GEOL. CROAT.	47/1	25 - 43	6 Figs.		7 Pls.	ZAGREB 1994

Foraminiferal Assemblages in the Cenomanian of the Buzet-Savudrija Area (Northwestern Istria, Croatia)

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Key words: Cenomanian, Benthic foraminiferal assemblages, Biostratigraphical zonation, NW Istria, Croatia

Abstract

In the Cenomanian shallow-water carbonates of Northwestern Istria five biostratigraphic zones have been established:

CEN-1 *Ovalveolina maccagnoae* and *Sellialveolina viallii* biozone in the early Lower Cenomanian;

CEN-2 *O. maccagnoae* to *Chrysalidina gradata* interval zone in the late Lower Cenomanian;

CEN-3 *C. gradata* biozone in the early Middle Cenomanian, locally subdivided into two subzones:

CEN-3a *C. gradata* and orbitolinids (lower part)

CEN-3b *C. gradata* without orbitolinids (upper part);

CEN-4 *C. gradata* and *Broeckina* (*P.*) *balcanica* biozone in the late Middle Cenomanian, and

CEN-5 *C. gradata*, *B.* (*P.*) *balcanica* and *Vidalina radoicicae* biozone in the Upper Cenomanian.

1. INTRODUCTION

During detailed investigation of the Cenomanian lithostratigraphy in northwestern Istria an abundant assemblage of microfossils, especially benthic foraminifera, has been observed. By determining their stratigraphic relationships it was possible to establish biostratigraphic zones, and to correlate them with the neighbouring area. This investigation represents only the beginning of complex biostratigraphical research of the NW part of the Adriatic carbonate platform. Thus, it should be emphasised that the units presented in this paper are, for the time being, completely informal, and will be subsequently revised during future research.

Biofacies of the Cenomanian deposits are the exclusive subject of this paper. The lithofacies will be mentioned only sporadically, when the appearance and disappearance of some taxa could be related to palaeoecological changes. In the study area obvious facies differentiation has been observed, which is, at least in this part of the Adriatic carbonate platform, characteristic for the Cenomanian. The problem of facies variability will be the subject of another paper (VLAHOVIĆ, in prep.).

Stratigraphic data for the investigated area are rather scarce, the most important being the basic geological map of the area (PLENIČAR et al., 1969, 1973), with it's bibliography. On the basis of macrofossils and superpositional relations the Upper Cretaceous deposits were divided into three stratigraphic units (Albian, Cenomanian and Cenomanian-Turonian).

Our investigation, based primarily on the rich microfossil assemblages, showns that the Cretaceous of the NW Istria comprises the uppermost Albian and almost complete Cenomanian. At the Savudrija peninsula there is a small singular outcrop of younger deposits in clear tectonic contact with the Cenomanian beds. These pelagic micrites, with a very rich planktonic assemblage (unfortunately without stratigraphically important taxa), could be correlated with similar deposits that were widely distributed over the Adriatic carbonate platform at the Cenomanian-Turonian boundary (GUŠIĆ & JELASKA, 1990, 1993). In all other localities Cenomanian deposits are transgressively overlain by Palaeogene foraminifera limestone.

2. THE MATERIAL

2.1. GEOLOGICAL COLUMNS

Cenomanian deposits in NW Istria extend between Buzet and Savudrija (Fig. 1), an area of approximately 30 x 3-4 km. They are strongly disturbed by younger tectonics, resulting in a lack of completely continuous profiles through the Cenomanian.

Of several measured and analysed sections three were chosen as the best representatives of this area. However, these columns are also incomplete, with initial or terminal parts of the Cenomanian deposits missing.

In the Kanegra column in the western part of the investigated area (Fig. 1) the Cenomanian deposits overlie the Albian limestones and dolomites in continuous succession. After 321.5 m (measured thickness) this section is terminated at the level of a common *Chondrodonta* tempestite coquina of Upper Cenomanian age, which is in obvious tectonic contact with the Turonian calcisphaerulid limestones.

The transition from the Albian to the Cenomanian was also recorded in the Marušići column (Fig. 1).

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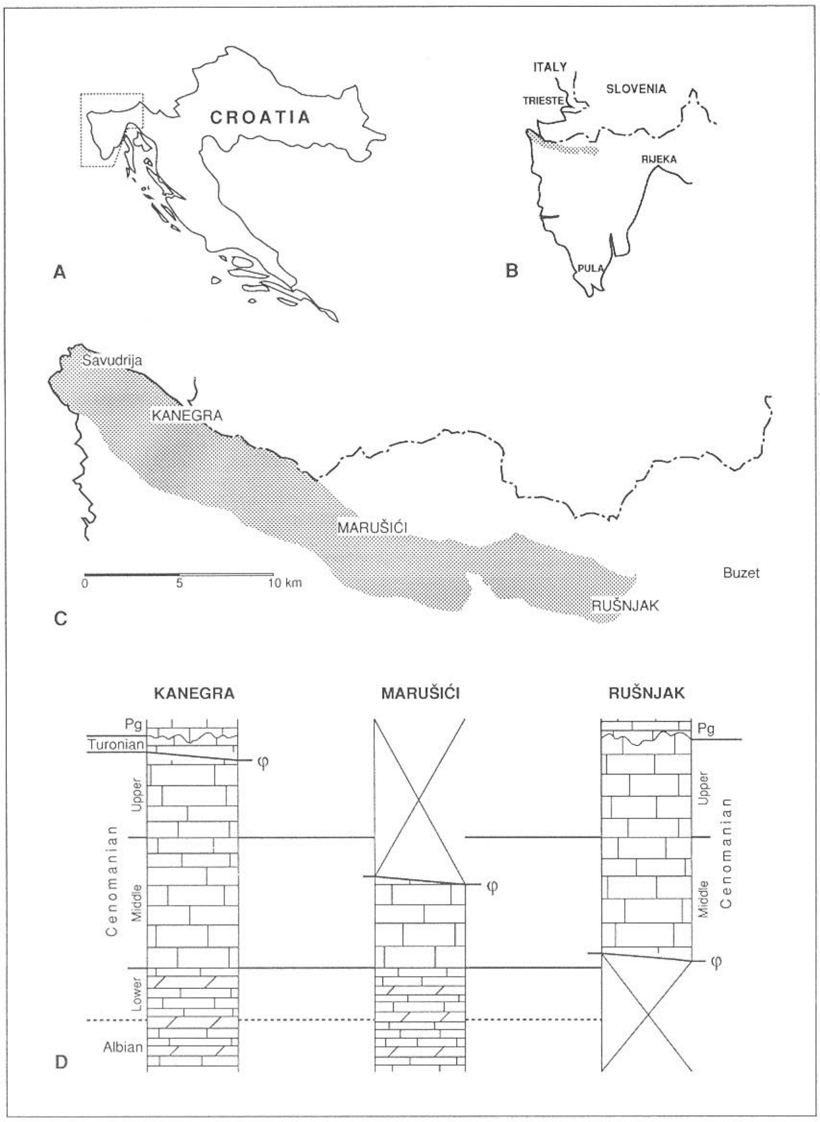

Fig. 1. A - C) Location map. Gray area represents the investigated area composed of the Upper Cretaceous deposits; D) Schematic stratigraphic columns (φ - faults).

However, in this section the succession is interrupted by a fault after 110 m (measured thickness). The youngest deposits here are of Middle Cenomanian age.

In the Rušnjak column, located in the eastern part of the investigated area (Fig. 1), the complete Lower Cenomanian is reduced due to tectonics. The section starts in the early Middle Cenomanian, and after 225 m (measured thickness) this column ends in the *Chondrodonta* level of the Upper Cenomanian, in beds somewhat younger than those of the Kanegra column.

2.2. THE FORAMINIFERAL ASSEMBLAGES

The determined microfossil assemblages include different species of miliolids, nezzazatids, alveolinids, ataxophragmiids, fischerinids and mostly indeterminable orbitolinids. Unfortunately, foraminiferal tests are commonly very intensively micritized, and sporadically recrystallized and late-diagenetically dolomitized, reducing the reliable determination of more species.

All determined forms will be presented in order of their appearance in the investigated columns.

2.2.1. The Kanegra column (Fig. 2)

Ovalveolina maccagnoae DE CASTRO
Sellialveolina viallii COLALONGO
Cuneolina pavonia d'ORBIGNY
Peneroplis sp.
Spiroloculina cretacea REUSS
Nezzazatinella picardi (HENSON)
Nummoloculina heimi BONET
Nezzazata simplex OMARA
Nummoloculina regularis PHILIPPSON
Pseudolituonella reicheli MARIE
Chrysalidina gradata d'ORBIGNY
Trochospira avnimelechi HAMAOUI & SAINT-MARC
Nezzazata conica (SMOUT)
Nezzazata gyra (SMOUT)
Peneroplis cf. *turonicus* SAID & KENAWY
Broeckina (Pastrikella) balcanica CHERCHI et al.
Biconcava bentori HAMAOUI & SAINT-MARC
Biplanata peneropliformis HAMAOUI & SAINT-MARC
Pseudorhapydionina dubia (DE CASTRO)
Spiroloculina robusta BRADY
Vidalina radoicicae CHERCHI & SCHROEDER
Vidalina cf. *hispanica* SCHLUMBERGER

Charentia cuvillieri NEUMANN
Pseudorhapydionina laurinensis (DE CASTRO)
Murgeina apula (LUPERTO-SINNI).

Sporadic pelagic influences were characterised by the abundance of gavelinids and calcisphaerulids.

2.2.2. The Marušići column (Fig. 3)

Nummoloculina heimi BONET
Spiroloculina cretacea REUSS
Cuneolina pavonia d'ORBIGNY
Ovalveolina maccagnoae DE CASTRO
Orbitolina (*Orbitolina*) sp.
Orbitolina (*Conicorbitolina*) sp.
Nezzazata simplex OMARA
Nezzazata conica (SMOUT)
Biplanata peneropliformis HAMAOUI & SAINT-MARC
Praealveolina sp.
Nezzazata gyra (SMOUT)
Nezzazatinella picardi (HENSON)
Pseudolituonella reicheli MARIE
Chrysalidina gradata d'ORBIGNY
Biconcava bentori HAMAOUI & SAINT-MARC

In the uppermost part of the column gavelinids and rotaliids were found.

2.2.3. The Rušnjak column (Fig. 4)

Nummoloculina heimi BONET
Chrysalidina gradata d'ORBIGNY
Cuneolina pavonia d'ORBIGNY
Nezzazata simplex OMARA
Nezzazata gyra (SMOUT)
Nezzazata conica (SMOUT)
Biconcava bentori HAMAOUI & SAINT-MARC
Nezzazatinella picardi (HENSON)
Pseudolituonella reicheli MARIE
Biplanata peneropliformis HAMAOUI & SAINT-MARC
Nummoloculina regularis PHILIPPSON
Trochospira avnimelechi HAMAOUI & SAINT-MARC
Peneroplis cf. *turonicus* SAID & KENAWY
Orbitolina (*Orbitolina*) sp.
Merlingina cretacea HAMAOUI & SAINT-MARC
Scandonea pumila SAINT-MARC
Broeckina (Pastrikella) balcanica CHERCHI et al.
Pseudorhapydionina dubia (DE CASTRO)
Vidalina radoicicae CHERCHI & SCHROEDER
Vidalina cf. *hispanica* SCHLUMBERGER
Peneroplis parvus DE CASTRO

In this column sporadic pelagic influences were also recorded, with the appearance of calcisphaerulids, gavelinids and rotaliids.

3. STRATIGRAPHIC INTERPRETATION

In the described foraminiferal assemblages long-ranging stratigraphic forms are predominant. Thus, special consideration was given to the shorter-ranging forms, allowing the establishment of a more detailed biostratigraphic subdivision. The determined stratigraphic ranges are shown in Fig. 5.

3.1 BIOSTRATIGRAPHIC ZONATION

On the basis of the stratigraphic ranges of some determined taxa in the Cenomanian of NW Istria (Figs. 2, 3 and 4) the following biostratigraphic units were established (Fig. 5):

CEN-1 *Ovalveolina maccagnoae* and *Sellialveolina viallii* biozone
CEN-2 *Ovalveolina maccagnoae* to *Chrysalidina gradata* zone
CEN-3 *Chrysalidina gradata* biozone, which, in the central part of the investigated area, is subdivided into two subzones:
- CEN-3a *Chrysalidina gradata* and orbitolinids
- CEN-3b *Chrysalidina gradata* without orbitolinids

CEN-4 *Chrysalidina gradata* and *Broeckina (Pastrikella) balcanica* biozone
CEN-5 *Chrysalidina gradata, Broeckina (Pastrikella) balcanica* and *Vidalina radoicicae* biozone.

The above mentioned units are nominated in accordance with the North American Stratigraphic Code (NORTH AMERICAN COMMISSION ON STRATIGRAPHIC NOMENCLATURE, 1983).

3.1.1. CEN-1 *Ovalveolina maccagnoae* and *Sellialveolina viallii* biozone

This biozone is present in the Kanegra and Marušići columns (Figs. 2 and 3). Beside *Ovalveolina maccagnoae* and/or *Sellialveolina viallii, Cuneolina pavonia, Spiroloculina cretacea, Nummoloculina heimi, Nezzazatinella picardi* and *Nezzazata simplex* were determined. The zone corresponds to the **taxon range zone.**

3.1.2. CEN-2 *Ovalveolina maccagnoae* to *Chrysalidina gradata* zone

This zone comprises the interval between the last appearance of *Ovalveolina maccagnoae* and the first appearance of *Chrysalidina gradata*. All the other forms are completely identical to the aforementioned zone. This zone represents an **interval zone**.

3.1.3. CEN-3 *Chrysalidina gradata* biozone

Biozone CEN-3 is marked by the first appearance of the three very important species for the Cenomanian: *Chrysalidina gradata, Nummoloculina regularis* and *Pseudolituonella reicheli*. A very rich assemblage of nezzazatids is also present, including *Nezzazata simplex, N. gyra, N. conica, Biconcava bentori, Biplanata peneropliformis*, and *Trochospira avnimelechi. Peneroplis* cf. *turonicus* also occurs. This biozone could be described as the *C. gradata* **partial range zone,** as it consists of the deposits prior to those with the first appearance of *Broeckina (Pastrikella) balcanica*. It can be further subdivided into two subzones, based on the presence of orbitolinids in the lower part, and their absence in the upper part. This subdivision is

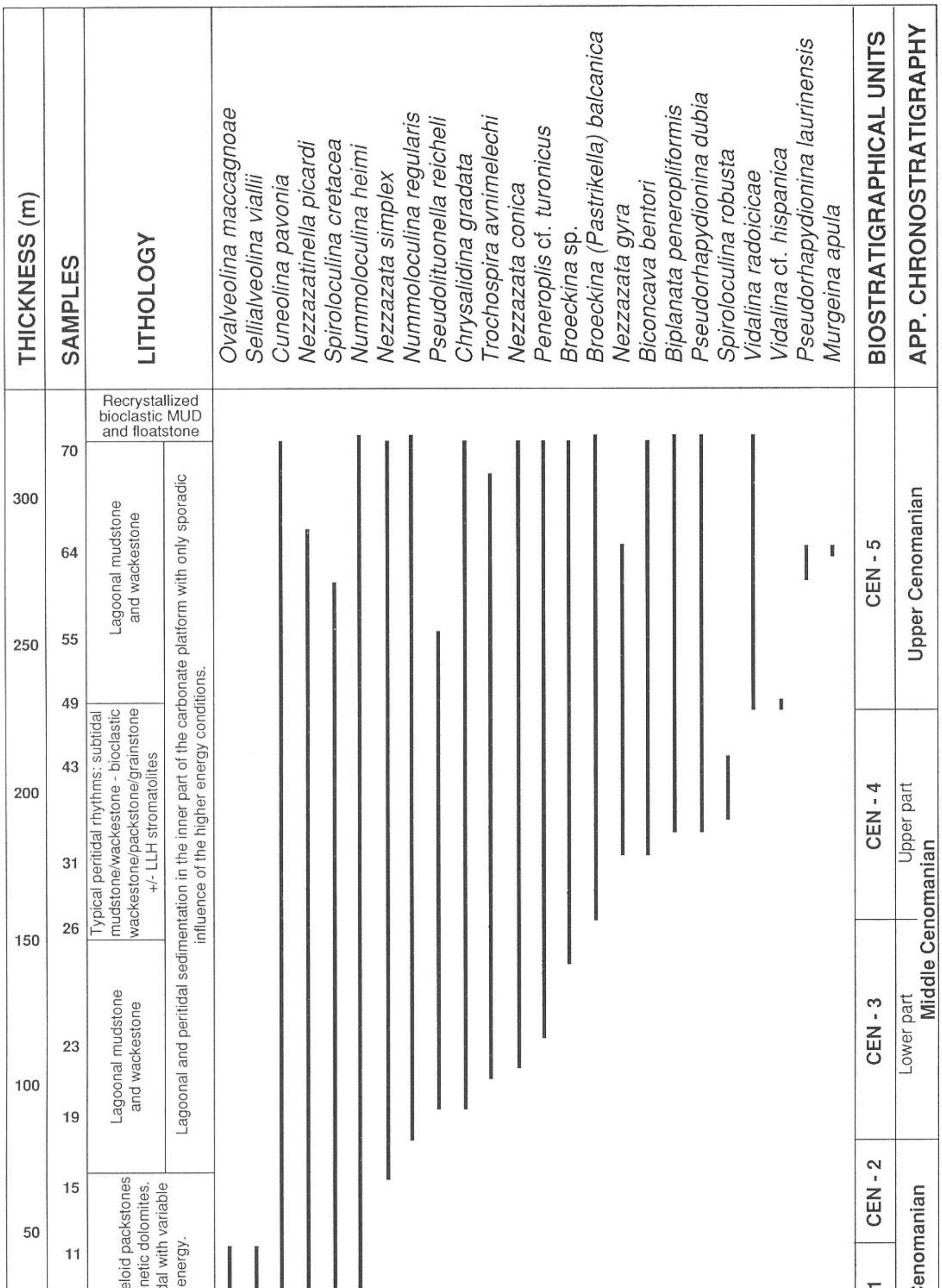

Fig. 2. Stratigraphic distribution of foraminiferal taxa in the Kanegra column.

especially applicable to the central part of the investigated area (Fig. 6). At the very end of deposition of the limestones comprising the CEN-2 biozone assemblage, facies differentiation occured in this part of the Adriatic carbonate platform. A shallow-water carbonate sand body with higher water-energy was formed in the central part, providing favourable conditions for orbitolinids. It is obvious that their abundance is a consequence of the influence of local environmental factors, which would designate this subzone as an **ecozone** (sensu VELLA, 1964). In the western part of the area (the Kanegra column), characterised by peritidal carbonate sedimentation, there are no orbitolinids at all, while on the somewhat deeper intraplatform carbonate ramp in the eastern part (the Rušnjak column) only reworked specimens were sporadically found. Unfortunately, orbitolinids are present exclusively in high-energy environments, hence are intensely abraded, and infrequently additionally micritized and recrystallized. That is why they are specifically, and even subgenerically almost

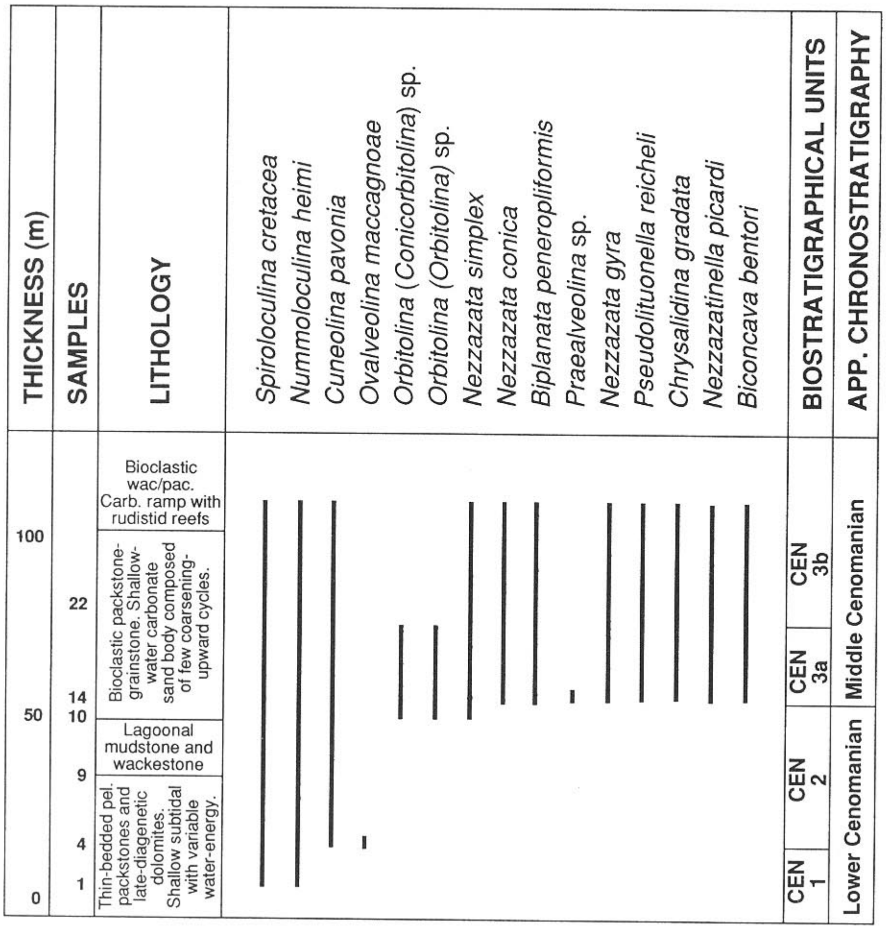

Fig. 3. Stratigraphic distribution of foraminiferal taxa in the Marušići column.

indeterminable. However, they probably belong to the subgenera *Conicorbitolina*, rarely to *Orbitolina*.

3.1.4. CEN-4 *Chrysalidina gradata* and *Broeckina (Pastrikella) balcanica* biozone

This biozone represents an **assemblage zone** bounded by the first appearance of *Broeckina (Pastrikella) balcanica* and the first appearance of *Vidalina radoicicae*. The foraminiferal assemblage also comprises previously mentioned forms, as well as *Pseudorhapydionina dubia*, *Spiroloculina robusta*, and in the Rušnjak column *Merlin-gina cretacea*.

3.1.5. CEN-5 *Chrysalidina gradata*, *Broeckina (Pastrikella) balcanica* and *Vidalina radoicicae* biozone

The beginning of this **assemblage zone** in the Rušnjak and Kanegra sections is marked by the first appearance of *Vidalina radoicicae*. This zone could also be nominated as the *Broeckina (Pastrikella) balcanica* and *Nummoloculina regularis* **acme-zone**, because it comprises the greatest abundance of those species. The new forms in this zone are *Pseudorhapydionina laurinensis*, *Murgeina apula*, *Peneroplis parvus* and *Vidalina* cf. *hispanica*.

3.2. THE STRATIGRAPHIC POSITION

The described foraminiferal assemblages are typical for the palaeobiogeographic provinces of the Cenomanian of Southern Tethys. In the investigated area only platform carbonates were found, without ammonites or stratigraphically important planktonic forms. The determination of the stratigraphic position of the established biozones is based on benthic foraminiferal investigations performed throughout the Mediterranean area in the last 20 years. The most important results were summarised in the monograph edited by SCHROEDER & NEUMANN (1985).

As a key to the determination of the stratigraphic position some typical benthic foraminiferal species were chosen. Their stratigraphic ranges were examined in the wider area of the Mediterranean, thus increasing their supporting value:

- *Ovalveolina maccagnoae* - the uppermost Albian to Middle Cenomanian,
- *Sellialveolina viallii* - the uppermost Albian to Middle Cenomanian,
- *Chrysalidina gradata* - the Middle and Upper Cenomanian,
- *Nummoloculina regularis* - the Middle and Upper Cenomanian,
- *Broeckina (Pastrikella) balcanica* - late Middle and the Upper Cenomanian, and
- *Vidalina radoicicae* - the Upper Cenomanian.

The stratigraphic age of the CEN-1 biozone could be determined only by the range of the species *O. maccagnoae* and *S. viallii*. In all distinctive papers (e.g. DE CASTRO, 1966, 1985a, b; SAINT-MARC, 1974, 1977; FLEURY, 1980; CHIOCCHINI et al., 1984; SIMMONS & HART, 1987) their vertical range is from the uppermost Albian to the upper part of the Middle Cenomanian[1]. Within the Adriatic carbonate platform *O. maccagnoae* is also known from this part of the Cretaceous (MAMUŽIĆ et al., 1976; VELIĆ et al.,

[1] The limestones containing those forms are almost completely micritized and late-diagenetically dolomitized. This was a great problem in their accurate determination, and it was not always possible to determine them specifically from our material. However, in the stratigraphical sense this would not cause any changes, concerning the fact that both species have similar stratigraphic ranges.

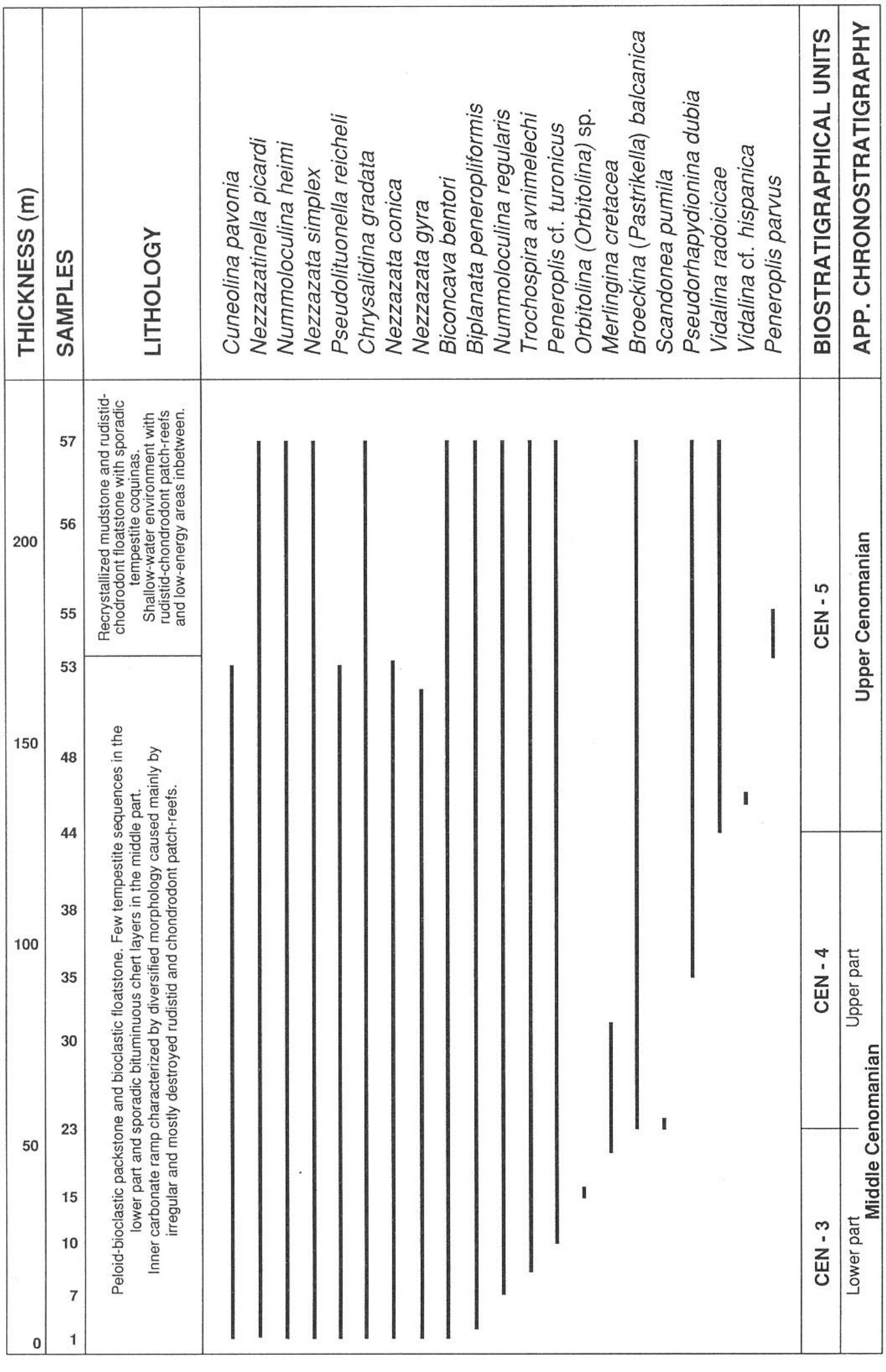

Fig. 4. Stratigraphic distribution of foraminiferal taxa in the Rušnjak column.

1979; VELIĆ, 1988). From the succession of the deposits, together with the fact that the younger CEN-3 zone is definitely of a Middle Cenomanian age, CEN-1 zone could correspond to the early Lower Cenomanian (the oldest part perhaps to the uppermost Albian). Other constituents of this zone have even wider ranges, mostly from the Albian to the end of the Cenomanian, like *Cuneolina* gr. *pavonia*, *Nummoloculina heimi*, *Spiroloculina cretacea*, *Nezzazatinella picardi* and *Nezzazata simplex*.

All the above mentioned forms, except orbitolinids, were also discovered in the CEN-2 zone. They are also abundant in all younger zones, and therefore will not be quoted further in the text. The lack of forms with narrower stratigraphic range is the reason why the stratigraphic age of the CEN-2 zone was not directly determined. According to stratigraphic superposition, it may be concluded that it is of late Lower Cenomanian (or even earliest Middle Cenomanian) age.

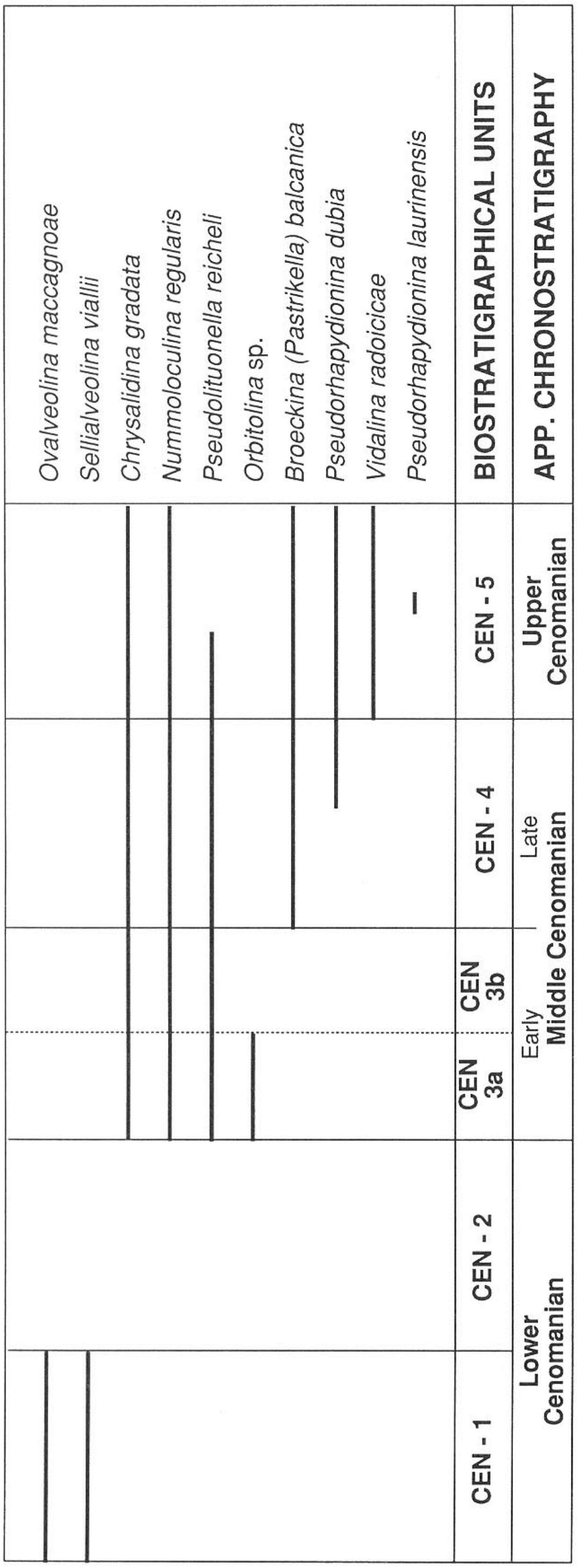

Fig. 5. Stratigraphic distribution and mutual relationships of characteristic Cenomanian foraminifera in the study area (not to scale).

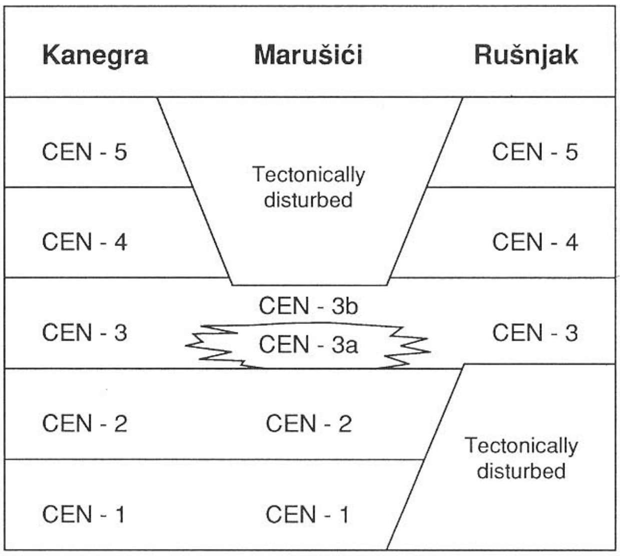

Fig. 6. Lateral relationships of biozones presented in this paper in the investigated area.

The almost synchronous appearance of *Chrysalidina gradata*, *Pseudolituonella reicheli* and *Nummoloculina regularis* in the examined sections is a very important biostratigraphic marker, denoting the beginning of the new, CEN-3 biozone. Stratigraphic ranges of the first two species in the investigated area are almost completely in accordance with the results summarised in SCHROEDER & NEUMANN (1985). The only difference is in the absence of *P. reicheli* in the Lower Cenomanian of NW Istria, which could be a consequence of unfavourable environmental conditions. *N. regularis* is also determined as the Middle and Upper Cenomanian form, corresponding to its stratigraphic range in other regions of the Mediterranean (e.g. SAINT-MARC, 1974; DECROUEZ, 1977a, b; BERTHOU, 1984; BILOTTE, 1984, 1985).

Peneroplis cf. *turonicus*, which is a frequent form in the Middle and Upper Cenomanian of the Kanegra and Rušnjak sections, is cited in the papers of SAINT-MARC (1974, 1977) and DECROUEZ (1976, 1977a, b) with almost the same range.

In the central and eastern part of the investigated area (the Marušići and Rušnjak columns) *Biconcava bentori*, *Biplanata peneropliformis*, *Nezzazata gyra*, *N. conica* and *Trochospira avnimelechi* were found from the early Middle Cenomanian, while in the western part (the Kanegra column) they appeared for the first time in the late Middle Cenomanian. Such a stratigraphic range mostly corresponds to those stated by HAMAOUI & SAINT-MARC (1970) and HAMAOUI (1985).

Taking into account all the aforementioned data, an early Middle Cenomanian age for the CEN-3 biozone can be proposed. In the central part of the investigated area this zone can be further subdivided into two subzones, the older (CEN-3a) with, and the younger (CEN-3b) lacking orbitolinids.

The first appearance of the species *Broeckina (Pastrikella) balcanica* in the investigated area represents another very important biostratigraphic marker, and the beginning of the new unit.

The stratigraphic range of *B. (P.) balcanica* in NW Istria is completely compatible with the original data of

CHERCHI et al. (1976), as well as with the results of FLEURY (1980), CHIOCCHINI et al. (1984) and CHERCHI & SCHROEDER (1985a) in other areas, and GUŠIĆ & JELASKA (1990) on the Adriatic carbonate platform. It should be noted that *Pseudorhapydionina dubia* was found in somewhat younger deposits than *B. (P.) balcanica.* According to the data from the literature, its stratigraphic position in the Mediterranean area is rather heterogeneous. For example, DE CASTRO (1985c) quotes the range from the Lower Cenomanian to the Lower Turonian, while BILOTTE (1984, 1985) quoted only an Upper Cenomanian age. The latter author also considers *Spiroloculina robusta* as a Middle to the Upper Cenomanian form.

By comparison of the published data with findings in NW Istria it was concluded that the CEN-4 biozone is of late Middle Cenomanian age.

The beginning of the youngest, CEN-5 biozone is marked by the first appearance of *Vidalina radoicicae.* Its stratigraphic position is very important for the determination of the age of the complete unit, because all the accompanied forms have longer stratigraphic ranges. The published Upper Cenomanian range (CHERCHI & SCHROEDER, 1985b) is also suggested by observations in the uppermost parts of the Kanegra and Rušnjak sections, indicating an Upper Cenomanian age for the CEN-5 zone.

In this biozone *Pseudorhapydionina laurinensis* and *Murgeina apula* appear for the first time. While the latter species has a wide stratigraphic range throughout the Upper Cretaceous, the range of *P. laurinensis* is much more important. In his original description DE CASTRO (1965) determined an Upper Cretaceous age. Later investigations resulted in variable opinions on its range, mostly in the Upper Cenomanian and the Lower Turonian (see summarised results in DE CASTRO, 1985c). Most authors consider this species as being of Upper Cenomanian age. This corresponds to the findings in NW Istria, as well as to the conclusion of DE CASTRO (1985c, p. 94). However, this species was also found in the Upper Santonian of Spain (BILOTTE, 1985; HOTTINGER et al., 1989).

In the same assemblage in the Rušnjak section *Peneroplis parvus* appears. This would propose an extension of its range to the Upper Cenomanian with regard to former investigations (DE CASTRO, 1965, 1985d; FLEURY, 1980).

Correlation of the presented results with earlier investigations on the Adriatic carbonate platform is not completely possible. Data of MAMUŽIĆ et al. (1976), BAUER & POLŠAK (1979), MAMUŽIĆ et al. (1979), MAMUŽIĆ, POLŠAK et al. (1981), MAMUŽIĆ, KOROLIJA et al. (1981) and GUŠIĆ & JELASKA (1990) point at a general Cenomanian age. However, foraminiferal assemblages cited in those papers also comprise forms characteristic of different parts of the Cenomanian. Beside other forms there are *Ovalveolina ovum* and *Orbitolina (O.) concava* in the Lower Cenomanian, *Chrysalidina gradata* and *Broeckina (Pastrikella) balcanica* in the Middle and Upper Cenomanian, as well as *Cisalveolina fraasi* in the Upper Cenomanian.

These data represent a very good foundation for future investigations, enabling to successively complement this biostratigraphical subdivision, and reliably correlate the Cenomanian deposits of the Adriatic carbonate platform, as well as with the wider area.

4. CONCLUSIONS

In the biostratigraphic zonation of the Cenomanian of NW Istria and the interpretation of the stratigraphic position particular attention was given to the forms having narrower stratigraphic ranges. The ranges of the following forms were taken as a basis for a discussion:

- *Chrysalidina gradata*, *Pseudolituonella reicheli* and *Nummoloculina regularis* are considered as Middle and Upper Cenomanian;
- *Broeckina (Pastrikella) balcanica* is considered to extend from the late Middle Cenomanian to the end of the Upper Cenomanian;
- *Vidalina radoicicae* is of the Upper Cenomanian age.

Five biostratigraphic zones were distinguished:

CEN-1 *Ovalveolina maccagnoae* and *Sellialveolina viallii* biozone in the early Lower Cenomanian;

CEN-2 *O. maccagnoae* to *Chrysalidina gradata* interval zone in the late Lower Cenomanian;

CEN-3 *C. gradata* biozone in the early Middle Cenomanian, locally subdivided into two subzones:

- CEN-3a *C. gradata* and orbitolinids (lower part)
- CEN-3b *C. gradata* without orbitolinids (upper part);

CEN-4 *C. gradata* and *Broeckina (P.) balcanica* biozone in the late Middle Cenomanian, and

CEN-5 *C. gradata*, *B. (P.) balcanica* and *Vidalina radoicicae* biozone in the Upper Cenomanian.

Additional data on the stratigraphic ranges of some forms found in the NW Istria have been gained:

- *Ovalveolina maccagnoae* and *Sellialveolina viallii* are of the Lower Cenomanian age;
- the upper boundary of the range of the orbitolinids is at the middle of the lower part of the Middle Cenomanian;
- *Pseudorhapydionina dubia* appeared in the late Middle Cenomanian, and lasted through the Upper Cenomanian;
- *P. laurinensis* was found only in the Upper Cenomanian.
- *Peneroplis parvus* was determined in the Upper Cenomanian.

Acknowledgements

This investigation was performed during work on the Lithostratigraphic map of the Republic of Croatia in Istria, and supported by The Ministry of Science of the Republic of Croatia through projects No. 1-09-202 and 1-09-299. We are indebted to the Institute of Geology for the entire support. Also, we are grateful to Prof. Josip TIŠLJAR, Dubravko MATIČEC, M.Sc. and Ladislav FUČEK, B.Sc., for their precious help during the field investigations.

The authors would like to thank Prof. Rolf SCHROEDER, Dr. Michel BILOTTE and Prof. Ivan GUŠIĆ for very helpful suggestions and comments on the manuscript of this paper.

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Manuscript received November 22, 1993.
Revised manuscript accepted June 26, 1994.

PLATE I

1 - 3 *Sellialveolina viallii - Ovalveolina maccagnoae* biofacies.
CEN-1 biozone, Kanegra column. 10x.
4 - 6 *Chrysalidina gradata.*
CEN-4 biozone, Rušnjak column. 20x.
7 - 8 *Pseudolituonella reicheli.*
7 CEN-4 biozone, Rušnjak column. 32x
8 CEN-4 biozone, Rušnjak column. 48x.

PLATE II

1 - 3 *Orbitolina (?Conicorbitolina)* sp.
CEN-3a biozone, vicinity of the Marušići column. 20x.
4 Abraded tests of *Praealveolina* sp., *Orbitolina* (?*Orbitolina*) sp. and rudistid shells.
CEN-3a biozone, Marušići column. 30x.

PLATE III

1 - 5 *Biconcava bentori.*
1 CEN-4 biozone, Kanegra column. 95x.
2, 3 CEN-4 biozone, Rušnjak column. 95x.
4 CEN-3 biozone, Rušnjak column. 95x.
5 CEN-4 biozone, Kanegra column. 95x.
6 - 8 *Biplanata peneropliformis.*
6 CEN-3 biozone, Rušnjak column. 50x.
7 CEN-4 biozone, Rušnjak column. 50x.
8 CEN-5 biozone, Rušnjak column. 50x.
9 *B. peneropliformis* and *Nezzazata simplex.* CEN-5 biozone, Rušnjak column. 50x.
10 - 11 *Merlingina cretacea.*
10 CEN-4 biozone, Rušnjak column. 95x.
11 CEN-3 biozone, Rušnjak column. 95x.

PLATE IV

1 - 6 *Broeckina (Pastrikella) balcanica.*
1 - 3 Equatorial sections
1 CEN-4 biozone, Kanegra column. 30x.
2 CEN-5 biozone, Rušnjak column. 30x.
3 CEN-5 biozone, Rušnjak column. 50x.
4 - 6 Transverse sections in typical biofacies with nezzazatids and miliolids.
4 CEN-5 biozone, Rušnjak column. 30x.
5, 6 CEN-5 biozone, Rušnjak column. 10x.

PLATE V

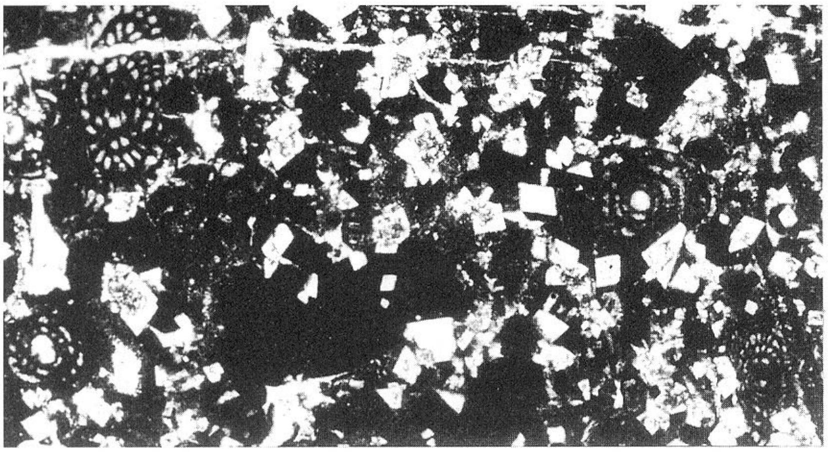
1 - 4	*Peneroplis* cf. *turonicus*.	
	1, 3	CEN-4 biozone, Rušnjak column. 60x.
	2	CEN-5 biozone, Rušnjak column. 60x.
	4	CEN-4 biozone, Kanegra column. 40x.
5 - 7	*Peneroplis parvus*.	CEN-5 biozone, Rušnjak column. 50x.
8 - 10	*Scandonea pumila*.	CEN-4 biozone, Rušnjak column. 100x.

PLATE VI

1 - 2	*Pseudorhapydionina dubia*.	
	1	CEN-4 biozone, Kanegra column. 50x.
	2	CEN-5 biozone, Kanegra column. 50x.
3	Biofacies with *P. dubia*.	CEN-5 biozone, Kanegra column. 45x.
4 - 6	*Pseudorhapydionina laurinensis*.	
		CEN-5 biozone, Kanegra column, 50x.
7, 8	Biofacies with *Nummoloculina regularis*, *Cuneolina* gr. *pavonia*, *P. dubia* and miliolids.	
		CEN-5 biozone, Rušnjak column. 20x.

PLATE VII

1 - 6	*Vidalina radoicicae*.	
	1	CEN-5 biozone, Rušnjak column. 90x.
	2-6	CEN-5 biozone, Kanegra column. 90x.
7, 8	?*Vidalina radoicicae*.	CEN-5 biozone, Rušnjak column. 90x.
9, 10	*Vidalina* cf. *hispanica*	
	9	CEN-5 biozone, Kanegra column. 90x.
	10	CEN-5 biozone, Rušnjak column. 90x.
11	*Vidalina* sp.	CEN-5 biozone, Kanegra column. 90x.



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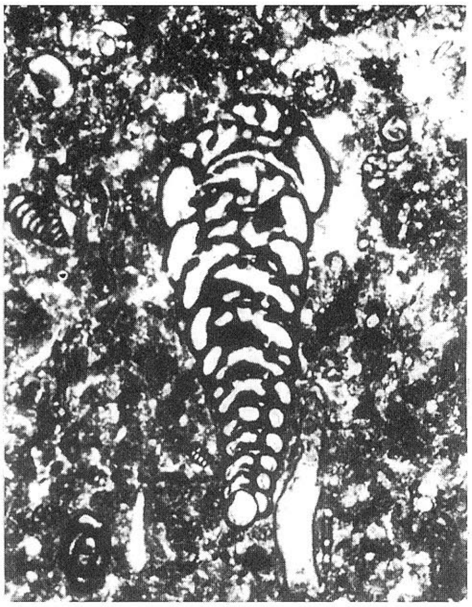

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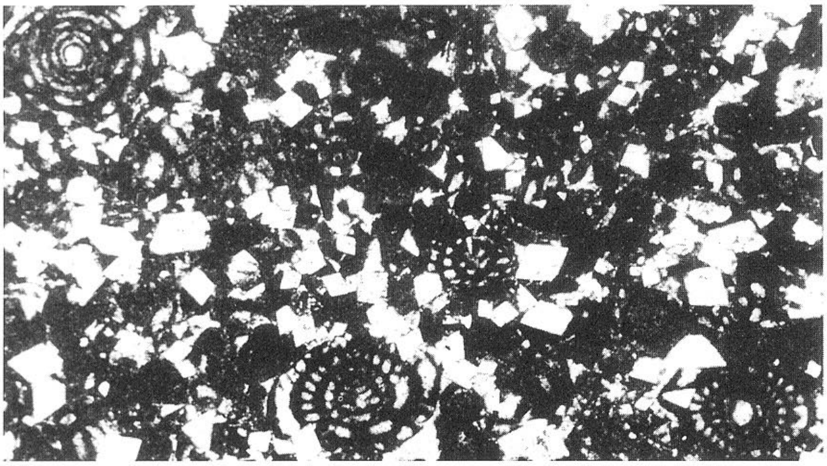

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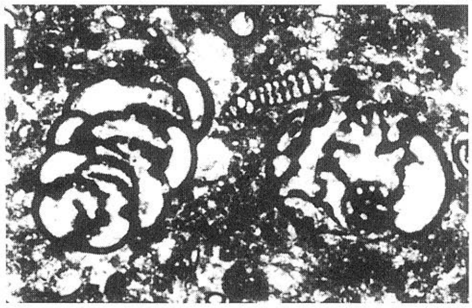

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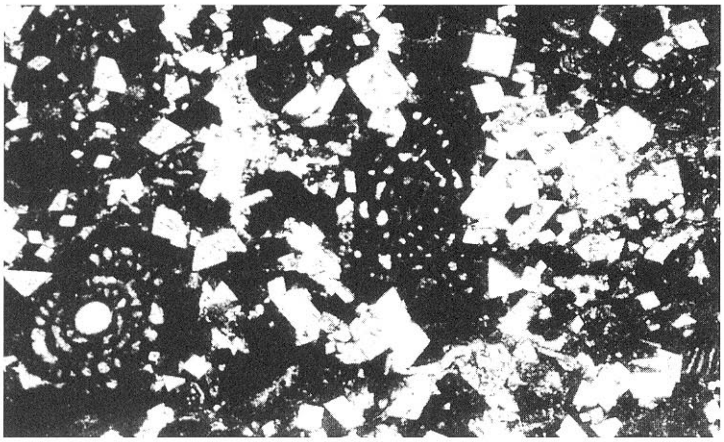

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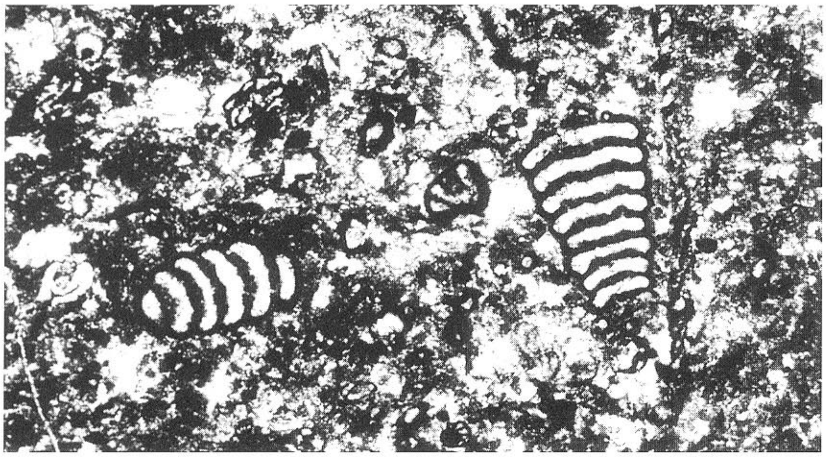

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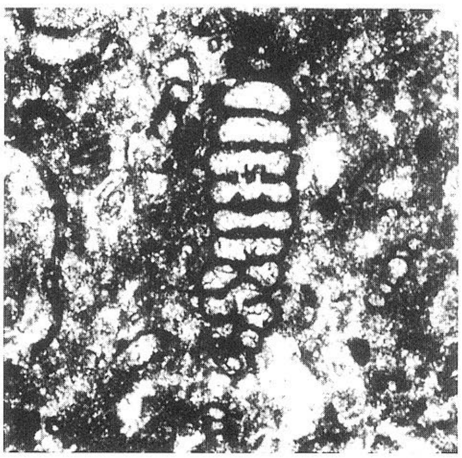

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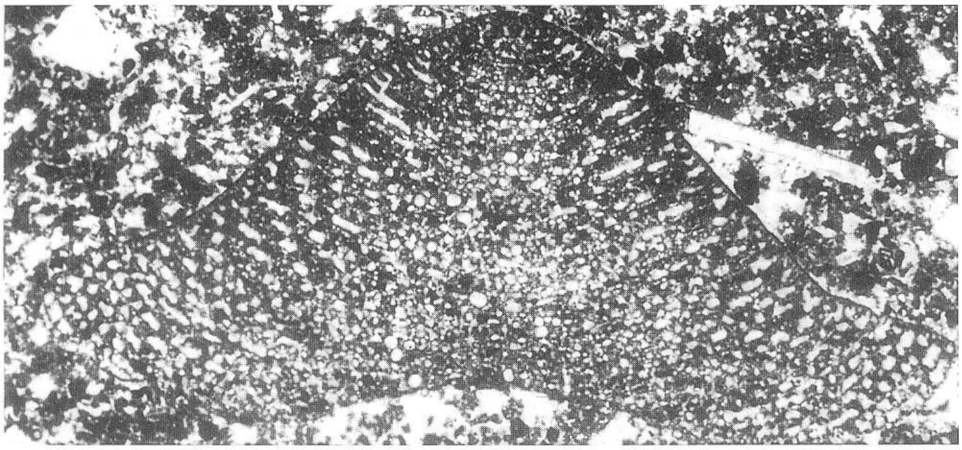

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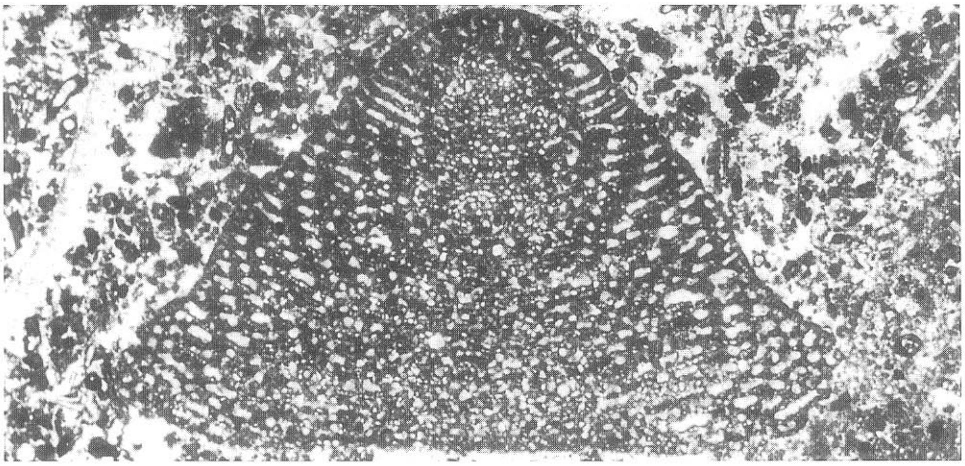

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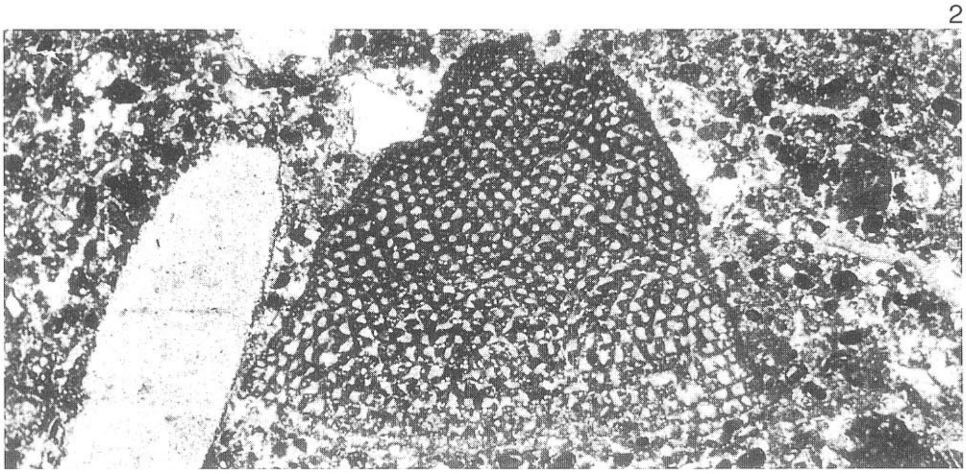

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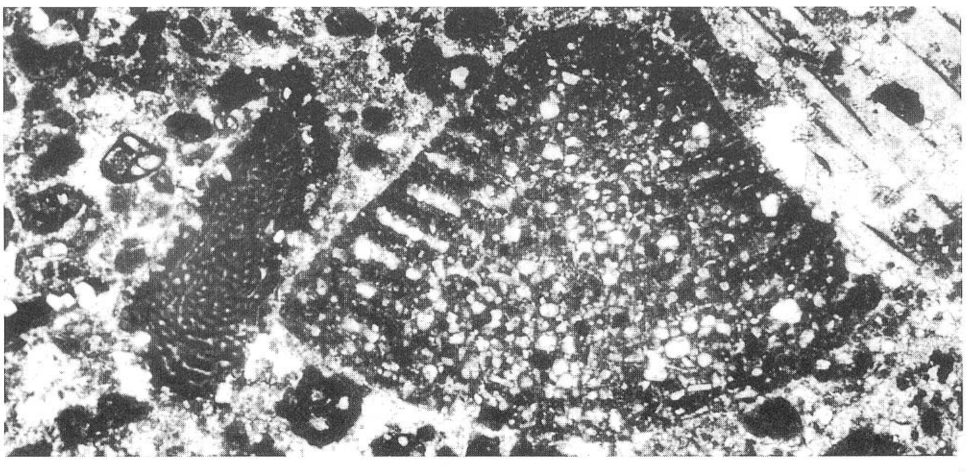

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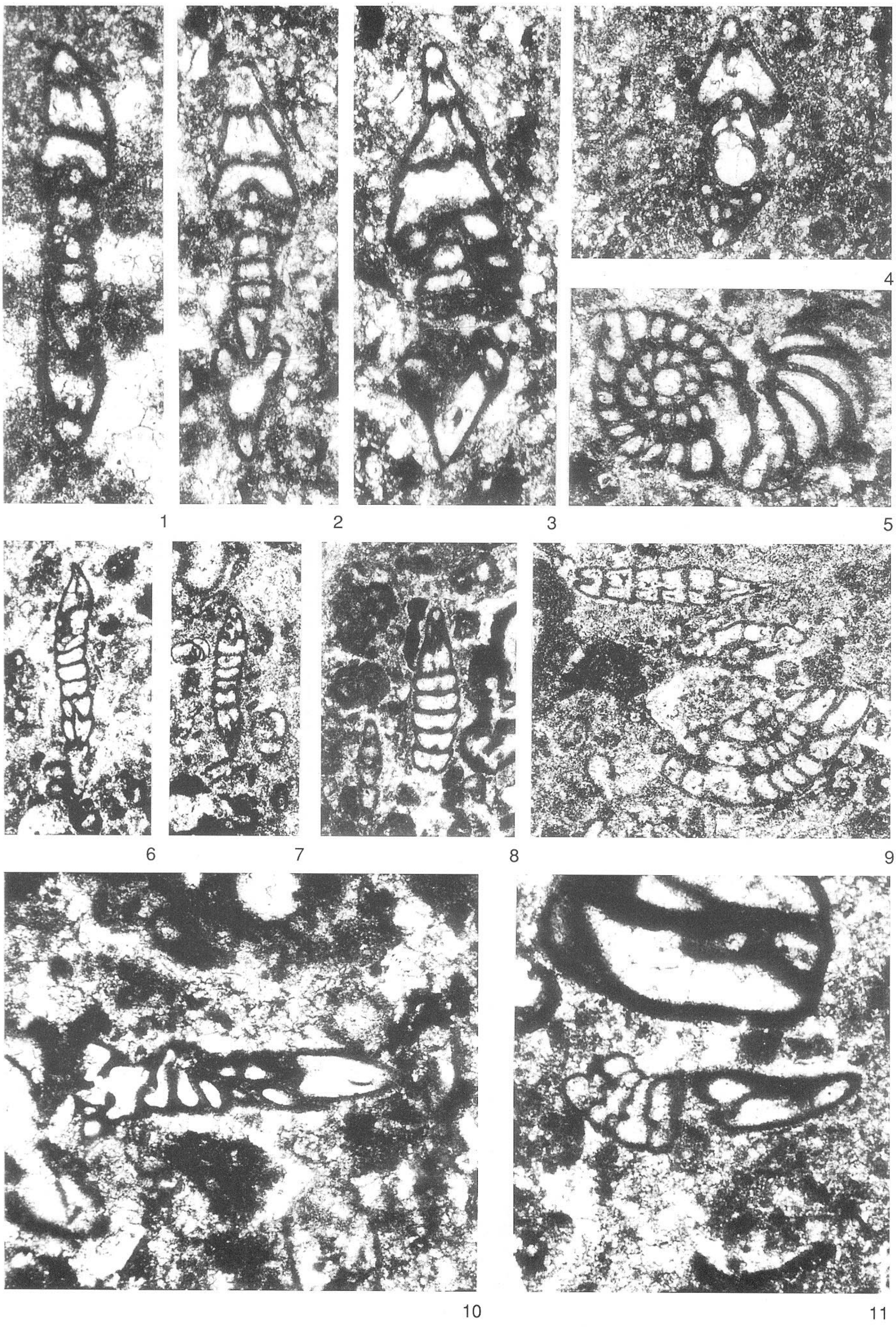
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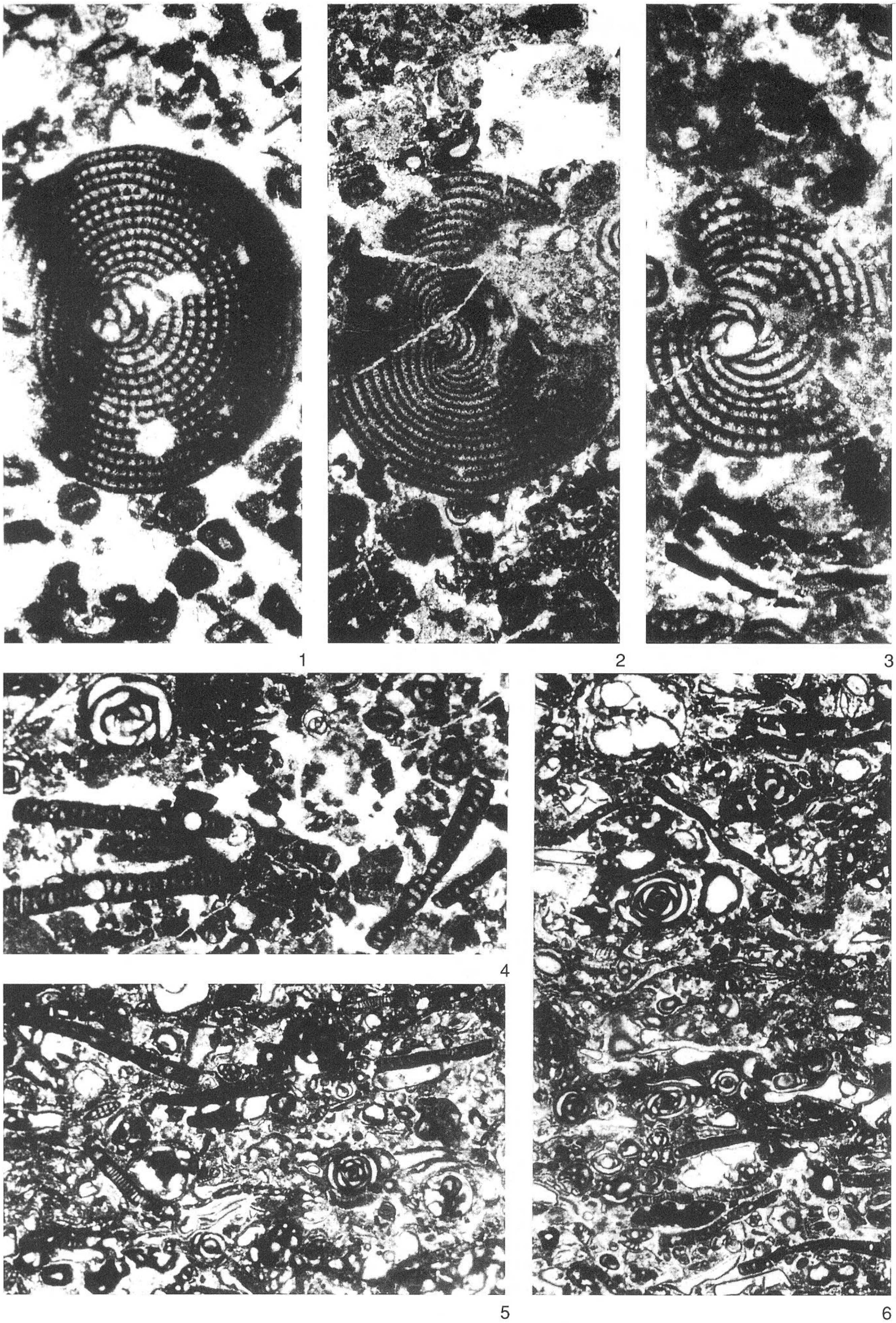
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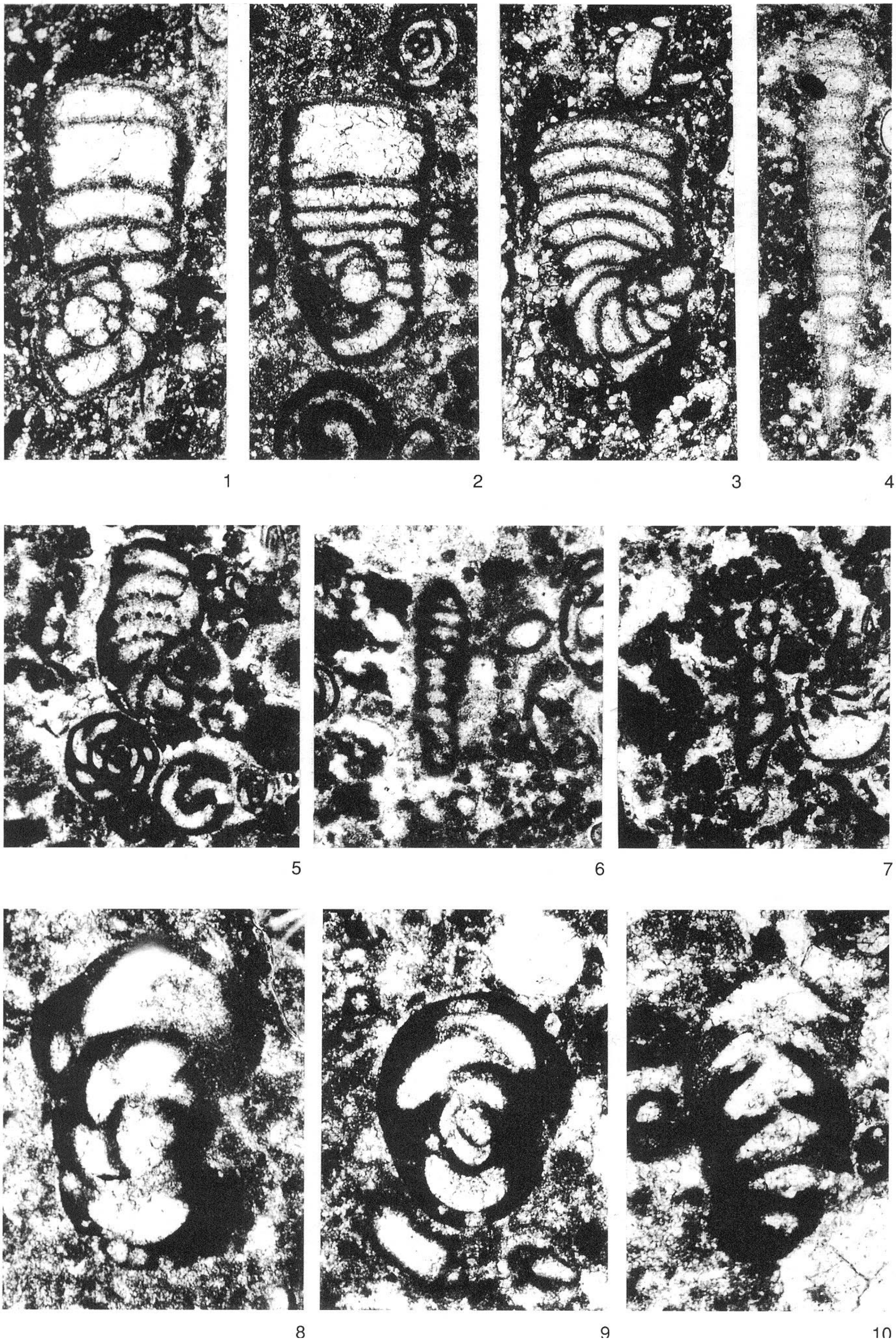
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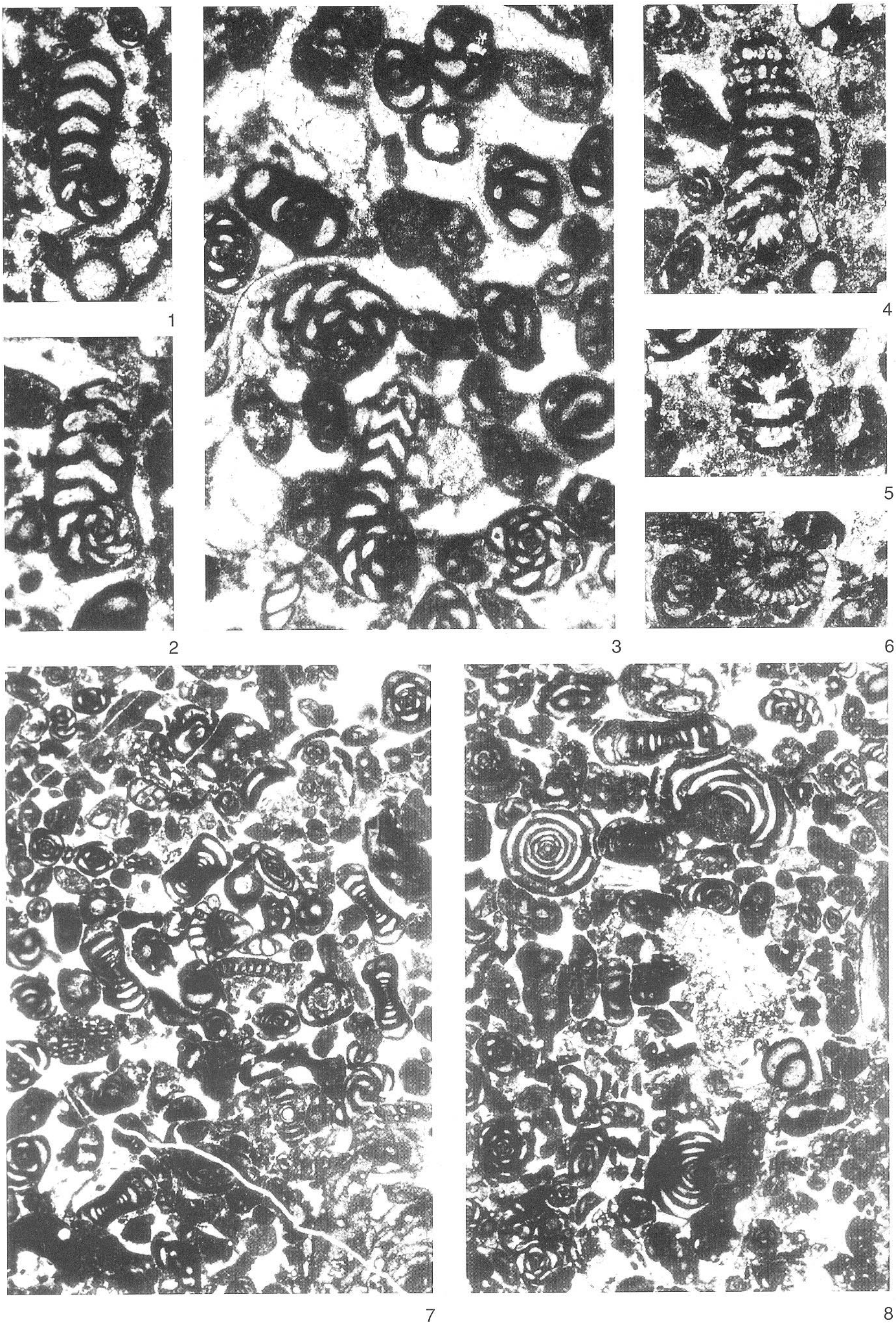
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