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A NEW REEF-BUILDING BRYOZOAN SPECIES FROM THE MIOCENE OF ROZTOCZE

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A new reef-building cyclostome bryozoan species *Fasciculipora janinae* sp. n. (Fasciculiporidae Walter) with highly variable zoaria has been recorded in the Miocene bioherms of Roztocze, Poland.

Key words: Bryozoa, Cyclostomata, taxonomy, Miocene, Poland.

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INTRODUCTION

The investigated bryozoans derived from the Miocene reefs exposed in quarries at Łysaków and at the Chełm Mt. by Modliborzyce (fig. 1).

The Miocene deposits are represented in that area by grey or brown, compact, massive limestones with several fissures filled up with calcite or fine-grained waste deposit. These rocks have been recognized for cryptalgal-serpulid reefs (Pisera 1978). According to Liszkowski and Muchowski (1968), the reef structures consist of up to 3—4 m thick bloks of massive limestone separated one from another by laminated detritic limestones and marls. The massive limestones are composed mainly of serpulid tubes embedded within cryptalgal limestone. The rocks contain an abundant but species-poor mollusk fauna including *Cerastoderma*, *Modiolus*, *Mohrensternia*, and *Gibbula*. Here and there, mollusk shells form coquinite accumulations. There are also some bryozoan bioherms attaining up to a few meters in length and one meter in thickness. The bioherms are built up by cyclostomate and cheilostomate bryozoans but the frame-building assemblage is monospecific in places, consisting of *Fasciculipora janinae* sp. n. Branching colonies of the new species are so variable that their isolated fragments might be easily misidentified as belonging to distinct species or even genera.

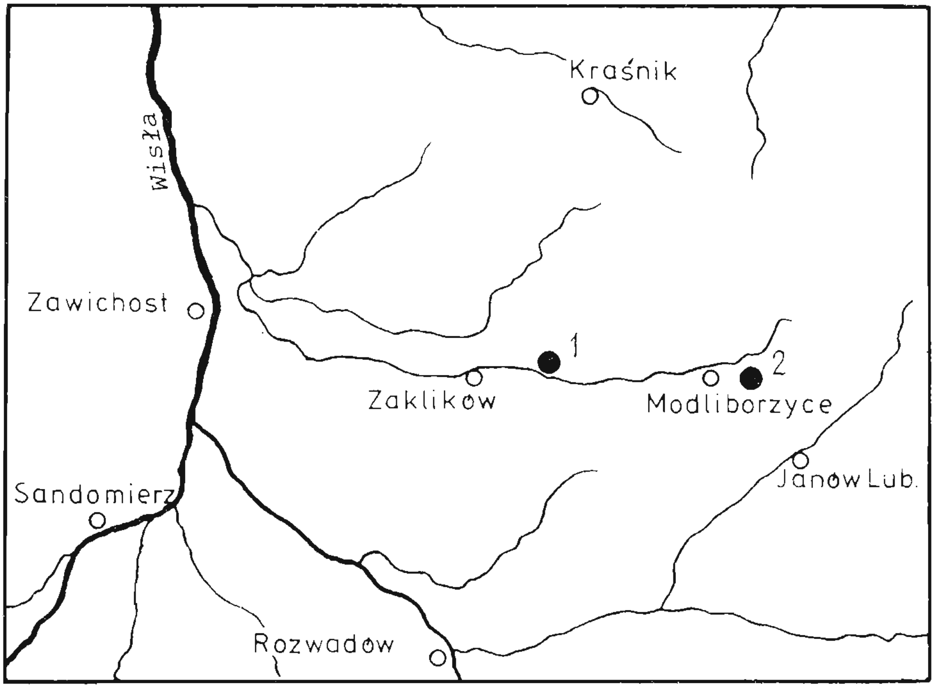

Fig. 1. Exposures yielding *F. janinae* sp. n.

The investigated collection is housed at the Department of Paleontology and Stratigraphy of the Academy of Mining and Metallurgy, for which the abbreviation ZPiS is used.

DESCRIPTION

Family **Fasciculiporidae** Walter, 1969

Diagnosis. — see Walter 1969.

Genera ascribed. — *Fasciculipora* d'Orbigny, 1847; *Apsendesia* Lamoroux, 1821.

Remarks. — Walter established the family Fasciculiporidae basing upon a study of representatives of the genera *Frondipora* and *Fasciculipora*. He assigned two genera, *Fasciculipora* and *Apsendesia*, to the new family. The two genera are species-poor and the generic difference consists in the mode of development of ovicells. Thus far, the fasciculiporid species are known merely from zoarial fragments and hence, recognition of the structure of the whole zoarium of *Fasciculipora janinae* sp. n. considerably contributes to the knowledge of this rather poorly understood bryozoan family.

Genus *Fasciculipora* d'Orbigny, 1847 (= *Fungella* von Hagenow 1851, *partim*)

Type species: *Fasciculipora ramosa* d'Orbigny, 1847, Recent.

Fasciculipora janinae sp. n.
(pls 11, 12, 13, 14; figs 2, 3, 4)

Syntypes: pls 12—14; figs 2—4; ZPiS No Sp.B 2—6.

Type locality: Łysaków, Roztocze, near Lublin.

Type horizon: Miocene, Lower Tortonian.

Derivation of the name: in honor of my wife Janina, botanist of the Jagiellonian University, Cracow.

Material. — Thousands of complete and fragmented specimens from Łysaków and Modliborzyce.

Diagnosis. — Colony branching, panache- or fan-like in outline. Zooecia clustered in bifurcate fascicles, circular to polygonal in cross section. Aperture terminal. Gonozooecia in form of lobe-like bubbles with a circular oeciopore, located between fascicle bifurcations.

Description. — A few successive developmental stages can usually be recognized in a colony (fig. 2):

Stage I. Branching colony grows at a circular to elliptic basal disc. It consists of tube-like individuals (fig. 2*a*) and higher on, of fascicles composed of long zooecial tubes circular to polygonal in cross section (fig. 2*b*). The fascicles resemble bifurcate branches subcircular in cross section and impose a panache- or fan-like outline to the colony (pl. 11: 3, figs 1—2);

Stage II. Colony of this developmental stage forms at the branches of I-stage colony. At the top of the branches, fascicles composed each of a few zooecia appear (fig. 2*c*). These fascicles are commonly bifurcate and very long, up to 4 cm in length. Intense budding results eventually in formation of numerous zooecial tubes arranged in form of a "crown" (fig. 2*d*). The zooecial tubes fuse one with another and hence, are polygonal in their crossection and aperture shape;

Stage III. Colony of this developmental stage forms at the "crowns" of II-stage colony. Zooecial tubes are again long. They give origin to fascicles composed each of merely a few up to some hundreds of individuals, forming irregular panaches, crests, or fans (pl. 12).

Among colony portions developed accordingly to the above presented pattern, there are commonly some portions inhibited in their growth by some unknown factors (fig. 2*e*). The normally developed colony portions are usually twice as large as the inhibited ones. In the latter areas, lateral branching occurs commonly (fig. 2*f*) resulting in formation of funnel-shaped structures including each a dozen or so zooecial tubes. One can also see singular zooecial tubes separating from branch walls within a zoarium; these tubes undergo a degeneration and form excrescences at the colony walls (fig. 2*g*). Similar tube-like excrescences develop due to the growth of a new colony from larva settled at the branches under unfavorable environmental conditions (fig. 2*g*).

Peculiar zoarial structures develop within the upper part of a II-stage "crown" owing to a clay influx. Those zooids that were able to endure the increased rate of mud sedimentation undergo irregular budding over a short span of time and form eventually smallsized twisted zoaria (fig. 2*h*; fig. 4).

Colony growth. — Sister zooid grows up from a basal disc and give subsequently origin to successive zooids. This process goes on repeatedly resulting in a high variability of zooid fascicles arranged usually in form of a fan or panache (fig. 2; pls 11, 12). Base of a branching colony appears considerably variable dependingly upon the substrate. A few tunnel-like tubes grow commonly up from the base and produce numerous offsets. The offsets give origin to long zooecial tubes clustered into fascicles. Very commonly, zoecial tubes separate by singles, doubles, triples,

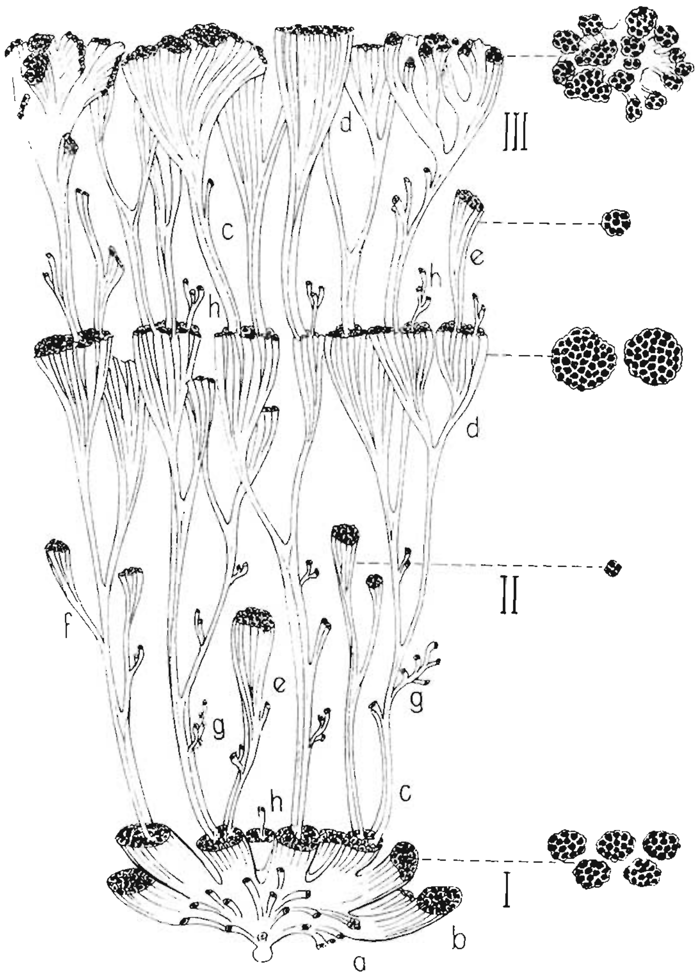

Fig. 2. A sketch of colony assemblage and growth modifications at particular developmental stages; I, II, III — developmental stages of a colony; *a* the earliest stage of colony formation; *b* fascicles of zooecial tubes; *c* branches of II- and III-stage colonies; *d* "crown" layer of II- and III-stage colonies; *e* colony fragments inhibited in their growth in an interlayer; *f* degenerated, twisted zooecial tubes at the walls of zooecial fascicles; *g* tube-like excrescences at the colony wall; *h* mortified colony fragments at the top of a "crown" layer.

etc. from the pile- or fan-like fascicles. Some fragments of zoaria, those provided with tubes running away by singles, may be suggestive of a quite distinct species. The mode of budding depends considerably upon the environmental conditions and developmental stage of a colony. Hence, zoarium is highly variable in shape among particular developmental stages. One deals with jerky regeneration of a colony in development of *Fasciculipora janinae* sp. n. Consequently, spongy layers consisting of parallel calcareous tubes alternate with compact ones built up by cemented colony "crowns". A phenomenon of such a cyclic degeneration and regeneration was already described by Hillmer (1971), Hillmer and Gauthier (1975), and Taylor (1976). The investigated specimens from Roztocze show up to three successive colony generations. The "crown" layers are separated from one another by sparsely spaced

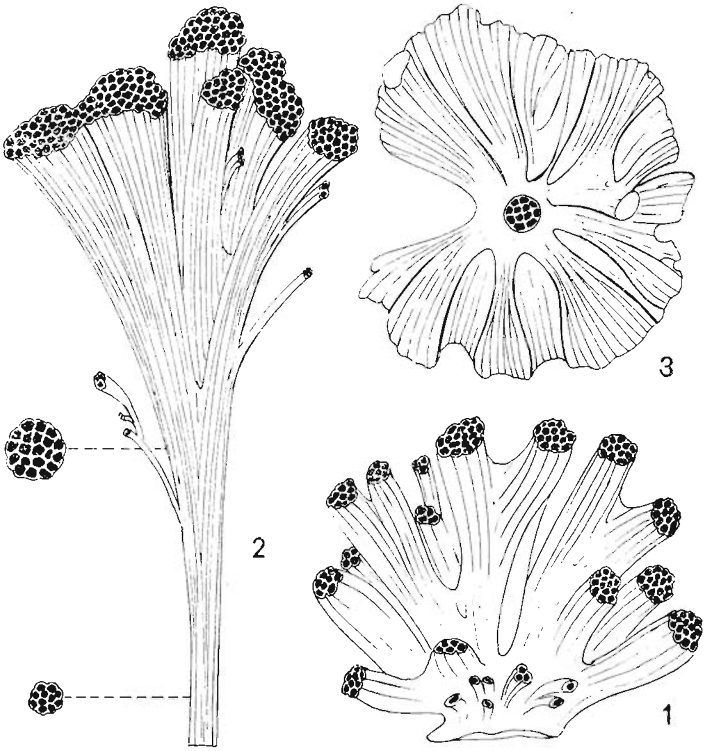

Fig. 3. Colony fragments; *a* normally developed colony; *b* zooecial fascicles of a II--stage colony; *c* downside view of a "crown".

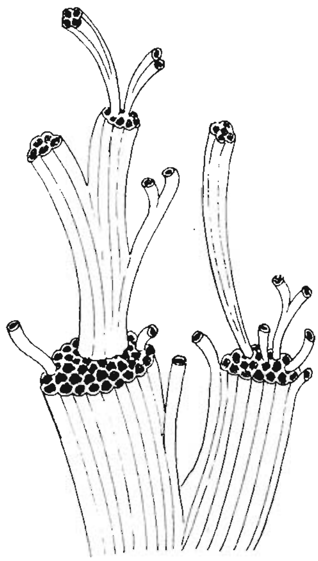

Fig. 4. Degenerated colony fragments at the top of zooecial fascicles.

pile-like fascicles of zooecial tubes giving here and there origin to tubes running away by singles, doubles, triples, etc. Polypids that lived between successive "crown" layers were degenerating or formed thin and twisted zooecial tubes and died off soon (fig. 2g). Larvae that settled in an interlayer produced colonies consisting merely of a few zooecial tubes. Consequently, excrescences formed by twisted thin zooecial tubes widely different from normal individuals developed at the pile-like fascicles in an interlayer (pl. 14: 1—2). A similar phenomenon took commonly place also at the termination of fascicles in the upper part of a "crown" layer. Calcareous mud clogged the apertures and by this way, killed the zooids. In response, the strongest individuals grew above the average level of a "crown" layer and gemmated. Growth of the offsets was however hampered by increased water turbidity, which resulted in a gradual degeneration and death of the affected part of a colony (figs 2*h*, 4). Such mortified colony fragments occur rather commonly in the investigated bryozoan bioherms. Degeneration was going differently in those parts of a colony that developed parallel to interlayer pile-like fascicles, as their growth was inhibited rapidly, as a rule.

Affinities and differences. — One can hardly compare the newly erected species to other representatives of the genus *Fasciculipora* Walter, 1969, because the specimens described thus far are incomplete. Development of a complex fasciculiporid colony has never been investigated in detail.

Fasciculipora janinae sp. n. resembles the following species: *Fasciculipora ramosa* d'Orbigny, *Fasciculipora quadriceps* (Busk) (= *Fungella quadriceps* Busk), *Meandropora aurantium* (Milne-Edwards) (= *Fascicularia aurantium* Milne-Edwards), and *Meandropora tubigera* (Busk) (= *Fungella multifida* Busk; = *Fascicularia tubipora* Busk). It differs from *Fasciculipora ramosa* d'Orbigny in its colony shape. As judged from d'Orbigny's description, *F. ramosa* forms irregularly branching colonies consisting of cylindrical branches variable in length, lobe-like to claviform at the ends. The illustrations demonstrate considerable differences in colony structure, while similarities appear merely between fragments of branches of the two species.

In my opinion, the specimens described by Busk (1859) under the name of *Fungella quadriceps* should be interpreted as an early developmental stage of a species of *Fasciculipora*. *F. janinae* sp. n. significantly differs from *F. quadriceps* in the colony shape. *F. quadriceps* shows four short, symmetrically arranged zooecial fascicles.

F. janinae resembles considerably *Meandropora aurantium* (Milne-Edwards) in the structure of zooecial fascicles and the morphology of some parts of aperture.

F. janinae resembles also *Meandropora tubigera* (Busk), mostly in fascicle morphology and arrangement of various parts of a colony, and in aperture shape. *M. tubigera* forms however more or less spherical colonies composed of branches imposing a concentric, ring-like zonation to a colony, which contrasts with colony structure in *F. janinae*.

Kluge (1962) reported *Fasciculiporoides americana* (d'Orbigny) from the present-day Arctic Ocean. That species resembles *Fasciculipora janinae* sp. n. in size and shape of terminal apertures, while the difference concerns mostly the structure and arrangement of zooecial fascicles.

Summary. — *F. janinae* occurs very abundantly in the Miocene bryozoan bioherms of Roztocze. Normally developed, panache- to fan-like colonies prevail in monospecific accumulations of zoaria of the investigated species; they are most commonly crushed and arranged into more or less distinct layers. Where the bioherms were affected by a clay influx, the colonies were undergoing a jerky regeneration, which has eventually resulted in formation of various zones built up by variably developed zoaria (pl. 13). Colonies covered with mud show an intact skeletal structure.

The here presented observations indicate that zooecia highly variable in shape may produce zoaria variable in shape in a single bryozoan species. Normally developed zoaria of *F. janinae* resemble very closely one another, while those contributing to successive colony layers vary considerably in shape. Zooecial apertures are circular in loose fascicles but polygonal in compact ones. Commonly, apertures are polygonal in the central part of a fascicle but circular at its periphery. Mostly circular apertures occur in "crown" layers of a colony inhibited in growth.

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NOWY GATUNEK MSZYWIOŁA RAFOTWÓRCZEGO Z MIOCENU ROZTOCZA

Streszczenie

Mszywioły, na których oparto niniejszą pracę, pochodzą z utworów rafowych miocenu odsłaniających się w kamieniołomach w Łysakowie oraz na górze Chełm koło Modliborzyc (fig. 1).

Miocen wykształcony jest w tych okolicach jako twarde zlewne wapienie niewarstwowane, szare lub brunatne, ze szczelinami wypełnionymi kalcytem lub drobnoziarnistą zwietrzeliną. Osady te zostały określone jako rafy kryptoalgowo-serpulowe (Pisera 1978). Według Liszkowskiego i Muchowskiego (1968) składają się one z brył niewarstwowanego wapienia o miąższości około 3—4 m, które są oddzielone od siebie warstwowanymi wapieniami laminowanymi detrytycznymi lub marglami. Wapień niewarstwowany złożony jest z rurek serpul otoczonych wapieniem kryptoalgowym. W skałach tych występują liczne, lecz monotonne mięczaki: *Cerastoderma*, *Modiolus*, *Mohrensternia*, *Gibbula*, które miejscami mogą tworzyć zlepy muszlowe. Miejscami pojawiają się biohermy mszywiołowe kilku metrów długości i do metra miąższości. Biohermy mszywiołowe zbudowane są ze szkieletów mszywiołów z rzędu Cyclostomata i Cheilostomata, a miejscami wyłącznie z kolonii jednego gatunku, *Fasciculipora janinae* sp. n. W budowie krzaczkowatych kolonii nowego gatunku zachodzą daleko idące różnice i zmienności (figs 2—4; pls 11—14). Znajdowane osobno fragmenty możnaby uważać nie tylko za różne gatunki, ale nawet za odrębne rodzaje.

W wypadku gdy mamy do czynienia z jednogatunkowym nagromadzeniem zoariów *Fasciculipora janinae* sp. n. obserwujemy normalnie wykształcone wachlarzykowate czy pióropuszowate kolonie, najczęściej są one połamane, tworzące warstewki. W miejscach, w których dochodziło do zamulania bioherm następowało skokowe odradzanie się kolonii; dzięki temu procesowi powstawały charakterystyczne strefy w biohermach (pl. 13) zbudowane z różnorodnie wykształconych zoariów opisanych w niniejszej pracy. Zamulane żywe kolonie gatunku *Fasciculipora janinae* sp. n. nie ulegały zniszczeniu.

Z poczynionych obserwacji wynika, iż w obrębie jednego gatunku może dochodzić do tworzenia się bardzo zmiennych w swym kształcie zooeciów łączących się w różnorodnego kształtu zoaria. Zoaria normalne są do siebie bardzo podobne, natomiast te, które budują nawarstwiające się strefy mają bardzo zmienne kształty. Również bardzo zmienne bywają apertury zooeciów — w wiązkach luźnych są one okrągłe, w zwartych zaś wieloboczne. W wielu pęczkach obserwujemy, iż w partiach środkowych apertury zooeciów są wieloboczne, w brzeżnych zaś okrągłe. W czasie zamierania osobników w koronach obserwujemy głównie okrągłe apertury.

EXPLANATION OF THE PLATES 11—14

Plate 11—bioherm fragment from Modliborzyce, plates 12—14 — specimens from Łysaków.

Plate 11

Bryozoan limestone built up by colony fragments of *Fasciculipora janinae* sp. n.; ZPiS No. Sp.B/1, ×3.

Plate 12

Fasciculipora janinae sp. n.

1—6. Upside, downside, and lateral views of various "crowns"; syntype, ZPiS No. Sp.B/2, ×4.
7—9. Degenerated zoarial fragments preserved on pile-like zooecial fascicles; syntype, ZPiS No Sp.B/3, ×10.

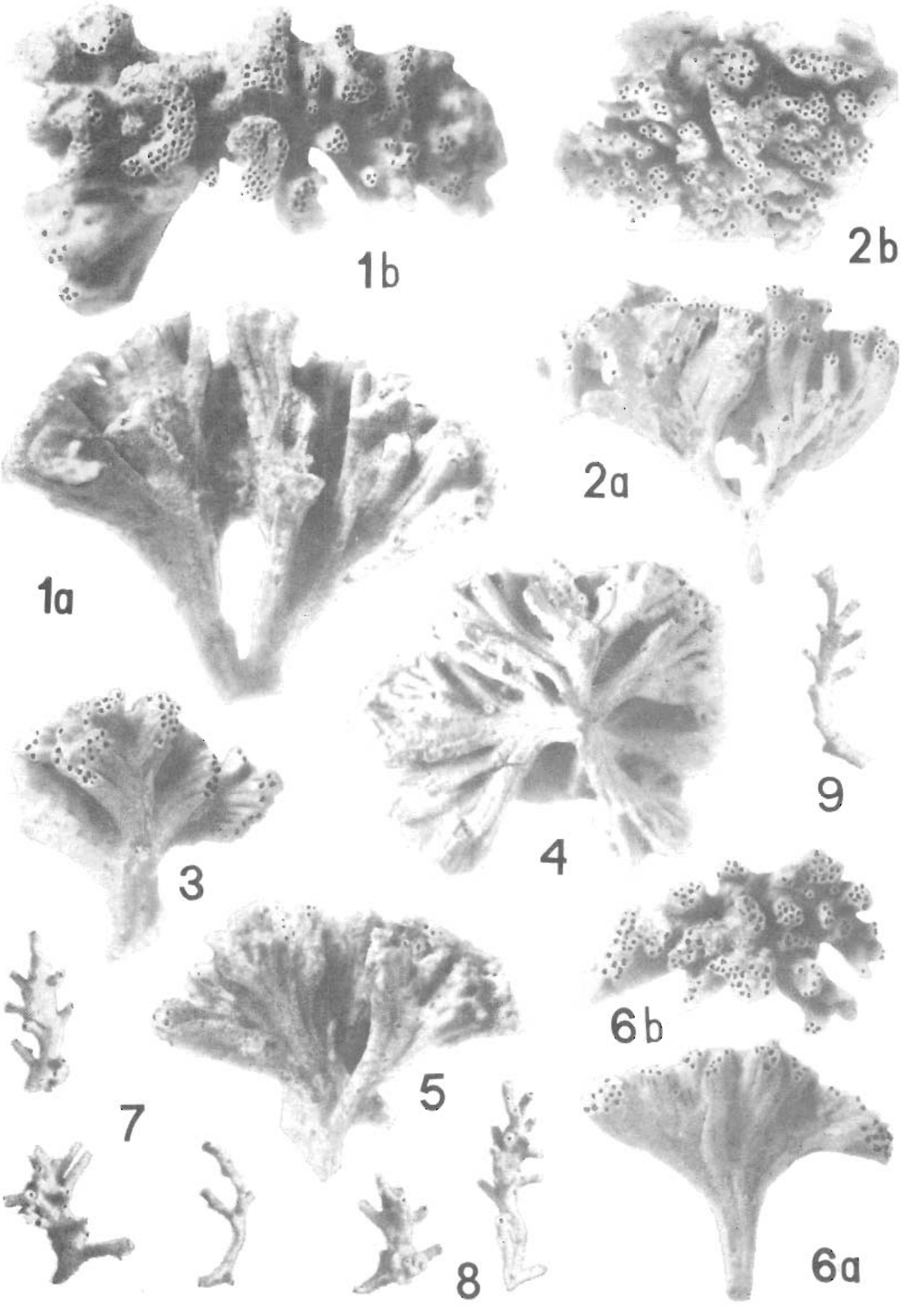
Plate 13

Fragment of a bioherm built up by colonies of *Fasciculipora janinae* sp.n., two zones of colony regeneration; syntype, ZPiS No. Sp.B/4, ×3.

Plate 14

Fasciculipora janinae sp. n.

1. *a* — lateral view of a "crown" layer, *b* — upside view of a "crown" layer; syntype, ZPiS No. Sp.B/5, ×4.
2. *a*, *b* — fragments of an interlayer: variously developed branches with occasionally running away singular zooecial tubes with circular apertures, degenerated colony fragments visible in places; syntype, ZPiS No. Sp.B/6, ×5.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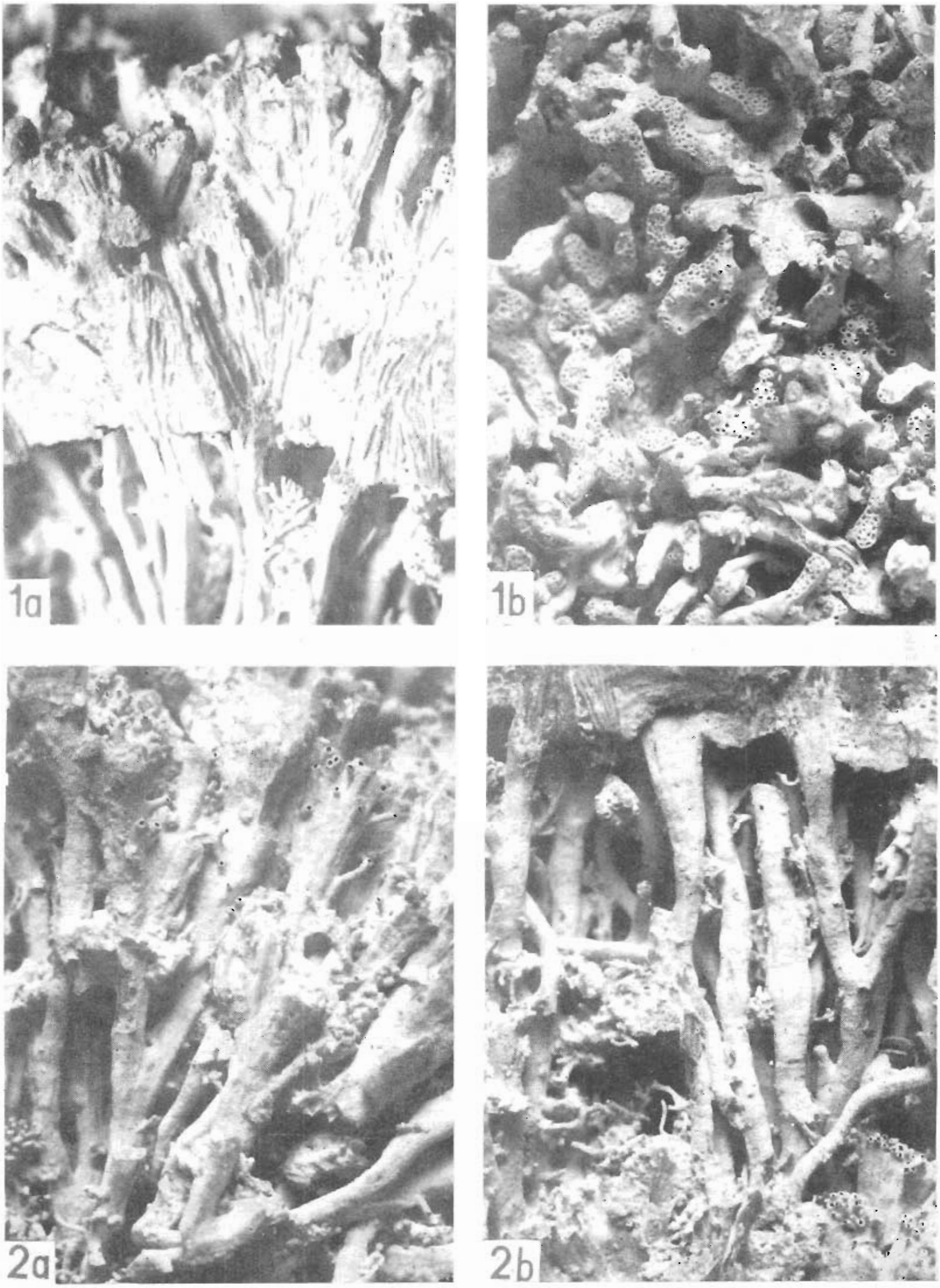
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