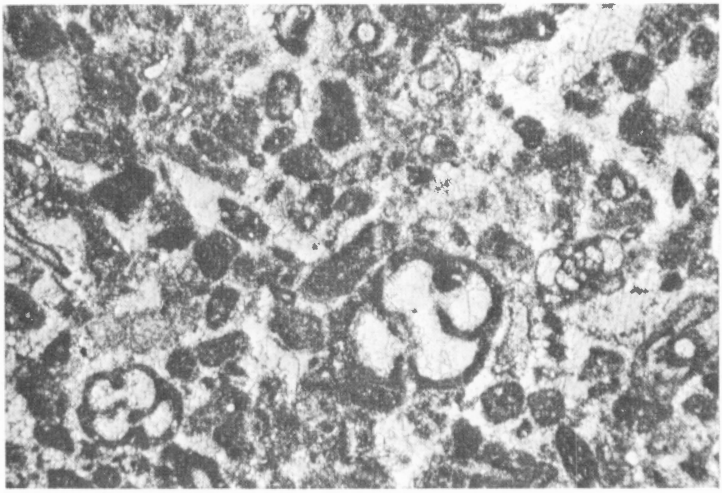
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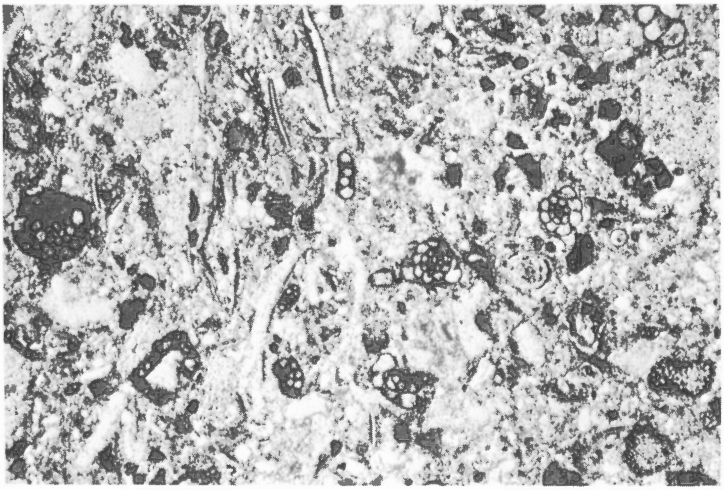
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PLATE XII

Figures 1-3 Microfacies of subzone D, foraminiferal zone 16 sup.

Fig. 1 Medium-grained packstone with recrystallization sparite. The allochems are composed of crinoids, echinoid plates and spines, oolites, proto-oolites, microbreccias, lumps, and Spongiostromids. Foraminifera are scarce and restricted to the Archaediscidae; *Planospirodiscus minimus* (Grozdilova and Lebedeva) and *Archaediscus* of the group *Archaediscus krestovnikovi* (Rauzer-Chernoussova).

Windsor, GSC *loc.* 82286, 38 x.

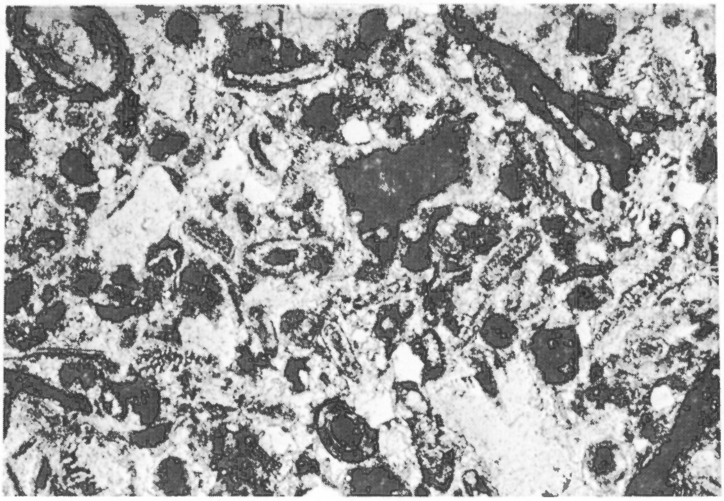
Fig. 2 Medium-grained packstone with recrystallization sparite. The allochems are composed of pelmatozoans, brachiopods, mollusks disarticulated Spongiostromids, few calcispherids (*Calcisphaera laevis* Williamson) and Foraminifera (*Earlandia* of the group *Earlandia clavatula* (Howchin), *Cornuspira* sp. and *Endothyra* sp.)

Windsor, Wallace Point Limestone, WP 1/3a, Moore Collection, Acadia University, 31 x.

Fig. 3 Foraminifera are scarce in oolitic packstones and grainstones, where they are usually only observed as nuclei. Two small Archaediscidae (*Planospirodiscus minimus* Grozdilova and Lebedeva and *Planospirodiscus* sp.) are here surrounded by a thin cortex. Void-filling sparite and recrystallization sparite are both present between the allochems.

Port Hood Island, Giant Ripple Limestone, GSC *loc.* 82313, 121 x.

Plate XII



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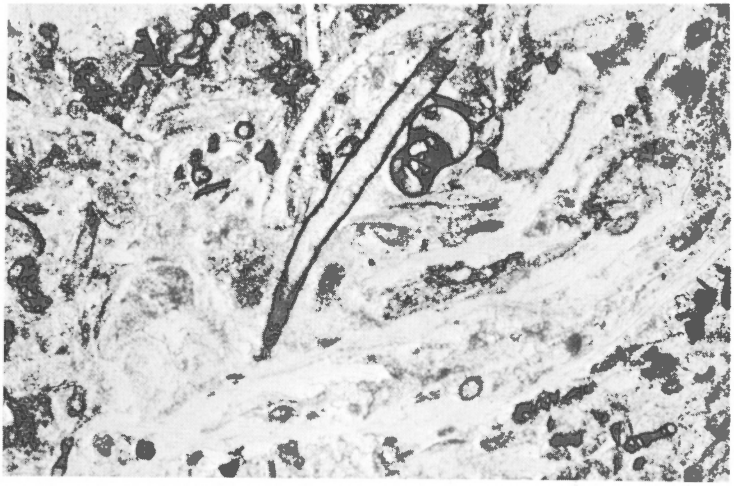

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PLATE XIII

Figures 1-3 Microfacies of subzone D, foraminiferal zone 16 sup.

Fig. 1 Tuffs of *Mitcheldeania* sp. are abundant in subzone D as well as in most marine carbonates of the Windsor Group. When they are not reworked these Porostromata constitute one of the most useful bathymetric indicators as they did not thrive below ten fathoms (*Mitcheldeania* is regarded as equivalent to *Girvanella* by Wood (1941) and Johnson (1956). However, the very loosely-knit *Mitcheldeania* tuff is probably different from the encrusting *Girvanella*).

Port Hood Island; Giant Ripple Limestone, GSC *loc.* 82313, 38 x.

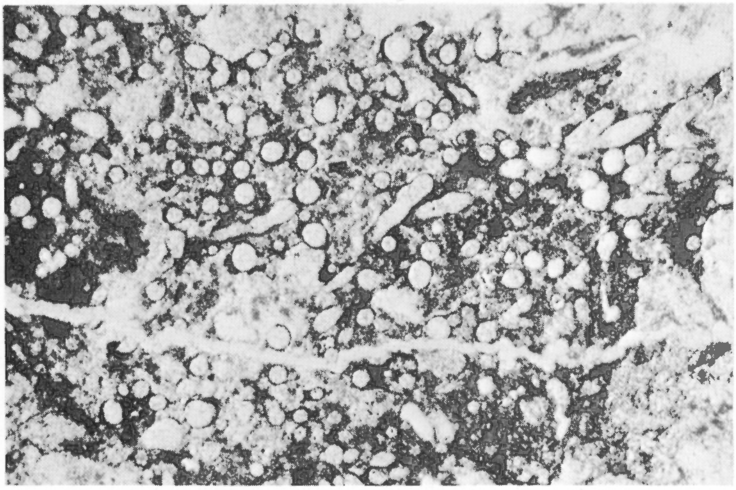
Fig. 2 Archaediscids are difficult to recognize in thin sections and hence are often overlooked; their pseudofibrous radial wall is superficially similar to the calcitic cortex of an oolite; this resemblance is fallacious as Archaediscid walls do not have true fibres. Here, *Planospirodiscus* forms the nucleus of a double-generation cortex.

Port Hood Island, Giant Ripple Limestone, GSC *loc.* 82313, 121 x.

Fig. 3 Floods of Archaediscidae are characteristic of normal marine salinity, and characterise front-reefs and basin carbonates. This packstone shows well-sorted *Planospirodiscus* and micritic lumps with recrystallized sparite.

Windsor, Avon Limestone, GSC *loc.* 82286, 121 x.

Plate XIII



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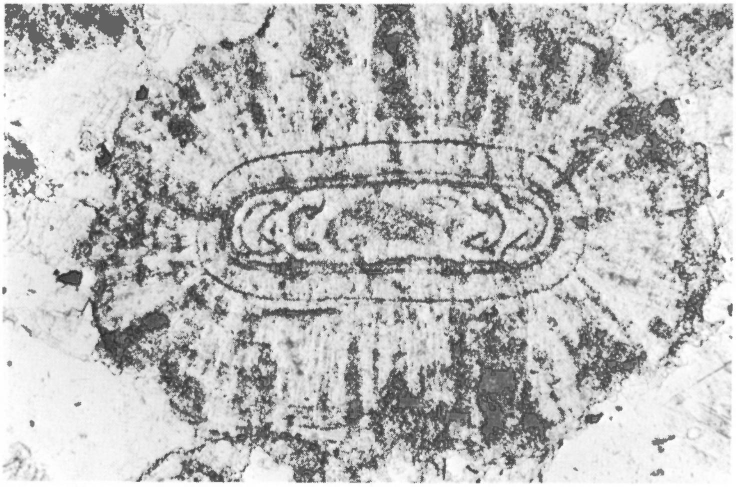

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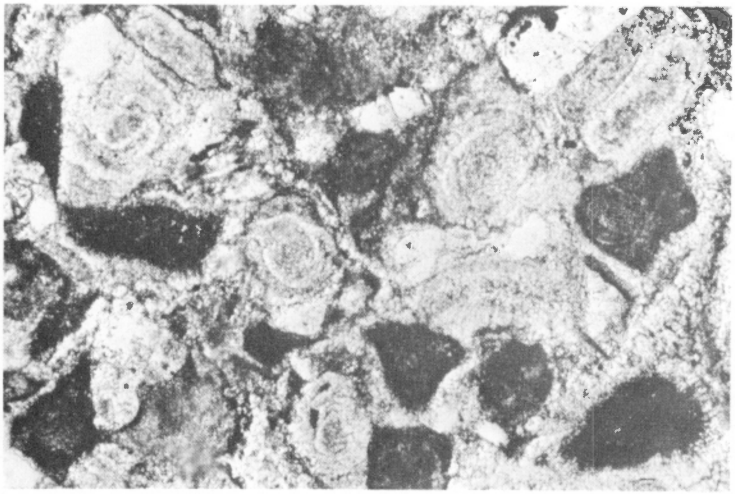

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PLATE XIV

Figures 1-3 Microfacies of the gigantoproductid beds, foraminiferal zone 16 sup. Poorly sorted, slightly recrystallized biomicrite (wackestone) with scattered detrital quartz grains. Allochems are mostly pelmatozoans and brachiopods with rare ostracods, bryozoans and spongiostromids.

Fig. 1 Contains Tetrataxis of the group Tetrataxis conica Ehrenberg undeterminable Endothyra sp. and Earlandia sp.

Sheep Island, GSC loc. 16824, 51 x.

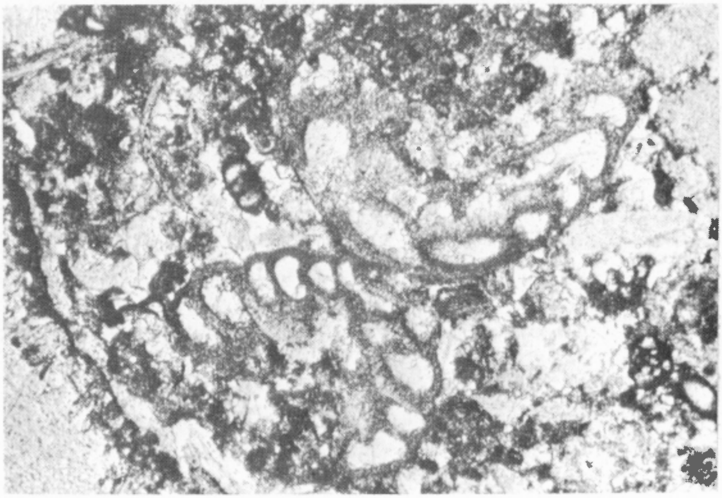
Fig. 2 Contains an oblique section of a crushed Koskinobigenerina.

Mahone Bay, GSC loc. 27594, 38 x.

Fig. 3 Contains Tetrataxis of the group Tetrataxis conica Ehrenberg, Archaediscus sp., Calcisphaera sp., Endothyra sp. and Eostaffella sp.

Seaboyer's, GSC loc. 27795, 51 x.

Plate XIV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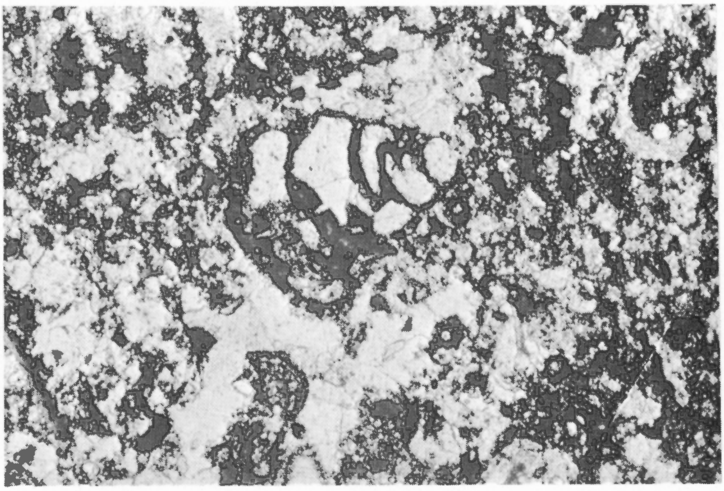
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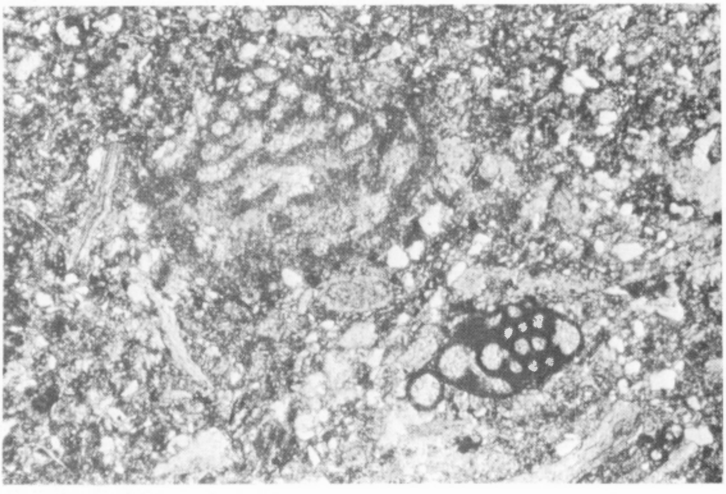
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PLATE XV

Figures 1-3 Microfacies of subzone E (lower part) and subzone F, foraminiferal zone 16 sup.

Fig. 1 Moderately recrystallized, fine-grained, impure, clayey biomicrite. Allochems formed of rare pelmatozoans, ostracods and *Planospirodiscus* sp. Microfacies characteristic of an open marine environment.

Windsor, Kennetcook Limestone (lower part), subzone E, K 1/7,Moore Collection, 148 x.

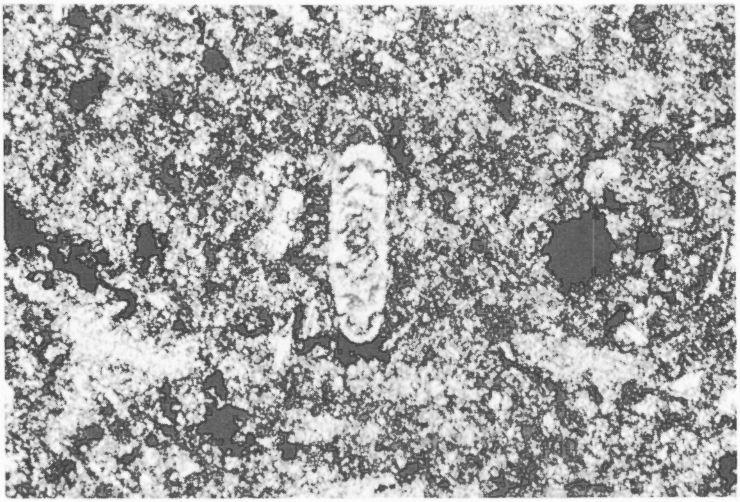
Fig. 2 *Eostaffella? discoidea* (Girty) in a quartz-bearing packstone. Note the micrite ghosts underlining the pelmatozoan debris or floating in the sparite.

Windsor, Kennetcook Limestone (lower part), subzone E, K 1/3, Moore Collection, 121 x.

Fig. 3 Recrystallized, impure, quartz-bearing packstone with original micritic matrix. Debris of brachiopods (mostly gigantoproductids) and rare bryozoans are conspicuous. Identifiable foraminifers are *Palaeotextularia* sp., *Earlandia* sp., *Eostaffella?* sp., *Pseudoendothyra* sp., and an axial section of *Endothyranopsis crassa* (Brady).

Seaboyer's; gigantoproductid beds, GSC loc. 27595, 38 x.

Plate XV



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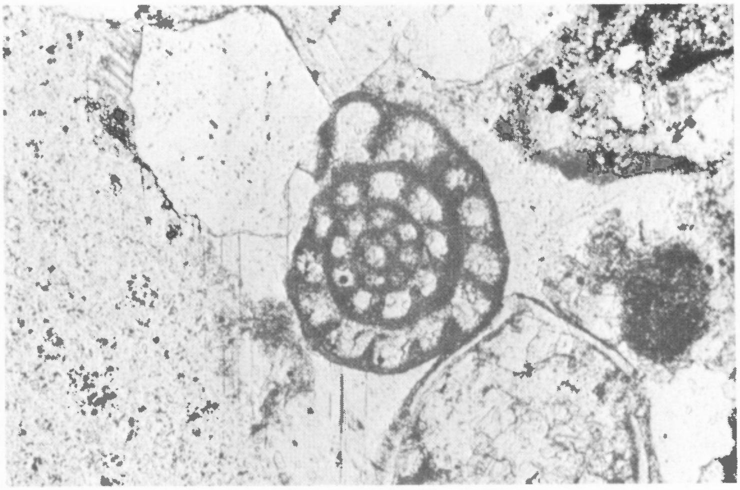

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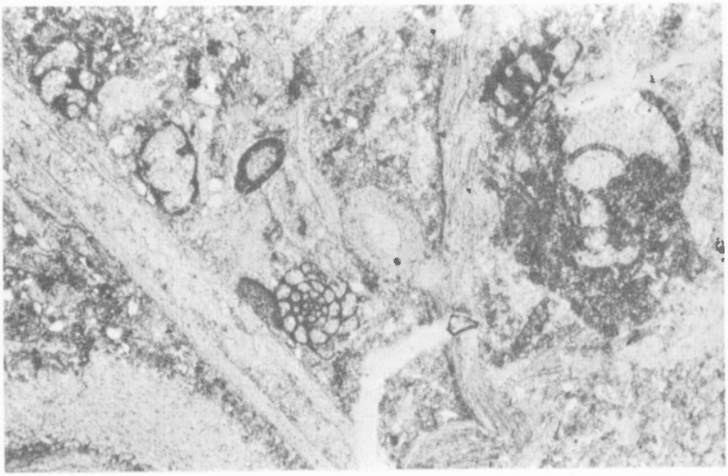

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PLATE XVI

Figures 1-3 Microfacies of subzone E, foraminiferal zone 17.

Fig. 1 Moderately recrystallized biomicrite grading into sparite. The contrast between the walls of the dense micritic *Cornuspira* sp. with that of the clear pseudofibrous *Planospirodiscus* sp. is striking. Moreover, the cornuspirid is partially altered, whereas the archaediscid remain intact. An undeterminable foraminifer (probably an Endothyridae) is visible below and to the right of *Planospirodiscus.*

Williams Point, *Schizodus* Limestone, GSC *loc.* 82258, 121 x.

Fig. 2 Highly recrystallized micrite matrix (microspar). Recrystallization is more advanced than in Figure 1, as the structure of the pelmatozoans and brachiopods is hardly recognizable and as the outline of the *Asteroarchaediscus* sp. and *Neoarchaediscus* is partly obliterated.

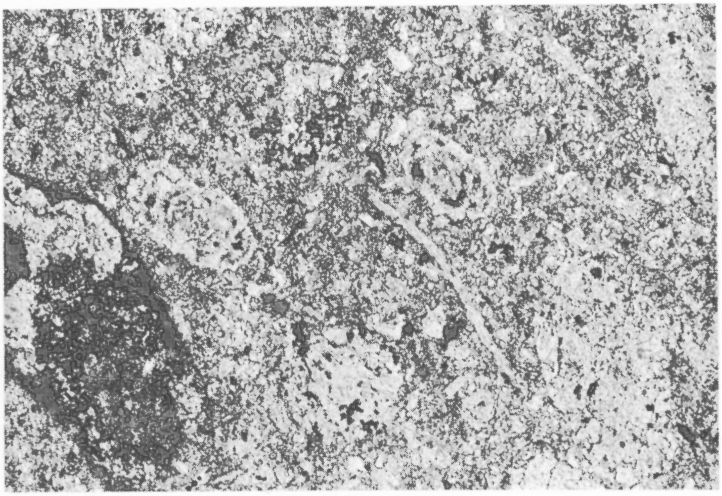
Milk Plant, GSC *loc.* 82263, 121 x.

Fig. 3 Quite at the opposite of Fig. 2, recrystallisation of the original micritic matrix does not alter the outline of *Endothyra* sp. In particular, the outer tectorium of this endothyrid is still recognizable in the septum of the penultimate chamber. The contrast between the void-filling sparite of the inner chambers of the Endothyridae and the recrystallization sparite of the matrix is striking. Note the presence of detrital quartz, always present in the early Namurian carbonates of the Windsor.

Milk Plant, GSC *loc.* 82263, 121 x.

Plate XVI


1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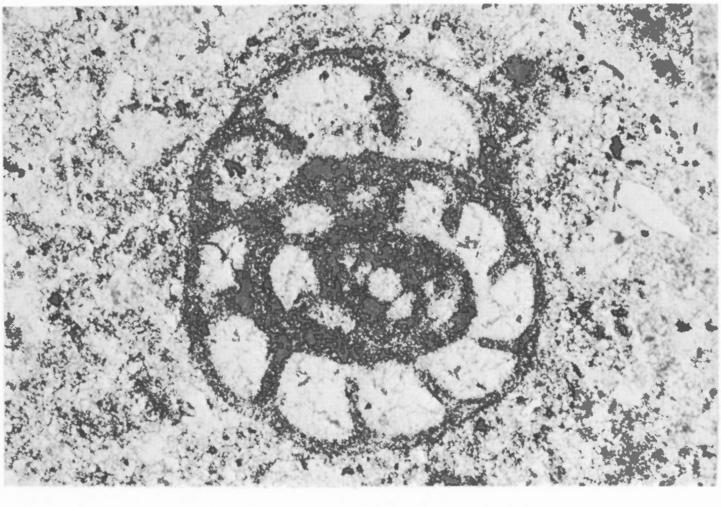
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PLATE XVII

Figures 1-3 Microfacies of subzone E, foraminiferal zone 17.

Fig. 1 Well sorted, fine-grained, penecontemporaneously recrystallized biosparite. The original micritic matrix has recrystallized into sparite and respects the foraminiferal micritic wall. The bulk of the allochems is formed by disarticulated spongiostromids. *Tetrataxis?* of the group *Tetrataxis? eominima* Rauzer-Chernoussova, *Earlandia* sp. *Endothyra* sp. and scattered calcispherids are also present.

Eureka, GSC *loc.* 82270, 31 x.

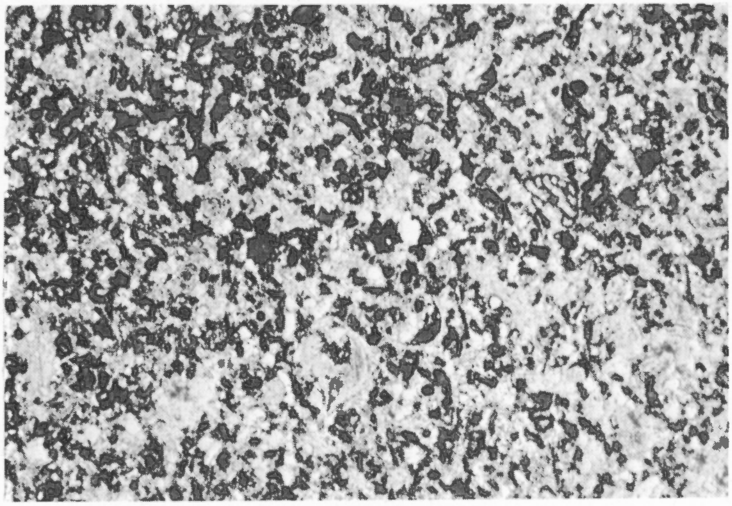
Fig. 2 Enlarged portion of the upper right hand part of Figure 1. It shows the micritic ghosts in the matrix, the contact with the monolayered *Tetrataxis* and the spongiostromid "pellets", usually misidentified as fecal pellets.

Eureka, GSC *loc.* 82270, 121 x.

Fig. 3 Oolitic grainstone with void-filling sparite. A sedentary *Tuberitina* sp. is fixed on an oolite. Note the pseudo-fibrous diagenetic layer at the contact of the dark micritic *Tuberitina* wall and the ultimate part of the oolitic cortex.

Port Hood Island, GSC *loc.* 82531, 121 x.

Plate XVII



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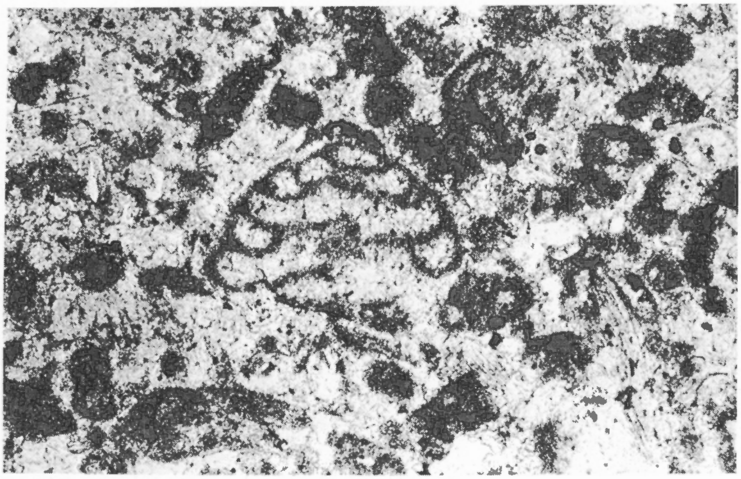

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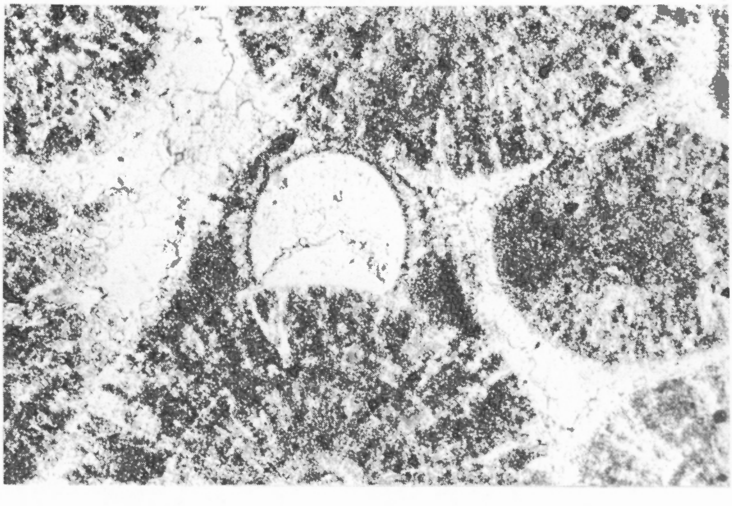

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PLATE XVIII

Figures 1-3 Microfacies of subzone E, foraminiferal zone 17.

Recrystallized biomicritic packstone. The bulk of the allochems is formed by pelmatozan debris, brachiopods and foraminifers. Nonskeletal material includes proto-oolites, lumps, and calcareous microbreccias.

Fig. 1 Most conspicuous foraminifers are: Endothyra of the group Endothyra bowmani Phillips in Brown emend Brady, Tetrataxis sp., Earlandia sp., and Mikhailovella? sp.

Williams Point, 1-69-k, Sage Collection, 31 x.

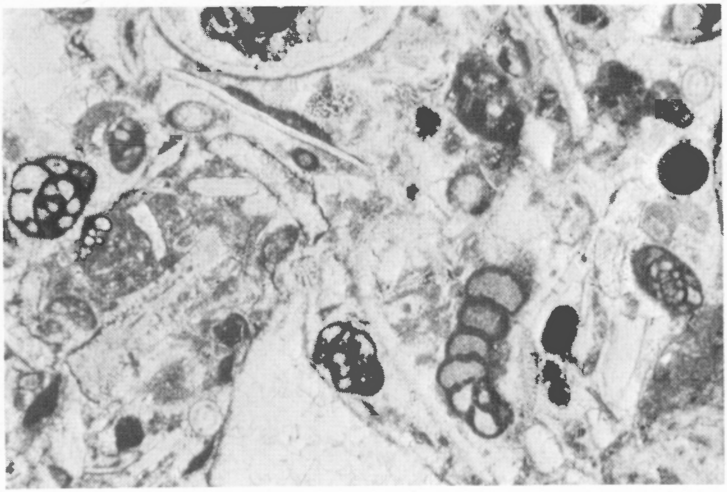
Fig. 2 The microfauna yields Climacammina of the group C. prisca (Lipina) (koskinobigenerina), Endothyra of the group Endothyra bowmani Phillips in Brown emend Brady, and Eostaffella? of the group Eostaffella? discoidea (Girty).

Williams Point, 1-69-f, Sage Collection, 31 x.

Fig. 3 The microfacies is characterized by Endothyra of the group Endothyra bowmani Phillips in Brown emend Brady, Calcisphaera laevis Williamson, Archaediscus of the group Archaediscus krestovnikovi Rauzer-Chernoussova and a monolayered Palaeotextularia of the group Palaeotextularia consobrina Lipina.

Williams Point, 1-69-o, Sage Collection, 31 x.

Plate XVIII



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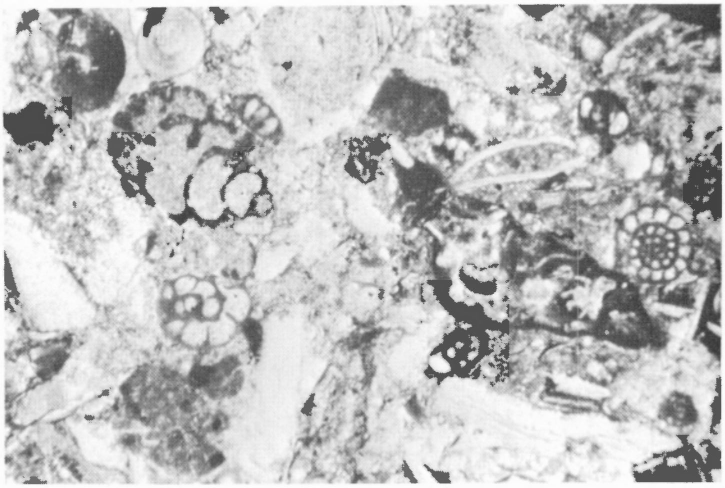

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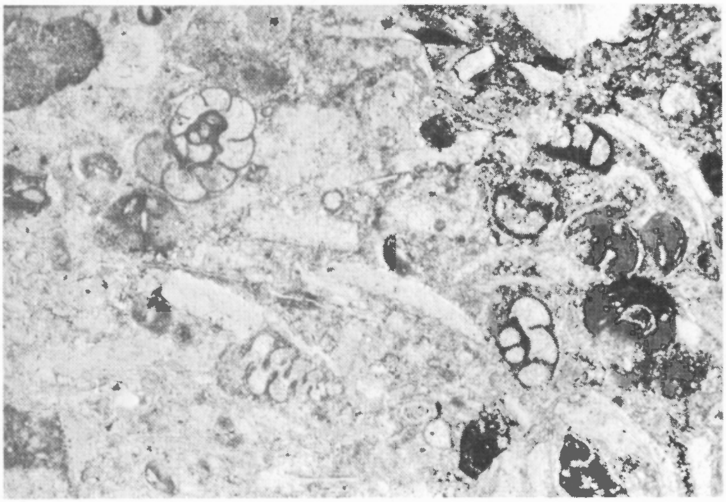

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PLATE XIX

Figures 1-3 Microfacies of subzone E, foraminiferal zone 17.

Fig. 1 Algal-foraminiferal association. *Pseudoglomospira? infinitesima* (Beede) and disarticulated debris of spongiostromids form the bulk of the allochems. Rare *Tuberitina* sp. and calcispherids are also present. The original micritic matrix is still recognizable, mostly as ghosts and converted into penecontemporaneous sparite.

Cape Dauphin, GSC *loc.* 82242, 38 x.

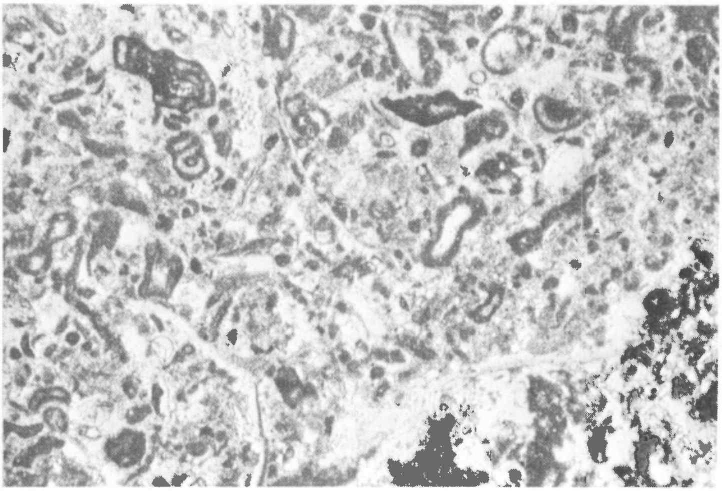
Fig. 2 *Ammovertella* sp. as nucleus of a highly recrystallized oolite. Numerous Cornuspiridae are present in the *Pseudoglomospira?* and *Pseudoglomospira?*-algal banks; they are often reworked as nuclei of the surrounding oolitic and proto-oolitic facies. The oolite is partially cerebroid.

Port Hood Island, 1-78, Sage Collection, 121 x.

Fig. 3 Algal-foraminiferal, poorly sorted, oolitized packstone, with penecontemporaneous recrystallization sparite. Some void filling sparite is also present. *Pseudoglomospira?* sp., disarticulated Spongiostromids, oolites, proto-oolites, and lumps form the bulk of the allochems. Pelmatozoans and brachiopods are also conspicuous. The microfacies corresponds to that of Fig. 1 reworked in a turbulent environment.

Cape Dauphin, GSC *loc.* 82242, 31 x.

Plate XIX



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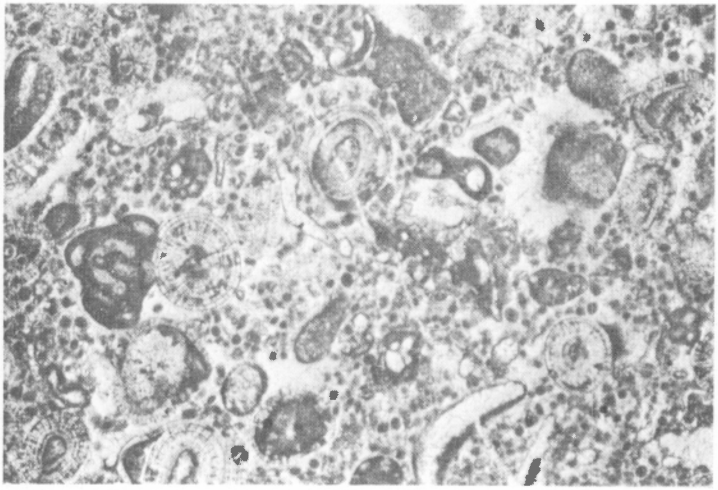

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