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THEODOR NEAGU *

CENOMANIAN PLANKTONIC FORAMINIFERA IN THE SOUTHERN PART OF THE EASTERN CARPATHIANS

(Pl. XIII—XXXVII, 1 Fig.)

Foraminiferele planctoniceale Cenomanianului din Partea de Sud a Carpatilor Orientali

(Pl. XIII—XXXVII, 1 Fig.)

A b s t r a c t: The writer puts forward some considerations of an evolutionary-phylogenetic character, with particular regard to planktonic Foraminifera of the Rotaliporidae family, as well as some remarks on the latter's relation to the others families of Cretaceous planktonic Foraminifera. The main elements of Cenomanian planktonic fauna in the southern part of the Eastern Carpathians are described. Two new species of the genus *Praeglobotruncana* are described: *Praeglobotruncana barbui* n. sp. and *P. prahovae* n. sp.

In contrast to the older (Aptian-Albian) formations, the basal Upper Cretaceous (Cenomanian-Turonian) deposits in the Eastern Carpathian Flysch, contain a very rich assemblage of both benthonic and planktonic Foraminifera. The abundance and good or very good preservation of these Foraminifera, as well as the fact that they have not been studied in detail so far (except for some early attempts by the present writer) determined us to start this study. As an account of the entire assemblage of benthonic and planktonic Foraminifera is beyond the scope of this account, only planktonic Foraminifera are considered.

The material studied comes from the numerous outcrops of Cenomanian deposits, occurring, from North to South, in the Teliu and Buzău Valleys (Brașov district), the Prahova and Belia Valleys (Prahova district), the Ialomița, Lupului and Ialomicioara Valleys (Dîmbovita district), Rucar basin, Dîmbovita Valley (Argeș district). From a litho-stratigraphical viewpoint, it is difficult to separate the Vraconian — Lower Cenomanian or the Upper Cenomanian — Lower Turonian deposits. Furthermore, on account of palaeontological-evolutionary requirements, it was considered useful not to limit the present study rigidly only to the Cenomanian deposits sensu stricto.

In the present account only palaeontological-systematic and theoretical-evolutionary aspects of the planktonic assemblage will be considered. Problems of a microbiostratigraphic nature will be treated in a later

* Address: Dr Theodor Neagu, Labor. Paleontologie Univ. București, B-dul N. Balcescu 1

paper. The taxonomic and evolutive problems arising during investigation of these Foraminifera were considered to be particularly interesting, and were therefore given close attention.

The assemblage of planktonic Foraminifera from the Cenomanian deposits are divided naturally into several groups, taxonomically different but closely related from an evolutionary viewpoint.

The basal group consists of the subfamily *Hedbergellinae,* whose evolution starts in the Lowermost Cretaceous, or possibly earlier, with the genus *Hedbergella* Brönnimann et Brown from which *Clavihedbergella* Banner et Blow, *Ticinella* Reichel and *Praeglobotruncana* Bermudez are derived. However, the most important and most interesting group, which is obviously derived from the genus *Hedbergella,* is the subfamily *Rotaliporinae.* This group is of palaeontologic--systematic value, since the Cenomanian planktonic Foraminifera have definite morphologic specialization, and of stratigraphic value, with regard to the microbiostratigraphy of this stage. The very rapid evolution of the *Rotalipora* group, throughout the Cenomanian Stage only, provides very good material for an evolutionary phylogenetic study, as it is easy to observe specimens with the common characters of at least two closely related species.

A careful examination of components of the genus *Hedbergella,* leads to some interesting observations concerning its evolution. Thus the species in the Lowermost Cretaceous (Valanginian-Hauterivian) displays primitive characteristics in the mode of coiling of chambers and the sizes of the test are small and very small (0,4-to 0,2 mm). As a whole, the genus displays a fair degree of homogeneity at this time. In the Aptian-Barremian deposits, there are new species of *Hedbergella* of medium size and with low trochospiral coiling of chambers (*H. trochoidea*). There also occur elements with very low trochospiral, almost planispiral coiling (*H.* aff. *H. planispira* Moullade, 1965) and even a new genus, *Clavihedbergella,* as a result of a more and more well-marked, digitiform elongation of the chambers of the last whorl. This new genus evolved in parallelism with the stem from which it derived, giving species as far as the Turonian and even Lower Senonian. In the Cenomanian, the species found in the Flysch deposits is *Clavihedbergella simplicissima* (Magné & Sigal), which still shows an obvious hedbergellian appearance. At the base of the Albian, and perhaps even in the Uppermost Bedoulian, a new genus diverged from the hedbergellian stem is *Ticinella.* This genus is characterized by general features of tests of hedbergellian type, with a slight trochospiral appearance of the test, up to a planispiral coiling, a great number of globular chambers (6 to 10) in the last whorl. A completely new character, by comparison with the primary stem, is seen in the occurrence of additional, umbilical apertures. This genus has a rather short range and is frequently encountered in Albian and Vraconian deposits (Sigal, 1966). Some workers (Loeblich & Tappan, 1961) are of the opinion, that this genus is also encountered throughout the entire Cenomanian. The specimens figured here (pl. XV, figs. 3—5, 8—14) show some morphological features of this genus, but they are obviously not true *Ticinella*; it seems that this is an example of homeomorphy. From an evolutionary viewpoint, the genus *Hedbergella* seems to be very sensitive and able to give rise to adaptative radiations, which permitted a pronounced evolution of the group:

Hedbergella—Ticinella—Rotalipora Brotzen, or *Hedbergella—Clavihedbergella—Hastigerinelloides—Schackoina* Thalmann, or *Hedbergella—Praeglobotruncana—Globotruncana* Cushman (text-fig. 1).

Although the transition from *Hedbergella* to *Ticinella* is very obvious in the morphological features of the test, it is rather difficult to trace some specimens with intermediate characteristics, with regard to the occurrence of additional appertures. This transition is, according to J. Sigal (1966, pp. 212—213), sharply distinguishable and in the opinion of the present author, transitional forms have little chance of being preserved. However, its connection with the basal stem is unquestionable.

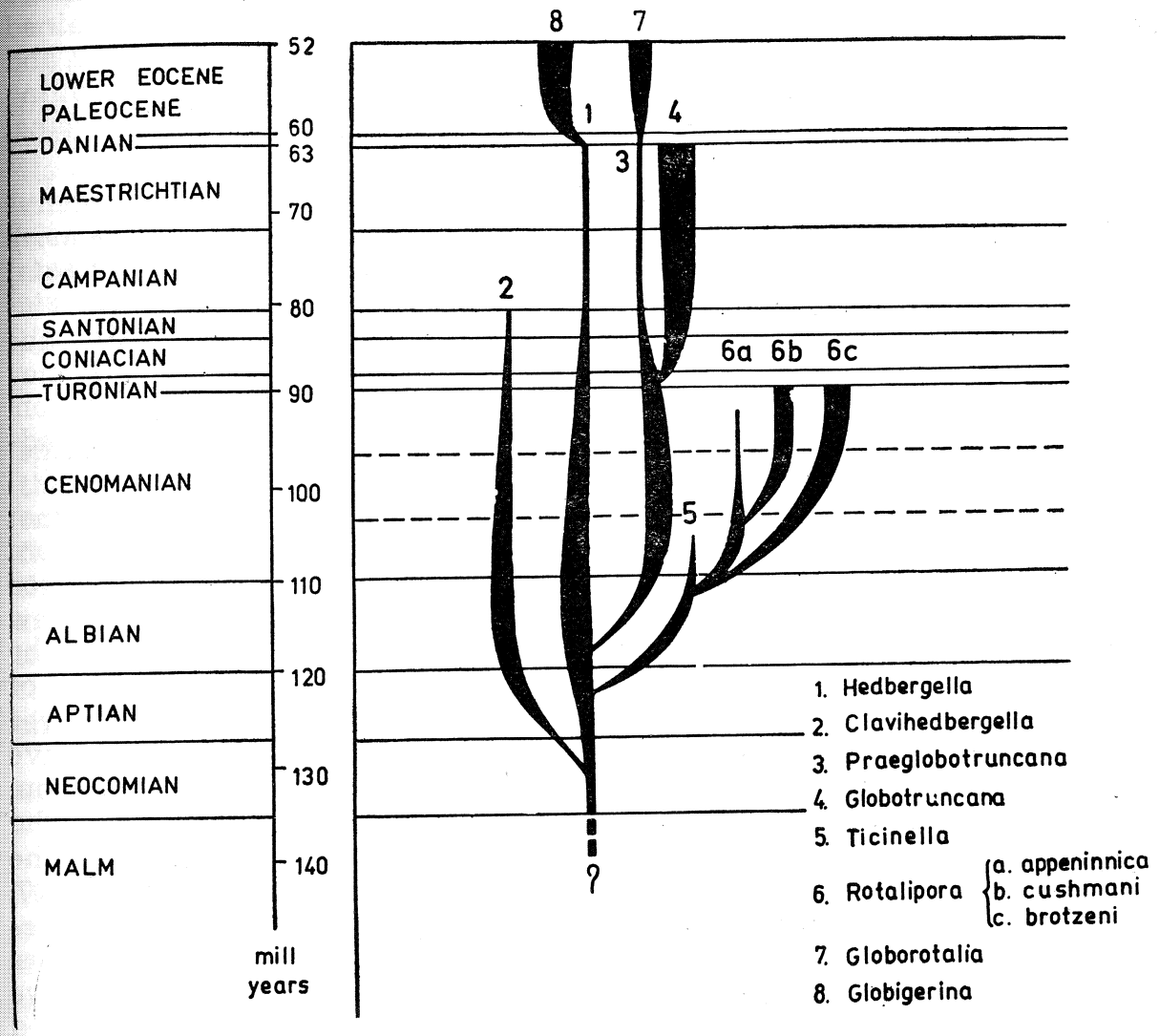

Fig. 1. Phyllogeny of the family Rotaliporidae and some related genera

Sigal's assumption (1966) that the *Rotalipora* group originates from this genus is in the opinion of the present author very logical, since besides the new element that appeared on the hedbergellian background of the test — the sutural apertures — there is only the peripheral keel of the chambers. From an evolutionary viewpoint, this opinion seems to be more logical than that expressed by Brönnimann and Brown (1956), who consider this group (*Rotalipora*) to be derived from the genus *Praeglobotruncana*. In the present author's opinion, the genus *Praeglobotruncana* likewise originates from the *Hedbergella* group. This

opinion is based on the fact that in the material studied, a progressive development of the peripheral keel (pl. XIV, fig. 10—12) was discernible. This is due to the appearance and more and more pronounced growth of rugosity on the chambers of the last whorl, which are gradually transformed into sutural keels. Thus, in the present concept, the genus *Praeglobotruncana* became a new adaptative radiation of the hedbergellian stem, which might have lead to the occurrence of new elements in the completion of its evolution, at the beginning of the Middle Turonian, ending with the appearance of the genus *Globotruncana*. Thus, in the evolution of the genus *Praeglobotruncana,* which appears simultaneously with the Middle Albian, the following evolutionary trends can be distinguished: a continuous increase in size, with a maximum attained in the Turonian as the species *P. oraviensis* and *P. gigantea*; a more and more obvious accentuation of the highly trochospiral character in coiling of chambers; the occurrence of a double peripheral keel (*P. algeriana, P. biconvexa, P. imbricata*).

In the Cenomanian deposits, the characteristic feature of this genus is the progressive development of the peripheral keel (*P. delrioensis*), then its thickening until it attains a rugged aspect (*P. marginaculeata*) and the high trochospiral appearence of the chambers coiling (*P. stephani, P. stephani gibba*). Besides their tendency of a growing size, the Turonian species of this genus also show more and more obvious tendency of globotruncanization of the general aspect. Owing to this phenomenon, the author assumes that the *Globotruncana group,* with all its more advanced Senonian types, originates from this genus.

From a phylogenetic, evolutionary viewpoint, the author does not believe that the *Globotruncanae* probably originated from the *Rotalipora* group, as this latter is too far evolved, too specialized, with much too well individualized elements, and could not form the origin of a new group. The trend of a growing size, is a pronounced enlargement of the umbilical area, as well as the essential element of the occurrence of double keels, which are observable at the *Praeglobotruncanae* of Lower and Middle Turonian age. Species of *Rotalipora* of this age if they have not completely disappeared, have representatives very specialized from an evolutionary viewpoint (*R. reicheli, R. cushmani turonica*), in the present author's opinion support the above-mentioned views. Thus, the author's viewpoint is totally opposed to that expressed by B a n d y (1967, p. 16), who shows that by the elimination of the supplementary apertures from the *Rotalipora* group, the new group of *Globotruncana* develops. Thus, according to this opinion, the genus *Globotruncana* should have made its appearance still earlier, as it has been generally ascertained that no species of the genus *Rotalipora* is found in deposits younger than Lowermost Turonian. At the time when assemblages of planktonic Foraminifera are dominated by *P. helvetica,* which in the author's opinion marks the beginning of Middle Turonian — at least in the flysch area of Eastern Carpathians — species of *Rotalipora* were no longer present. But directly after this time or perhaps at the same time the first species of the genus *Globotruncana,* some of which are bicarinate, also occur. It is impossible to admit that this genus derived from the *Rotalipora appenninica* group since, if the problem is considered from a stratigraphic viewpoint only, this group is not found after the Upper Cenomanian. In the Upper Cenomanian it occurs very sporadically, while two well

specialized groups of the genus were dominant, i.e. *Rotalipora cushmani* and *Rotalipora brotzeni*. All these reasons support the present author's belief that the origin of the *Globotruncana* group is not to be found in the genus *Rotalipora*, but in the genus *Praeglobotruncana*.

In its later evolution during Senonian time, this genus is represented by *P. havanensis*, the test morphology of which shows many resemblances with the Dano-Paleocene *Globorotalia compressa*. This observations lead to the assumption that this genus, the evolution of which comes to an end in the last part of Maestrichtian, forms the origin of the *Globorotalia* group. The evolution of this starts in Dano-Paleocene, and which hence occurs as a logical continuation of its origin, the genus *Praeglobotruncana*.

Considered from a palaeontological and microstratigraphic viewpoint, the most characteristic element is, however, the genus *Rotalipora*. As was shown before, this group was derived from the genus *Ticinella* and its evolution starts concomitantly with the upper boundary of the Albian and with the beginning of the Vraconian. The transition between these two genera is apparently represented by specimens of the *Rotalipora multiloculata, R. ticinensis, R. techamaensis* type, which frequently occur in the Upper Albian and the Vraconian. From these types three basal branches diverged in the Cenomanian: *Rotalipora appenninica, R. cushmani, R. brotzeni*.

The *Rotalipora appenninica* branch is distinguished by a low-trochospiral test, the spiral side being as a rule flatter than the umbilical one, the periphery of the test is lobate and unicarinate, the umbilicus well marked and open, but not wide. The chambers on the spiral side are flattened, with arcuate and keeled sutures, while on the umbilical side they have a pyramidal-rounded and not very high aspect. The sutural apertures, which surround the umbilicus, are situated at the base or near the base of the sutures. Moderately developed ornamental elements — carina, pustules — are observed only on the umbilical side of the first chambers in the last whorl.

This branch includes the subspecies *Rotalipora appenninica appenninica* (R e n z), *R. appenninica gandolfii* L u t e r b a c h e r & P r e m o l i - S i l v a, *R. appenninica evoluta* (S i g a l).

Stratigraphically, this group is of a particular value in the Upper Vraconian and at the base of the Middle Cenomanian. They may, however, be encountered in the Middle and Upper Cenomanian, but here their frequency of occurrence is much diminished.

The *Rotalipora cushmani* branch differs from the previous one in the convex to pronounced convex aspect of the spiral side, in the deepened or markedly deepened aspect of the sutures on the spiral side wherefore the chambers have a truncated convex aspect, as well as in the migration of the sutural apertures from the internal side of the umbilicus to the exterior, attaining even half the distance between the periphery and the umbilicus or even going beyond this limit towards the exterior. The ornamental elements of the chambers (pustules, carina) are developed both on the spiral and especially on the umbilical side of the test. The aspect of the chambers on the umbilical side is markedly tetrahedral with deep sutures strong edges (towards the umbilical area) and well ornamented surface. The sutural and peripheral keels are generally well developed, but on some subspecies in the Upper Cenomanian and basal

Lower Turonian, they are somewhat decreased (*R. cushmani turonica*) or show a well marked reduction (*R. cushmani montsalvensis, R. cushmani minor*). This phenomenon, as well as the maximum morphological complication of *R. reicheli,* are, in the author's opinion, symptoms of an exhaustion of the group evolutionary potential, prior to its disappearance. There the present author does not agree with the opinion expressed by Brönnimann and Brown (1956), concerning the transition from *Globigerina infracretacea* to *Rotalipora* by way of the *R. montsalvensis minor* type. Stratigraphically, the evolution of this branch starts in the Middle Cenomanian, and the acme is reached in the Upper Cenomanian and basal Lower Turonian, during which the branch also disappears.

The author has included the following subspecies in this branch: *Rotalipora cushmani cushmani* (Morrow), *R. cushmani expansa* (Carbonier), *R. cushmani turonica* (Brotzen), *R. cushmani montsalvensis* (Mornod), *R. cushmani minor* (Mornod), *R. cushmani thomei* (Hagn & Zeil).

The third branch comprises those species, which within this genus show the most complicated morphology. Thus, on the umbilical side a progressive increase in height of the chambers emphasizes its shape of a truncated cone. There is a marked development of the ornamentation of the chambers with the appearance of strong keels and pustules, and a progressively more pronounced widening of the umbilicus, which at the terminus type of this branch, *Rotalipora reicheli,* becomes very wide, like a flared crater. Another particular character of the umbilical side in this branch is the gradual development of an umbilical roof, the outline of which is already seen in Albian specimens (*R. techamaensis*), seen at an advanced stage in *R. brotzeni* and finally forming in *R. reicheli* a true roof of the umbilicus, similar but not identical to that of *Abathomphalus mayaroensis.* On the spiral side, the chambers are truncated and disposed in a somewhat higher whorl in the first species of the branch (*R. techamaensis, R. greenhornensis, R. brotzeni*), while in the evolved and very far evolved ones of the Middle and Upper Cenomanian (*R. micheli, R. deeckei, R. reicheli*), the coiling of the young stage is conical, followed by the almost planispiral adult stage. The sutural keels of the spiral side, generating the peripheral keels, have beaded appearance, which is strongly marked in the last species. The periphery of the test has also undergone obvious alteration. Beginning with a very weakly lobate outline, observable particularly on the last chambers (*R. techamaensis, R. greenhornensis*), the outline becomes obviously lobate (*R. micheli*), and finally passes to a very lobate outline (*R. reicheli*). The possibility that from this group the genus *Globotruncana* originates by its branch *G. sigali — G. lapparenti,* as suggested by J. Klaus (1959, p. 827), is in the present author's opinion rather far from reality for more than one reason, among which the most important is the existence of a time interval between the disappearance of the species *R. brotzeni* (Upper Cenomanian-basal Lower Turonian), from which according to the author, would derive *G. sigali,* and the appearance of the last named species (middle part of the Middle Turonian). As has been shown before, this branch is also much too advanced from an evolutionary point of view to form the origin of a new group. The development of the umbilical device similar to that of *Globotruncana* is in the opinion of the author

present only an example of convergence between these two groups, and not proof of phylogenetic relations. As a matter of fact, J. Klaus (1957) expresses a total conviction in this respect by starting that the true Globotruncanae are derived from the stem *P. renzi*. The present author is totally in agreement with this and would add that the entire *Globotruncana* group originates from *Praeglobotruncana* and not from the *Rotalipora* group. Thus a monophyletical origin of this group is supported.

In this branch the author includes the following species: *Rotalipora techamaensis* Marinos & Zingula, *R. greenhornensis* (Morrow), *R. brotzeni* Sigal, *R. globotruncanoides* Sigal, *R. micheli* (Sacal & Debourle), *R. deeckei* (Franke), *R. reicheli* Mornod.

To solve the big problems connected with the evolution of the Cretaceous planktonic Foraminifera, the present author's opinion is that on the basis of its morphological characters, the hedbergellian stem may be considered as the origin, the starting point of the great development of the genus *Globigerina,* which begins with the Danian (text-fig. 1). The other genera will be included in another paper, which will deal with all planktonic Foraminifera encountered in the Cretaceous deposits.

PALAEONTOLOGICAL PART

Superfamily Globigerinacea Carpenter, Parker et Jones, 1862.
Family Rotaliporidae, Sigal, 1958
Subfamily Hedbergellinae, Loeblich et Tappan, 1961
Genus *Hedbergella* Brönnimann & Brown, 1958

Hedbergella brittonensis Loeblich & Tappan

Plate XIII, figs. 7—13, plate XIV, figs. 1—6, 16—18; plate XV, figs. 1—2

Hedbergella brittonensis Loeblich & Tappan, 1961, p. 274, pl. 4, fig. 1—8.
Globigerina sp., Küpper, 1955, p. 117, pl. 18, fig. 9.

Occurrence: Middle-Upper Cenomanian, Belia Valley (Prahova district).

Dimensions: greatest diameter 0,34 mm — 39 mm; smallest diameter; 0,31 mm — 0,34 mm; thickness: 0,19 mm — 0,27 mm.

Hypotypes: L.P.B. (Laboratory of Palaeontology Bucarest), 9149.

Hedbergella delrioensis (Carsey)

Plate XIV, figs. 7—9, 13—15

Globigerina cretacea d'Orbigny var. *delrioensis* Carsey, 1926, p. 43
Globigerina cretacea d'Orbigny, Tappan, 1940, p. 121, pl. 19, fig. 11; 1943, p. 512, pl. 82, fig. 16—17.
Globigerina gautierensis Brönnimann, 1952, p. 11, pl. 1, fig. 1—3, text-fig. 2.
Globigerina delrioensis Carsey, Frizzell, 1954, p. 127, pl. 20, fig. 1.
Praeglobotruncana gautierensis (Brönnimann), Bolli, 1959, p. 265, pl. 21, fig. 3—6.
Praeglobotruncana (*Hedbergella*) *delrioensis* (Carsey), Banner & Blow, 1959, p. 8.
Hedbergella delrioensis (Carsey); Loeblich & Tappan, 1961, p. 275, pl. 2, fig. 11—13; Renz, Luterbacher & Schneider, 1963, p. 1083, pl. 9, fig. 5; Eicher, 1966, p. 27, pl. 5, fig. 12—13.

Occurrence: Middle-Upper Cenomanian, Belia Valley (Prahova district) D. Stînii Hill (Covaşna district).

Dimensions: greatest diameter: 0,29 — 0,42 mm; smallest diameter: 0,25—0,31 mm; thickness: 0,17—0,22 mm.

Hypotypes: L.P.B. 9075, 9150.

Hedbergella aprica (Loeblich & Tappan)

Plate XV, figs. 3—5, 8—13

Ticinella aprica Loeblich & Tappan, 1961, p. 292, pl. 4, fig. 14—16.

„Ticinella" aprica Loeblich & Tappan; Sigal, 1966, p. 208.

Rugoglobigerina? aprica (Loeblich & Tappan); Eicher, 1966, p. 29, pl. 5, fig. 14.

Occurrence: Upper Cenomanian-Lowermost Turonian, Belia Valley (Prahova district).

Dimensions: greatest diameter: 0,39 mm, 0,52 mm; smallest diameter: 0,34—0,42 mm; thickness: 0,17—0,32 mm.

Hypotypes: L.P.B. 9152.

Remarks: In its characteristics, this species clearly differs from those of the genus *Ticinella*. As was shown by J. Sigal (1966, p. 208), the lamellar extensions into the umbilical area actually cover only remains of the anterior apertures, which should not be mistaken for the additional sutural intraumbilical apertures of the genus *Ticinella*. The stratigraphic position likewise proves the fact that the species of Loeblich and Tappan could not belong to the genus *Ticinella*, which as yet is only known as far as the Vraconian at the most. In the opinion of the present author, this species represents in terms of evolution the first development of the so called level with „large Globigerinae" known at the beginning of the Turonian.

Hypotypes: L.P.B. 9152.

Genus *Clavihedbergella* Banner & Blow, 1959

Clavihedbergella simplicissima (Magné & Sigal)

Plate XIII, figs. 1—6

Hastigerinella simplicissima Magné & Sigal, 1953, p. 487, pl. 14, fig. 11.

Praeglobotruncana (Clavihedbergella) simplicissima (Magné & Sigal); Banner & Blow, 1959, p. 19.

Hedbergella amabilis Loeblich & Tappan, 1961, p. 274, pl. 3, fig. 1, 4, 6, 7 (not figs. 2, 3, 5).

Clavihedbergella simplex (Morrow); Loeblich & Tappan, 1961, p. 279, pl. 3, fig. 11 (not figs. 12, 13, 14).

Clavihedbergella simplicissima (Magné & Sigal); Caron, 1966, p. 71, pl. 6, fig. 5.

Occurrence: Cenomanian D. Stînii Hill (Covaşna district) Belia Valley (Prahova district).

Dimensions: greatest diameter: 0,29—0,39 mm; smallest diameter: 0,24—0,32 mm; thickness 0,12—0,15 mm.

Hypotypes: L.P.B. 9076, 9148.

Genus *Praeglobotruncana* Bermudez 1952

Praeglobotruncana delrioensis (Plummer)

Plate XVI, figs. 4—6, plate XVIII, figs. 1—3, 7—8, plate XXI, figs. 3—8, plate XXII, figs. 1—3

Globorotalia delrioensis Plummer, 1931, p. 199, pl. 13, fig. 2; Frizzell, 1954, p. 129, pl. 20, fig. 27.

Praeglobotruncana delrioensis (Plummer); Bermundez, 1952, p. 52, pl. 7, fig. 1; Klaus, 1959, p. 793, pl. 6, fig. 1; Loeblich & Tappan, 1961, p. 280, pl. 6, fig. 9—12; Lehman, 1962, p. 140, pl. 2, fig. 1—2; Caron, 1966, p. 72, pl. 2, fig. 1; Marianos & Zingula, 1966, p. 337, pl. 37, fig. 11; Salaj & Samuel, 1966, p. 188, pl. 15, fig. 3.

Occurrence: Middle — Upper Cenomanian, Belia Valley (Prahova district).

Dimensions: greatest diameter: 0,41—0,42 mm; smallest diameter: 0,32—0,36 mm; thickness: 0,20—0,24 mm.

Hypotypes: L.P.B. 9155.

Praeglobotruncana stephani stephani (Gandolfi)

Plate XVI, figs. 1—3, 7—12, plate XVIII, figs. 4—6, 9—10, plate XXI, figs. 9—10, plate XXIII, fig. 3

Globotruncana stephani Gandolfi, 1942, p. 130, pl. 3, fig. 4, 5, pl. 4, fig. 36, 37, 41—44, pl. 6, fig. 4 (partim), pl. 9, fig. 5, 8, pl. 14, fig. 2.

Globotruncana (G.) stephani Gandolfi; Reichel, 1950, p. 608, pl. 16, fig. 6.

Rotundina stephani (Gandolfi); Subbotina, 1953, p. 165, pl. 2, fig. 5—7, pl. 3, fig. 1—2.

Praeglobotruncana stephani (Gandolfi); Bolli, Loeblich & Tappan, 1957, p. 39, pl. 9, fig. 2; Eicher, 1965, p. 905, pl. 106, fig. 7; 1966, p. 28, pl. 6, fig. 4; Marianos & Zingula, 1966, p. 337, pl. 37, fig. 10; Marks, 1967, p. 273, pl. 2, fig. 4—12, pl. 3, fig. 1—6.

Praeglobotruncana delrioensis (Plummer); Neagu, 1959, pl. 1, fig. 16—18.

Praeglobotruncana stephani (Gandolfi) var. *turbinata* (Reichel); Neagu, 1959, pl. 2, fig. 1—3.

Praeglobotruncana stephani stephani (Gandolfi); Klaus, 1959, p. 794, pl. 6, fig. 2; Caron, 1966, p. 73, pl. 2, fig. 3.

Occurrence: Middle-Upper Cenomanian, Lower Turonian Belia Valley (Prahova district), Cenomanian Teliu Valley (Brașov district), Rucăr basin (Argeș district), Ialomița Valley (Dîmbovița district).

Dimensions: greatest diameter 0,37—0,48 mm; smallest diameter 0,32—0,38 mm; thickness 0,19—0,24 mm.

Hypotypes: L.P.B. 9077, 9154.

Praeglobotruncana stephani gibba Klaus

Plate XX, figs. 7—12, plate XXI, figs. 1—2

Globotruncana stephani turbinata Reichel; Mornod, 1950, p. 588, text-fig. 11 (1 a-c, 2 a-c); Hagn & Zeill, 1954, p. 34, pl. 5, fig. 3—4; Książkiewicz, 1958, pl. 1, fig. 14.

Globotruncana (G.) stephani turbinata Reichel, 1950, p. 609.

Praeglobotruncana stephani turbinata (Reichel); Klaus, 1969, p. 795, pl. 6, fig. 3.

Praeglobotruncana delrioensis turbinata (Reichel); Brönnimann & Brown, 1956, p. 514, text-fig. 16, 17 (i, j, h).

Praeglobotruncana stephani gibba Klaus, 1960 a, p. 304, text-fig. 1 f; Caron, 1966, p. 73, pl. 2, fig. 4.

Praeglobotruncana gibba Klaus; Salaj & Samuel, 1966, p. 188, pl. 15, fig. 2.

Occurrence: Middle-Upper Cenomanian, Teliu Valley (Brașov district), Upper Cenomanian, Rucăr basin (Argeș district).

Dimensions: greatest diameter 0,41—0,46 mm, smallest diameter 0,37—0,42 mm; thickness 0,25—0,36 mm.

Hypotypes: L.P.B. 9078, 9159.

Praeglobotruncana marginaculeata (Loeblich & Tappan)

Plate XVI, figs. 13—15, plate XVII, figs. 1—7

Globorotalia marginaculeata Loeblich & Tappan, 1946, p. 257, pl. 37, fig. 19—21, text-fig. 4a.

Praeglobotruncana marginaculeata (Loeblich & Tappan); Klaus, 1960 a, p. 301, text-fig. 1b-d; Caron, 1966, p. 73, pl. 2, fig. 2; Salaj & Samuel, 1966, p. 192, pl. 15, fig. 4.

Praeglobotruncana delrioensis (Plummer); Loeblich & Tappan, 1961, pl. 6, fig. 9.

Occurrence: Middle-Upper Cenomanian, Teliu Valley (Brașov district), Middle Cenomanian, Belia Valley (Prahova district).

Dimensions: greatest diameter 0,32—42 mm; smallest diameter 0,25—0,36 mm; thickness 0,15—0,24 mm.

Hypotypes: L.P.B. 9079, 9156.

Praeglobotruncana algeriana Caron

Plate XVII, figs. 8—15, plate XX, figs. 4—6, plate XXII, figs. 7—8, plate XXIII, figs. 1—2

Globotruncana renzi Gandolfi, 1942, pl. 10, fig. 2.

Praeglobotruncana renzi (Thallman); Klaus, 1959, p. 795, pl. 6, fig. 4.

Praeglobotruncana algeriana Caron, 1966, p. 74, pl. 2, fig. 5.

Occurrence: Middle-Upper Cenomanian-Lowermost Turonian, Belia Valley (Prahova district), Upper Cenomanian, Rucăr basin (Argeș district).

Dimensions: greatest diameter 0,39—0,46 mm; smallest diameter 0,34—0,41 mm; thickness 0,22—0,25 mm.

Remarks: *P. algeriana* Caron is the first species of the genus *Praeglobotruncana* with a double peripheral keel.

Hypotypes: L.P.B. 9158.

Praeglobotruncana praehelvetica (Trujillo)

Plate XV, figs. 6—7

Rugoglobigerina praehelvetica Trujillo, 1960, p. 340, pl. 49, fig. 6.

Praeglobotruncana praehelvetica (Trujillo); Marianos & Zingula, 1966, p. 338, pl. 38, fig. 9.

Occurrence: Uppermost Cenomanian-Lower Turonian. Belia Valley (Prahova district).

Dimensions: greatest diameter 0,59 mm; smallest diameter 0,54 mm; thickness 0,32 mm.

Remarks: In the slightly truncated appearance of the spiral side, in the tendency to develop a peripheral keel, and in the lobate aspect of the periphery, of the test, the specimens described resemble Trujillo's species, which obviously does not belong to *Rugoglobigerina*.

Hypotypes: L.P.B. 9153.

Praeglobotruncana barbui Neagu n. sp.

Plate XVIII, figs. 11—15, plate XIX, figs. 1—12, plate XX, figs. 1—3

Holotype L.P.B. 9159, pl. XX, fig. 1—3.

Stratum typicum Upper Cenomanian.

Locus typicus Rucăr basin-Argeș district Romania.

Diagnosis: Test free, trochospiral, composed of 2 to 3 whorls on the spiral side; slightly convex with truncated chambers and sutures marked by strongly ornamented keels; the rather well developed umbilicus is frequently covered with lamellar extensions of the anterior apertures; peripherally, test is obviously lobate and provided with a well developed peripheral keel; aperture is an interiomarginal bow.

Description: Test free, trochospiral composed of 2 to 3 whorls, which are perceptible on the spiral side, slightly convex with truncated chambers and sutures marked by strongly arcuated keels; the last whorl consists of 4 to 4 1/2 or, as a rule, of 5 large chambers, which develop gradually and have a triangular or triangular-rounded shape, being higher around the umbilicus, with deepened straight and radiate sutures; the surface of all the chambers or only of the last 2—3 chambers is smooth, while the others are ornamented with fine pustules. The rather well developed umbilicus, is frequently covered with the lamellar extensions of the anterior apertures. Peripherally the test is obviously lobate, and provided with a well developed peripheral keel, which is, however, lacking or poorly developed on the last chamber. The aperture, in the form of an interiomarginal bow, stretches beyond the midway to the margin, as a rule showing a small lip, which continues into a lamellar extension.

Occurrence: Upper Cenomanian, Belia Valley (Prahova district), Rucăr basin (Argeș district).

Dimensions: holotype: greatest diameter 0,49 mm, smallest diameter 0,42 mm; thickness 0,22 mm; paratypes: greatest diameter 0,36 mm — 0,51 mm; smallest diameter 0,31 mm — 0,42 mm thickness 0,20 mm — 0,24 mm.

Remarks: On account of its shape and the disposition of the chambers in the last whorl, this species is very near to *P. inornata* (Bolli) but differs from it in its other characters, particularly in its well developed peripheral keel and the sutural keels on the spiral side.

This species was named in honour of the author's professor of Micropalaeontology, Dr. I. Z. Barbu, in appreciation of his micropalaeontological studies in Romania.

Holotype: L.P.B. 9159.

Paratypes: L.P.B. 9160.

Praeglobotruncana prahovae Neagu n. sp.

Plate XXI, figs. 11—13, plate XXII, figs. 4—6, 9—11; plate XXIII, figs. 4—10, plate XXIV, figs. 1—9

Holotype: L.P.B. 9155, pl. XXIII, fig. 4—6.
Stratum typicum: Lowermost Turonian.
Locus typicus: Belia Valley, Prahova district, Romania.
Diagnosis: Test free, trochospiral with chambers arranged in 2 to 3 whorls, with a strongly convex to conical-convex spiral side; the last whorl is composed of 6—8 large triangular-rounded chambers; the umbilicus is wide or very wide deep and frequently covered with the lamellar extensions of the anterior apertures; periphery is markedly lobate and provided with a faint keel; aperture consist of a low interiomarginal bow.
Description: Test free, trochospiral with chambers arranged in 2 to 3 whorls, with a strongly convex to conical-convex spiral side; sutures of chambers are arcuate, deepened and faintly carinate (particularly on older whorls); surfaces of chambers are convex to markedly convex; the last whorl is composed of 6 to 8 large triangular to rounded chambers, slightly flattened towards the periphery, with radiate and deep sutures, the surface being smooth or covered with fine pustules, which are, however, lacking in the 2—3 last chambers. The umbilicus is wide or very wide, deep, and frequently covered with the lamellar extensions of the anterior apertures. Periphery is markedly lobate and provided with a faint keel, which may be absent on the last 2—3 chambers. Aperture consists of a low interiomarginal bow and is protected by a lip that continues umbilically by a lamellar extension.
Occurrence: Upper Cenomanian, Rucăr basin (Argeș District), Upper Cenomanian-Lower Turonian, Belia Valley (Prahova district).
Dimensions: holotype greatest diameter 0,54 mm; smallest diameter 0,46 mm; thickness 0,29 mm; paratypes: greatest diameter 0,48 mm — 0,58 mm; smallest diameter 0,42 mm — 0,53 mm; thickness 0,24 mm — 0,39 mm.
Remarks: In the general petaloid outline of the test, this species is like *P. oraviensis* Scheibnerová (1960); it differs from this however in the shape and arrangement of the chambers on the umbilical side and in the strongly convex outline of the test, a character which brings it close to *P. stephani gibba* Klauss, but from which it differs in all other features, in its great number of chambers in the last whorl; in its wide umbilicus and the strongly convex shape of the test this species is related to *P. paradubia* (Sigal), but differs from it in the presence of the peripheral keel and the shape of the chambers. Unfortunately, Sigal (1952) does not give a full description of this species, while the figure is quite inadequate to characterize a new species.
Holotype: L.P.B. 9155.
Paratypes: L.P.B. 9156.

Subfamily Rotaliporinae
Genus *Rotalipora* Brotzen 1942

Rotalipora appenninica appenninica (Renz)

Plate XXV, figs. 1—6

Globotruncana appenninica Renz, 1936, p. 14, text-fig. 2.
Globotruncana appenninica Renz var, *alfa* Gandolfi, 1942, p. 117, text-fig. 40.

Globotruncana (*Rotalipora*) *appenninica* (Renz) var. *alpha* Gandolfi; Reichel, 1950, p. 605, text-fig. 3.

Rotalipora appenninica (Renz); Subbotina, 1953, p. 159, pl. 1, fig. 5—8, pl. 2, fig. 1—2; Marianos & Zingula, 1966, p. 338, pl. 38, fig. 1.

Globotruncana (*Rotalipora*) *appenninica balernaensis* Gandolfi, 1957, p. 60, pl. 8, fig. 3.

Rotalipora (*Thalmanninella*) *appenninica balernaensis* Gandolfi; Klaus, 1959, p. 808, pl. 3, fig. 2.

Rotalipora balernaensis (Gandolfi); Loeblich & Tappan, 1961, p. 297, pl. 8, fig. 11.

Rotalipora appenninica appenninica (Renz); Luterbacher & Premoli-Silva, 1962, p. 266, pl. 19, fig. 1—2, pl. 20, fig. 1—4; Caron, 1966, p. 72, pl. 1, fig. 4.

Thalmanninella appenninica (Renz); Salaj & Samuel, 1966, p. 177, pl. 11, fig. 8.

Occurrence: Lower Cenomanian, Prahova Valley (Prahova district), Cenomanian Teliu Valley (Brașov district).

Dimensions: greatest diameter 0,46 mm — 0,55 mm; smallest diameter 0,37 mm — 0,39 mm; thickness 0,19 mm — 0,22 mm.

Hypotypes: L.P.B. 9080, 9081, 9164.

Rotalipora appenninica evoluta (Sigal)

Plate XXXVII, fig. 6—8

Rotalipora cushmani (Morrow) var. *evoluta* Sigal, 1948, p. 100, pl. 1, fig. 3, pl. 2, fig. 2.

Globotruncana (*Rotalipora*) *evoluta* Sigal; Carbonier, 1952, p. 118, pl. 7, fig. 2.

Rotalipora (*Thalmanninella*) *evoluta* (Sigal); Klaus, 1959, p. 810, pl. 4, fig. 3.

Rotalipora evoluta (Sigal); Loeblich & Tappan, 1961, p. 298, pl. 7, fig. 3; Săndulescu, 1967, pl. 1, fig. 2.

Rotalipora appenninica evoluta (Sigal); Luterbacher & Premoli-Silva, 1962, p. 268, pl. 20, fig. 5; Caron, 1966, p. 72, pl. 1, fig. 3; Renz, Luterbacher, Schneider, 1963, p. 1088, pl. 7, fig. 3.

Occurence: Cenomanian Teliu Valley (Brașov district).

Dimensions: greatest diameter 0,48 mm — 0,51 mm; smallest diameter 0,41 mm — 0,42 mm; thickness 0,19 mm.

Hypotypes: L.P.B. 9165.

Rotalipora cushmani cushmani (Morrow)

Plate XXV, figs. 7—9, plate XXVI, figs. 1—9

Globorotalia cushmani Morrow; Cushman, 1946, p. 152, pl. 62, fig. 9; Frizzell, 1954, p. 129, pl. 2, fig. 28.

Rotalipora cushmani (Morrow), Sigal, 1948, p. 96, pl. 1, fig. 2, pl. 2, fig. 1; Hagn & Zeill, 1954, p. 29, pl. 1, fig. 3, pl. 4, fig. 8—10; Brönnimann & Brown, 1956, p. 537, pl. 20, fig. 10—12; Renz, Luterbacher, Schneider, 1963, p. 1080, pl. 7, fig. 1; Săndulescu, 1967, pl. 2, fig. 1; Marianos & Zingula, 1966, p. 338, pl. 38, fig. 7; Marks, 1967, p. 272, pl. 1, fig. 1—12, pl. 2, fig. 1—3.

Rotalipora (*Rotalipora*) *cushmani* (Morrow); Klaus, 1959, p. 814, pl. 5, fig. 2.

Rotalipora cushmani cushmani (Morrow), Samuel & Salaj, 1966, p. 184, pl. 13, fig. 2, 4.

Occurrence: Middle-Upper Cenomanian-Lowermost Turonian, Belia Valley (Prahova district), Upper Cenomanian, Rucăr basin (Argeș district), Ialomița Valley (Dîmbovița district).

Dimensions: greatest diameter 0,49 mm — 0,78 mm; smallest diameter 0,41 mm — 0,71 mm; thickness 0,25 mm — 0,34 mm.

Hypotypes: L.P.B. 9166—9167.

Rotalipora cushmani turonica (Brotzen)

Plate XXVII, figs. 1—6

Rotalipora turonica Brotzen, 1942, p. 32, text-fig. 10, 11 (4); Sigal, 1948, p. 96, pl. 1, fig. 1; Hagn & Zeill, 1954, p. 27, pl. 1, fig. 5, pl. 4, fig. 3—4; Bolli, Loeblich & Tappan, 1957, p. 41, pl. 9, fig. 6; Săndulescu, 1967, pl. 1, fig. 4.

Globotruncana (*Rotalipora*) *turonica* (Brotzen), Reichel, 1950, p. 607, pl. 16, fig. 5, pl. 17, fig. 5.

Rotalipora (*Rotalipora*) *turonica* (Brotzen), Klaus, 1959, p. 815, pl. 5, fig. 3.

Rotalipora cushmani turonica (Brotzen), Salaj & Samuel, 1966, p. 185, pl. 13, fig. 1, pl. 14, fig. 1.

Occurrence: Middle-Cenomanian, Belia Valley (Prahova district), Rucăr basin (Argeș district), Ialomița Valley (Dîmbovița district).

Dimensions: greatest diameter 0,58 mm — 0,75 mm; smallest diameter 0,54 mm — 0,66 mm; thickness 0,36 mm — 0,39 mm.

Hypotypes: L.P.B. 9176.

Rotalipora cushmani thomei Hagn & Zeill

Plate XXVIII, fig. 1—6

Rotalipora cushmani thomei Hagn & Zeill, 1954, p. 28, pl. 1, fig. 6, pl. 4, fig. 5—6; Salaj & Samuel, 1966, p. 185, pl. 12, fig. 6.

Occurrence: Middle Cenomanian, Belia Valley (Prahova district).

Dimensions: greatest diameter 0,49 mm — 0,54 mm; smallest diameter 0,41 mm — 0,44 mm; thickness 0,25 mm — 0,29 mm.

Hypotypes: L.P.B. 9168.

Rotalipora cushmani expansa (Carbonier)

Plate XXVIII, figs. 7—9, plate XXIX, figs. 1—5

Globotruncana (*Rotalipora*) *turonica* (Brotzen) var. *expansa* Carbonier, 1952, p. 118, pl. 6, fig. 4.

Rotalipora cushmani expansa (Carbonier), Salaj & Samuel, 1966, p. 183, pl. 12, fig. 7.

Occurrence: Upper Cenomanian, Belia Valley (Prahova district), Rucăr basin (Argeș district).

Dimensions: greatest diameter 0,48 mm — 0,65 mm; smallest diameter 0,41 mm — 0,51 mm; thickness 0,20 mm — 0,31 mm.

Hypotypes: L.P.B. 9169.

Rotalipora cushmani montsalvensis (Mornod)

Plate XXIX, figs. 6—9, plate XXX, figs. 1—2

Globotruncana (*Rotalipora*) *montsalvensis* Mornod, 1950, p. 584, text-fig. 4 (I a—c), 7 (1 a—c).

Rotalipora montsalvensis (Mornod), Hagn & Zeill, 1954, p. 25, pl. 1, fig. 4; Vinogradov, 1960, p. 34, pl. 2, fig. 6—8; Renz, Luterbacher, Schneider, 1963, p. 1099, pl. 8, fig. 1.

Rotalipora (*Rotalipora*) *montsalvensis* (Mornod); Klaus, 1959, p. 813, pl. 5, fig. 1.

Rotalipora cushmani montsalvensis (Mornod), Salaj & Samuel, 1966, p. 184, pl. 13, fig. 5.

Occurrence: Upper Cenomanian, Belia Valley (Prahova district).

Dimensions: greatest diameter 0,51 mm — 0,61 mm; smallest diameter 0,56 mm — 0,59 mm; thickness 0,31 mm — 0,32 mm.

Hypotypes: L.P.B. 9170.

Rotalipora cushmani minor (Mornod)

Plate XXX, figs. 3—5, plate XXXI, figs. 6—8

Globotruncana (*Rotalipora*) *montsalvensis* Mornod var. *minor* Mornod, 1950, p. 586, text-fig. 4 (II a—c), 8 (1—4).

Rotalipora (*Rotalipora*) *montsalvensis* var. *minor* Mornod, Klaus, 1959, p. 812, pl. 4, fig. 5; Renz, Luterbacher, Schneider, 1963, pl. 1089, pl. 2, fig. 2.

Rotalipora cushmani minor (Mornod), Salaj & Samuel, 1966, p. 185, pl. 13, fig. 6.

Occurrence: Upper Cenomanian, Belia Valley (Prahova district).

Dimensions: greatest diameter 0,46 mm; smallest diameter 0,42 mm; thickness 0,22 mm — 0,24 mm.

Hypotypes: L.P.B. 9171.

Rotalipora globotruncanoides Sigal

Plate XXX, figs. 6—7, plate XXXI, figs. 1—5

Rotalipora globotruncanoides Sigal, 1948, p. 100, pl. 1, fig. 4, pl. 2, fig. 35; 1952, p. 26, text-fig. 24; Hagn & Zeill, 1954, p. 23, pl. 4, fig. 7; Banner & Blow, 1959, pl. 2, fig. 4; Renz, Luterbacher, Schneider, 1963, p. 1087.

Globotruncana (*R*) *globotruncanoides* Sigal, Küpper, 1955, p. 113, pl. 18, fig. 1.

Rotalipora greenhornensis (Morrow), Loeblich & Tappan, 1961, pl. 7, fig. 8—9.

Rotalipora (*Thalmanninella*) *globotruncanoides* Sigal, Klaus, 1959, p. 805, pl. 4, fig. 1.

Thalmanninella globotruncanoides (Sigal), Salaj & Samuel, 1966, p. 180, pl. 15, fig. 6.

Occurrence: Middle Cenomanian, Belia Valley (Prahova district), D. Stînii Hill (Covaşna district), Teliu Valley (Braşov district).

Dimensions: greatest diameter 0,56 mm — 0,75 mm; smallest diameter 0,51 mm — 0,66 mm; thickness 0,25 mm — 0,27 mm.

Hypotypes: L.P.B. 9089, 9172.

Rotalipora brotzeni (Sigal)

Plate XXXI, figs. 9—10, plate XXXII, figs. 1—6, plate XXXIII, figs. 5—7, plate XXXIV, figs. 1—3

Thalmanninella brotzeni Sigal, 1948, p. 102, pl. 1, fig. 5, pl. 2, fig. 6—7; Bermudez, 1952, p. 53, pl. 7, fig. 2, pl. 27, fig. 6; Sigal, 1952, p. 26, text-fig. 25; Brönnimann & Brown, 1956, p. 533; Salaj & Samuel, 1966, p. 178, pl. 11, fig. 4.

Globotruncana (Th) brotzeni (Sigal); Mornod, 1950, p. 586, text-fig. 9 (1).

Rotalipora (Th) brotzeni (Sigal); Klaus, 1959, p. 805, pl. 3, fig. 1.

Rotalipora brotzeni (Sigal); Bolli, Loeblich, Tappan, 1957, p. 41, pl. 9, fig. 7; Renz, Luterbacher, Schneider, 1963, p. 1087.

Rotalipora greenhornensis (Morrow); Loeblich & Tappan, 1961, pl. 7, fig. 10 (not fig. 5—8).

Occurrence: Middle Cenomanian, Belia Valley (Prahova district), Upper Cenomanian, Rucăr basin (Argeș district).

Dimensions: greatest diameter 0,50 mm — 0,53 mm; smallest diameter 0,41 mm — 0,49 mm; thickness 0,24 mm — 0,25 mm.

Hypotypes: L.P.B. 9173.

Rotalipora micheli (Sacal & Debourle)

Plate XXXII, figs. 7—9, plate XXXIII, fig. 1—3

Globotruncana appenninica Renz var. *gama* Gandolfi, 1942, p. 119, pl. 14, fig. 6, text-fig. 41 (1a—b), 42 (1).

Rotalipora reicheli Mornod, Subbotina, 1953, pl. 2, fig. 4 (not. fig. 3).

Globotruncana (Rotalipora) micheli Sacal & Debourle, 1957, p. 58, pl. 25, fig. 4—5, 12.

Rotalipora appenninica marchigiana Borsetti, 1962, p. 36, pl. 3, fig. 4, 6, text-fig. 34—35, 48—49.

not *Rotalipora (Th)* cf. *micheli* (Sacal & Debourle), Klaus, 1959, p. 810, pl. 4, fig. 4.

Occurrence: Upper Cenomanian, Belia Valley (Prahova district).

Dimensions: greatest diameter 0,56 mm — 0,58 mm; smallest diameter 0,44 mm — 0,49 mm; thickness 0,29 mm — 0,31 mm.

Hypotypes: L.P.B. 9173.

Rotalipora deeckei (Franke)

Plate XXXVI, figs. 4—6, plate XXXVII, figs. 1—5

Rotalia deeckei Franke, 1925, p. 90, text-fig. 5.

„Rotalia" deeckei Franke, Dalbiez, 1957, p. 187, text-fig. 1—5.

Rotalipora (Thalmanninella) deeckei (Franke), Klaus, 1960 c, p. 107, text-fig. 1.

Thalmanninella deeckei (Franke), Salaj & Samuel, 1966, p. 179, pl. 12, fig. 4.

Occurrence: Upper Cenomanian, Rucăr basin (Argeș district).

Dimensions: greatest diameter 0,56 mm — 0,65 mm; smallest diameter 0,49 mm — 0,54 mm; thickness 0,27 mm — 0,29 mm.

Hypotypes: L.P.B. 9176.

Rotalipora reicheli Mornod

Plate XXXIV, figs. 4—6, plate XXXV, figs. 4—6, plate XXXVI, figs. 1—3

Globotruncana (*Rotalipora*) *reicheli* Mornod, 1950, p. 583, text-fig. 5 (IV a—c), 6 (1—6), pl. 15, fig. 2 a—p, 3—8; Carbonier, 1952, p. 119, pl. 7, fig. 4.

Rotalipora reicheli Mornod, Subbotina, 1953, p. 162, pl. 2, fig. 3; Hagn & Zeill, 1954, p. 25, pl. 1, fig. 2, pl. 4, fig. 1—2, pl. 7, fig. 11; Neagu, 1959, p. 169, pl. 3, fig. 1—9; Vinogradov, 1960, p. 38, pl. 3, fig. 11—12; Loeblich & Tappan, 1961, p. 301, pl. 8, fig. 12; Săndulescu, 1967, pl. 2, fig. 3.

Rotalipora (*Thalmanninella*) *reicheli* (Mornod), Klaus, 1959, p. 806, pl. 4, fig. 2, text-fig. 7 (3a—c); 1960 c, p. 707, text-fig. 2.

Thalmanninella reicheli (Mornod), Samuel & Salaj, 1966, p. 181, pl. 11, fig. 7.

Occurrence: Upper Cenomanian, Prahova Valley, Belia Valley (Prahova district), Teliu Valley (Brasov district), Rucăr basin (Argeș district), Ialomița Valley (Dîmbovița district).

Dimensions: greatest diameter 0,66 mm — 0,78 mm; smallest diameter 0,61 mm — 0,73 mm; thickness 0,32 mm — 0,42 mm.

Hypotypes: L.P.B. 9088, 9175.

Labor. Paleontologie
Univ. București

REZUMAT

Depozitele Cretacicului superior bazal (Cenomanian-Turonian inferior) din zona de curbură a flișului Carpaților Orientali conțin spre deosebire de formațiunile mai vechi, o foarte bogată asociație de foraminifere atît benthonice cît și planctonice a cărei prezentare completă ar fi depășit cu mult spațiul acordat. De aceia autorul a decis să prezinte pentru început doar foraminiferle planctonice care au o deosebită importanță pentru microbiostratigrafia acestor depozite. In prezenta lucrare autorul urmărește doar aspectul paleontologic-sistematic și teoretic-evolutiv al asociației de foraminifere planctonice renunțînd în mod deliberat la problemele de ordin microbiostratigrafic. Privită din aceste puncte de vedere asociația de foraminifere planctonice din depozitele cenomanianului se separă în mod natural în cîteva grupe diferite taxonomic dar strîns legate din punct de vedere evolutiv. Grupul de bază îl formează subfamilia Hedbergellinae a cărei evoluție începe din baza Cretacicului inferior prin genul *Hedbergella*. Din acest gen se vor desprinde mai tîrziu genurile *Clavihedbergella, Ticinella* și *Praeglobotruncana*. Tot în acest gen își are originea și subfamilia Rotaliporinae. Desprins din trinchiul hedbergellian încă din Aptian genul *Ticinella* are o existnță scurtă (Albian-Vraconian). Genul *Hedbergella,* din punct de vedere evolutiv, ni se pare a fi foarte sensibil și capabil de a da naștere la radiații adaptative care au permis o accentuată evoluție a grupului. Aceste radiații sînt: *Hedbergella—Ticinella—Rotalipora*; *Hedbergella—Clavihedbergella—Hastigerinelloides—Schackoina; Hedbergella—Praeglobotruncana—Globotruncana*. După părerea noastră originea genului *Rotalipora* stă în genul *Ticinella,* fiind în această privință întru totul de acord cu J. Sigal (1966). Noi considerăm că genul *Praeglobotruncana* își are

originea tot în grupul hedbergellian. Această evoluție s-a făcut prin desvoltarea tot mai accentuată a unei rugozități po lojele ultimului tur de spiră, rugozități ce se transformă treptat în carene periferice. Genul *Praeglobotruncana* devine astfel o nouă radiație adaptativă a trunchiului hedbergelian capabilă să dea naștere la elemente noi, genul *Globotruncana*. Tendința de creștere a taliei, de lărgire accentuată a zonei ombilicale precum și apariția de duble careme observate la populația genului *Praeglobotruncana* în Turonianul inferior și mediu, atunci cînd speciile de *Rotalipora* dacă nu au dispărut complet au reprezentanți foarte specializați din punct de vedere evolutiv (*R. reicheli, R. cushmani turonica*) sînt puncte demonstrative în sprijinul originii în *Praeglobotruncana* a genului *Globotruncana*. In evoluția ulterioară genul *Praeglobotruncana* este reprezentat în Senonianul superior prin *Praeglobotruncana havanensis* care prezintă multe asemănări în morfologia testului cu *Globorotalia compresa* din dano-paleocen. Această observație ne duce la părerea că din punct de vedere evolutiv acest gen care la sfîrșitul Maastrichtianului își încheie evoluția, stă la originea grupului *Globorotalia* care își începe evoluția din dano-paleocen și care apare astfel o continuare logică a originei sale cretacice-genul *Praeglobotruncana*.

Elementul cel mai caracteristic din punct de vedere paleontologic și microbiostratigrafic al Cenomanianului îl formează însă genul *Rotalipora*. Acest gen cu originea sa în *Ticinella*, își începe evoluția odată cu limita superioară a albianului și începutul vraconianului. Trecerea între aceste două genuri se pare că s-a realizat prin specimene de tipul *R. multiloculata, R. ticinensis, R. techamaensis*, frecvente în albianul superior și vraconianul inferior. Din aceste specii primitive se vor desvolta în Cenomanian 3 ramuri de bază și anume:

1. *Rotalipora appenninica* ce cuprinde: *Rotalipora appenninica appenninica* (Renz), *R. appenninica gandolfi* Luterbacher & Premoli-Silva, *R. appenninica evoluta* (Sigal);

2. *Rotalipora cushmani* ce cuprinde: *R. cushmani cushmani* (Morrow), *R. cushmani expansa* (Carbonier), *R. cushmani turonica* (Brotzen), *R. cushmani montsalvensis* (Mornod), *R. cushmani minor* (Mornod), *R. cushmani thomei* (Hagn & Zeill);

3. *Rotalipora brotzeni* ce cuprinde: *R. tehamaensis* Marianos & Zingula, *R. greenhornensis* (Morrow), *R. brotzeni* Sigal, *R. globotruncanoides* Sigal, *R. micheli* Sacal & Debourle, *R. deeckei* (Franke), *R. reicheli* Mornod.

Pentru a încheia problemele mari legate de evoluția foraminiferelor planctonice din Cretacic, considerăm că trunchiul hedbergellian prin caracterele sale morfologice poate fi socotit ca originea, punctul de plecare, al noului gen terțiar *Globigerina* a carei puternică evoluție va începe odată cu Danianul (text-fig. 1). (Problemele legate de celelalte genuri planctonice din cretacic cu o valoare și răspîndire mai reduse vor fi abordate cu o altă ocazie).

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EXPLANATION OF PLATES

Plate XIII

Fig. 1—6. *Clavihedbergella simplicissima* (Magne & Sigal), Middle Cenomanian, Belia Valley, L.P.B. 9148, ×100

Fig. 7—13. *Hedbergella brittonensis* Loeblich & Tappan, Upper Cenomanian, Belia Valley, L.P.B. 9149, ×95

Fig. 14. *Hedbergella delrioensis* (Carsey), Upper Cenomanian, Belia Valley, L.P.B. 9150, ×100

Plate XIV

Fig. 1—6, 16—18. *Hedbergella brittonensis* Loeblich & Tappan, Upper Cenomanian, Belia Valley, L.P.B. 9149, ×95

Fig. 7—9, 13—15. *Hedbergella delrioensis* (Carsey), Upper Cenomanian, Belia Valley, L.P.B. 9150, ×95

Fig. 10—12. *Praeglobotruncana* aff. *delrioensis* (Plummer), Upper Cenomanian, Belia Valley, L.P.B. 9151, ×100 (Specimen with hedbergellian's character)

Plate XV

Fig. 1—2. *Hedbergella brittonensis* Loeblich & Tappan, Upper Cenomanian Belia Valley, L.P.B. 9149, ×95

Fig. 3—5, 8—14. *Hedbergella aprica* (Loeblich & Tappan), Upper Cenomanian, Belia Valley, L.P.B. 9152, ×100

Fig. 6—7. *Praeglobotruncana praehelvetica* (Trujillo), Lowermost Turonian, Belia Valley, L.P.B. 9153, ×100

Plate XVI

Fig. 1—3, 7—12. *Praeglobotruncana stephani stephani* (Gandolfi), Upper Cenomanian, Belia Valley, L.P.B. 9154, ×100

Fig. 4—6. *Praeglobotruncana delrioensis* (Plummer), Upper Cenomanian, Belia Valley, L.P.B. 9155, ×100

Fig. 13—15. *Praeglobotruncana marginaculeata* (Loeblich & Tappan) Middle Cenomanian, Belia Valley, L.P.B. 9156, ×105

Plate XVII

Fig. 1—7. *Praeglobotruncana marginaculeata* (Loeblich & Tappan) Middle Cenomanian, Belia Valley, L.P.B. 9156, ×105

Fig. 8—15. *Praeglobotruncana algeriana* Caron, Middle Cenomanian, Belia Valley, L.P.B. 9154, ×100

Plate XVIII

Fig. 1—3, 7—8. *Praeglobotruncana delrioensis* (Plummer), Middle-Upper Cenomanian, Belia Valley, L.P.B. 9155, ×95

Fig. 4—6, 9—10. *Praeglobotruncana stephani stephani* (Gandolfi) Middle Cenomanian, Belia Valley, L.P.B. 9154, ×95

Fig. 11—15. *Praeglobotruncana barbui* Neagu n. sp. paratypes, (11—13 Upper Cenomanian, Belia Valley, 14—15, Rucăr basin) L.P.B. 9160, ×100

Plate XIX

Fig. 1—12. *Praeglobotruncana barbui* Neagu n. sp. paratypes, Upper Cenomanian (1—6, Belia Valley, 7—12 Rucăr basin), L.P.B. 9160, ×100

Plate XX

Fig. 1—3. *Praeglobotruncana barbui* Neagu n. sp. holotype, Upper Cenomanian Rucăr basin, L.P.B. 9159, ×100

Fig. 4—6. *Praeglobotruncana algeriana* Caron, Upper Cenomanian, Rucăr basin, L.P.B. 9157, ×100

Fig. 7—12. *Praeglobotruncana stephani gibba* Klaus, Upper Cenomanian, Rucăr basin, L.P.B. 9158, ×100

Plate XXI

Fig. 1—2. *Praeglobotruncana stephani gibba* Klaus, Upper Cenomanian, Rucăr basin, L.P.B. 9158, ×100

Fig. 3—8. *Praeglobotruncana delrioensis* (Plummer), Upper Cenomanian, Rucăr basin, L.P.B. 9155, ×100

Fig. 9—10. *Praeglobotruncana stephani stephani* (Gandolfi), Upper Cenomanian Rucăr basin, L.P.B. 9154, ×95

Fig. 11—13. *Praeglobotruncana prahovae* Neagu n. sp. Upper Cenomanian, Rucăr basin, paratype, L.P.B. 9162, ×95

Plate XXII

Fig. 1—3. *Praeglobotruncana delrioensis* (Plummer), Upper Cenomanian, Rucăr basin, L.P.B. 9155, ×100

Fig. 4—6, 9—11. *Praeglobotruncana prahovae* Neagu n. sp. paratypes, 4—6 Upper Cenomanian, Rucăr basin, L.P.B. 9162, 9—11, Lowermost Turonian, Belia Valley, L.P.B. 9162, ×100

Fig. 7—8. *Praeglobotruncana algeriana* Caron, Lowermost Turonian, Belia Valley, L.P.B. 9157, ×100

Plate XXIII

Fig. 1—2. *Praeglobotruncana algeriana* Caron, Upper Cenomanian, Rucăr basin, L.P.B. 9157, ×100

Fig. 3. *Praeglobotruncana stephani stephani* (Gandolfi), Upper Cenomanian, Rucăr basin, L.P.B. 9154, ×95

Fig. 4—10. *Praeglobotruncana prahovae* Neagu n. sp. Lowermost Turonian (4—6 holotype, Belia Valley, L.P.B. 9161, 7—10 paratypes, Belia Valley), L.P.B. 9162, ×100

Plate XXIV

Fig. 1—9. *Praeglobotruncana prahovae* Neagu n. sp. Lowermost Turonian, paratypes, Belia Valley, L.P.B. 9162, ×100

Plate XXV

Fig. 1—6. *Rotalipora appenninica appenninica* (Gandolfi). Lower Cenomanian, Prahova Valley, L.P.B. 9164, ×100

Fig. 7—9. *Rotalipora cushmani cushmani* (Morrow). Middle Cenomanian, Belia Valley, L.P.B. 9166, ×100

Plate XXVI

Fig. 1—9. *Rotalipora cushmani cushmani* (Morrow). Middle Cenomanian, Belia Valley, L.P.B. 9166, ×100

Plate XXVII

Fig. 1—6. *Rotalipora cushmani turonica* (Brotzen), Middle Cenomanian, Belia Valley, L.P.B. 9167, ×100

Plate XXVIII

Fig. 1—6. *Rotalipora cushmani thomei* Hagn & Zeill, Middle Cenomanian, Belia Valley, L.P.B. 9168, ×100

Fig. 7—9. *Rotalipora cushmani expansa* (Carbonier), Upper Cenomanian, Belia Valley, L.P.B. 9169, ×100

Plate XXIX

Fig. 1—5. *Rotalipora cushmani expansa* (Carbonier), Upper Cenomanian, Belia Valley, L.P.B. 9169, ×100

Fig 6—9. *Rotalipora cushmani montsalvensis* (Mornod), Upper Cenomanian, Belia Valley, L.P.B. 9170, ×100

Plate XXX

Fig. 1—2. *Rotalipora cushmani montsalvensis* (Mornod), Upper Cenomanian, Belia Valley, L.P.B. 9170, ×100

Fig. 3—5. *Rotalipora cushmani minor* (Mornod), Upper Cenomanian, Belia Valley, L.P.B. 9171, ×100

Fig. 6—7. *Rotalipora globotruncanoides* Sigal, Middle Cenomanian, Belia Valley, L.P.B. 9172, ×100

Plate XXXI

Fig. 1—5. *Rotalipora globotruncanoides* Sigal, Middle Cenomanian, Belia Valley, L.P.B. 9172, ×100
Fig. 6—8. *Rotalipora cushmani minor* (Mornod), Upper Cenomanian, Belia Valley, L.P.B. 9171, ×100
Fig. 9—10. *Rotalipora brotzeni* Sigal, Middle Cenomanian, Belia Valley, L.P.B. 9173, ×100

Plate XXXII

Fig. 1—6. *Rotalipora brotzeni* Sigal, 1—3, Middle Cenomanian, Belia Valley, 4—6 Upper Cenomanian, Belia Valley, L.P.B. 9173, ×100
Fig. 7—9. *Rotalipora micheli* (Sacal & Debourle), Upper Cenomanian, Belia Valley, L.P.B. 9174, ×100

Plate XXXIII

Fig. 1—3. *Rotalipora micheli* (Sacal & Debourle), Upper Cenomanian, Belia Valley, L.P.B. 9174, ×100
Fig. 4—8. *Rotalipora brotzeni* Sigal, Upper Cenomanian, Belia Valley, L.P.B. 9173, ×100

Plate XXXIV

Fig. 1—3. *Rotalipora brotzeni* Sigal, Upper Cenomanian, Belia Valley, L.P.B. 9173, ×100
Fig. 4—6. *Rotalipora reicheli* Mornod, Upper Cenomanian, Belia Valley, L.P.B. 9175, ×100

Plate XXXV

Fig. 1—3. *Rotalipora brotzeni* Sigal, Middle Cenomanian, Belia Valley, L.P.B. 9173, ×100
Fig. 4—6. *Rotalipora reicheli* Mornod, Upper Cenomanian, Belia Valley, L.P.B. 9175, ×100

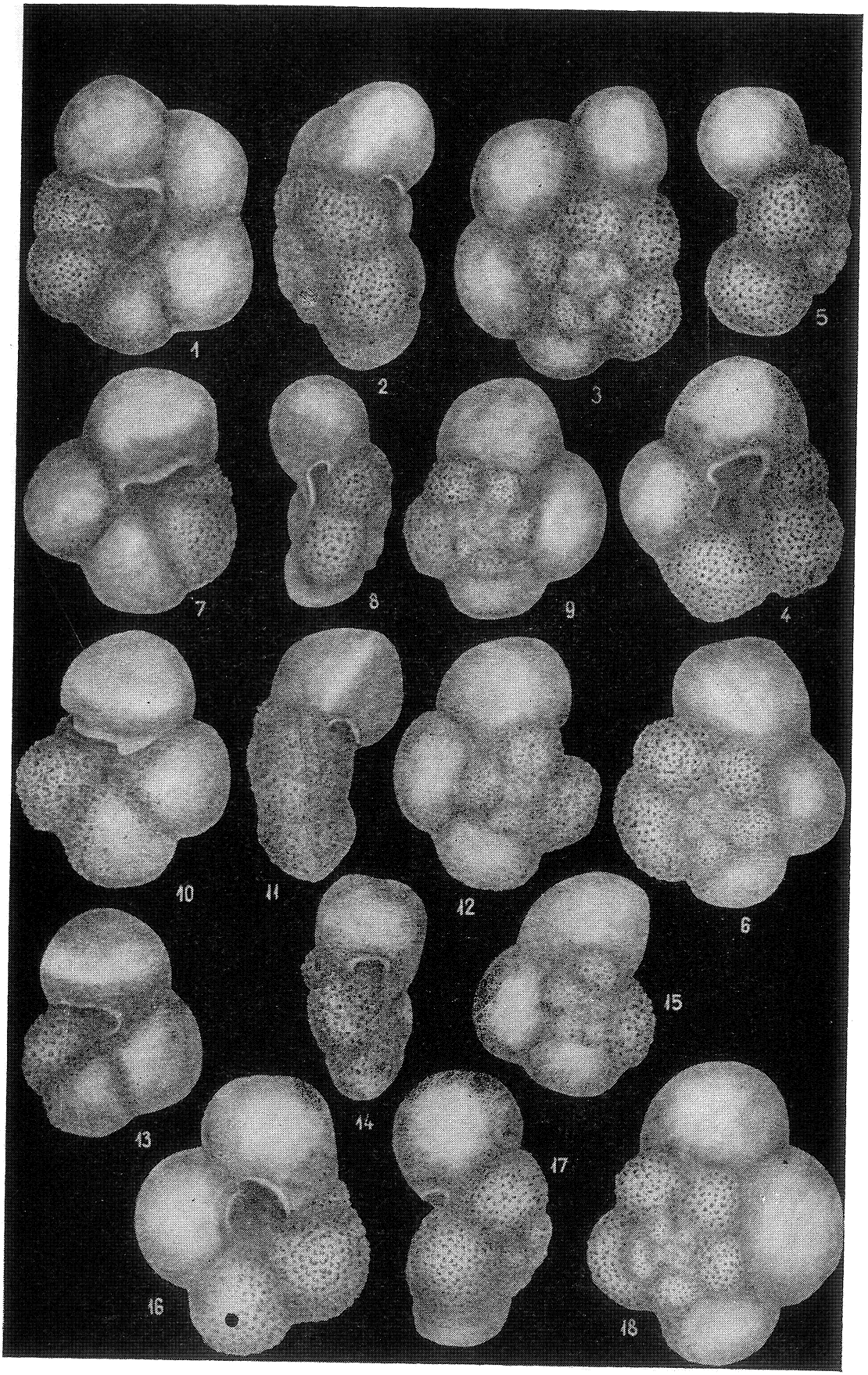
Plate XXXVI

Fig. 1—3. *Rotalipora reicheli* Mornod, Upper Cenomanian, Belia Valley, L.P.B. 9175, ×100
Fig. 4—6. *Rotalipora deeckei* (Franke), Upper Cretaceous, Rucăr basin, L.P.B. 9176, ×100

Plate XXXVII

Fig. 1—5. *Rotalipora deeckei* (Franke), Upper Cenomanian, Rucăr basin, L.P.B. 9176, ×100
Fig. 6—8. *Rotalipora appenninica evoluta* (Sigal), Cenomanian, Teliu Valley, L.P.B. 9165, ×100
All figures have been drawn with the aid of camera lucida by the author himself.

T. Neagu



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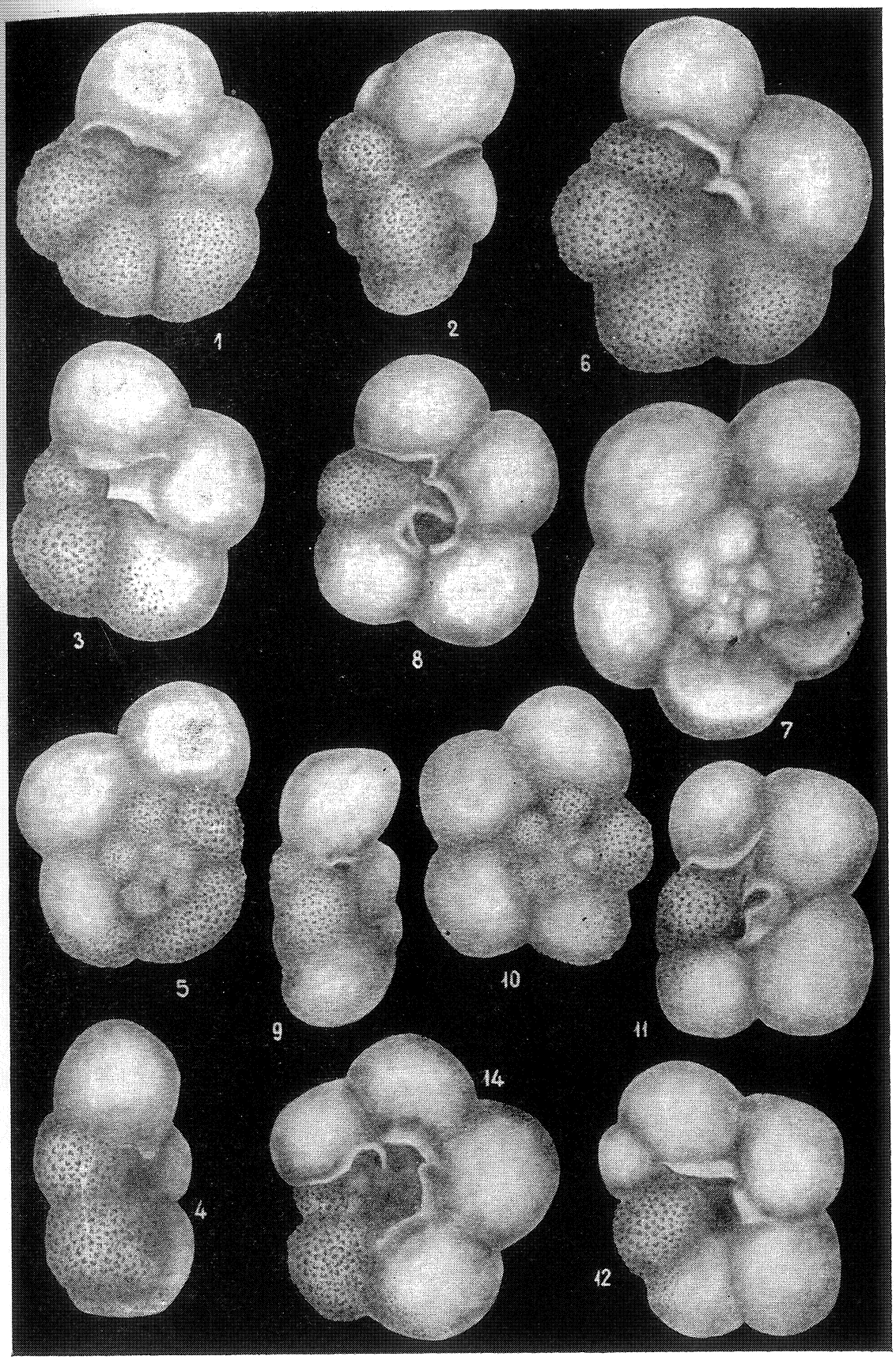

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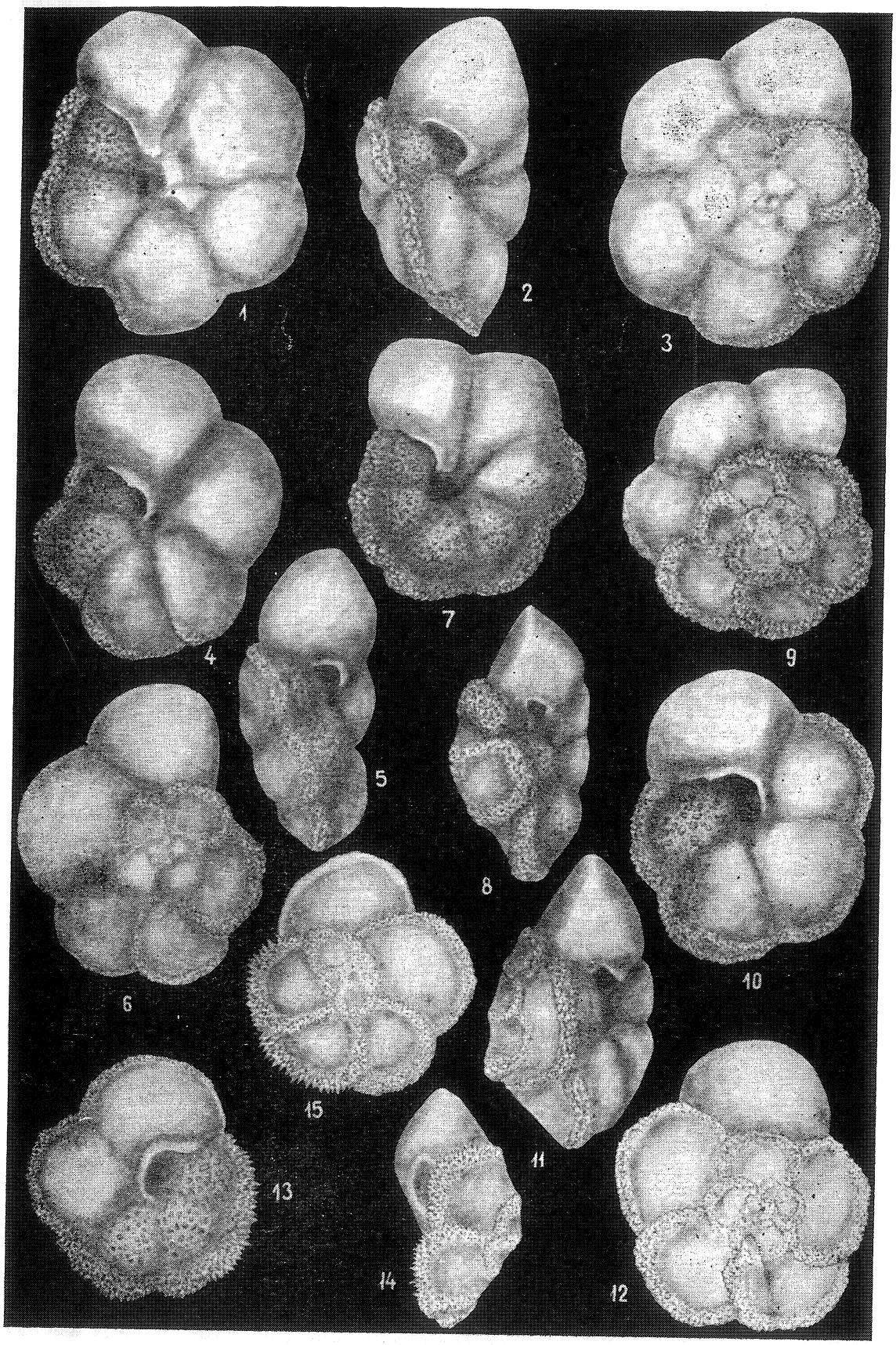

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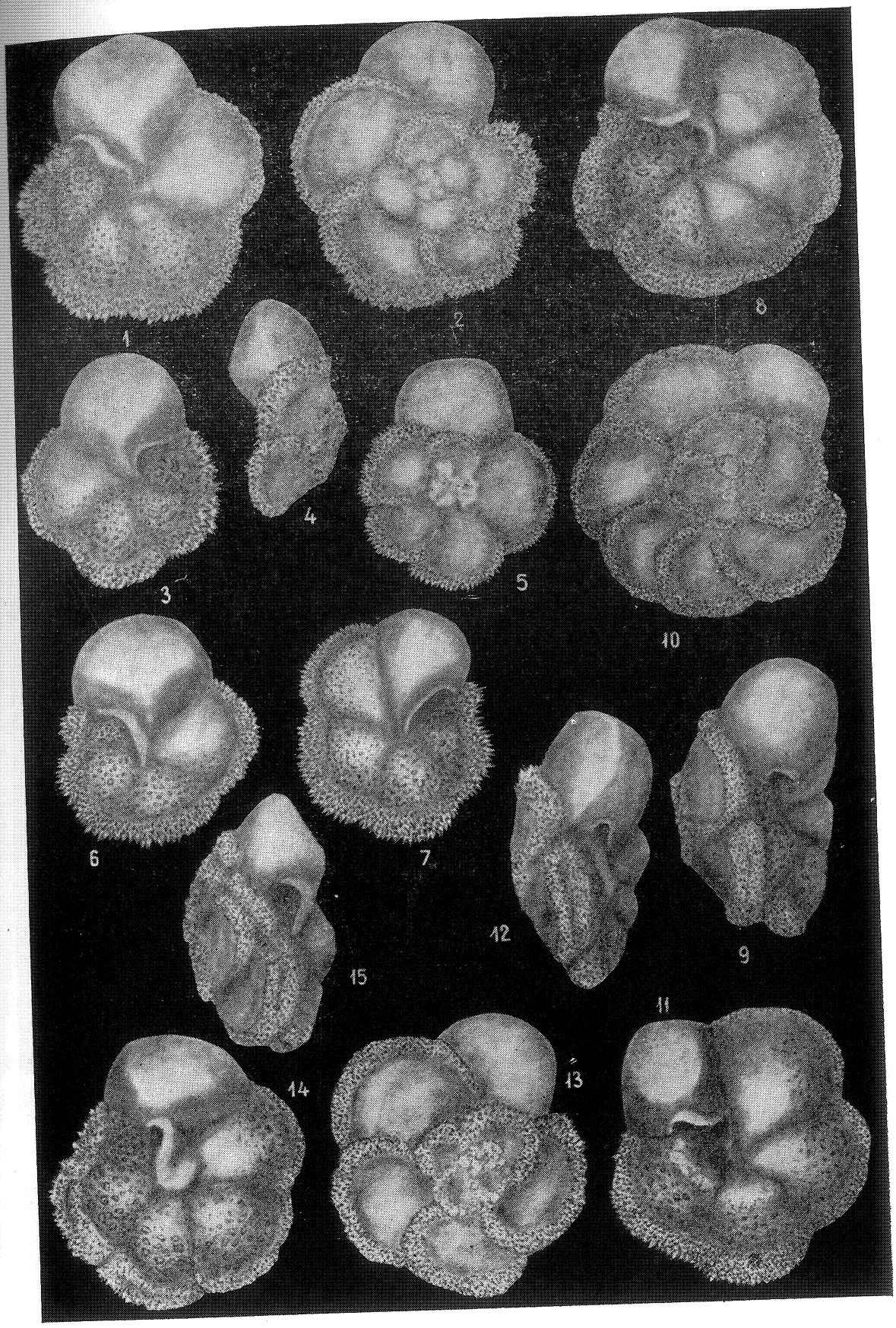

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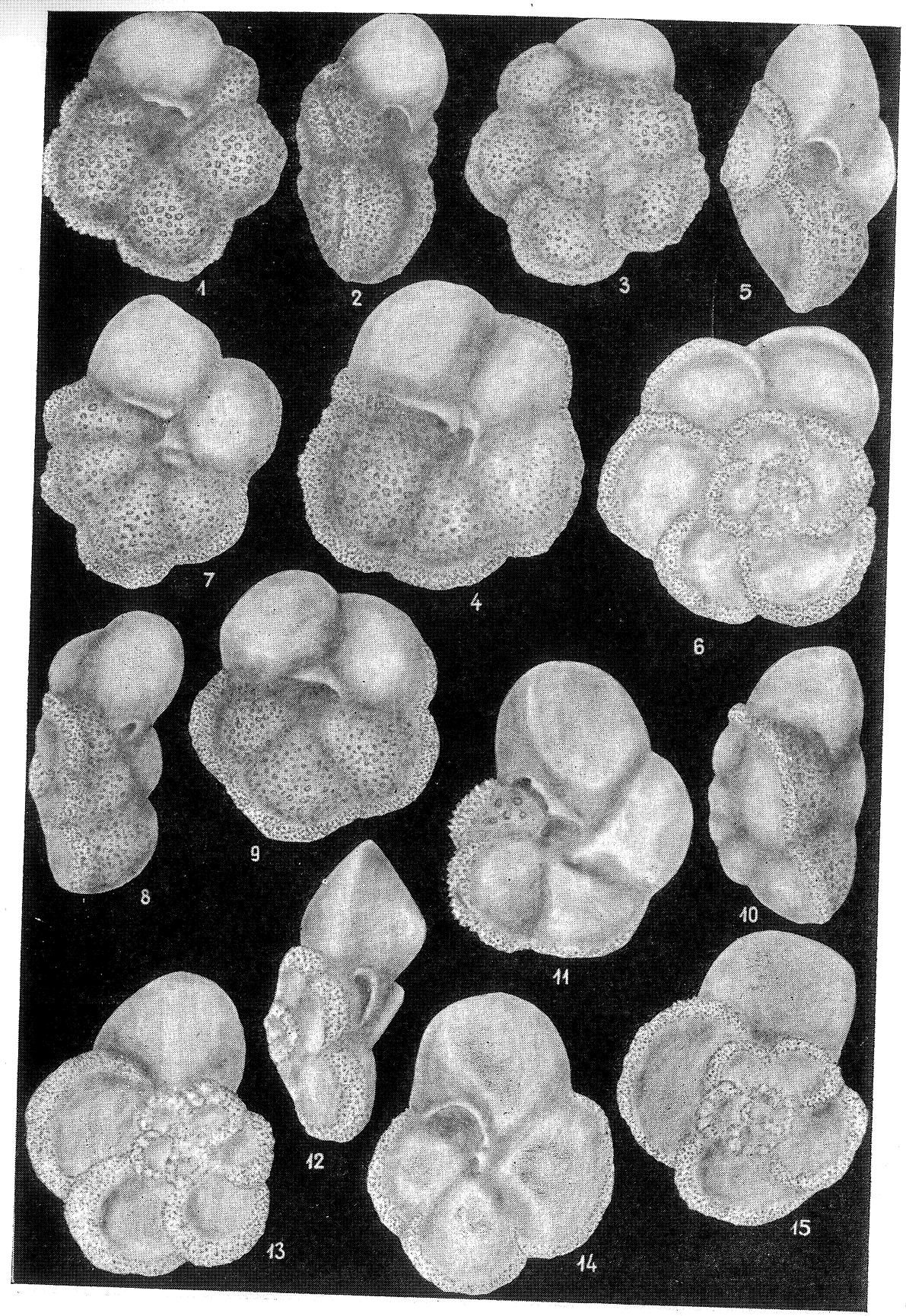

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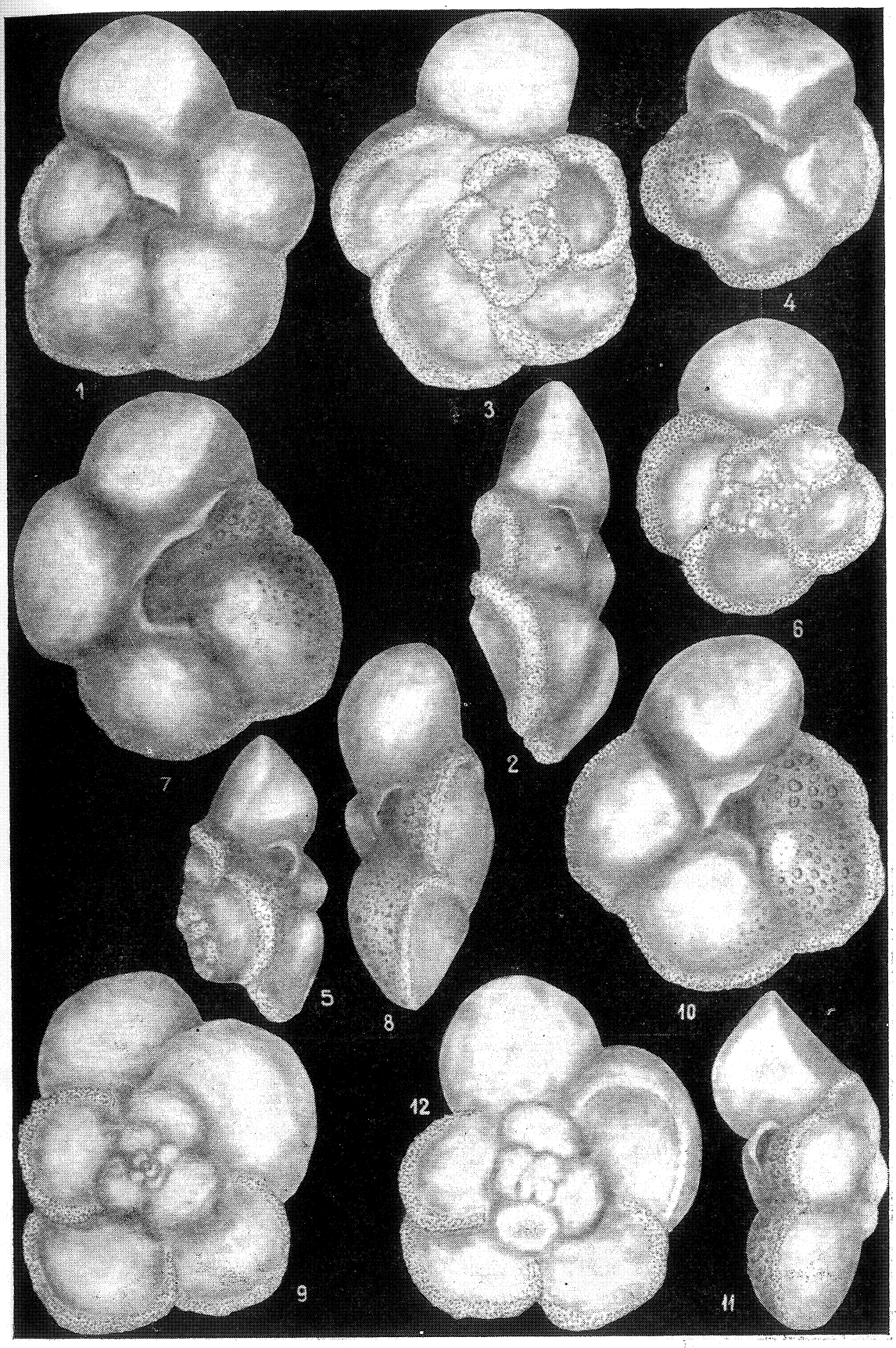

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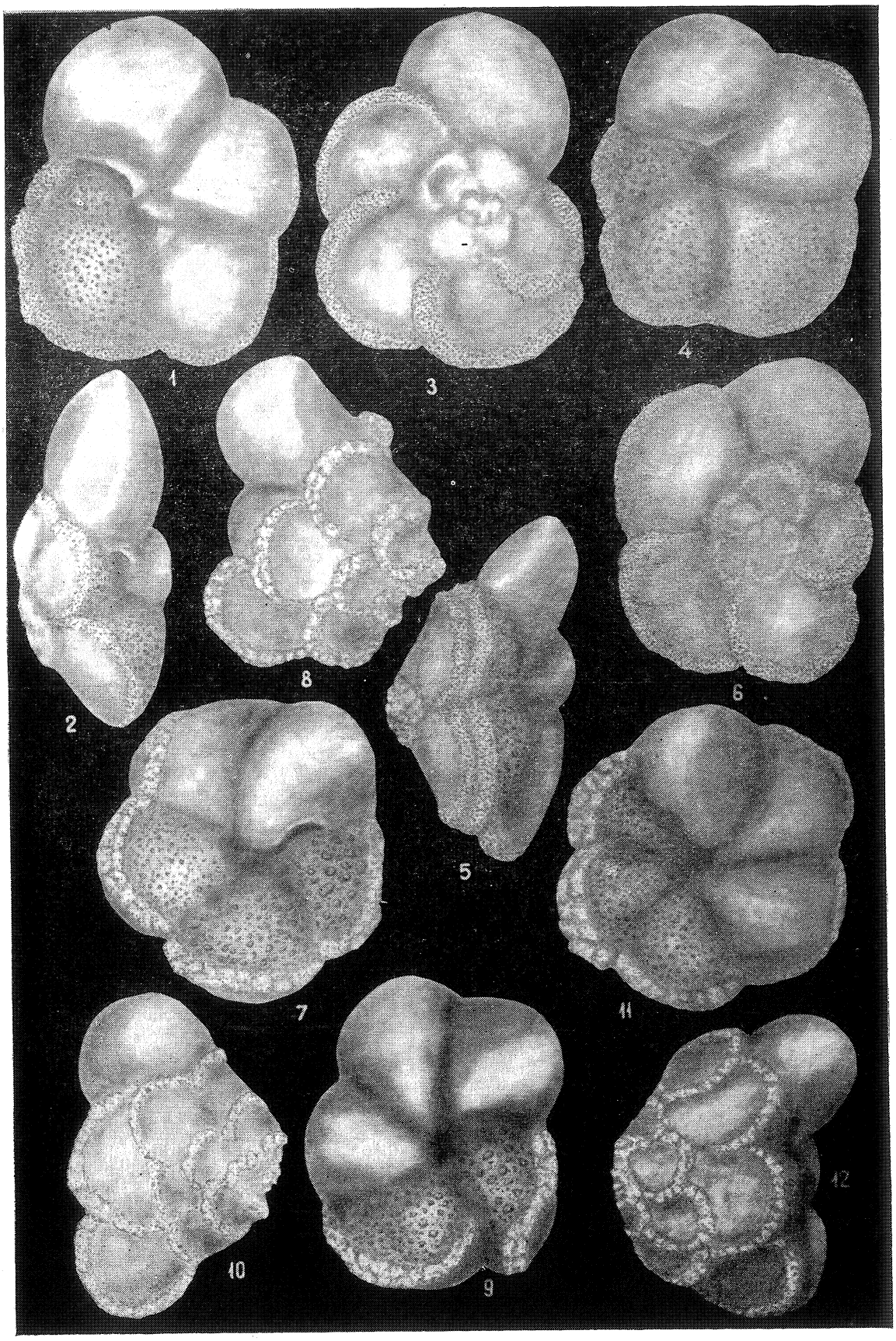

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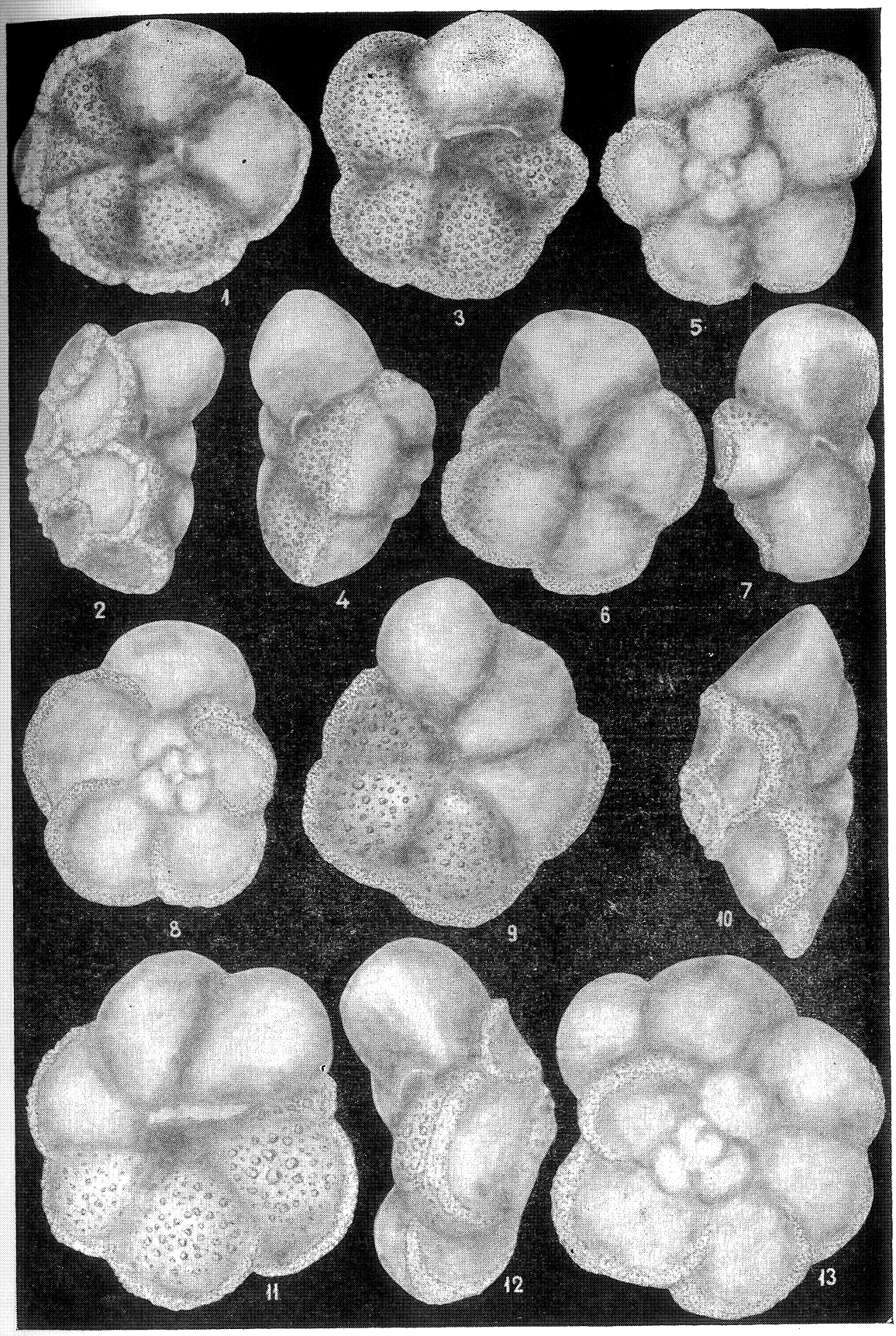

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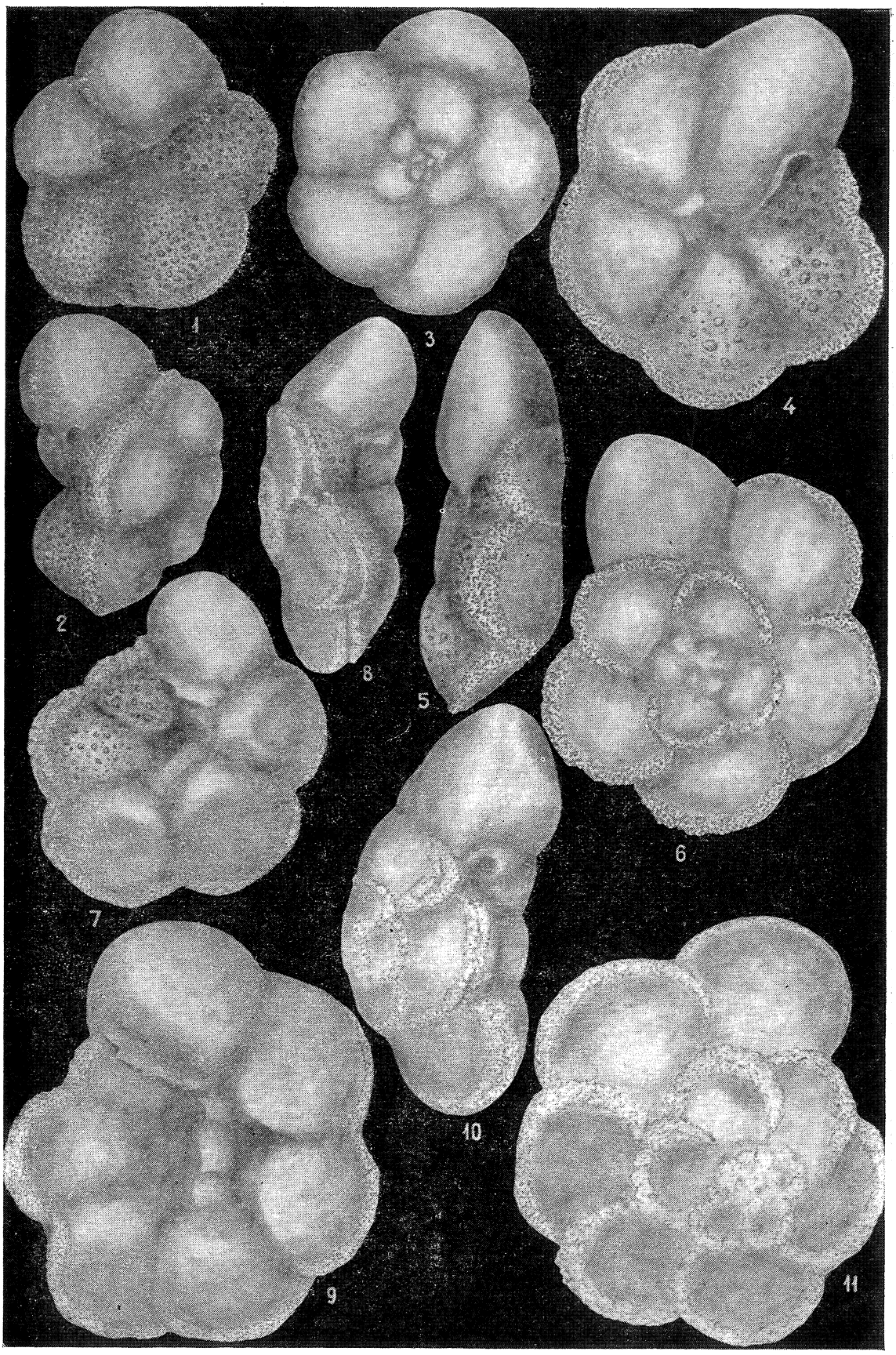

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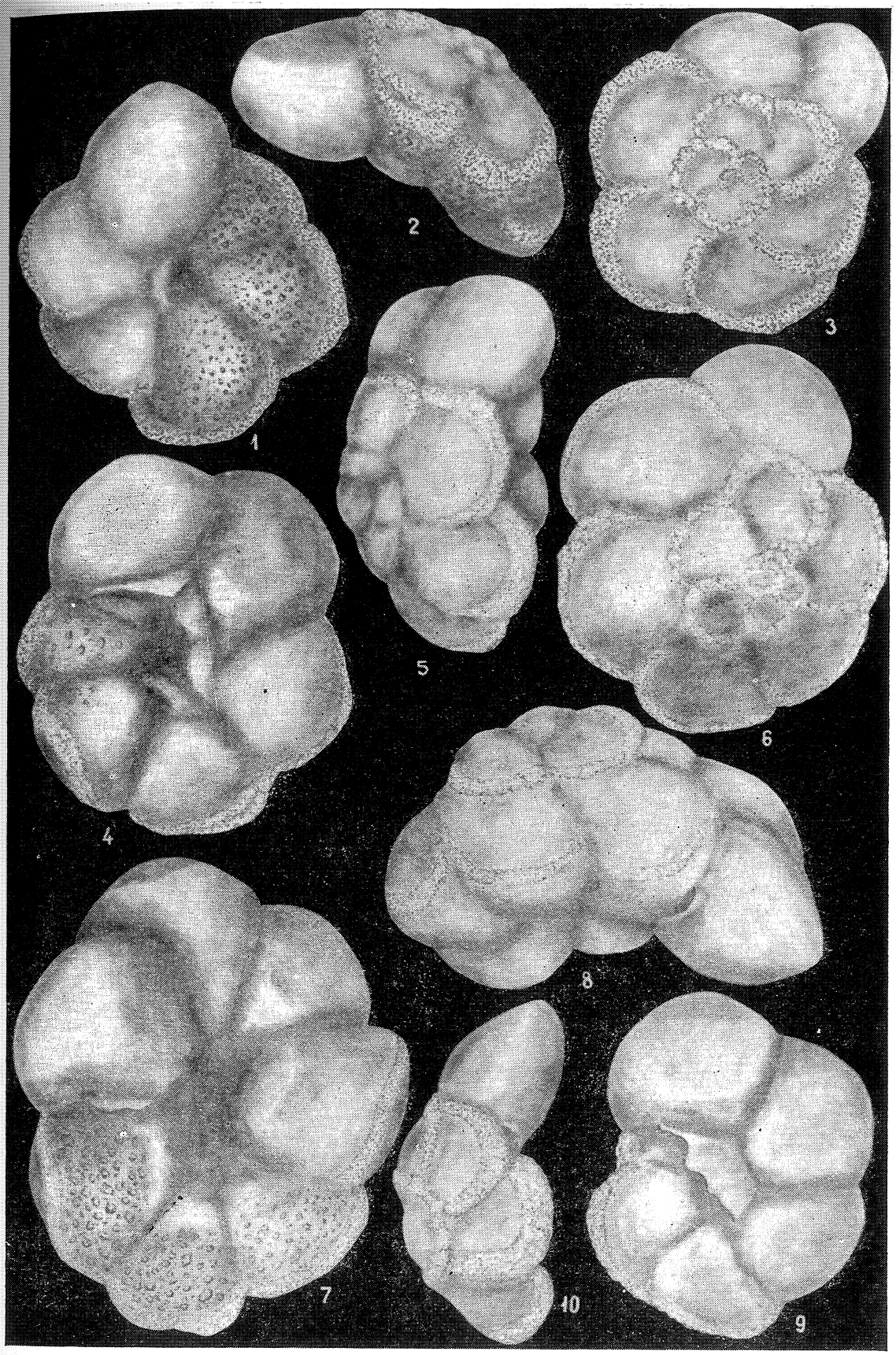

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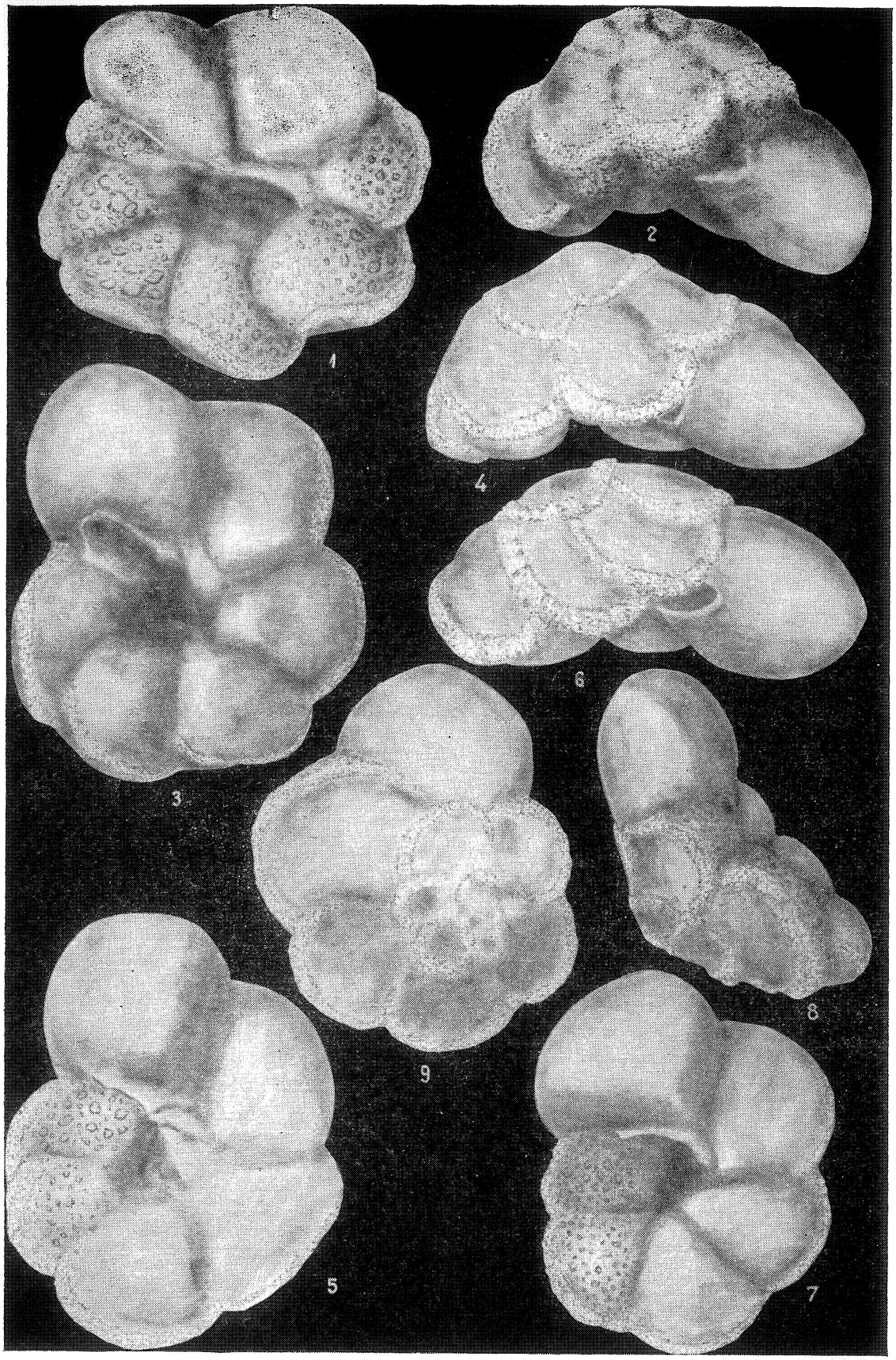

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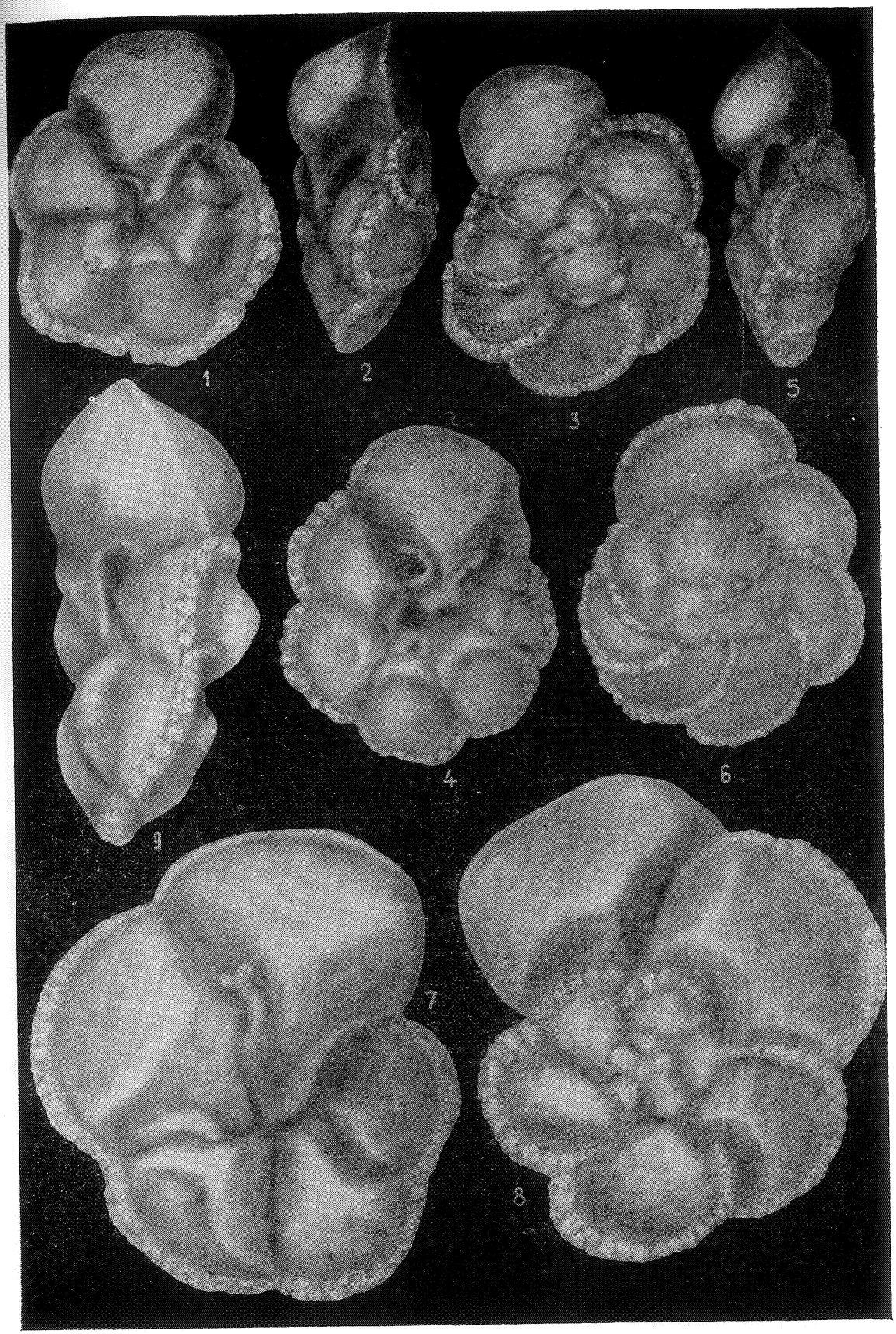

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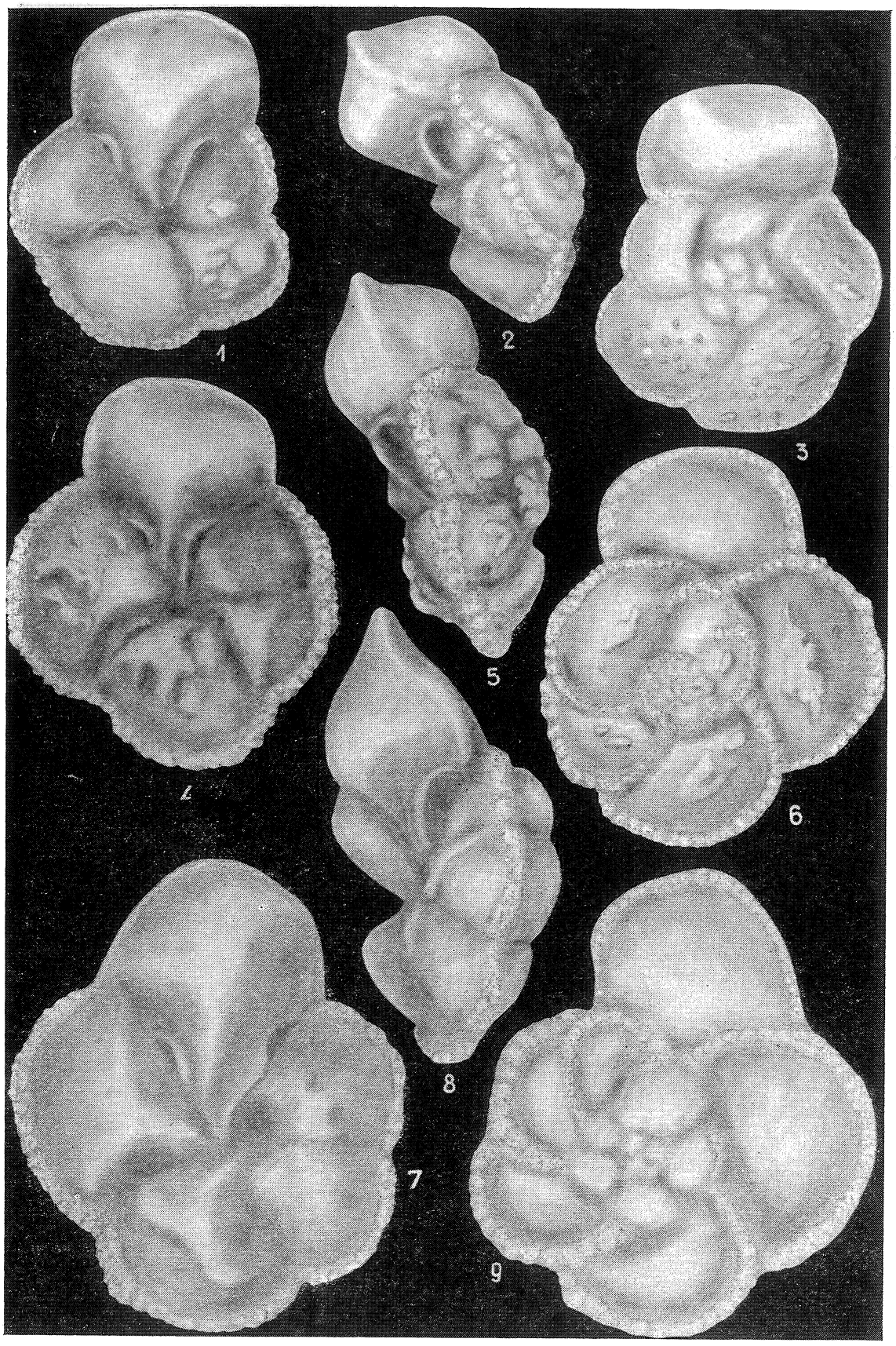

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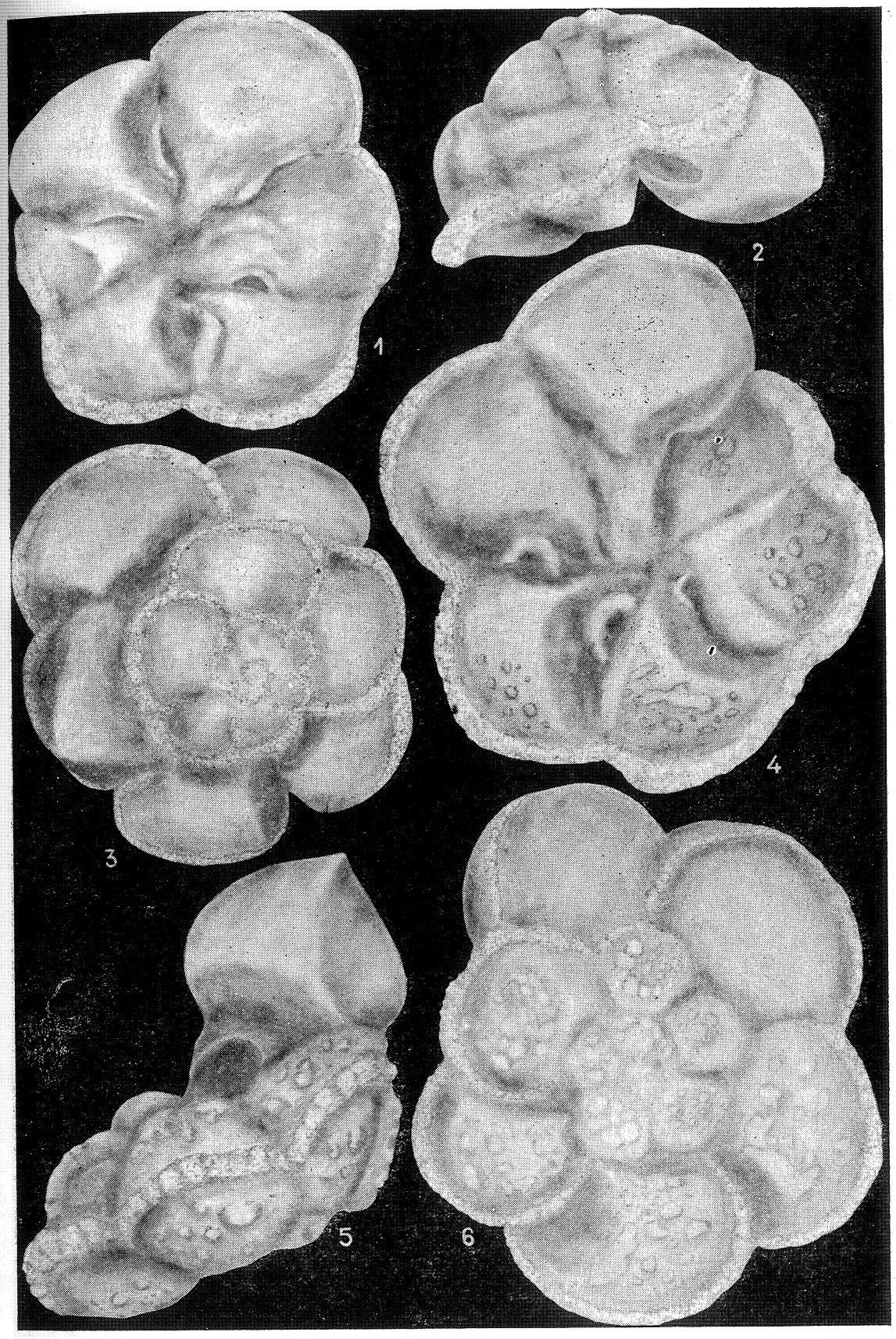

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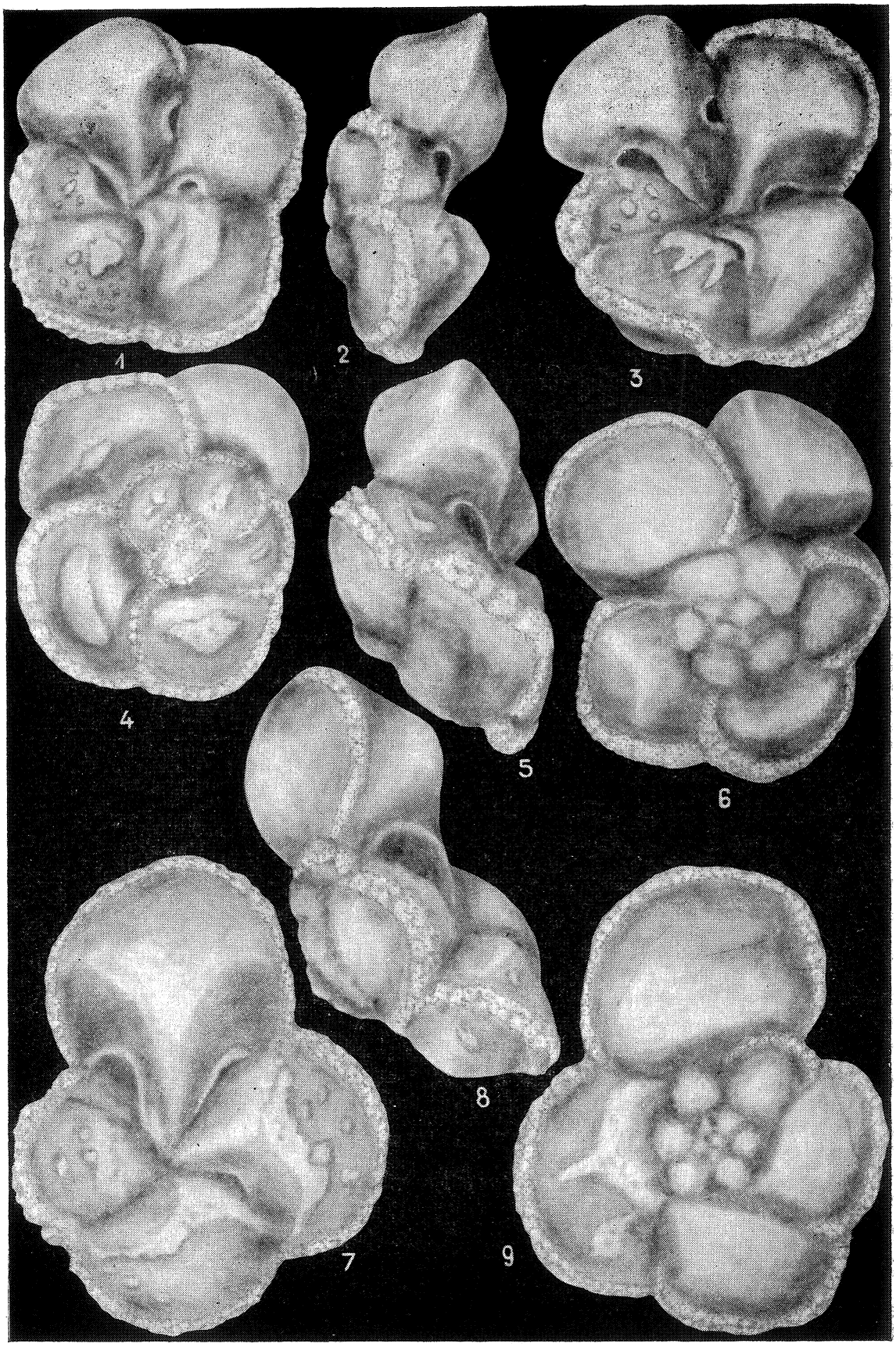

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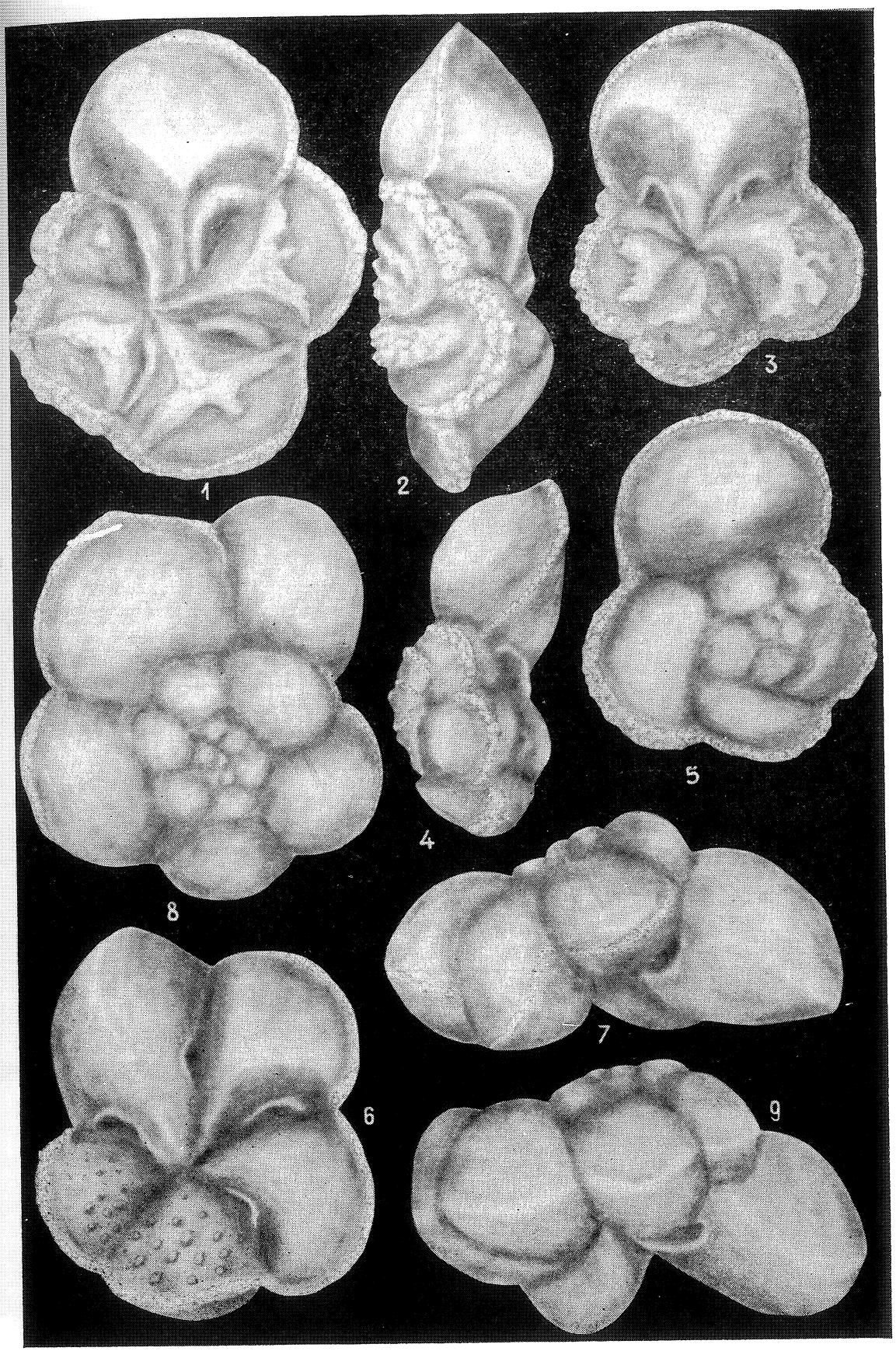
Tabl. XXIX



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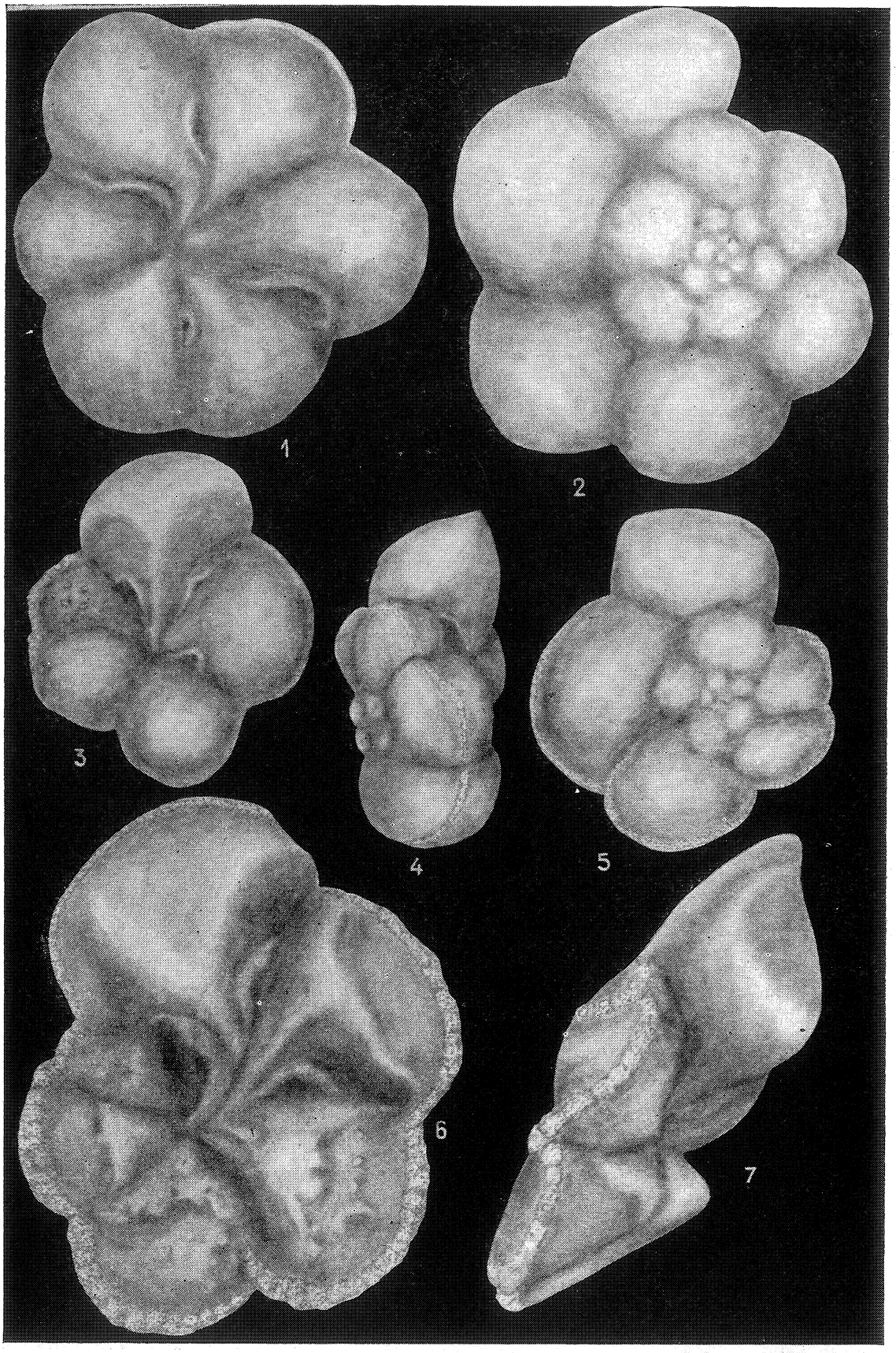
Rocznik Pol. Tow. Geol., t. XXXIX z. 1—3 *Tabl. XXX*



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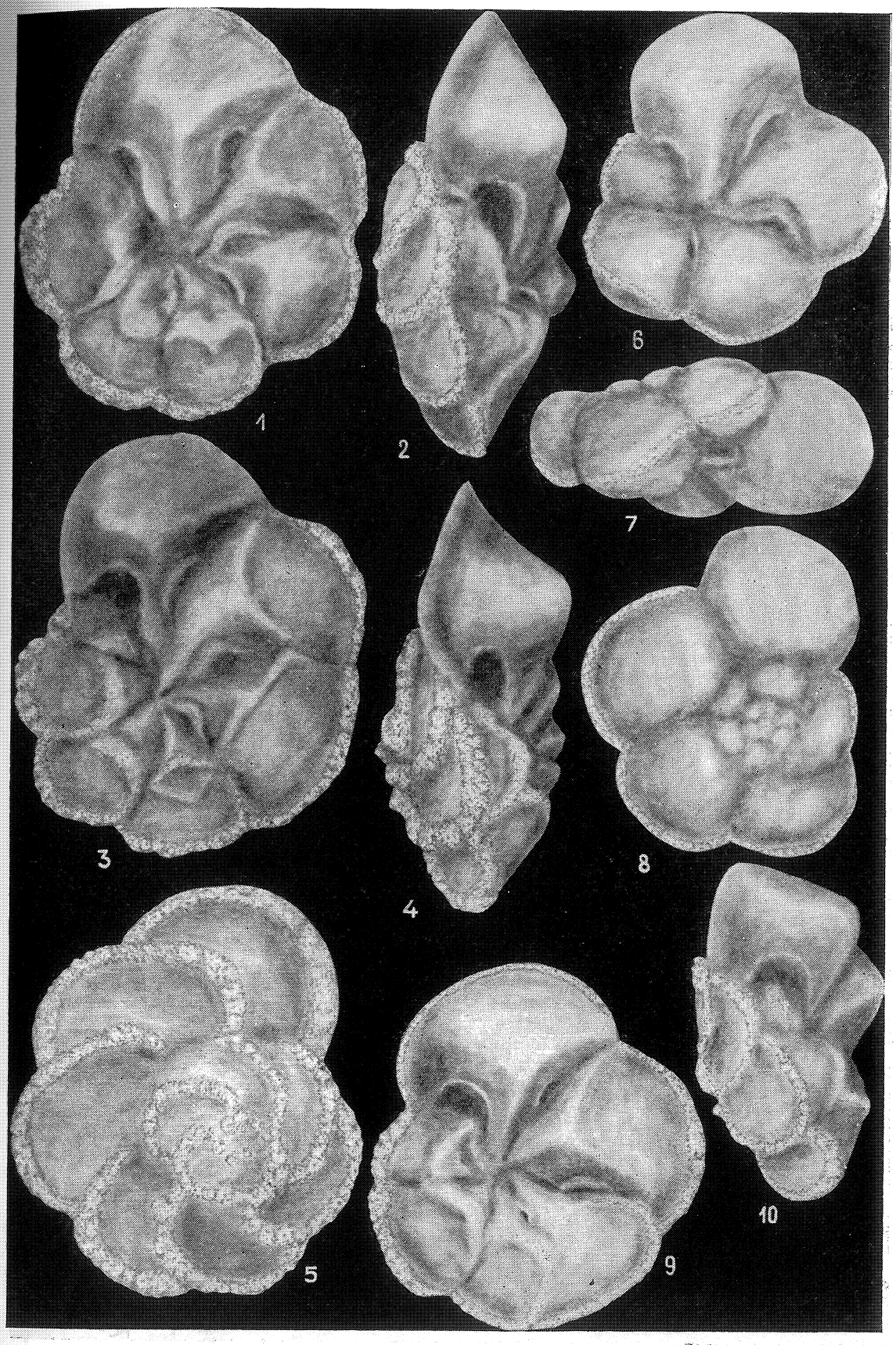
Rocznik Pol. Tow. Geol., t. XXXIX z. 1—3

Tabl. XXXI



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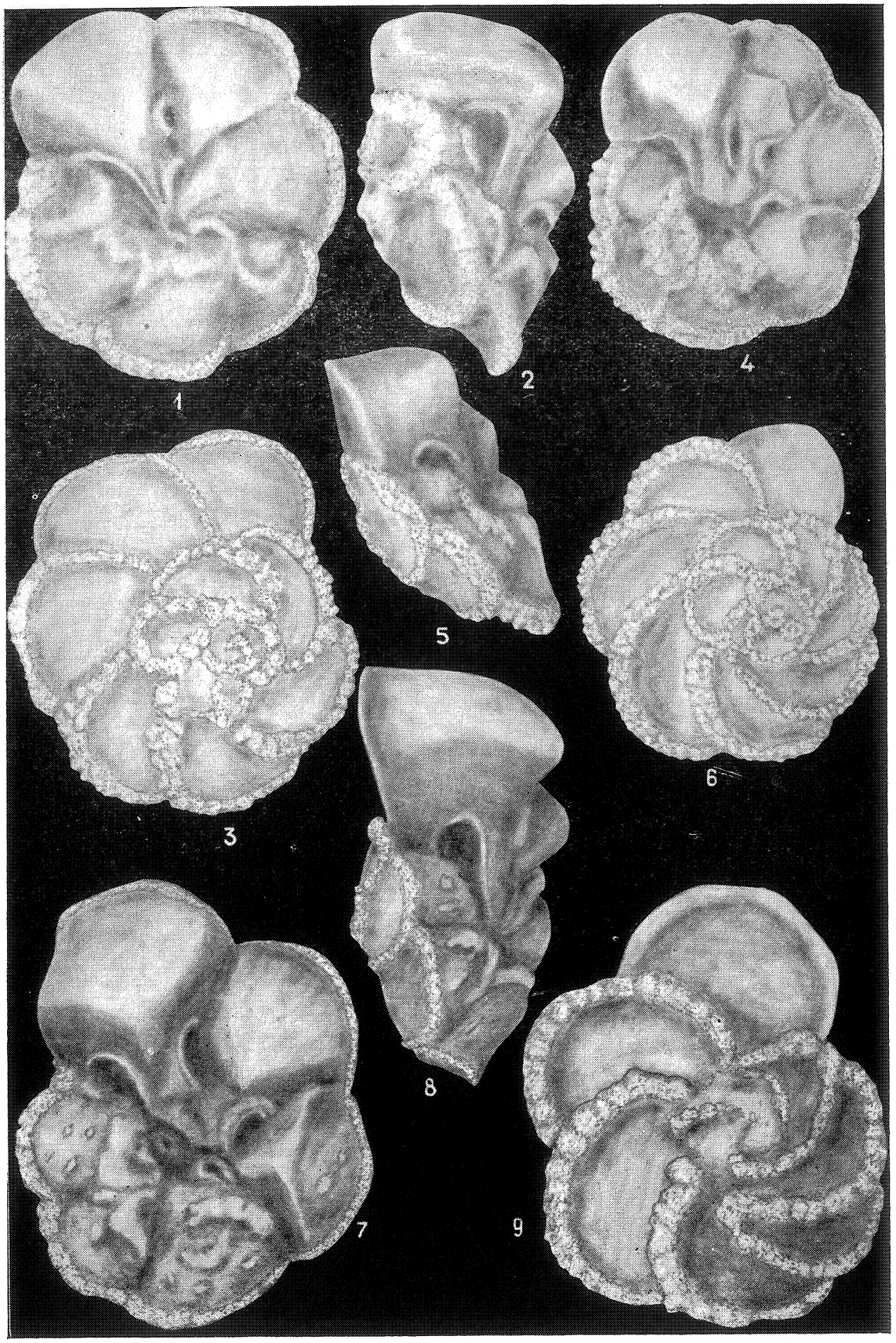

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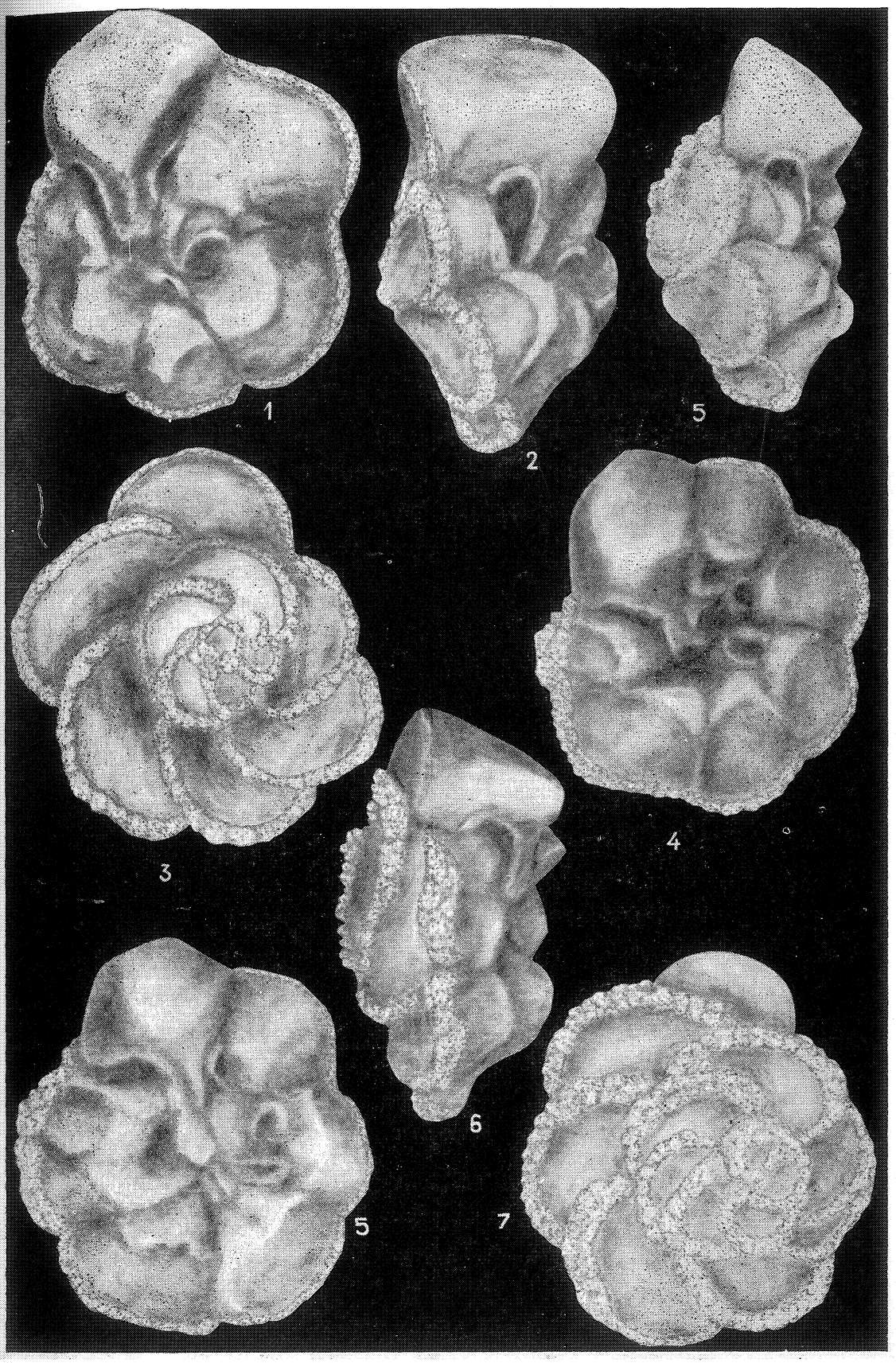

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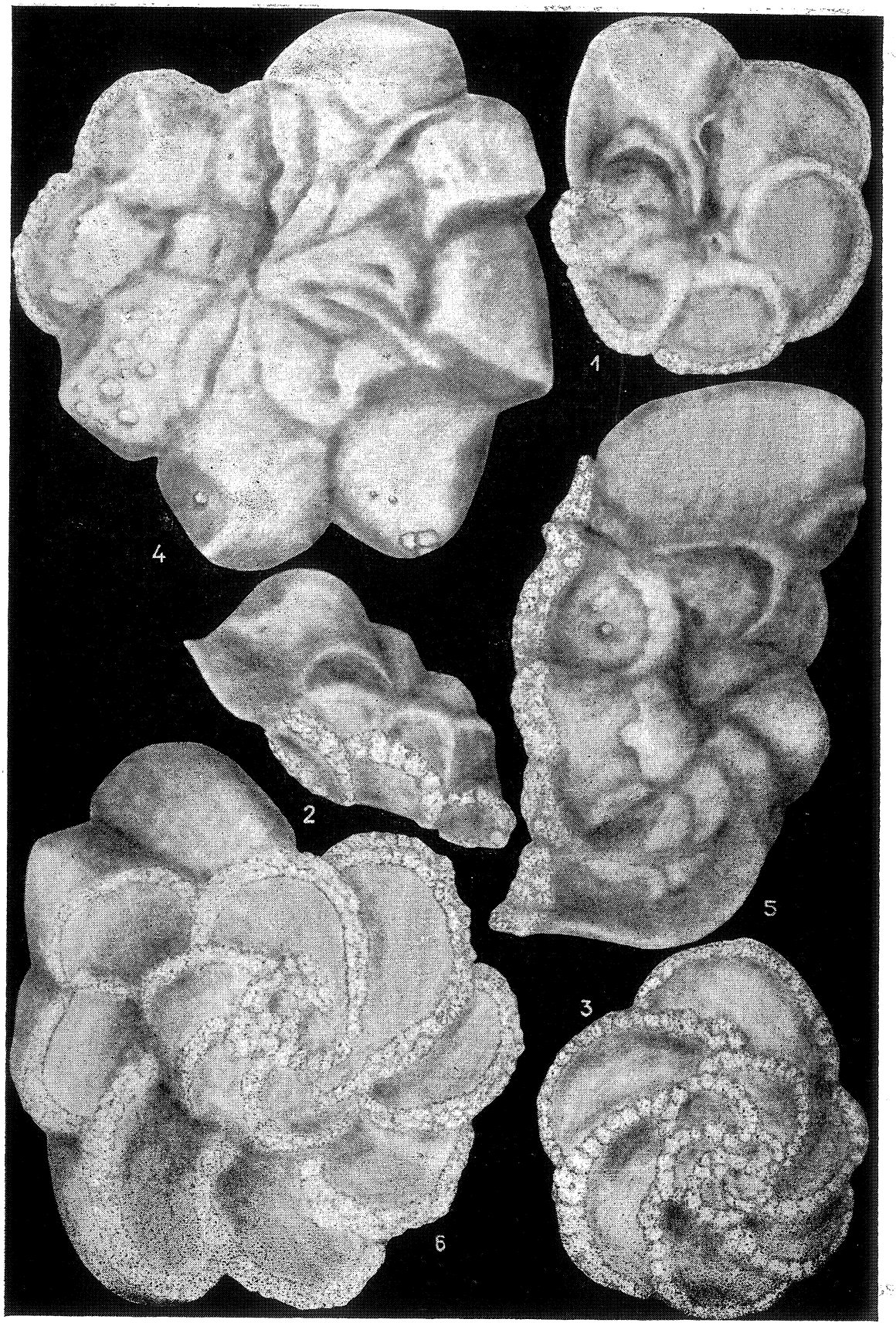

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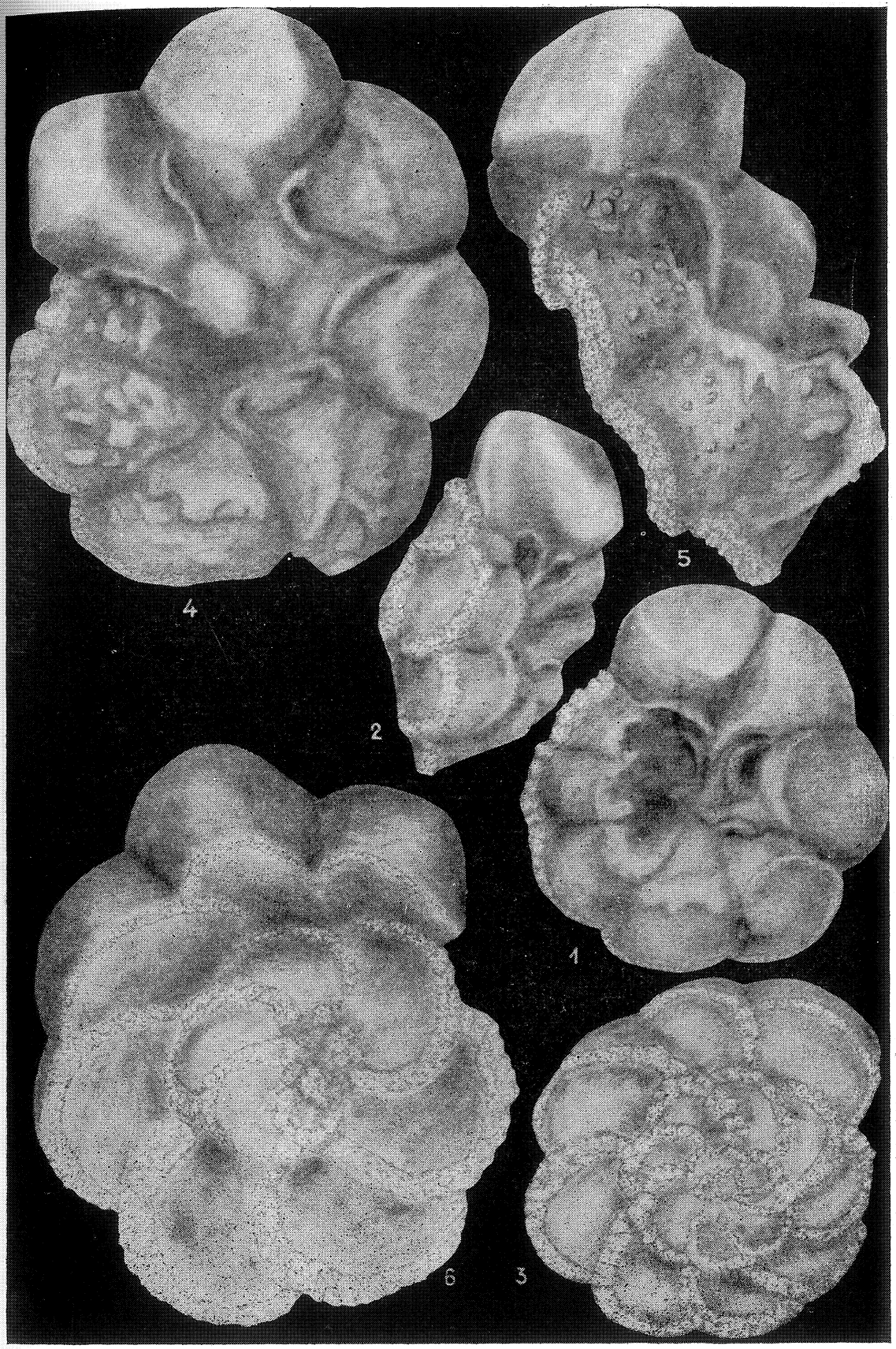

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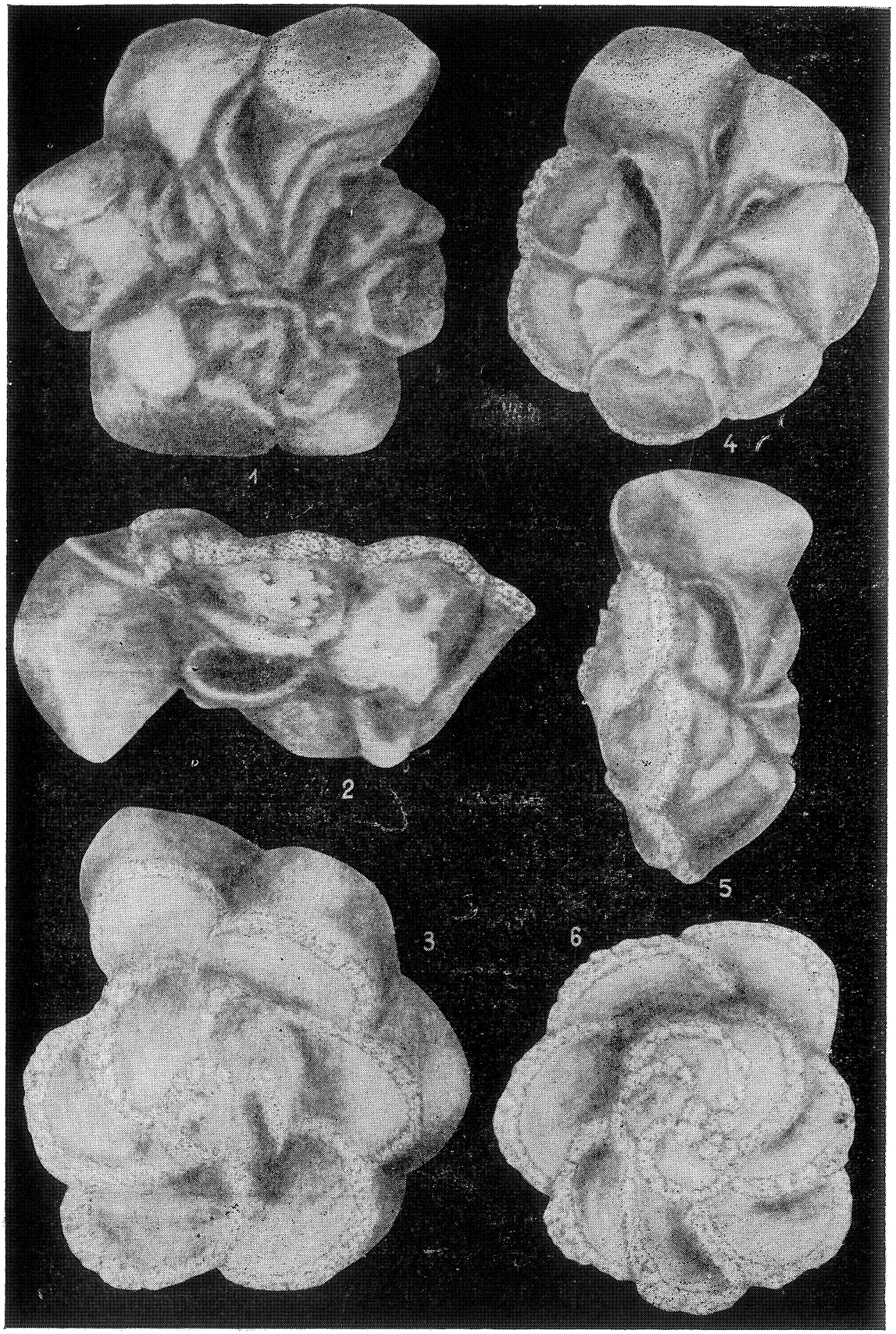

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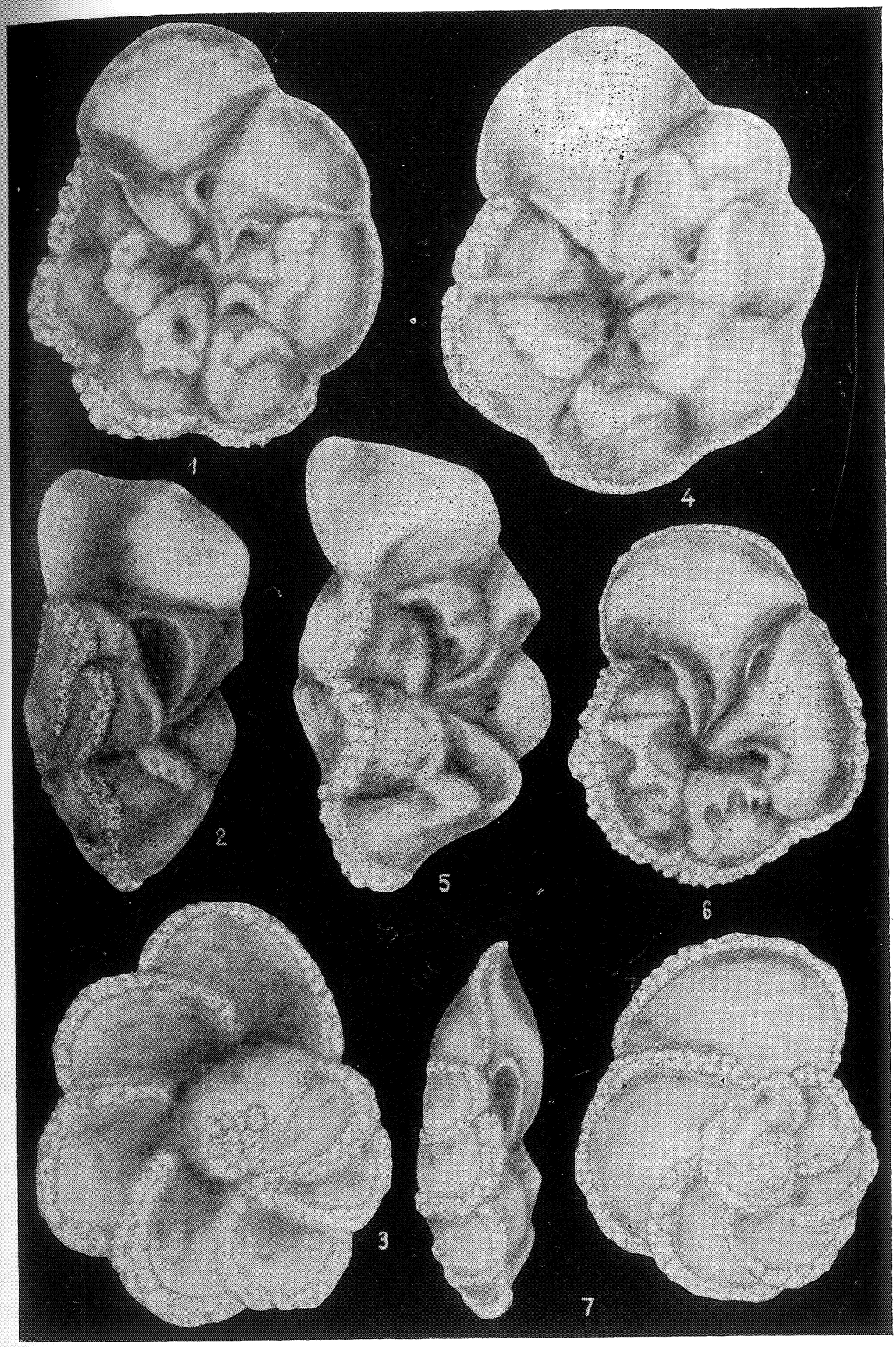
Tabl. XXXVII



T. Neagu