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Bulletins of American Paleontology

Begun in 1895

VOLUME 109, NUMBER 349 MARCH 5, 1996

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by

Eric Prosh and Colin W. Stearn

Paleontological Research Institution
1259 Trumansburg Road
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BULLETINS OF AMERICAN PALEONTOLOGY
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Subscriptions to *Bulletins of American Paleontology* may be started at any time, by volume or year. Current price is US $62.50 per volume. Numbers of *Palaeontographica Americana* are priced individually, and are invoiced separately on request.

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ISSN 0007-5779
ISBN 0-87710-440-9
Library of Congress Catalog Card Number: 95-071054

Printed in the United States of America
Allen Press, Inc.
Lawrence, KS 66044 U.S.A.

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STROMATOPOROIDS FROM THE EMSIAN (LOWER DEVONIAN) OF ARCTIC CANADA

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ABSTRACT

Early Devonian limestones of Ellesmere, Bathurst, and smaller islands between them in the Canadian Arctic Archipelago contain a diverse fauna of stromatoporoid sponges. This fauna provides the best evidence in North America of the early recovery phase of this reef-building group from a diversity low at the Silurian/Devonian boundary, a recovery that lead to its diversity peak in Givetian time. Stromatoporoids from the lower member of the Blue Fiord Formation locally form large reefal masses. Well preserved stromatoporoids also occur less abundantly: 1. in the top of the underlying Eids Formation, 2. in the upper member of the Blue Fiord Formation, 3. in the Disappointment Bay Formation, which is correlative of the upper Blue Fiord, and, 4. in the overlying Bird Fiord Formation, and a correlative unnamed formation, both of which span the Lower/Middle Devonian boundary. The stratigraphic distribution of these stromatoporoids can be accurately determined according to conodont biostratigraphy as spanning the *dehiscens* to *partitus* (Emsian to basal Eifelian) conodont zones. Common occurrences of *Stromatoporella perannulata, Stictostroma gorriense, Habrostroma proxilaminatum,* and *Parallelopora campbelli* in the arctic fauna and southern Ontario and the adjacent United States, indicate that the Detroit River Group is of similar Emsian age, and that the Eastern Americas realm was open to migration from the Arctic. Similarity of species with the Emsian faunas of Russia, Australia and China suggests the cosmopolitan and equatorial distribution of stromatoporoids in Emsian time and opens possibilities for using the group in correlation. The fauna is therefore important in establishing both the evolution of the order and also its geographic distribution in Early Devonian time.

Twenty-five species (assigned to 22 genera) are described. The species concept used is a broad one and the range of variation in each taxon is documented. New species described are: *Gerronostroma septentrionalis, Anostylostroma anfractum, Pseudoactinodictyon conglutinatum, Stictostroma? nunavutense, Clathrocoilona vexata, Stromatopora hensoni.* The morphologic limits of the following genera are considered in the description of species: *Plectostroma, Aculatostroma* and *Atelodictyon, Clathrocoilona, Salairella* and *Syringostromella.* The range of *Trupetostroma* is extended downward into Emsian strata.

INTRODUCTION

Rocks of earliest Devonian age cover a relatively small area of the North American platform because this was a time of worldwide regression at the close of the Tippecanoe sequence. Reef faunas of this age are restricted in their distribution and of low diversity. In North America the Kaskaskia transgression appears to have started in the north and, spreading southward in shallow seas across the platform, brought with it a reef-building fauna rich in stromatoporoids. The first reef complexes of regional extent built in this sea were in the area that is now the Canadian Arctic Archipelago and are contained within the Blue Fiord Formation. This study describes the elements of this resurgent reef fauna. In eastern and arctic North America the growth of the reef fauna in subsequent Middle and Late Devonian time was progressively inhibited by siliciclastic input, but in the Western Canada Sedimentary Basin reefs thrived through the middle part of the period and their growth culminated in giant Frasnian reef complexes.

This study expands and refines earlier work by Stearn (1983) on the Emsian stromatoporoids of southern Ellesmere Island. Stearn described a fauna collected from the lower 100 m (lower Emsian, *dehiscens* Zone) of the Blue Fiord Formation in the type area between Eids and Sör Fiords (Text-fig. 1A). Of the 11 species described by Stearn (1983), eight are recognized in this study: *Clathrodictyon ellesmerense* Stearn, 1983, *Gerronostroma septentrionalis* n. sp., *Clathrocoilona vexata* n. sp., *Stromatopora polaris,* Stearn, 1983, *Stromatopora* cf. *S. hupschii* (Bargatzky, 1881), *Glyptostromoides simplex* (Yang and Dong, 1979), *Salairella prima* Khromych, 1971, and *Atopostroma distans* (Ripper, 1937b). The three species that do not occur in the collections studied here, which were made by Gary Smith and Eric Prosh, are all represented in Stearn's (1983) collections by single specimens. These include *Gerronostroma* cf. *G. immemoratum* Bogoyavlenskaya, 1977, *Amphipora* sp., and *Labechia* sp. No amphiporids were found in these larger collections. The single poorly preserved specimen referred to *Labechia* sp. has been tentatively identified as *Syringodictyon tuberculatum* (Nicholson) by St. Jean (1986).

ACKNOWLEDGEMENTS

We are grateful to Gary P. Smith who, in the preparation of his doctoral dissertation (Smith, 1984), col-

lected most of the specimens on which this study is based. The field work of Smith (in 1978, 1979, and 1980) and of Prosh (in 1983 and 1992) was made possible by the logistic support of the Polar Continental Shelf Project of Natural Resources Canada. Smith's field work was funded by Natural Resources Canada, the Natural Science and Engineering Council, and the McGill Centre for Northern Studies and Research. The research of Eric Prosh and Colin Stearn is funded by grants from the Natural Sciences and Engineering Research Council, Canada to Stearn. For critical comments that have improved the manuscript we are grateful to Barry Webby, Carl Stock, and Warren Allmon.

STRATIGRAPHY

INTRODUCTION

The Emsian and basal Eifelian stromatoporoids described in this study were collected from the Eids, Blue Fiord, Disappointment Bay, Bird Fiord, and an unnamed formation. The great majority of specimens were collected by Gary Smith and Colin Stearn from the Blue Fiord Formation (lower to upper Emsian) of Ellesmere Island. Most of the Blue Fiord specimens were collected along a broad outcrop belt extending from Blue and Bird fiords in the west to Sör Fiord in the east (Text-fig. 1A). Because this outcrop belt includes the type section of the Blue Fiord Formation, localities within the belt are referred to in the text as within the "type area" or in the "vicinity of the type section". Supplementary collections from the Eids and Bird Fiord formations, which respectively underlie and overlie the Blue Fiord Formation (Text-fig. 2), were also included in the study. Collections of Smith and Stearn from the Blue Fiord Formation northeast of the type area in the vicinty of Vendom Fiord (Text-fig. 1B) and by Smith from southwestern Ellesmere Island at Muskox and Goose Fiords (Text-fig. 1C) were also studied. The location of the collections studied and the stratigraphic sections measured by Smith (1984) are plotted on Text-figure 1 and listed by latitude and longitude in Appendix 1. The geology of this southern coast of Ellesmere Island has been described recently by Mayr *et al.* (1994).

The Disappointment Bay Formation of Bathurst, Cornwallis, and adjacent islands is a correlative of the middle-to-upper Blue Fiord Formation of Ellesmere Island (Text-fig. 2). Small collections from the Disappointment Bay Formation on Truro Island (Text-fig. 1, loc. 34) made by Eric Prosh in 1983 and 1992 and from Lowther Island (Text-fig. 1, loc. 33) in 1983 are also described here.

On Bathurst Island and neighbouring islands, the uppermost Emsian and Eifelian are represented by an unnamed limestone that has been referred to incorrectly as the Blue Fiord Formation. Stromatoporoids were collected from this unnamed formation on Bathurst Island by Smith and on nearby Truro Island by Prosh.

EIDS FORMATION

The Eids Formation (Text-fig. 2) consists mostly of calcareous siltstone and shale, with less limestone, siltstone and sandstone. It conformably underlies the Blue Fiord Formation in southern and central Ellesmere Island (Trettin, 1978). West of Sör Fiord it reaches a thickness of 767 m (Uyeno, 1990). With the exception of the uppermost beds transitional to the Blue Fiord Formation, the Eids Formation is poorly fossiliferous. It ranges in age from Lochkovian to earliest Emsian. Silty carbonates on Bathurst and adjacent islands assigned by Kerr (1974) to the Eids Formation are much younger than the Eids on Ellesmere Island.

Stromatoporoid specimens identified in this study as from the Eids Formation come from the upper 100 m in the Blue and Sör fiords areas of Ellesmere Island. In these areas the upper Eids consists of dark gray, calcareous siltstone and mudstone with interbeds of fossiliferous lime wackestone and isolated bioherms (Smith, 1984).

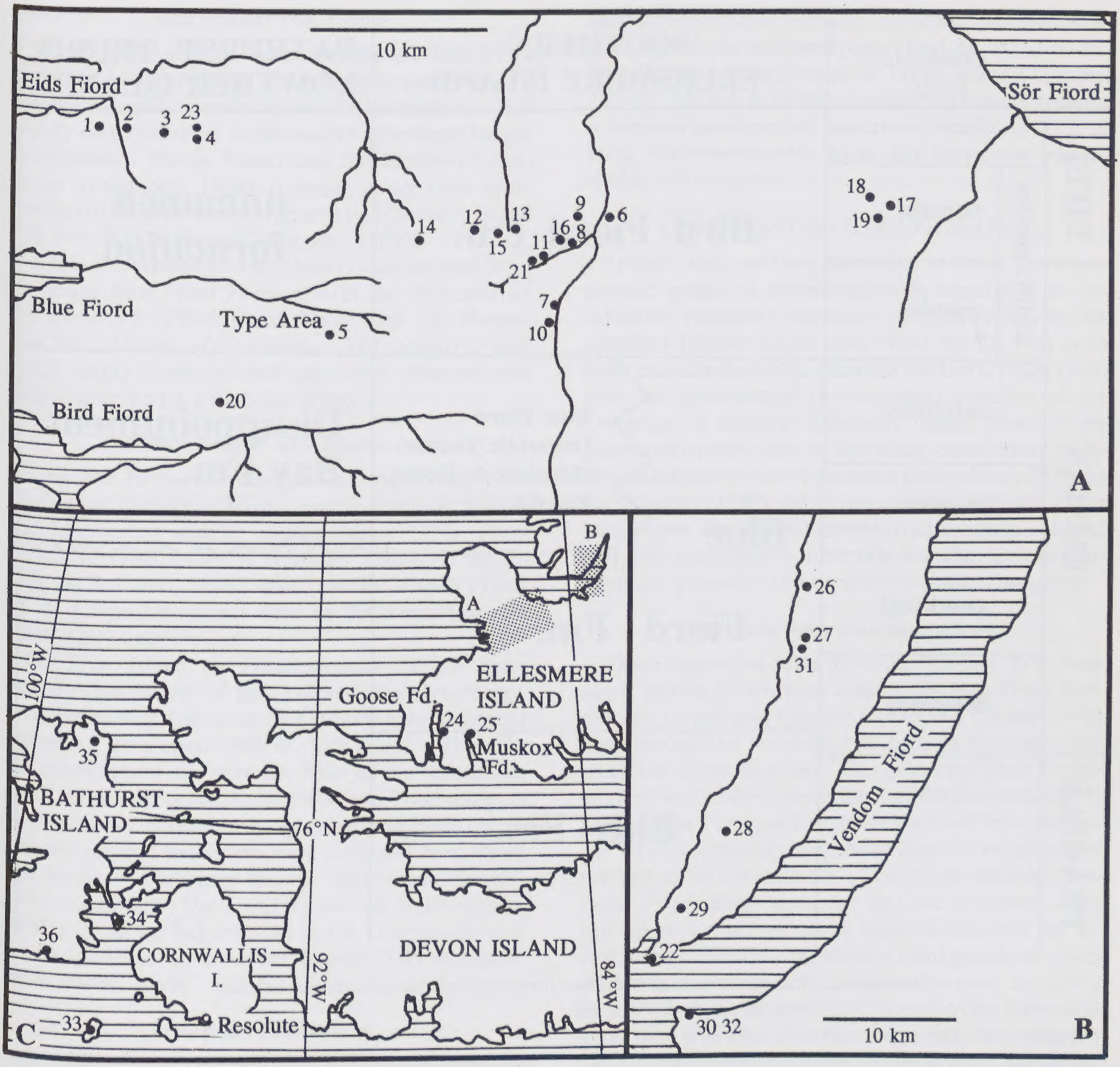
BLUE FIORD FORMATION

The Blue Fiord Formation is an important and widely distributed cliff-forming unit in the arctic islands. The best exposed sections occur on southern Ellesmere Island and adjacent islands. The type section was designated by McLaren (1963) between Blue Fiord and Eids Fiord (Text-fig. 1A). The typical Blue Fiord is predominantly a dark fossiliferous limestone spanning most of the Emsian Stage (Smith, 1984).

The Blue Fiord Formation has been recorded from the arctic islands west of Ellesmere Island (Thorsteinsson and Tozer, 1962) and from the subsurface (Mayr, 1980) in the Bent Horn oilfield (a short distance west of the northwest tip of Bathurst Island and just off Text-fig. 1C). Much of what has been referred to the Blue Fiord Formation in the western arctic islands, however, is of Eifelian age, and should ultimately be referred to a new, as yet undescribed formation (see unnamed Formation below).

Studies of Blue Fiord macrofossils include those of Brice (1982) and Jones and Boucot (1983) on brachiopods, Ormiston (1967) on trilobites, and Pedder (1982, 1983) on corals.

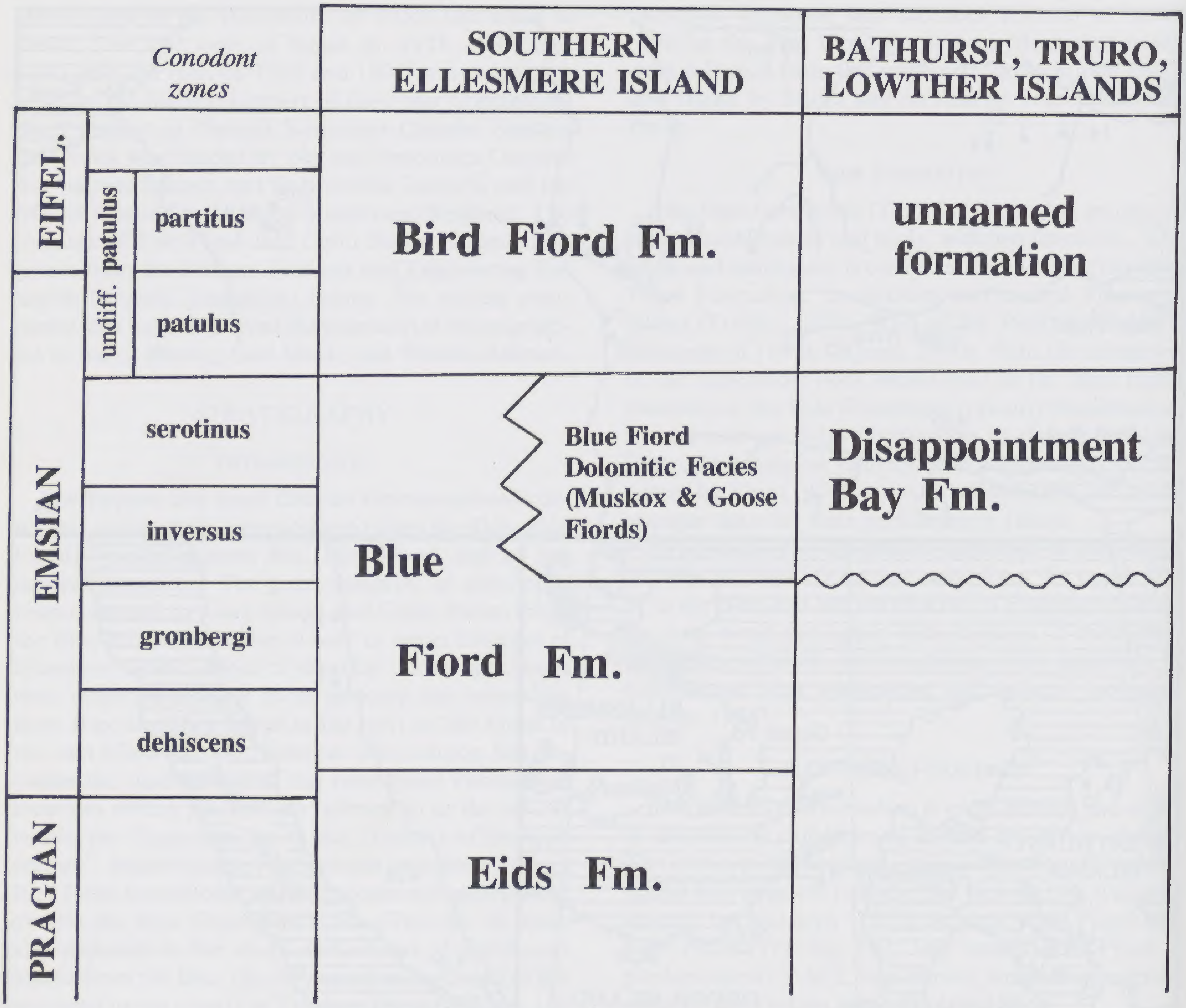
In the type area of the Blue Fiord Formation, McLaren (1963) recognized two members: a lower limestone and shale member and an upper brown limestone member. The lower member is about 700 m thick



Text-figure 1.—Position of collecting localities in Canadian arctic islands. Precise positions by longitude and latitude for the numbered localities are given in Appendix 1. A. Blue Fiord-Sör Fiord area. B. Vendom Fiord area. C. Localities outside A and B. The stippled boxes show the positions of maps A and B. Truro Island—34, Lowther Island—33.

(689 m; Uyeno, 1990) and consists of brownish gray to brown nodular limestones and lesser interbedded gray calcareous mudstones and shales (McLaren, 1963). The lower member is cliff-forming, abundantly fossiliferous and contains large stromatoporoid-bearing bioherms. Smith (1984), and Smith and Stearn (1982, 1987a) recognized a variety of lithologic units within the lower member: interbedded lime mudstone and shale, argillaceous fossiliferous wackestone, skeletal grainstone to packstone, coral-stromatoporoid boundstone. The upper brown limestone member is 572 m thick in a section near the type section (Uyeno, 1990) and consists of brown and brownish gray, bioclastic, coarse-grained limestone but contains relatively few fossils.

On the west side of Vendom Fiord (Text-fig. 1B) the Blue Fiord Formation consists of about 1200 m of limestone and minor siltstone. Two informal units are



Text-figure 2.—Correlation chart of formations from which stromatoporoids were collected.

recognized: 1) a lower carbonate member about 900 m thick consisting of gray limestone with dolostone interbeds and dark grayish-brown limestone, and 2) an upper siltstone-carbonate member of greenish siltstones, calcareous siltstones and limestone interbeds overlain by a resistant grayish-yellow limestone and dolostone (Uyeno, 1990). The upper siltstone-carbonate member is the same unit provisionally assigned to the Bird Fiord Formation by Jones (1982).

To the north and east of the type area as far as central Ellesmere Island, Blue Fiord lithologies represent progressively more restricted depositional environments (Kerr, 1976; Trettin, 1978). On southernmost Ellesmere Island at Goose Fiord and adjacent Muskox Fiord, the formation is mostly dolomitic and deposition began later than in the type area, in Late Emsian time (Text-fig. 2)(Mayr *et al.*, 1994). This platformal dolomitic facies also occurs on adjacent parts of Devon Island (Kerr, 1977; Prosh *et al.*, 1988). Lithologically the dolomitic Blue Fiord consists of vuggy dolostone, vuggy lime mudstone, and dark fossiliferous lime wackestones and dolowackestones (Smith and Stearn, 1987b). The dolomitic Blue Fiord records a period of late Emsian transgression and platform inundation; it is approximately correlative with the upper member of the type Blue Fiord. Smith and Stearn (1987b) proposed that the dolomitic facies of the Blue Fiord be assigned to the Disappointment Bay Formation, but the term Blue Fiord is retained for these beds here (Prosh *et al.*, 1988).

BIRD FIORD FORMATION

The Bird Fiord Formation overlies the Blue Fiord Formation conformably, and reflects in its lithology a transition to siliciclastic depositional conditions. It is widely distributed on southwestern Ellesmere Island, northwestern Devon Island and the Bathurst Island group (Goodbody, 1989). It ranges in age from latest Emsian to Eifelian. In the type area on Ellesmere Island it is over 800 m thick (Goodbody, 1989).

A few stromatoporoid specimens were studied from the lower Bird Fiord Formation in the type area on the north side of Bird Fiord. These beds (the Norwegian Bay Member of Goodbody, 1989) consist of bioclastic sandy limestone and calcareous siltstone with minor shale and argillaceous siltstone.

DISAPPOINTMENT BAY FORMATION

This late Emsian formation (Text-fig. 2) has been studied on Cornwallis Island, eastern Bathurst Island, and intervening smaller islands (Kerr, 1974; Thorsteinsson, 1980, 1986). It is mostly dolostone but locally on Bathurst, Truro, and Lowther islands (Text-fig. 1C), rare limestones (low in the formation) are abundantly fossiliferous.

On Truro Island, the Disappointment Bay Formation consists mostly of light-colored, massive, vuggy, microcrystalline dolostone with subordinate laminated dolostone. It is about 200 m thick (Kerr, 1974). On the northeastern tip near the base of the formation, small reef knolls occur. Kerr (1974) and Thorsteinsson (1986) do not indicate this occurrence on their maps. Stromatoporoid specimens were collected from these reef knolls of dark gray-brown, bituminous, fossiliferous packstone. The small knolls are lithologically similar to coeval larger knolls in the Disappointment Bay Formation on Lowther Island (Thorsteinsson, 1980; Prosh, 1989).

UNNAMED FORMATION

An unnamed unit consisting of limestone and minor dolostone and shale conformably overlies the Disappointment Bay Formation on eastern Bathurst, Cornwallis, and intervening small islands (map unit D-1 of Thorsteinsson, 1986). On Bathurst Island it incorporates most or all of what Kerr (1974) erroneously referred to as the Blue Fiord Formation. Kerr's Bathurst Island "Eids Formation", a distal equivalent of his "Blue Fiord Formation", probably also belongs to the unnamed formation (Thorsteinsson, pers. comm., 1992). The unnamed formation spans the Emsian–Eifelian boundary and is 20–100 m thick (Thorsteinsson, 1986) (Text-fig. 2).

Stromatoporoids used in this study were collected from the lower 100 m of the formation at the northeasternmost end of Bathurst Island and at Dyke Ackland Bay on the southern coast (Text-fig. 1C, locs. 35, 36). On the western coast of Truro Island (Text-fig. 1C, loc. 34) 4–6 m of the unnamed formation contain a coral-stromatoporoid biostrome locally up to 6 m thick. Stromatoporoids from this biostrome are included in this study.

CONODONT BIOSTRATIGRAPHY

In this study we have been able to relate the stratigraphic ranges of stromatoporoids directly to an established conodont zonation, in other words to the standard Emsian zonal scale (Text-fig. 2). This is in great measure due to the excellent work of Uyeno (1990) who has documented the conodont zonation of the Devonian of southern Ellesmere Island. Many of the stromatoporoids used in this study come from localities identical or closely comparable to those of Uyeno and Klapper (1980) and Uyeno (1990). In the following paragraphs, the biostratigraphic framework is outlined and the stratigraphic intervals bearing stromatoporoids are placed in the standard conodont zonation.

DEHISCENS AND *GRONBERGI* ZONES

These zones comprise the lower Emsian. In a measured section in the type area of the Blue Fiord Formation, Uyeno and Klapper (1980) and Uyeno (1990) have recognized the *dehiscens* Zone in the lower 267 m of the lower member. The *gronbergi* Zone is recognized by the first appearance of *Polygnathus* aff. *P. perbonus* as *Polygnathus gronbergi* itself does not occur. In this section the *gronbergi* Zone is recognized in the 267 to 393 m interval of the lower member. Because *P. gronbergi* is absent and the *gronbergi* Zone here spans a relatively small stratigraphic interval, we commonly combine the *dehiscens* and *gronbergi* zones in dating. Consequently, stromatoporoids occurring exclusively from the lower 250 m or so of the formation of the type area Blue Fiord are assigned to the *dehiscens* Zone. Stromatoporoids occurring through the lower member up to about 400 m are assigned to a combined *dehiscens*/*gronbergi* Zone.

In the Vendom Fiord area, conodont zones in the lower member of the Blue Fiord Formation cannot be as precisely placed as in the type area (Uyeno, 1990). Conodonts and macrofossils associated with the *dehiscens* Zone occur low in the formation. The *dehiscens* and *gronbergi* zones probably occur in the lower two thirds of the lower member here: *P. inversus* first appears high in the lower member. Stromatoporoids from low in the lower member at Vendom Fiord are assigned to the *dehiscens* Zone; those from low to medial parts of the member to the combined *dehiscens*/*gronbergi* Zone.

In the Sör Fiord area, Uyeno and Klapper (1980) have identified *P. dehiscens* from the uppermost beds of the Eids Formation. The full extent of its occurrence in this formation is not known, but presumably the base of the Emsian is near the top of the formation. Stromatoporoids from the highest beds of the Eids Formation are assigned to the *dehiscens* Zone; those 50 or more meters below the top of the Eids are possibily uppermost Pragian.

INVERSUS ZONE

This zone is widely and readily recognized in arctic Devonian strata. In the Blue Fiord type area, the *inversus* Zone spans the interval from 393 to 1104 m, the upper half of the lower member and much of the upper member (Uyeno, 1990). At Vendom Fiord the *inversus* Zone ranges from the upper part of the lower member through much of the upper member of the Blue Fiord Formation. In both the type and Vendom Fiord areas, in the upper member of the formation, stromatoporoids are relatively rare and are assigned to a combined *inversus/serotinus* Zone.

On southernmost Ellesmere Island, the dolomitic facies of the Blue Fiord Formation ranges in age from the *inversus* to *serotinus* zones (Smith and Stearn, 1987b). Stromatoporoids from this dolomitic facies from Muskox Fiord and Goose Fiord areas, are all from low in the formation and assignable to the *inversus* Zone.

Although the lower Disappointment Bay Formation is firmly dated as *inversus* Zone, the upper part is dolomitic and evaporitic and unfossiliferous. Stratigraphic relations suggest that the formation spans the full *serotinus* Zone as well. Stromatoporoids from the lower Disappointment Bay Formation at Truro and Lowther islands occur within the *inversus* Zone (Thorsteinsson, 1980).

SEROTINUS ZONE

In a section 2.5 km east of the type section of the Blue Fiord Formation the *serotinus* Zone is identified in the interval of the upper member from 1104 m to the top of the formation at about 1260 m (Uyeno, 1990). At Vendom Fiord the zone is recognized in the uppermost part of the Blue Fiord upper member. Although *P. serotinus* itself ranges up into the overlying Bird Fiord Formation, the overall faunal and stratigraphic context suggests that the zone ends at the top of the Blue Fiord Formation in the type area (Uyeno, 1990).

UNDIFFERENTIATED *PATULUS* ZONE

The Emsian–Eifelian boundary is placed at the boundary between the *patulus* and *partitus* zones (Ziegler and Klapper, 1985). Because in the arctic islands the nominal conodonts of neither of these zones has been recognized, this interval must be dated by other fossil occurrences and by stratigraphic context. For dating stromatoporoid occurrences, we treat this interval as the undifferentiated *patulus* Zone (*i.e.*, combined *patulus* and *partitus* zones). Two formations that contain stromatoporoids span this interval: 1) the lower Bird Fiord Formation of Ellesmere Island, and 2) the lower unnamed formation of Truro and eastern Bathurst Islands.

1) Uyeno (1990) placed the Lower–Middle Devonian boundary at or near the base of the Bird Fiord Formation at its type section. Although diagnostic conodonts are absent, brachiopods and corals from higher in the formation suggest Eifelian and Dalejan (late Emsian) ages (Uyeno, 1990). Goodbody (1989) considerd the basal Bird Fiord to be included in the *patulus* Zone. On this basis we date the stromatoporoids that have been collected from the lower Bird Fiord Formation on Ellesmere Island as coming from the undifferentiated *patulus* Zone.

2) Similar uncertainty in dating applies to the unnamed formation of Truro and Bathurst islands. Kerr (1974) considered the lower unnamed formation (Blue Fiord of Kerr) as Eifelian and possibly latest Emsian in age, largely on the basis of its trilobite fauna. A sample of the unnamed formation analyzed for conodonts by T. T. Uyeno yielded no specimens (Uyeno, pers. comm. 1993; GSC internal report 02-TTU-93).

The age of the unit underlying the unnamed formation is important in estimating the age of the formation. In the area of Cornwallis, Truro and Lowther islands, the Disappointment Bay Formation is dated as *inversus* Zone (Thorsteinsson, 1980) on the basis of diagnostic conodonts recovered from rare limestones low in the formation. The upper Disappointment Bay Formation is assumed to span most, or all, of the *serotinus* Zone and the transition to limestones of the unnamed formation is assumed to begin at about the *patulus* Zone. This conclusion is based on correlation of the transition from Blue Fiord to Bird Fiord formations on Ellesmere Island with that between the Disappointment Bay and unamed formation in the Cornwallis Island area suggested by Thorsteinsson (1986).

Stromatoporoids collected from the unnamed formation come from the base at Truro Island and from the lower 100 m of the formation on eastern Bathurst Island. In both areas they are probably of latest Emsian age (*patulus* Zone). Due to the uncertain dating of this interval, however, they are assigned to the undifferentiated *patulus* Zone.

The stromatoporoid fauna offers some clue as to the age of the lower unnamed formation (Text-fig. 3). Some faunal turnover is apparent between the the Blue Fiord (*dehiscens* to *serotinus* zones) and the unnamed formation (undifferentiated *patulus* Zone) collections, but a significant number of species range through both assemblages. This suggests that no hiatus separates the Blue Fiord and younger assemblages.

STROMATOPOROID BIOSTRATIGRAPHY AND PALEOGEOGRAPHY

In this study stromatoporoid ranges have been precisely dated, allowing meaningful comparisons of the arctic Emsian fauna to coeval faunas world-wide and the assessment of the biostratigraphic usefulness of stromatoporoids (Text-fig. 3). Of the 25 taxa described in this study, 13 have been recorded from other places and supply information on the distribution of stromatoporoid faunas in Emsian time. These regions are, in decreasing order of similarity and importance: 1) north-central United States and southwestern Ontario, 2) Russian Asia, 3) southeastern Australia, and 4) China. When localities sharing species with the Arctic Emsian fauna are plotted on a reconstruction of the continental configurations of Early Devonian time, such as that of Scotese (Stock, 1990), they are distributed throughout the tropical world of that time. On a broad scale the Emsian stromatoporoid fauna appears to have been a cosmopolitan one and stromatoporoids must have propagated along the tropics with little impediment.

SOUTHWESTERN ONTARIO AND NORTH-CENTRAL UNITED STATES

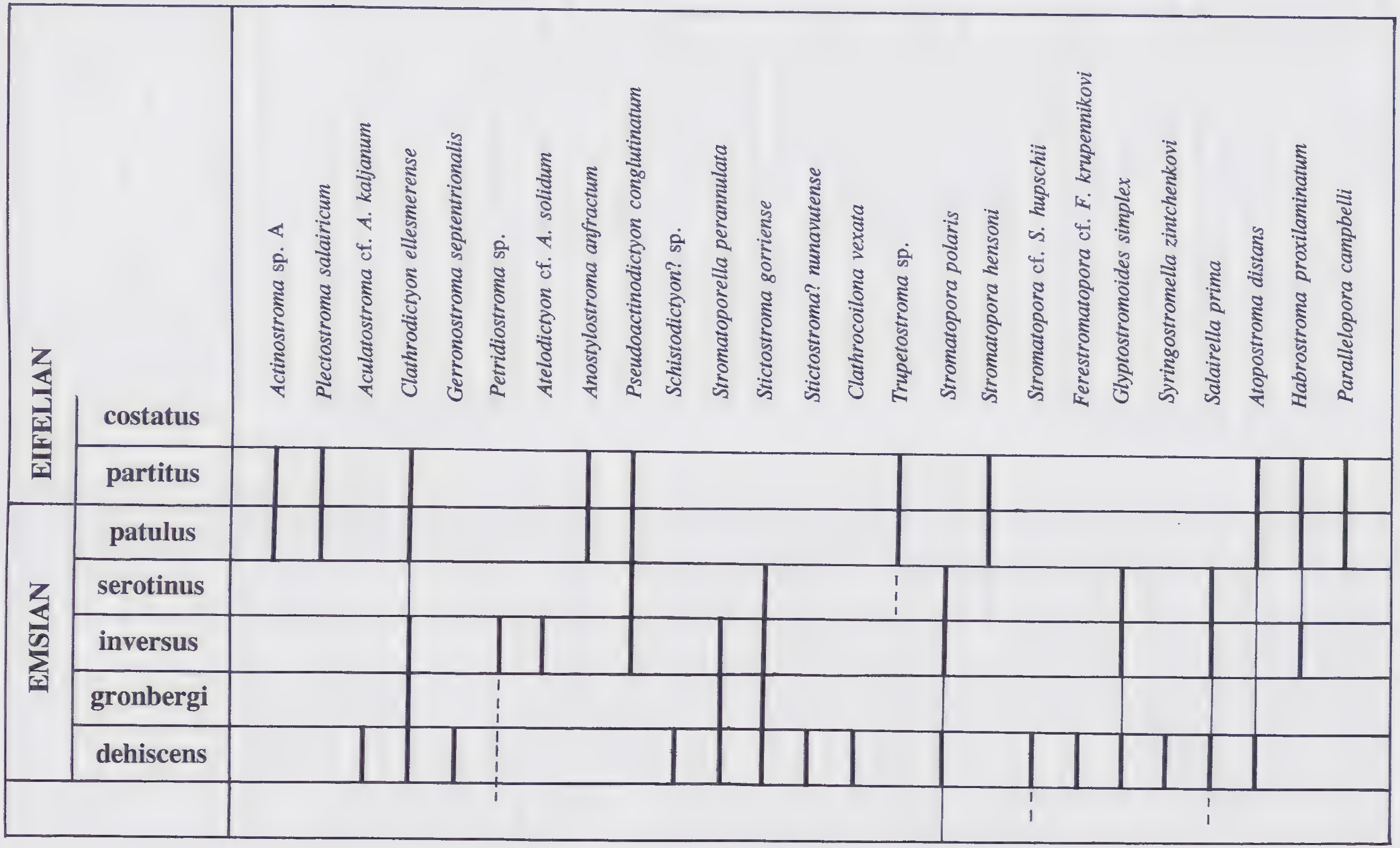
Four species known only from this mid-continent region, *Stromatoporella perannulata* Galloway and St. Jean, *Stictostroma gorriense* Stearn (=*mamilliferum* Galloway and St. Jean), *Habrostroma proxilaminatum* (Fagerstrom), and *Parallelopora campbelli* Galloway and St. Jean, have been identified in the arctic Emsian fauna. In addition the arctic *Trupetostroma* sp. and *Pseudoactinodictyon conglutinatum* n. sp. are closely comparable to species from southwestern Ontario (Fagerstrom, 1982). This sharing of species has led Prosh and Stearn (1993) to conclude that the Detroit River Group of southern Ontario is entirely of Emsian age. The reasoning that led to the reinterpretation of the correlation of the Detroit River Group is presented elsewhere (Prosh and Stearn, 1993). The identity of species indicates a dispersal of stromatoporoids along an open seaway connection from the Arctic to the mid-continent during *serotinus* Zone time and perhaps as early as during *inversus* Zone time. That the isolation of the Eastern Americas Realm of Oliver (1976b) based on the distribution of rugose corals (Oliver, 1976a; Oliver and Pedder, 1989) and on stromatoporoids (Stock, 1990) was not as absolute as proposed, has already been suggested by Stearn (1983) and is fully supported by this study. The migration route of stromatoporoids across the present site of Hudson Bay may have been closed to rugose corals by ecological barriers. Evidence is accumulating that environments favorable to stromatoporoids and tabulate corals may have been different from those that favored rugose corals (Mallamo *et al.*, 1993). In any case, the paleogeographic reconstructions of Oliver (1976b), Oliver and Pedder (1989), and Witzke (1990) need to be modified to show an open seaway connection between the Arctic Islands and southwestern Ontario.

NORTHERN ASIA

Plectostroma salairicum (Yavorsky) is known in the Arctic from the unnamed formation (Bathurst Island) and from the Kuznetsk Basin of central Russia (Yavorsky, 1930). The age of both these occurrences is virtually identical, at or near the Emsian-Eifelian boundary. *Aculatostroma* cf. *A. kaljanum* (Bogoyavlenskaya) from the lower Emsian part of the Blue Fiord Formation is known (as *Coenellostroma kaljanum* Bogoyavlenskaya) from the eastern slope of the northern Urals and from lower Emsian strata (Bogoyavlenskaya, 1977; Khodalevich *et al.*, 1982). *Gerronostroma* cf. *G. immemoratum* Bogoyavlenskaya, described by Stearn (1983) from the lower Blue Fiord, also was originally described from this fauna. *Atelodictyon* cf. *A. solidum* Khromych (Blue Fiord Formation, *inversus* Zone) was previously recorded (*A. cylindricum solidum* Khromych) from probable mid-to-late Emsian rocks in northeastern Siberia (Khromych, 1971, 1976). Two other arctic species are also recorded from Russia, but appear to be longer ranging. *Syringostromella zintchenkovi* Khalfina occurs in the upper Lochkovian of the Salair, southcentral Russia (Khalfina, 1961) and *Salairella prima* Khromych from probable Pragian rocks in Severo-Vostok, eastern Siberia (Khromych, 1971, 1976). Both of these species also occur in Australia (see below).

AUSTRALIA AND CHINA

Affinities with the Early Devonian faunas of Victoria (Webby *et al.*, 1993) are indicated by the cosmopolitan species *Syringostromella zintchenkovi* Khalfina, *Stromatopora polaris* Stearn, *Atopostroma distans* (Ripper) and *Salairella prima* Khromych. The arctic Emsian fauna shares 7 genera in common with the 11 taxa described by Webby and Zhen (1993) from the Jesse Limestone of New South Wales. At the specific level *Atopostroma distans* and *Salairella prima* occur in both faunas.



Text-figure 3.—Stratigraphic ranges of Lower and lower Middle Devonian stromatoporoids.

The species *Glyptostromoides simplex* (Yang and Dong) is common to the Emsian of the south China continental plate and the arctic Emsian.

DISCUSSION

This synthesis demonstrates that the stromatoporoids have more biostratigraphic value than has been conventionally attributed to them. A prerequisite for the confident use of these fossils in correlation is that dating of occurrences be precise as in this study of the Emsian of the Arctic. Such dating has generally been lacking in classical studies of stromatoporoid systematics in part because rigorous, internationally accepted standards of dating postdate many of these studies. Stromatoporoids have been conventionally regarded as poor candidates for correlation in the belief that the species are too long ranging and too provincial. Conservative taxonomic philosophies, species defined without clear appraisal of range of variation within skeletons or between specimens, and oversplitting of taxa have made recognition of species across national boundaries difficult. The recognition of the world-wide distribution and narrow stratigraphic range of some species in this study demonstrates that the biostratigraphic and paleogeographic value of this group is potentially great. Some genera in which taxonomic problems at the species level persist, such as *Stromatopora* and *Clathrocoilona,* may be poor candidates for correlative purposes, but other genera, such as *Stictostroma* and *Stromatoporella,* where species are better defined, have great biostratigraphic potential.

The chronologic development of stromatoporoids in Early Devonian time has recently been reviewed by Webby *et al.* (1993). The diversity and wide distribution of the Emsian world fauna shows that the rapid diversification of stromatoporoids to form the better-known reef complexes of Middle and Late Devonian time was well underway in Early Devonian time.

SYSTEMATIC PALEONTOLOGY

INTRODUCTION

Stromatoporoids are an extinct class of sponges allied to the extant coralline sponges (Stearn, 1972, 1975a). Little can be gleaned from the distant stromatoporoid-sponge relationship, however, to assist in setting limits to extinct stromatoporoid species. Most of the classical systematic studies of stromatoporoids (pre-1960s) employed a species concept that by current standards would be considered narrow. Sample suites were often limited in size and geographic scope, and as a result new species were plentiful. Many of these have since been combined in synonymy. In more recent years, larger samplings have been collected, and more attention has been paid to morphometric analysis (*e.g.*, Fagerstrom, 1982), and a much broader concept of the stromatoporoid species has ensued. The species concept we apply here is a relatively broad one (Stearn, 1989a).

Many stromatoporoid species demonstrate significant structural or morphometric variability. In many species a large proportion of the range of variability may be expressed within a single skeleton. In general, a grouping of specimens may be confidently considered a unique species when the range of variability (however broad) is continuously expressed across the full collection, with no major gaps or discontinuities. An obvious precondition for recognizing the range of variability is a relatively large number of specimens. A good indication of the broad species concept as applied herein is shown by a comparison of total species diversity with generic diversity. The Arctic Emsian stromatoporoid fauna comprises 25 species in 22 genera; only two genera are represented by more than a single species.

A consequence of a broad species concept is that, in our opinion, the notion of subspecies is generally inapplicable to stromatoporoids. Because variability within a species is already great, rarely (if ever) will a given population consistently demonstrate characteristics deserving subspecies rank.

Species synonymies listed are meant to be all-inclusive, listing all species considered identical to the species being described. Those species described as *confere* (*cf.*) to an earlier description have the compared references listed in the synonymy (following *cf.*). *Confere* (*cf.*) is the only nomenclatorial qualifier employed here. It is used for described species that closely resemble those described elsewhere. Reservation may be due to minor morphologic differences, too small a sampling to assure that the full range of variability is present, or inadequacies in the original description. Expanded study of such species may ultimately demonstrate that they are the named species (delete *cf.*) or, much less likely, that they are separate but closely related species.

Species-level taxa are distinguished by letters (*e.g.*, *Actinostroma* sp. A) when we judge that a distinctive morphology is exhibited that is likely to result in a new species being described when more and better specimens have been studied. If the material is sufficient for a generic identification only, the generic name is modified only by sp. (*Trupetostroma* sp. = a species of *Trupetostroma*).

In the course of this study, approximately 800 thin-sections were examined. The preservation of identified specimens is graded according to the scale: exceptionally well preserved; well preserved; moderately well preserved; mediocre; poor. These categories are approximate and subjective, but in general imply the following. Exceptionally well preserved specimens preserve all macrostructure and especially microstructure in very fine detail, uniformly throughout the specimen; specimens of this quality are exceedingly rare. Well preserved specimens show little or no diagenetic alteration; macrostructural details are fully preserved, and original microstructures are preserved over most of the specimen. Moderately well preserved specimens show some diagenetic alteration; macrostructure is largely unaffected, but microstructural detail may be obscured, although it is generally preserved at least locally. Most identified specimens are either well or moderately well preserved. Mediocre preservation applies to specimens in which macrostructural details are obscured, at least partly, and no original microstructural detail remains; specimens so preserved remain identifiable on macrostructural grounds only. Poorly preserved specimens preserve no microstructural detail, and macrostructures are largely obscured. In general, poorly preserved specimens cannot be confidently assigned (to species) in isolation, but can be identified in the context of the full collection studied.

The value of classifying the preservation of specimens (in combination with the number of specimens identified) is that it allows the reader to gauge independently the confidence of the species identifications/descriptions. This is particularly true for newly described species.

Morphological measurements provided are in metric units, commonly centimetres (cm), millimetres (mm), or micrometres (μm). Most measurements are derived from thin-section examination. Most frequently cited morphological parameters are laminar and pillar spacing, and laminar and pillar thickness. Laminar and pillar spacing are conventionally expressed as number of laminae/pillars occurring per 2 mm distance, commonly cited as an average of n measurements with a minimum and maximum range of values per specimen or species.

Morphological terminology follows the established literature on stromatoporoid systematics. Definitions of recently introduced terms may be found in such papers as Stearn, (1989b, 1991, 1993) and Stock (1989). Introductory glossaries appear in older papers such as Galloway and St. Jean (1957). In this report, we deviate from the normal terminology only for the following morphological feature. Where astrorhizae in tangential section are without walls and defined only by areas devoid of structural elements, the term "canal" or "tube" is inapproporiate; we use the term "astrorhizal path" or "path".

Type specimens designated in this report are housed in the Type Collection at the Geological Survey of Canada, Ottawa, Ontario, and are identified with a six-digit number with the prefix GSC (*e.g.*, GSC 108863). The locations from which these specimens were collected are listed in Appendix 2. The precise location of collections is recorded by latitude and longitude in Appendices 1 and 2 because very few geographic names are available in the High Arctic. Appendix 3 is a catalog of the other specimens identified in this study with their collection localities referenced to Appendix 1 and Text-figure 1. These specimens are in the general collections of the Geological Survey in Ottawa marked with a prefix number 110, 111, 120, or 129 followed by a hyphen and a second number (e.g., 110-286). The few types referred to by the prefix ROM are from the collection of the Royal Ontario Museum, Toronto, Ontario, Canada.

SYSTEMATICS

Class **STROMATOPOROIDEA** Nicholson and Murie, 1878

Order **ACTINOSTROMATIDA** Bogoyavlenskaya, 1969

Family **ACTINOSTROMATIDAE** Nicholson, 1886

Genus **ACTINOSTROMA** Nicholson, 1886

Type species.—*Actinostroma clathratum* Nicholson, 1886.

Actinostroma sp. A

Plate 1, figures 1–3

Description.—Skeleton large, hemispherical; surface bearing low mamelons closely and regularly spaced; no astrorhizae visible on surface.

Vertical section: Laminae thin, flat or very gently undulate, consistently parallel, commonly passing laterally into a series of dots; thickness 0.02–0.04 mm, where poorly preserved may thicken to 0.06–0.08 mm; spaced 7 to 10 per 2 mm, average 8.3 (n=30). Latilamination absent, although successive spacing phases (vertical gradations of distantly to closely spaced laminae) 0.4–0.5 mm thick generally present. Pillars regularly spaced, 9 to 10 per 2 mm, average 8.9 (n=30); thickness variable, 0.04–0.08 mm, average 0.06 (n=30); apparent vertical length limited, commonly span 1 to 5 laminae; maximum observed length 3 mm, long pillars generally slightly bent, rarely straight. Astrorhizae uncommon, inconspicuous, defined by zones of gentle laminar doming, interlaminar dilation, and upward-divergent pillars; apparent vertical canal width 0.3–0.5 mm. Dissepiments scattered. Skeletal microstructure compact.

Tangential section: In interlaminar areas, pillars form isolated dots, 0.04–0.06 mm diameter, a few joined by or bearing partial colliculi; towards and into laminar bands, pillars colliculate, forming polygonal network; colliculi 0.01–0.02 mm thick. Preservation of colliculi variable, poorly or unpreserved in much of specimen. Dissepiments log, arcuate lines joining several pillars. Astrorhizae small, ill-defined, indicated by vague paths of absent skeletal elements at and near mamelon summits; lateral path width approximately 0.2 mm.

Material.—Large fragment of a single specimen *ca.* 40 cm basal diameter by 20 cm high. Hypotype GSC 108852. Well preserved.

Discussion.—This specimen probably represents a new species of *Actinostroma,* but, despite locally excellent preservation, one specimen is insufficient material to establish the species.

Since Flügel's (1959) monographic treatment of the genus *Actinostroma,* many species have been added, still others removed to *Plectostroma* and *Densastroma.* Nonetheless, the basic species groupings recognized by Flügel (1959) remain valid. Of the three main Devonian *Actinostroma* species-groups outlined by Flügel (*A. clathratum, A. hebbornense,* and *A. stellatum* species-groups), this Arctic species shows closest affinity to species of the *A. hebbornense* group: thin laminae and pillars, both spaced about 5 per mm. Species from all three of these Devonian groups are most plentiful in the Givetian and Frasnian, but one Eifelian species, *A. perspicuum* Počta, 1894, shows interesting parallels to *Actinostroma* sp. A. *Actinostroma perspicuum* has similar thin laminae and thin, relatively short pillars, but it is markedly cystose and has commonly convergent laminae. Although the Bohemian *A. perspicuum* (Choteč Limestone) and the Arctic specimen do not therefore appear to be closely related, both are characterized by very thin structural elements, primitive representatives of a general trend towards elemental thickening exhibited by later Givetian and Frasnian species (Flügel, 1959).

Occurrence.—Truro Island, unnamed limestone formation; highest Emsian/basal Eifelian (undifferentiated *patulus* Zone).

Genus **PLECTOSTROMA** Nestor, 1964

PLECTOSTROMA SALAIRICUM
(Yavorsky, 1930)

Type species.—*Actinostroma intertextum* Nicholson, 1886.

Plate 1, figures 4,5

Actinostroma salairicum Yavorsky, 1930, p. 489–490, pl. II, figs. 1–3.
Plectostroma salairicum (Yavorsky, 1930). Flügel and Flügel-Kahler, 1968, p. 376.
? *Actinostroma salairicum* Yavorsky. Khromych, 1984, p. 113–114, pl. VI, fig. 1.

Description.—Skeleton laminar to weakly domed, up to 10 cm diameter. Surface smooth; astrorhizae inconspicuous in hand-specimen.

Vertical section: Dense network of pillars and subordinate colliculate laminae. Pillars 0.03–0.05 mm thick; spaced 6 to 8 per mm, average 7.0 per mm (n=20, combined specimens); vertical extent variable 0.3–1.5 mm, commonly 0.5 mm; commonly thicker/more opaque than colliculi; irregular thin phases of very dark pillars grossly resemble latilaminae, but true latilaminae absent. Colliculi thin 0.02–0.03 mm; commonly arched (between neighbouring pillars), fewer straight/horizontal; dominantly arise at uniform levels to impart horizontal fabric to skeleton, locally network irregular; where colliculate laminae occur, spacing 7 to 9 per mm, commonly 7 to 8 per mm, specimen GSC 108853 average 7.8 range 7 to 9, GSC 108854 average 7.7 range 7 to 9 (each n=10). Skeletal microstructure compact. Astrorhizae prominent, vertically persistent; axial canal 0.20–0.30 mm diameter, canal walls 0.04–0.05 mm thick; lateral canals branching downward from axial canal; astrorhizal tabulae (resembling enlarged colliculi) abundant, one for every three to five colliculate laminae. Dissepiments absent.

Tangential section: Pillars dark, solid dots 0.02–0.04 mm diameter; either isolated, or tightly linked by colliculi into network; four, less commonly five, colliculi arise from each pillar. Astrorhizae simple, single axial canal surrounded by a few simple lateral canals, 0.12–0.20 mm wide average 0.15 mm; center-to-center spacing 5 to 7 mm.

Material.—Two specimens. Hypotypes GSC 108853, 108854. Well preserved.

Discussion.—Yavorsky's (1930) original description and illustrations of *Plectostroma salairicum* closely match the Arctic specimens, and only a minor difference in pillar spacing distinguishes the two (5 to 6 per mm for Yavorsky's specimens, 6 to 8 per mm for those herein). The astrorhizal systems of the Arctic and Yavorsky's specimens, however, are identical.

Yavorsky (1930, p. 489) noted the locality of *P. salairicum* as "Kuznetsk Basin, Kara-Chumysh River, in beds with *Pentamerus pseudobaschkiricus* Tschern." (now referred to *Zdimir pseudobaschkiricus*). The *Zdimir pseudobaschkiricus–Megastrophia uralensis* Zone includes mixed elements of both the *patulus* and *partitus* Zones (conodonts), and is therefore uppermost Emsian and/or lowest Eifelian (Rzhonsnitskaya, 1988). This matches the age of the Bathurst Island unnamed formation, as currently understood (undifferentiated *patulus* Zone).

Differences of opinion persist as to the assignment of species such as *P. salairicum* to the genera *Plectostroma* or *Actinostroma.* As noted by Nestor (1964, p.109), in the generic definition of *Plectostroma,* "the difference consists (sic) in the connective processes, which in *Plectostroma* are distributed irregularly, but in *Actinostroma* they occur on definite levels and form regular, concentric laminae." Various species, however, demonstrate differing degrees of collicular irregularity versus alignment. At one extreme, the type species of *Plectostroma, P. intertextum* (Nicholson, 1886), shows random distribution of colliculi. Other species, such as *P. necopinatum* Nestor, 1964, show rare collicular alignment. Near the opposite extreme, species such as *P. salairicum* have many more colliculi in alignment than are not, a fact that has prompted Khromych (1984) to retain *P. salairicum* in the genus *Actinostroma* (but see below). Still, a strictly statistical distinction between *Plectostroma* and *Actinostroma* (on the basis of proportions of aligned versus unaligned colliculi) would obscure important relationships between species that are clearly related and intergradational in nature. As Stock (1979) has noted, *Plectostroma* represents a useful grouping of species intermediate in skeletal element size and spacing between *Actinostroma* and *Densastroma* (this latter with a very fine skeletal network). This broader approach follows that of Flügel and Flügel-Kahler (1968) and Flügel (1974), who initially reassigned *Actinostroma salairicum* Yavorsky to *Plectostroma.*

The assignment by Khromych (1984) of specimens to *Actinostroma salairicum* Yavorsky is questionable. Khromych's Siberian specimens have more distantly spaced and thicker structural elements than either Yavorsky's (1930) or those herein (3 to 4 pillars per mm; 5 "laminae" per mm; pillars 0.12–0.15 mm thick; "laminae" 0.08–0.10 mm thick; Khromych, 1984).

Flügel (1974, p. 178) tabulated the major morphologic features of six Devonian species of *Plectostroma,* including *P. salairicum.* An additional five Devonian species from the former Soviet Union are listed by Bogoyavlenskaya and Khromych (1985).

Occurrence.—Bathurst Island, Dyke Ackland Bay; unnamed limestone, lower 100 m; uppermost Emsian/basal Eifelian (undifferentiated *patulus* Zone).

Genus **ACULATOSTROMA** Khalfina, 1968

Type species.—*Syringostroma verrucosum* Khalfina, 1961.

Aculatostroma cf. **A. kaljanum**
(Bogoyavlenskaya, 1977)
Plate 2, figures 1–5

cf. *Coenellostroma kaljanum* Bogoyavlenskaya, 1977, p. 15, Pl. 4, figs. 1a, 1b.

Description.—Skeleton laminar to gently wavy, up to 10 cm.

Vertical section: Laminae colliculate, mostly continuous, very gently undulate; on a fine scale, ragged not smooth; locally inflected into shallow impersistent mamelons; thin, 0.02–0.04 mm, commonly diagenetically thickened to 0.05–0.06 mm; spaced regularly, 8 to 11 per 2 mm, average 9.7 (n=10). Pillars short, confined to interlaminar interval, generally offset between successive laminae, rarely superposed; 0.04–0.06 mm thick, locally thickened to 0.08 mm; spaced regularly, 8 to 11 per 2 mm, average 9.4 (n=10). Colliculi arise sharply off pillars, forming vaulted cell-shaped galleries. Skeletal microstructure compact. Astrorhizae abundant, poorly formed; axial canals vertically impersistent, roughly 0.6–0.8 mm diameter, many inclined, may or may not be accompanied by impersistent mamelons; astrorhizal tabulae abundant, crowded, thin 0.01–0.02 mm (but may be greatly thickened by diagenesis), dominantly sub-horizontal, flat or broadly convex, locally concave; lateral branches and tributaries indicated by lenticular or irregular zones of tabulae. Dissepiments (smaller than tabulae) in skeletal galleries, common not abundant. Latilaminae 3–4 mm thick, may be floored by thin band of sediment and thick (1–1.5 mm) basal layer of disordered skeletal material; thick root-like basal layer forms floor of specimen GSC 108855.

Tangential section: Laminae diffuse meandering bands. Pillars vermiform or cateniform, locally linked into network; 0.04–0.06 mm thick; about one-quarter of pillars dot-like, 0.04–0.06 mm diameter; commonly linked by finer elements, either partial colliculi or dissepiments, 0.01–0.02 mm thick. Astrorhizae scattered, discontinuous, irregularly branching segments, *ca.* 0.6 mm diameter; tabulate, or locally empty; generally, not exclusively, at mamelon summits.

Material.—Two fragmentary specimens, one well preserved, one poorly preserved. No growth surfaces preserved. Hypotype GSC 108855. Second specimen 110-132.

Discussion.—This species demonstrates similarities to *Aculatostroma kaljanum* (Bogoyavlenskaya) from the *karpinskii* horizon (Emsian, *gronbergi–inversus* Zones; Khodalevich *et al.,* 1982), eastern slope of the northern Urals. Bogoyavlenskaya's (1977) description is sketchy, and precludes thorough comparison. Laminar spacing of *A. kaljanum* is noted as 4 per mm, laminar width 0.07–0.1 mm, and pillar thickness "does not exceed 0.1 mm" (Bogoyavlenskaya, 1977, p.15). The cited thicknesses exceed those of the Ellesmere specimens, but Bogoyavlenskaya's illustration (1977; Plate 4, fig. 1) suggests laminae and pillars approximately 0.05 mm thick. Significantly, Bogoyavlenskaya (1977, p.15) describes the astrorhizae as "numerous and simple", and "astrorhizal tabulae numerous, arranged parallel to laminae", the same condition as in the Ellesmere specimens. Additionally, Bogoyavlenskaya noted the occurrence of an "epitheca" (0.5 mm thick) on the undersurface of some specimens; a potentially similar structure, a digitate, root-like basal phase of disordered skeletal material, is present in one of the Ellesmere specimens (GSC 108855). This last feature, while interesting, is of negligible taxonomic value because it is an abnormal growth phenomenon.

Considerable uncertainty has surrounded the generic assignment of species to either of *Aculatostroma* or *Atelodictyon,* and whether *Aculatostroma* itself is an actinostromatid (colliculate laminae) or a clathrodictyid (continuous laminae) (see Stearn, 1991). For the most part the fine structure of Ellesmere *Aculatostroma* cf. *A. kaljanum* is diagenetically obscured, but a few thin zones of one or two laminae (occurring beneath sediment interlayers) preserve skeletal elements in extreme detail. Plate 2, figures 4 and 5 depict the colliculate pillars found in such a zone; note how the colliculi arise sharply, parasol-like, off the short pillars.

The astrorhizae of *Aculatostroma* cf. *A. kaljanum* are unusual in their disordered arrangement, abundance of near-horizontal tabulae or cysts, and apparent facultative association with mamelons. It is possible that they instead represent intergrowths of commensal or parasitic organisms. Plate 2, figure 3 presents supplementary evidence to suggest that the tubes are indeed astrorhizal canals, albeit aberrant ones; on this slabbed, tangential surface, the tubes can be seen to radiate from a central area, branching dichotomously and slightly thinning outward. Such a horizontal pattern is inconsistent with the commensal habit of a foreign organism (such as *Syringopora*), and the abundant horizontal tabulae mitigate the possibility of an invading borer. The common occurrence of these tubes in the arctic specimens and those from the Urals [*A. kaljanum* (Bogoyavlenskaya)] implies that the structures are intrinsic to the stromatoporoid, rather than a the product of a chance guest or invading organism.

The preservation of the Ellesmere specimens deserves some additional mention. As noted in the description, skeletal elements (laminae, pillars, dissepiments, tabulae) are commonly thickened, in some specimens by as much as 10 times the original thickness. Periodic, thick (0.5–1.0 mm), dark bands parallel the laminae in specimen GSC 108855, and they are confluent with, and appear to be composed of, the same material as the skeletal elements. The dark bands, of diagenetic origin, occur at the same periodicity as latilaminar boundaries (elsewhere indicated by thin sediment interlayers). In thin section, ghosts of skeletal elements are discernable within the thick bands, i.e., the bands are not part of the original skeletal architecture. Rather, they appear to be preferentially nucleating at latilaminar bases. Where the bands are thickest (especially within the basal layer), their crystalline habit is bundled, and their optical characteristics suggest fascicular-optic calcite (*sensu* Kendall, 1977). This latter is generally considered strictly a void-filling fabric, but in this instance it appears to be displacive (replacement).

A second specimen, not as well preserved as the one described and illustrated is also assigned to this species. In the second specimen, laminar spacing is slightly closer than in GSC 108855, 7 to 9 per 2 mm, and it displays slightly fewer astrorhizal canals, although equally poorly formed.

Occurrence.—Blue Fiord Formation, lower 100 m; Vendom Fiord (GSC 108855), Eids Fiord (one specimen); lower Emsian (*dehiscens* Zone).

Order **CLATHRODICTYIDA**
Bogoyavlenskaya, 1969

Family **CLATHRODICTYIDAE** Kühn, 1927

Genus **CLATHRODICTYON**
Nicholson and Murie, 1878

Type species.—*Clathrodictyon vesiculosum* Nicholson and Murie, 1878.

Clathrodictyon ellesmerense Stearn, 1983
Plate 3, figures 1–3

Clathrodictyon ellesmerense Stearn, 1983, p. 545, 547, fig. 3A–3E; 1989a, fig. 1A.

Material.—Twenty-one specimens; poorly to moderately well preserved. Hypotypes GSC 108856 to 108858. Other specimens at Geological Survey listed in Appendix 3.

Discussion.—This species was established by Stearn (1983) for specimens collected from the lower Blue Fiord Formation in the vicinity of the type section. The majority of specimens of *Clathrodictyon ellesmerense* in this study come from equivalent localities on Ellesmere Island, ranging from *dehiscens* to *gronbergi* Zones (lower Emsian). Additional specimens of *C. ellesmerense* from the Bird Fiord Formation of Ellesmere Island and from Bathurst Island extend the stratigraphic range of this species to lowest Eifelian.

The additional specimens of this study expand the morphological parameters of *Clathrodictyon ellesmerense* from the original description of Stearn (1983). The new specimens demonstrate a greater range of laminar spacing than do those in the original collection (about 11.5 per 2 mm; Stearn, 1983); pillar spacing and the thickness of the skeletal elements are within the originally cited ranges. In the additional specimens, laminar spacing ranges from about 10 to 15 per 2 mm, with the majority of specimens measuring 10 to 12 laminae per 2 mm.

Specimens with especially closely spaced laminae may demonstrate these distinctive features: 1) repeated variations in laminar spacing (=successive phases); and 2) local development of vertically impersistent papillae. Of the 13 specimens of *Clathrodictyon ellesmerense* from the lower Blue Fiord Formation, two display successive phases of growth in which laminar spacing changes from a minimum of 8 per 2 mm progressively up to 16 per 2 mm, over vertical distances of 3 to 5 mm (Pl. 3, fig. 1). Such rhythmic changes may indicate seasonal variation in growth rate (Stearn, 1989a). Another two of the Blue Fiord specimens of *C. ellesmerense* display discrete protuberances measuring 1–2 mm wide by 2–3 mm high (Pl. 3, fig. 3). They are formed as small domal inflections of the laminae and are vertically limited and not associated with astrorhizal canals. In thin section, no distributional pattern of the protuberances is readily apparent within the skeleton, but one hand-specimen suggests they occur at growth interruptions, and may be an intrinsic response to unfavourable environmental conditions.

As noted earlier by Stearn (1983), some specimens of *Clathrodictyon ellesmerense* display dense intergrowths of syringoporid corals.

Occurrence.—Blue Fiord Formation; lower 100 m, type area (15 specimens); lower member, Vendom Fiord (two specimens); lower Emsian (*dehiscens-gronbergi* Zones). Blue Fiord Formation, upper member, Vendom Fiord (one specimen); Disappointment Bay Formation, Truro Island (one specimen); *inversus* Zone. Bird Fiord Formation, Ellesmere Island, type area (one specimen); Northeastern Bathurst Island, unnamed limestone formation (one specimen); highest Emsian-basal Eifelian (undifferentiated *patulus* Zone).

Genus **GERRONOSTROMA** Yavorsky, 1931

Type species.—*Gerronostroma elegans* Yavorsky, 1931.

Gerronostroma septentrionalis, new species

Plate 3, figures 4, 5; Plate 4, figures 1–4

Gerronostroma sp. A Stearn, 1983, p. 547–548, figs. 4A, 4B.

Diagnosis.—Thin laminae, closely but variably spaced 9 to 18 in 2 mm; pillars thin, spaced regularly and closely, 11 to 20 in 2 mm; dissepiments uncommon.

Description.—Skeletal form variable, laminar to weakly domical, commonly irregular, rarely bulbous. Surfaces poorly exposed, apparently bearing numerous, small mamelons. Latilaminae common, thickness 0.7–1.0 cm.

Vertical section: Laminae continuous, flat or gently undulate, less commonly highly undulate-to-irregular; thin, 0.03 to 0.04 mm, rarely to 0.05 mm; in specimens with syringoporids, deflected slightly downward at corallite margins. Laminar spacing very close, but highly variable; species range 9 to 18 per 2 mm, commonly 13 to 16 per 2 mm; holotype GSC 108859 average 15.2 (n=20) range 13 to 18, paratype GSC 108860 average 15.5 (n=10) range 13 to 17, paratype GSC 108862 average 14.2 (n=10) range 13 to 16. Successive phases of laminar spacing common, 1.5 to 2.0 mm thick, or about four to five phase-cycles per latilamina; where closely spaced, rare pairs of laminae may be tightly adpressed, separated by gap of 0.01 to 0.02 mm. Basal phase of stringy material 0.2 to 0.3 mm thick at base of latilaminae, also as thin lenses irregularly throughout skeleton; some latilaminar surfaces show minor erosion (truncated or missing upper laminae). Pillars thin, 0.02–0.04 mm; generally superposed through interval of 2 to 10 laminae, although readily lost to diagenesis; dominantly simple, straight, rod-shaped; a few slightly thickened or apparently split upward; spacing variable, generally very close and regular, species range 11 to 20 per 2 mm, commonly 13 to 17 per 2 mm, holotype average 16.5 (n=20) range 14 to 20, paratypes GSC 108860 average 15.0 range 13 to 17, GSC 108861 average 13.5 range 12 to 15, GSC 108862 average 15.1 range 13 to 17 (all n=10); tending to be closer where laminae closely spaced. Astrorhizae variably present, common or abundant in most specimens, in a few rare or absent, consisting of central bundle of few vertical canals 0.1 to 0.2 mm diameter, and many smoothly curved lateral branches merging into galleries; associated with shallow mamelons, vertically persistent up to full latilaminar height; pervasive lateral branches as small circular gaps 0.2 mm diameter or short tubes locally interrupting laminae, abundant near axis and along certain levels; absent or imperceptible in specimens with commensal syringoporids. Dissepiments uncommon except in areas of skeletal repair. Skeletal microstructure compact, minutely speckled; some specimens irregularly fibrous.

Tangential section: Laminae dense meandriform bands. Pillars commonly small dots, 0.02–0.04 mm diameter, or short vermiform strands; closely spaced, about 0.04 mm apart. Astrorhizae axial bundle of three to five canals and surrounding dense array of outward-branching lateral canals; canal width 0.1 to 0.2 mm; complexity and density highly variable between specimens, closest center-to-center spacing about 5 mm.

Material.—Twenty-four specimens, mostly well-preserved. Seven specimens with commensal syringoporids, seventeen without. Holotype GSC 108859; paratypes GSC 108860 to 108862. Other specimens listed in Appendix 3.

Discussion.—*Gerronostroma septentrionalis* n. sp. demonstrates extremely broad variation in laminar and pillar spacing, astrorhizal arrangement and abundance, and overall growth form. It is the same species recognized earlier by Stearn (1983) as *Gerronostroma* sp. A (also from the lower Blue Fiord Formation, Ellesmere Island). Minor differences between the earlier description and this one are attributable to the broad specific variation of *G. septentrionalis* n. sp., not fully represented in the small collection of Stearn (1983). The earlier description noted the astrorhizae as being inconspicuous and latilamination as not prominent, which by the present species-concept are more exceptions than the norm. The pillar spacing cited by Stearn (1983), 11 to 12 per 2 mm, is within the range of *G. septentrionalis* n. sp., although low; laminar spacing for *G.* sp. A Stearn, 1983, is 16 to 18 per 2 mm. The new specimens of *G. septentrionalis* n. sp. demonstrate roughly a one-to-one ratio of pillar to laminar spacing (for any specimen or uniform region within a specimen). The apparent disparity exhibited by the specimens of Stearn (1983) is due to preferential diagenetic loss of pillars, a feature consistently evident in both collections. Some specimens show partial or complete removal of pillars, leaving only the closely spaced laminae intact.

Another specimen referred by Stearn (1983) to *Gerronostroma* cf. *G. immemoratum* Bogoyavlenskaya is not conspecific with *Gerronostroma septentrionalis* n. sp. Its laminar and pillar spacings are well outside the range of *G. septentrionalis* n. sp. and, moreover, its skeletal element thicknesses are much greater. Considering the geographic and stratigraphic similarity of the collection of Stearn (1983) and those herein, the absence of new specimens similar to *G.* cf. *G. immemoratum* is puzzling. Still, the species appears to be valid, and the paleogeographic relationship to the eastern Urals suggested by *G.* cf. *G. immemoratum* is supported by the present evidence (see under occurrence of *Aculatostroma* cf. *A. kaljanum,* p. 17).

G. septentrionalis n. sp. shows little similarity to other known species of *Gerronostroma.* Two lower Emsian species are described by Lessovaya (1970) from the Zeravshan Range, Uzbekistan: *Gerronostroma istekense schirdagica* Lessovaya has much thicker skeletal elements, more widely spaced, than *G. septentrionalis* n. sp.; and *Gerronostroma uralicumforme* Lessovaya appears more reasonably to belong to *Atopostroma* Yang and Dong. Of the three upper Lochkovian species of *Gerronostroma* described by Stearn (1990) from the Stuart Bay Formation, Bathurst Island, none is closely comparable to *G. septentrionalis* n. sp.

About one-third of the specimens of *Gerronostroma septentrionalis* n. sp. exhibit dense intergrowths of a syringoporid coral (e.g. Pl. 4, fig. 3). The intergrown corallites are either very abundant or completely absent, i.e., there is no intermediate condition of just a few intergrown corallites. This implies that the relationship between the coral and *G. septentrionalis* n. sp. is neither accidental nor parasitic, for which a gradation of intergrowth densities should occur. Mutualism is unlikely, as *Gerronostroma* specimens without the coral are abundant and show no obvious signs of lesser growth than those with the coral. Rather, strict commensalism on the part of the coral is indicated.

Gerronostroma septentrionalis n. sp. is commonly found competitively overgrowing other stromatoporoid species (primarily *Stromatopora polaris* Stearn and *Stictostroma*? *nunavutense* n. sp.). A third of the specimens demonstrate this overgrowth, and of these, three specimens (including the holotype) show intimate interfingering of the competing stromatoporoids. In the holotype (GSC 108859), at least five such interfingering episodes occur within one latilamina of *G. septentrionalis* n. sp. (Pl. 4, fig. 4). The overtopping/recolonization by *Gerronostroma* is in each instance clearly defined by a characteristic mat of basal stringy tissue. By the end of the latilaminar event, the competing species appears to have been excluded from the holotype specimen, and indeed in each example observed *Gerronostroma* ultimately overgrows the other in vertical succession.

Etymology.—Latin *septentrionalis,* of, or from the north.

Occurrence.—Blue Fiord Formation, lower member; Ellesmere Island, vicinity formation type area (21 specimens), Vendom Fiord (two specimens); lower Emsian (*dehiscens* Zone). Uppermost Eids Formation, Eids Fiord, Ellesmere Island (one specimen); lower Emsian (*dehiscens* Zone).

Genus **PETRIDIOSTROMA** Stearn, 1992,
(*nom. subst. pro Petrostroma* Stearn, 1991
non Petrostroma Döderlein, 1892)

Type species.—*Simplexodictyon simplex* Nestor, 1966.

Petridiostroma sp.
Plate 5, figures 1–2

? *Anostylostroma laxum* Nicholson. Stearn, 1990, p. 503–504, figs. 3.3–3.5.

Description.—Skeleton laminar to irregular. Latilaminae about 5 mm thick evident in some specimens.

Vertical section: Laminae continuous, gently undulate; 0.04–0.06 mm thick, commonly 0.05 mm thick; spaced 6 to 8 per 2 mm, specimen averages 7.5 (GSC 108863), 6.3 (GSC 108864) (each n=10); microstructure compact. Pillars simple, commonly rod-shaped, some slightly thickening upward to meet overlying lamina, rarely branching upward; 0.04–0.08 mm thick, average 0.055mm (GSC 108863; n=20); variably spaced, 7 to 11 per 2 mm, specimen averages 8.8 (GSC 108863), 8.5 (GSC 108864) each n=10; arrangement between successive laminae irregular, random, pillars neither consistently staggered nor superposed; locally absent for lengths up to 1.0 mm. Dissepiments common, broadly convex; thin 0.02 mm.

Tangential section: Pillars solid dots 0.04–0.08 mm diameter; rarely incomplete small circles with clear center, diameter up to 0.12 mm. Dissepiments conspicuous, shallow arcs or irregular segments bridging pillars. Astrorhizae absent.

Material.—Three specimens, ranging from poorly to moderately well preserved. Hypotypes GSC 108863, 108864. Other specimen 111-1.

Discussion.—These few specimens from Ellesmere Island are best assigned to the genus *Petridiostroma* (Stearn, 1992) on the basis of their planar laminae and predominantly simple pillars. They are quite similar to specimens from the upper Lochkovian of Bathurst Island ("Stuart Bay" Formation) referred to *Anostylostroma laxum* by Stearn (1990). The Bathurst Island specimens have more distantly spaced laminae (ten-count average of 5.5 in 2 mm in one specimen, 7.1 in the other) and pillars (ten-count average of 5.5 in 2 mm in one specimen, 6.2 in 2 mm in the other) than do those described here, but they are otherwise closely comparable. In light of recent study (Stearn, 1991), *Anostylostroma* should be restricted to species in which the majority of pillars branch-upward irregularly and complexly. As such, the Lochkovian specimens referred to *Anostylostroma laxum* by Stearn (1990) should be reassigned to *Petridiostroma.* These Lochkovian specimens show a predominance of simple pillars, and only a few are Y-shaped (Stearn, 1990). Re-examination of the specimens reveals that less than one per cent of the pillars branch, a proportion comparable to the Ellesmere Island *Petridiostroma* sp. specimens. Tangential sections are especially diagnostic, for although the few branched pillars appear prominent in vertical section, tangentially the overwhelming majority of pillars are dots. Nonetheless, more specimens of the Ellesmere Island *Petridiostroma* sp. are needed to support a definite relationship to the Lochkovian specimens. *Anostylostroma laxum* (Nicholson, 1887) itself (*cf. e.g.,* Fagerstrom, 1982; Bjerstedt and Feldmann, 1985) is best assigned to the genus *Schistodictyon* (pillars branch upward dichotomously) (Stearn, 1991).

Occurrence.—Blue Fiord Formation, Ellesmere Island; Goose Fiord, dolomitic facies (one specimen), mid-Emsian (*inversus* Zone); Vendom Fiord, near base of upper member (two specimens), lower Emsian (*inversus* Zone).

Genus **ATELODICTYON** Lecompte, 1951

Type species.—*Atelodictyon fallax* Lecompte, 1951.

Atelodictyon cf. **A. solidum** Khromych, 1976

Plate 5, figures 3,4

cf. *Atelodictyon cylindricum solidum* Khromych, 1976, p. 48, pl. IV, figs. 4a, 4b, 4c.

Description.—Fragmentary; skeleton laminar.

Vertical section: Laminae thin, 0.02–0.03 mm, locally thickened to 0.05 mm; mostly continuous, but locally broken, due either to poor preservation or penetration by astrorhizal canals; spaced 4 to 5 per 2 mm; irregularly undulate, interlaminar spaces locally swollen or pinched out. Coenosteles complex, thin; dominantly vertical, but irregularly sinuous, crumpled. Two types of coenosteles occur (with numerous intergradational forms): dominantly 1) thin, 0.02–0.04 mm, tightly crowded, paired or in interwoven hairlike bunches, commonly splaying upward to meet overlying lamina; subordinately 2) thicker, up to 0.10 mm, thickening or splitting upward to meet lamina. Coenostele spacing 8 to 11 per 2 mm, average 9.5 (n=10), but locally tightly crowded and individuallly indiscernable. Astrorhizae large, extensive, composed axially of vertical bundles of canals, each 0.4–0.5 mm wide, spread laterally like buttressed roots of a tree; astrorhizal tributaries widely scattered, form hollow circles or short tubes, commonly truncating laminae. Dissepiments uncommon, thin, broadly convex, mostly preservationally obscured. Microstructure probably compact.

Tangential section: Coenosteles vermiform to netlike; thickness variable, 0.03–0.08 mm; rarely dots 0.02–0.05 mm diameter; rarely irregularly ring-shaped; where netlike, enclosing galleries 0.2–0.5 mm across. Astrorhizae large, very prominent, axial canal diameter 0.4–0.5 mm; at optimal height of section forming rosettes, comprising a central bundle of 5 to 6 vertical canals, surrounding array of long ramifying lateral canals extending up to 1.5 cm; tributary canal segments 0.2–0.3 mm diameter scattered throughout skeleton; central canal margins generally well-defined, tributary canals less defined, merge into skeletal network. Distance between astrorhizal centres about 1.0 cm.

Material.—Two specimens, one moderately well preserved (GSC 108865), one poorly preserved (120-6).

Discussion.—These few but distinctive specimens compare favorably with *Atelodictyon solidum* Khromych, 1976, known from the Emsian of the Ulakhan-Sis Range, northeastern Siberia. Khromych (1976) noted the following characteristics of *A. solidum*: laminae 0.05 mm thick, spacing 5 to 10 per 2 mm; pillars 0.04–0.07 mm thick, spacing 10 per 2 mm; astrorhizal canals 0.55 mm wide, distance between neighboring astrorhizae 9.1 mm. Morphometric differences between this and the Ellesmere specimens are therefore minor, with the possible exception being the more closely spaced laminae of Siberian *A. solidum.* Shared features of primary importance are the nature and disposition of the coenosteles, and particularly the large, pervasive astrorhizae, which are identical in the Siberian and Ellesmere Island specimens. Any reservation expressed in the assignment of the Ellesmere specimens is principally due to the limited material available, rather than to morphologic differences, which are within an acceptable range of specific variability.

Atelodictyon solidum was originally described as a subspecies *A. cylindricum solidum* Khromych, 1976. *Atelodictyon cylindricum* Khromych, 1971 is an unusual species with a cylindrical or spherical growth form; it occurs in the Lower Devonian (?Lochkovian-Pragian) Nelyudimskaya Suite of the Omulevski Mountains, northeastern Siberia. In consideration of age and morphologic differences, we elevate *A. c. solidum* Khromych, 1976 to species level.

The exact age of *Atelodictyon solidum* Khromych is uncertain. Khromych (1976, p. 48) lists it as "Eifelian stage, lower Tababastaakhskaya Subsuite, Ulakhan-Sis Range." Traditionally Soviet geologists have set the Lower–Middle Devonian boundary much lower than in the West, in what is now considered Emsian. Only relatively recently have Soviet/Russian stratigraphers adopted international boundary-placements (*cf.* Rzhonsnitskaya, 1988). An additional complication with the northeast-Siberian material is that Khromych's (1974, p. 71–73; 1976, p. 40) correlations are based almost entirely on stromatoporoids alone, unsupported by other fossil groups. Allowing for these uncertainties, the age of the Tababastaakhskaya subsuite appears to be Emsian, probably mid-to-late Emsian, therefore comparable to the *inversus* Zone provenance of the Ellesmere specimens.

Due to the apparent incompleteness of the laminae of *Atelodictyon* cf. *A. solidum,* consideration was given to an assignment to the actinostromatid genus *Aculatostroma* (which also has vermiculate to cateniform pillars in tangential section; *cf.* Stearn, 1991). As noted in the description above, discontinuities in the laminae of this species are attributable to preservation (see below) and, moreover, to interruption by the pervasive astrorhizal system. Most importantly, the coenosteles (pillars) in vertical detail show no evidence of becoming colliculate at their tops; they mostly either splay apart into fine strands, or thicken to meet the lamina above, against which they are sharply abutted.

Atelodictyon cf. *A. solidum* exhibits unusual preservation, although common for other stromatoporoids from the same locality (the shallow-platform, dolomitic facies of the Blue Fiord of southwesternmost Ellesmere Island). Intraskeletal galleries of *A.* cf. *A. solidum* are filled with early-stage, opaque calcite cement, which is poorly transparent in thin-section. When viewed in transmitted light, skeletal elements and cement-filled galleries are nearly equally opaque, and indistinguishable. Examination and illustration of this species therefore had to be done in reflected light, which accounts for the murkier appearance of Pl. 5, figs. 3 and 4 compared to others.

Occurrence.—Blue Fiord Formation, Muskox Fiord, Ellesmere Island; mid-Emsian (*inversus* Zone).

Family **TIENODICTYIDAE**
Bogoyavlenskaya, 1965

Genus **ANOSTYLOSTROMA** Parks, 1936

Type species.—*Anostylostroma hamiltonense* Parks, 1936.

Anostylostroma anfractum, new species
Plate 6, figures 1–5

Diagnosis.—Laminae thin, spaced 7 to 10 in 2 mm; pillars variable, complexly upwardly branched or joined, distinctive in form in tangential section as short chains, geniculate strands, and triskelions.

Description.—Skeleton laminar to slightly domed.

Vertical section: Laminae continuous, gently undulate; thin, 0.03–0.04 mm, locally thickened to 0.05–0.06 mm; regularly spaced, 7 to 10 per 2 mm, specimen averages 9.2, 8.6, 9.5, 7.2 (GSC 108866 to 108869; each n=10); microstructure transversely fibrous or locally transversely porous. Pillars highly variable, mostly upward-branching, either irregularly or simply (Y-shaped); a few upward-thickening or rod-shaped; commonly confined to single interlaminar interval, a few superposed over 2 to 4 laminae. Pillar thickness 0.03–0.08 mm, commonly 0.05–0.06 mm; may thicken upward to as much as 0.20 mm at overlying lamina; spaced 7 to 10 per 2 mm, specimen averages 7.6, 8.8, 8.5, 9.0 (GSC 108866 to 108869; each n=10). Dissepiments common, generally not abundant; thin, 0.02 mm; long, broad, sub-horizontal, gently convex. Latilaminae absent, but thin (0.5–1.0 mm) basal phases of unordered skeletal material may occur overlying growth interruptions.

Tangential section: Laminae moderately dark bands, mostly 0.1–0.2 mm wide; gently meandering. Pillars isolated or interconnected strands, uniformly thick 0.02 mm diameter; strands commonly geniculate, composed of short straight portions (about 0.2 mm long) turning sharply at obtuse angles; shapes commonly approach a triskelion; a few strands interconnected, but not for great lengths; some isolated oblique or circular dots, 0.02 mm diameter, may be locally abundant; very rarely form irregular rings. Pillar microstructure transversely fibrous. Astrorhizae absent.

Material.—Four fragmentary specimens. Preservation mediocre to moderately well preserved. Holotype GSC 108866. Paratypes GSC 108867 to 108869.

Discussion.—*Anostylostroma anfractum* n. sp. is most clearly distinguished in tangential section by its pillars, which appear as angular, geniculate strands forming triskelions, short chains, or isolated masses. It has the most complex pillar arrangement of any species of *Anostylostroma,* which typically exhibit short vermiform pillars in tangential section. The pillars of *Anostylostroma confluens* Galloway and St. Jean, 1957, from the Givetian of Indiana, approach this form, but are not as interconnected as those of *A. anfractum* n. sp. The cross sections of the pillars of *A. confluens* cut in tangential section are short, vermiform or coalescing, and without the geniculate form of *A. anfractum* n. sp.

The regularity of pillars in tangential section belies the extreme variability of pillars in vertical sections of *A. anfractum* n. sp. Two factors complicate characterization of pillars in vertical aspect: generally mediocre preservation, and variation in proportions of different pillar types between specimens. In vertical section, two of the paratypes (GSC 108868 and 108869) exhibit the commonest pillar arrangement, dominated by complexly branching, irregular, commonly inclined pillars. A third paratype (GSC 108867) in contrast displays a more orderly arrangement of pillars, in which simple rods are comparatively common (Pl. 6, fig. 3). The holotype (GSC 108866) represents an intermediate case, with complex and simple pillars occurring in near equal proportions.

Etymology.—Latin *anfractum*: bending, winding, or circuitous. Describes the pillars in tangential section.

Occurrence.—Northeastern Bathurst Island; unnamed limestone formation, lower 100 m; highest Emsian/basal Eifelian (undifferentiated *patulus* Zone).

Genus **PSEUDOACTINODICTYON** Flügel, 1958

Type species.—*Pseudoactinodictyon juxi* Flügel, 1958.

Pseudoactinodictyon conglutinatum, new species

Plate 7, figures 1–4

Diagnosis.—Laminae thick, compounded of fusion of adjacent thin laminae, locally split like those of *Simplexodictyon,* widely spaced 2 to 4 in 2 mm; pillars robust, spooled or dividing upward, dotlike of sausage-shaped in cross section.

Description.—Skeleton domal to hemispherical, up to 10 cm diameter. Surface irregular, without perceptible mamelons or astrorhizae.

Vertical section: Laminae undulate; spacing wide, inconsistent, 2 to 4 per 2 mm, holotype (GSC 108870) average 3.3 (n=10); distance between successive laminae variable, commonly 0.30–1.40 mm, holotype (GSC 108870) average 0.65 mm range 0.40–1.00 mm (n=30), paratype (GSC 108871) average 0.76 mm range 0.35–1.35 mm (n=30), locally as much as 2.0 mm. Laminae compound, formed by fusion of adjacent thin laminae, either completely or incompletely; completely fused laminae thick 0.14–0.28 mm average 0.20 mm (n=20, combined GSC 108870 and 108871), no axial zone; incompletely fused twin laminae separated by thin gap ca. 0.02 mm, locally swollen forming flat-bottomed vacuities, lower twin lamina generally thinner 0.04–0.06 mm than upper twin 0.12–0.16 mm; laminae locally perforate, perforations/foramina occluded by dissepiments at or near laminar level. Pillars commonly simple spool-shaped, or upward-dividing Y-shaped; thick 0.12–0.20 mm, holotype (GSC 108870) average 0.13 mm paratype (GSC 108871) average 0.17 mm (each n=10); spacing variable, range 4 to 8, commonly 5 to 7 per 2 mm, holotype (GSC 108870) average 5.5 per 2 mm (n=20), paratype (GSC 108871) average 6.6 per 2 mm (n=10). Dissepiments common, locally abundant. Microstructure compact. Astrorhizae obscure, indicated only by vaguely defined zones of downturned laminae, inwardly inclined pillars, dense concentrations of dissepiments and laminar perforations.

Tangential section: Pillars solid dots 0.10–0.14 mm diameter, or thicker, irregular, sausage-shaped or confluent (toward upper laminae). Dissepiments common, locally abundant, linking just less than half of pillars. Interlaminar gaps and vacuities scattered but prominent, more prevalent/conspicuous than in vertical section.

Material.—Three partial skeletons, moderately well preserved. Holotype GSC 108870, paratype GSC 108871, specimen 111-19.

Discussion.—Compared to Middle Devonian species of *Pseudoactinodictyon, P. conglutinatum* n. sp. displays generally thicker structural elements and wider laminar spacing. The most closely comparable species are *P. juxi* Flügel, 1958 from the Givetian of Sauerland, Germany (Flügel, 1958), and *P. vagans* Parks, 1936 from the Detroit River Group (probably Emsian) of Ontario and Ohio (Fagerstrom, 1982). The spacing of both laminae and pillars is roughly one and one-half times denser in *P. vagans* than in *P. conglutinatum* n. sp., and skeletal elements are finer (*P. vagans* laminae 0.05–0.07 mm, pillars 0.05–0.10 mm thick). Pillar thickness of *P. juxi* is comparable to *P. conglutinatum* n. sp., and ranges of laminar thicknesses overlap (0.10–0.20 mm vs. 0.14–0.28 mm); spacing of skeletal elements is somewhat closer in *P. juxi* (4 to 6 laminae, 6 to 8 pillars in 2 mm).

The most noteworthy feature of *Pseudoactinodictyon conglutinatum* n. sp. is the arrangement of successive laminae, either fused to form thick compound laminae, or separated by a gap of irregular thickness. Such an arrangement suggests a growth pattern in which each successive unit, composed of thin upper and lower laminae joined by pillars, is separated by an interruption in growth. The succeeding thin lower lamina is lain atop the upper lamina of the previous growth unit, and either "welded" to it, or remains separated by a gap. This unusual growth pattern is also known in (and characteristic of) the genera *Simplexodictyon* (formerly *Diplostroma*; *cf.* Nestor, 1976; Stearn, 1991) and *Nuratodictyon* (known from only one specimen; Lessovaya, 1972, Stearn, 1980). The significance of such gaps between the laminae is further discussed by Stearn and Pickett (1994). Mori (1968) first recognized that the "split" laminae of *Simplexodictyon* indicate pauses in growth, the gaps being devoid of skeletal elements and often incorporating trapped sediment or encrusting organisms. No trapped sediment or encrusting organisms are present within the interlaminar gaps of *Pseudoactinodictyon conglutinatum* n. sp. Another difference from *Simplexodictyon* is that in this latter genus divergent laminae are much more common than fused laminae, but in *P. conglutinatum* n. sp. gaps are distributed sporadically: in the paratype (GSC 108871) gaps are much rarer than in the holotype (GSC 109970).

Stearn (1980, 1991) proposed the Family Simplexodictyidae (formerly Diplostromatidae) for species demonstrating the interrupted growth pattern diagnostic of *Simplexodictyon* and *Nuratodictyon.* Recognition of this unusual growth pattern outside these two genera, as is the case here, may require reevaluation or some redefinition of the Family Simplexodictyidae.

Simplexodictyon grandiosum Lessovaya, 1970 from the upper Emsian (*Favosites regularissimus* Zone) of Uzbekistan (Lessovaya, 1970), shows certain similarities to *Pseudoactinodictyon conglutinatum* n. sp. from Ellesmere Island, and may be related. *Simplexodictyon grandiosum* is very robustly built (laminae and pillar spacings 4 to 5 per 2 mm), and has thick (0.2–0.4 mm), "bipartite" laminae with an axial light-coloured zone (Lessovaya, 1970; p. 87). Lessovaya's description and illustrations do not however indicate any divergence or gaps between the compound or "bipartite" laminae; the pillars of *S. grandiosum* are thick, simple and spool-shaped. It appears unlikely that *Pseudoactinodictyon conglutinatum* n. sp. and *Simplexodictyon grandiosum* are the same species, but that the central Asian species may be another Lower Devonian form of *Pseudoactinodictyon,* allied to *Pseudoactinodictyon conglutinatum* n. sp. An earlier suggestion by Stearn (1991) that *Simplexodictyon grandiosum* should be reassigned to the genus *Petridiostroma* is probably incorrect.

Etymology.—From the Latin *conglutinatus,* bound or glued together; describes the fused twin laminae.

Occurrence.—Blue Fiord Formation, Ellesmere Island; formation type section, upper member, from a unit lying 200–400 m below the top of the formation (two type specimens); upper Emsian (*inversus-serotinus* Zones). Bird Fiord Formation, near base of formation; Bird Fiord, Ellesmere Island (one specimen); uppermost Emsian/basal Eifelian (undifferentiated *patulus* Zone).

Genus **SCHISTODICTYON** Lessovaya, 1970

Type species.—*Schistodictyon posterius* Lessovaya, 1970.

Schistodictyon? sp.

Plate 7, figures 5,6

Description.—Skeleton apparently laminar.

Vertical section: Laminae thin 0.03–0.04 mm, regular, continuous, flat or gently undulate; spacing regular, 7 to 10 per 2 mm, average 8.6 (n=10); microstructure compact, locally weakly transversely fibrous. Pillars very variable: simple spool-shaped (44%), upward-thickening to meet overlying lamina (28%), upward-bifurcating Y-or V-shape (26%); doubly upward-dividing (2%) (n=100); dominantly vertical, but commonly inclined; spaced 7 to 9 per 2 mm, average 7.7 (n=10); thickness 0.04–0.06 mm, up to 0.10 mm at junction with overlying lamina; rarely superposed.

Tangential section: Laminae form thin, diffuse, meandering bands. Pillars dominantly simple dots 0.04–0.08 mm diameter, may be vermiform or linked toward laminae; irregular rings rare. Dissepiments rare. Astrorhizae absent.

Material.—A single specimen, GSC 108872. Well preserved.

Discussion.—This single specimen is questionably assigned to the genus *Schistodictyon* on the basis of its Y-and V-shaped pillars (a few of which are doubly bifurcating). Ideally, *Schistodictyon* is characterised by a predominance of bifurcating pillars (Stearn, 1991), as demonstrated by *S. papillatum* (Parks) (*cf.* Stearn, 1991, fig. 2.2). In vertical sections of *Schistodictyon*? sp. from Ellesmere Island, only about one-quarter of the pillars are bifurcating; about one-half are simple rods and the remainder are intermediate in nature (*i.e.*, upward-thickening). Specimens such as this, which show characteristics intermediate between *Schistodictyon* and related genera such as *Petridiostroma* and *Anostylostroma*, are not unusual. Because the true morphological range of this species cannot be understood from a single specimen, the generic assignment must remain equivocal.

Vertical sections of *Schistodictyon*? sp. are similar to those of *Petridiostroma* sp. (also from the Blue Fiord Formation, Ellesmere Island). The main difference is the proportion of bifurcating pillars (which are rare in *Petridiostroma* sp.). Tangential sections more clearly show this distinction, but the possibility cannot be dismissed that the single specimens separately assigned to *Schistodictyon*? sp. and *Petridiostroma* sp. are conspecific. Many more specimens are needed before these problems can be meaningfully resolved.

Specimens from the Emsian of eastern Australia assigned to *Schistodictyon* sp. by Webby and Zhen (1993) are quite similar to the Blue Fiord specimen, but again too little material is available from which to draw firm conclusions.

Occurrence.—Blue Fiord Formation, lower 100 m; vicinity type section; lower Emsian (*dehiscens* Zone).

Order **STROMATOPORELLIDA** Stearn, 1980

Family **STICTOSTROMATIDAE** Khalfina and Yavorsky, 1973

Genus **STICTOSTROMA** Parks, 1936

Type species.—*Stictostroma gorriense* Stearn, 1995.

Stictostroma gorriense Stearn, 1995a
Plate 8, figures 1–5

non *Stromatopora mammillata* Nicholson, 1873, p. 94, pl. 4, fig. 4.
Stictostroma mammillatum (Nicholson). Parks, 1936, p. 78–81, pl. 14, figs. 3–6.
Stictostroma mamilliferum Galloway and St. Jean, 1957, p. 125–127, pl. 6, figs. 4a,b; Galloway, 1957, pl. 31, fig. 6, pl. 33, fig. 9; St. Jean, 1962, p. 188–189, pl. 31, figs. 1–5; Fagerstrom, 1982, p. 40–41, pl. 8, figs. 6,7; Prosh and Stearn, 1993, figs. 3c, 3d.
Stictostroma mccannelli Fagerstrom, 1961, p. 7, pl. 2, figs. 7–9; 1982, p. 40–41.
Stictostroma gorriense Stearn, 1995a, p. 26, figs. 1.6, 1.7, 2.5, 2.6; 1995b, p. 1–3.

Description.—Skeleton weakly domical to thick-laminar with ragged edge; rarely encrusting or intergrown. Surfaces bearing abundant, small, very regularly spaced mamelons, ca. 1 mm high, 1–2 mm diameter, 4–5 mm center-to-center distance. Latilaminae moderately well developed, 2–4 mm thick.

Vertical section: laminae continuous, flat or very gently undulate, consistently parallel; regularly spaced, commonly 13 to 15 per 2 mm, specimens GSC 108873 average 14.3 range 12 to 17, GSC 108177 average 14.2 range 12 to 16, GSC 108176 average 14.0 range 13 to 15, GSC 108874 average 13.8 range 12 to 15 (all n=10); thickness 0.03–0.06 mm, commonly 0.04–0.05 mm; microstructure ordinicellular, transverse tubules and intervening skeletal material both about 10–15 μm wide, grading locally to tripartite or with median row of cellules; diagenetically altered laminae tripartite, with median pale band 0.02–0.04 mm thick and dark exterior bands 0.01 mm thick, vaguely transversely fibrous. Pillars stout, spool-shaped, 0.04–0.08 mm thick, thickening and merging into laminae; very rarely formed by up-arching and merger of lower lamina (in the manner of *Stromatoporella*); irregularly offset between successive laminae, rarely superposed; spaced irregularly 7 to 12 per 2 mm, specimens GSC 108873 average 9.2 range 7 to 11 (n=20), GSC 108177 average 9.6 range 8 to 11 (n=10), GSC 108176 average 9.7 range 9 to 11 (n=10), GSC 108874 average 10.1 range 9 to 12 (n=10); locally absent for lengths up to 1 mm; microstructure poorly preserved, generally suggesting cellules or vertically-aligned tubules. Dissepiments broadly convex, very thin, 5–10 μm, commonly occupying uppermost portion of galleries; easily lost diagenetically, probably originally common. Mamelons variably and only sparingly evident (despite prominence on exposed surfaces), apparent in some specimens and not in others; mostly shallow, vertically impersistent, with no or very weak astrorhizal canals; less commonly may be vertically persistent up to 5 mm height, with poorly developed astrorhizae, central canal 0.15 mm wide. Intergrown organisms (corals, algae) common.

Tangential section: laminae thick diffuse bands. Open gallery space generally comprises less than half total area. Pillars subcircular, isolated, numerous, crowded, 0.04–0.10 mm diameter; ring-pillars absent; microstructure cellular (sectioned transverse tubules), cellule diameter 10–15 μm, but fine-structure only very rarely preserved, commonly compact. Astrorhizae comprise few, short, poorly-defined canals, 0.10 mm diameter; about half of all mamelon centers without astrorhizae.

Material.—Eight specimens; one complete skeleton, 7 partial (2 of which are encrusting). Moderately well to well preserved. Hypotypes GSC 108873 to 108875, 108176, 108177. Other specimens listed in Appendix 3.

Discussion.—*Stictostroma gorriense* has been widely recognized from southern Ontario; the most thorough synonymy to date was provided by Fagerstrom (1982,

Table 1.—Comparative measurements of *Stictostroma gorriense* Stearn.

Species	*lamin. spac'g/ 2 mm**	*lamin. thick. mm**	*pillar spac'g/ 2 mm*	*pillar thick. mm*	*mam. h'ght mm*	*mam. diam. mm*	*mam. spac'g. mm c-c*	*astrorhizae*	*lati. spac'g mm*
Blue Fiord specimens *S. gorriense*	13–15 (12–17)	.04–.05 (.03–.06)	7–12	.04–.08	1	1–2	4–5	some, poor	2–4
Galloway and St. Jean (1957) *S. mamilliferum*	11–13	.03–.06	4–7	.02–.2	2	3–7	7–12	none	1–2
Fagerstrom (1982) as *S. mamilliferum*	9–14		+10					variable	1–3
Fagerstrom 1961 as *S. mccannelli* = *S. mamilliferum*	11–13	0.1	8–12	.01–.2	.5–2	4–6	6–8	short	1–3
Parks (1936) as *S. mammillatum*	12	.04	±10	.02–.16			8	none	

* Average spacing and range ( ) are given.

Abbreviations: *lamin.*—laminar, *spac'g*—spacing, *thick.*—thickness, *mam.*—mamelon, *h'ght*—height, *diam.*—diameter, *mam. spac'g* mm c-c—mamelon spacing millimeters center-to-center, *lati.*—latilaminar.

p.40). Major morphologic measurements of previously described occurrences and of the Blue Fiord specimens are shown in Table 1. The Blue Fiord specimens fall within the specific range of variation for most criteria, with the spacing of their laminae falling at the closely-spaced extreme. Narrowly spaced laminae distinguish *S. gorriense* from the closely related species *S. problematicum* and *S. anomalum* (see Fagerstrom, 1982). As is apparent in Table 1, there is considerable variation in morphometric ranges between described occurrences. Some of this variation may be due to geographic variability, but most, as noted by Fagerstrom (1982), is artifactual, due to excessively small sample sizes.

A feature of considerable importance is the development of numerous, close-set mamelons. In contrast to previous descriptions, the mamelons of Blue Fiord *S. gorriense* are smaller and more crowded, but otherwise similar in terms of form and arrangement. Although numerous (on exposed growth surfaces), the mamelons of Blue Fiord *S. gorriense* are narrow and mostly impersistent, so that their expression in vertical thin-section is often severely muted. Development of astrorhizae is similarly highly variable. Although Galloway and St. Jean (1957) diagnosed *S. mamilliferum* = *gorriense* as without astrorhizae, Fagerstrom's (1982) analysis of a large sampling revealed weak astrorhizae in some specimens. The same irregular development of astrorhizae occurs in the Blue Fiord specimens, roughly half with and half without astrorhizae.

The Arctic occurrence of this species is of biostratigraphic significance, relating the Blue Fiord Formation (Emsian) to North American midcontinent occurrences of uncertain chronostratigraphy. *Stictostroma gorriense* has been recorded from the lower Detroit River Group of southern Ontario (Parks, 1936; Galloway and St. Jean, 1957; Fagerstrom, 1961, 1982). A correlation using this species and *Stromatoporella perannulata* suggests that the Detroit River Group is fully Emsian in age (Prosh and Stearn, 1993).

Occurrence.—Blue Fiord Formation, Ellesmere Island; lower member, vicinity type section (six specimens), lower Emsian (*dehiscens* Zone); upper member, Vendom Fiord (two specimens), upper Emsian (*inversus–serotinus* Zones).

Stictostroma? nunavutense, new species
Plate 9, figures 1–5

Diagnosis.—Thick, regularly spaced extensive laminae of microtubulate to ordinicellular microstructure with two to three internal tubules within thickness of lamina. Vertical elements rarely irregular post-pillars, commonly coenosteles, thick. Astrorhizal systems diffuse, pervasive, interrupting the lateral regularity of the structure.

Description.—Skeleton hemispherical to irregular, up to 10 cm diameter; surface rough, without mamelons or visible astrorhizae. Latilaminae crude, irregular, 0.5–1.0 cm thick.

Vertical section: Laminae thick 0.15–0.20 mm, gently undulate to irregular; variably continuous, locally interrupted by abundant foramina; spacing very regular, 6 to 8 per 2 mm, specimen GSC 108876 (holotype) average 7.0 range 6 to 8, GSC 108877 average 6.9 range 6 to 8 (each n=10). Laminar microstructure microtubulate to ordinicellular; lateral tubules commonly 2 to 3 within the thickness of laminae, 0.02 mm wide; microstructure commonly diagenetically altered to transversely fibrous or compact. Pillars and coenosteles variable in form; most commonly as thick as laminae, 0.10–0.20 mm; stout, uniformly thick or slightly expanding to meet overlying lamina; randomly offset, locally superposed over three or four laminae; thin pillars fewer, rod-shaped, as thin as 0.05 mm;

microstructure of thick pillars tubulate to fibrous, of thin pillars compact. Galleries variable, commonly circular 0.10–0.15 mm diameter, some laterally elongate, vermicular. Locally where interrupted by astrorhizal systems, macrostructural framework tends toward amalgamate. Dissepiments rare, very fine, 0.01 mm thick. Astrorhizae vague, indicated only by upward-doming of laminae, interruption of laminae by vertical canals, and zones of disordered lateral canals 0.15 mm diameter merging intimately with galleries.

Tangential section: Thick, labyrinthine network with little open gallery space. Dominantly closed labyrinthine network of coenosteles 0.15–0.20 mm across; isolated pillars subordinate, either subcircular dots (post-pillars) or short vermiform segments 0.10–0.15 mm diameter. Microstructure clotted, grading to irregularly tubulate in thick labyrinthine elements and laminae. Astrorhizae common, defined by short, branching astrorhizal paths between coenosteles, weakly ordered radial zones of short irregular canals 0.15 mm diameter, grading rapidly into labyrinthine gallery space. Astrorhizal centres spaced about 6 mm apart.

Material.—Six specimens, ranging from poorly to well preserved. Holotype GSC 108876; paratypes GSC 108877 and 108878. See Appendix 3 for other specimens.

Discussion.—*Stictostroma*? *nunavutense* n. sp. is characterized by thick, regularly spaced laminae, generally equally thick pillars that are either offset or irregularly superposed, and tubulate microstructure. It is an unusual new species not readily assignable to known genera. Compared to most species of *Stictostroma,* the skeletal elements of *S.*? *nunavutense* are much thicker and less regularly arranged. It is tentatively assigned to *Stictostroma* on the basis of its continuous laminae, non-superposed pillars, and similar microstructure. Numerous stromatoporellid species (of *Stromatoporella, Stictostroma,* and *Clathrocoilona*) have previously been described as microtubulate (*e.g.,* Birkhead, 1967; Zukalová, 1971).

The astrorhizae of *Stictostroma*? *nunavutense* n. sp. are unusually diffuse and apparently pervasive. They do not form discrete structures, but rather considerably modify the structural architecture of the stromatoporoid at intervals; in this indirect way they are diagnostic. In vertical section the astrorhizae *per se* are difficult to locate, defined by zones of vertically elongate canals that intimately merge into the gallery network. In tangential section they are more easily identified, forming clusters of canals that again merge radially into galleries. Tangential sections indicate the astrorhizae are abundant and very closely spaced (about 6 mm apart). In vertical section, therefore, the astrorhizae may simply appear as zones where complex galleries occur and laminae may be discontinuous, and the skeleton itself may verge on an amalgamate structure. The "background" architecture of the stromatoporoid, as it were, is continuous thick laminae, dominantly circular galleries; the astrorhizal systems are so integrated into the skeleton, however, that this unmodified structure occurs in only about half the vertical view.

All specimens of this species show variably irregular growth form, and none of the specimens is uniquely composed of this species. All show varying degrees of intergrowth with other stromatoporoid species, most commonly *Gerronostroma septentrionalis* n. sp. and *Stictostroma gorriense* Stearn, 1995.

Etymology.—For Nunavut, the territory of the eastern Canadian Arctic; in the language of the Inuit, "land of the people."

Occurrence.—Blue Fiord Formation, lower member, lower 100 m; Ellesmere Island, Eids Fiord; lower Emsian (*dehiscens* Zone).

Genus **STROMATOPORELLA** Nicholson, 1886

Type species.—*Stromatoporella granulata* Nicholson, 1886

Stromatoporella perannulata
Galloway and St. Jean, 1957
Plate 10, figures 1,2

Stromatoporella cellulosa Parks, 1936, p. 108–110, pl. 4, figs. 6,7; non *Clathrodictyon cellulosum* Nicholson and Murie, 1878, p. 221, pl. 2, figs. 6–10.

Stictostroma eriense Parks. Lecompte, 1951, pl. XX, figs. 2, 2a, 2b.

Stromatoporella perannulata Galloway and St. Jean, 1957, p. 142–144, pl. 9, figs. 3a,b; St. Jean, 1986, p. 1043–1045, figs. 5.4–5.6; Prosh and Stearn, 1993, Figs. 3a,3b.

Stromatoporella eriensis (Parks). Galloway and St. Jean, 1957, p.145–147, pl.10, figs. 2a,b.

Stromatoporella perannulata(?) Fagerstrom, 1982, p. 38–39, pl. 7, figs. 2–4.

Stromatoporella eriense(?) (Parks). Fagerstrom, 1982, p. 39, pl. 7, fig. 5.

Description.—Skeleton laminar, thick, only gently undulate. Surface bears few small low-relief mamelons, 0.1 mm high, 0.2 mm diameter, irregularly spaced 1–2 cm apart, without astrorhizae; surface visibly fine granular. Latilaminae moderately to poorly developed, up to 1.0 cm thick.

Vertical section: Laminae continuous, generally consistently parallel, rarely merging laterally, gently to moderately undulant; extremely crenulate on a fine-scale; very thin 0.02–0.04 mm, but commonly thickened and obfuscated diagenetically; regularly spaced, 7 to 10 per 2 mm, specimens GSC 108175 average 8.5 range 8 to 10, GSC 108879 average 7.7 range 7 to 8, GSC 108880 average 7.7 range 7 to 9 (all n=10); microstructure finely transversely porous or fibrous, locally altered to compact, not tripartite. Pillars either rings or simple posts, continuous lateral count of 100 complete pillars (GSC 108175) 51% rings 49% posts; rings extend fully to overlying lamina, central lumen 0.03–0.06 mm across, walls as laminae 0.02–0.04 mm thick; posts simple, may very gently thicken at laminae, 0.02–0.05 mm thick; no pattern of distribution rings and posts, although either may cluster 3 or 4 consecutive, certain interlaminar spaces may display more of one than another; never superposed, fairly consistently offset; spaced 6 to 9 per 2 mm, specimens GSC 108175 average 7.3 range 6 to 9, GSC 108879 average 7.3 range 6 to 8, GSC 108880 average 7.4 range 6 to 9 (all n=10); microstructure of rings transversely fibrous, continuous with laminae, of posts vaguely fibrous or compact. Galleries subequally elongate-rectangular or subcircular; subcircular where ring-pillars abundant, locally forming short bead-like chains; elongate galleries up to 2 mm long locally present where pillars absent. Dissepiments only locally abundant, very broadly convex, thin 0.02 mm. Mamelon columns rare (present only GSC 108175), up to 1.5 cm high; one thin section (of GSC 108175) preserves short segment (2.0 mm) central astrorhizal canal, without lateral tributaries; astrorhizae otherwise absent. One specimen (110-236) with abundant commensal corals.

Tangential section: Laminae forming meandering thin bands or lines, highly scalloped (linked partial-ring pillars) or confluent with ring-pillars. Ring-pillars abundant, either half total pillars (GSC 108175) or fewer than half (GSC 108879, 108880); most common within or adjacent to laminae, less commonly within interlaminar spaces; wall thickness 0.02–0.04 mm, central lumen 0.04–0.12 mm diameter; roughly 0.10–0.12 mm apart center-to-center; microstructure transversely porous or fibrous. Post pillars small, irregular dots, 0.03–0.08 mm diameter; many intergrading shapes between ring and post pillars. Mamelon columns marked by sectioned laminae forming bull's-eyes, roughly 1–2 mm apart center-to-center; no astrorhizae.

Material.—Six specimens, ranging from poorly to exceptionally well preserved. Hypotypes GSC 108175, GSC 108879, GSC 108880. Other specimens listed in Appendix 3.

Discussion.—*Stromatoporella perannulata* is widely documented from the North American midcontinent. The type specimens of Galloway and St. Jean (1957) come from the Jeffersonville Limestone near Louisville, Kentucky. Many more specimens are recorded from southern Ontario and vicinity. Fagerstrom (1982) listed many occurrences from the Formosa Reef Limestone (Amherstburg Formation) and the Detroit River Group of Ontario, and from the Columbus Limestone near Marblehead, Ohio. St. Jean (1986) described *S. perannulata* from the Port Colborne area (Niagara Peninsula) of Ontario, in rocks of uncertain assignment (Bois Blanc Formation or lower Onondaga Limestone). The Port Colborne specimens of St. Jean (1986) are strikingly similar to those from the Blue Fiord Formation (compare Plate 10, figures 1 and 2 herein to figs. 5.4 to 5.6 of St. Jean, 1986).

Stromatoporella eriensis (Parks) does not objectively differ from *S. perannulata,* and most references to *S. eriensis* should be transferred to *S. perannulata.* As noted by Fagerstrom (1982), the presumed difference, that *S. perannulata* has mamelons and *S. eriensis* has none, is untenable. Larger collections of specimens (of Fagerstrom, 1982, and herein) demonstrate variable development of mamelons in *S. perannulata.* In given specimens mamelons may be weakly developed or locally absent, and therefore present in some thin-sections and absent in others. The synonymy herein includes all references to *Stromatoporella eriensis* exclusive of the type specimens of Parks, 1936 (originally referred to *Stictostroma eriense*). Examination of Parks' types reveals specimens unlike *S. perannulata.* Parks' holotype 2610.D (ROM 13190) shows more widely spaced laminae (6 to 8 per 2 mm) that are at least twice as thick (0.05–0.10 mm) as those of *S. perannulata.* Also the strong crenulation of laminae into the pillars of *S. perannulata* is poorly developed in Parks' types (2601.D, 2602.D, 2603.D). Although assignable to *Stromatoporella,* Parks' types represent a species other than *S. perannulata.* The species *Stromatoporella eriensis* (Parks) therefore appears to be uniquely confined to Parks' (1936) types, but all subsequent references to *S. eriensis* belong to *S. perannulata.*

In the Arctic, *S. perannulata* is confined to the Emsian Blue Fiord Formation (*dehiscens* to *inversus* Zones). The presence of *S. perannulata* and *Stictostroma gorriense* in both the Blue Fiord Formation and the Detroit River Group of Ontario suggests these units are time-correlative, *i.e.,* the Detroit River Group is Emsian (Prosh and Stearn, 1993).

Occurrence.—Blue Fiord Formation, Ellesmere Island; lower member, Eids Fiord (one specimen), Sör Fiord (2 specimens), Vendom Fiord (one specimen), lower Emsian (*dehiscens–gronbergi* Zones); platformal dolomitic facies, Goose Fiord, Muskox Fiord (one specimen each), mid-Emsian (*inversus* Zone).

Genus **CLATHROCOILONA** Yavorsky, 1931

Type species.—*Clathrodocoilona abeona* Yavorsky, 1931.

Clathrocoilona Yavorsky, 1931, p. 1394–1395, 1407; Kossareva, 1976, p.21; Stock, 1982, p. 670–673; synonymies therein.

Discussion.—Yavorsky's original diagnosis of the genus, based uniquely on the type *Clathrocoilona abeona,* stressed strictly macrostructural details, principally the abundant astrorhizal foramina, thick continuous laminae, and non-superposed pillars. He characterized the microstructure as compact, but noted the presence of a white median line in the laminae. Subsequent authors placed greater emphasis on microstructure, and differing assessments of the composition of *Clathrocoilona* resulted in divergent suprageneric assignments. Galloway (1957) and Galloway and St. Jean (1957) considered *Clathrocoilona* to be "coarsely maculate" (although with thick, tripartite laminae), and hence assigned *Clathrocoilona* to the Stromatoporidae. Although Lecompte (1951) did not recognize *Clathrocoilona* as valid, many species he placed in *Stromatoporella* were later reassigned to *Clathrocoilona* (Flügel and Flügel-Kahler, 1968; Kossareva, 1976). Still, Lecompte's emphasis on the tripartite laminae of these species helped influence subsequent workers to include *Clathrocoilona* with the Stromatoporellidae (Zukalova, 1971) or Stromatoporellida (Stearn, 1980). Most recently, Stock (1982) placed *Clathrocoilona* in the Stromatoporidae, interpreting its microstructure as "originally microreticulate or melanospheric, but may be altered to compact" (p. 671), and noting the common occurrence of tripartite laminae.

Kossareva (1976) advanced understanding of *Clathrocoilona* with a redescription of the genus and a detailed microstructural analysis of Yavorsky's types (regrettably unillustrated). Kossareva described the laminae of *Clathrocoilona* as composite, made up of 2 to 4 microlaminae joined by micropillars. In Kossareva's concept the multilayered laminae appear to bear 1 to 3 light median bands, in places preserving the micropillars and appearing cellular, elsewhere appearing continuous or hollow. Commonly the tissue is permeated by small pores. For much of the skeleton, Kossareva described the elements as having a "felted appearance", implying a disordered microstructural network, producing a tangle of microlaminae and light bands.

The foregoing brief history illustrates the variety of suprageneric assignments proposed for *Clathrocoilona,* and how interpretation of its complex microstructure has influenced its assignment. Similarly, *Clathrocoilona vexata* n. sp. (described below) demonstrates a bewildering variety of microstructures, that has prompted one of us (ECP) to interpret them as diagenetic modifications of microreticulation (hence favoring assignment to Order Syringostromatida), the other author (CWS) as variability in the original skeletal microstructure. Owing to these uncertainties, and to the subjectivity of interpreting microstructure, we retain *Clathrocoilona* in the Order Stromatoporellida.

Clathrocoilona vexata, new species

Plate 10, figures 3, 4; Plate 11, figures 1–8;
Plate 12, figures 1,2

Clathrocoilona cf. *C. saginata* Lecompte. Stearn, 1983, p. 549, 551, figs. 5G, 5H.

Diagnosis.—Skeletal elements in alternately thick and thin successive phases; very closely spaced laminae and pillars.

Description.—Skeletal form variable, commonly thin encrusting, some irregular, rarely small hemispheres. Surface irregular; small mamelons abundant, astrorhizae imperceptible. Latilaminae 2–3 mm thick.

Vertical section: Alternating zones or phases of thin and thick skeletal elements (laminae and pillars). Laminae very irregular, undulate, discontinuous, interrupted by abundant foramina and coalescing laterally; sharply inflected into shallow mamelons confined to single latilamina; spaced 9 to 14 per 2 mm, holotype GSC 108881 average 10.7 range 9 to 12, paratype GSC 108882 average 13.0 range 11 to 14 (each n=10); thick laminae 0.06–0.15 mm; thin laminae as thin as 0.02 mm; commonly thick laminae (and pillars) at base latilamina, grade to thin at top. Pillars spool-shaped, thick 0.05–0.14 mm, or thin to 0.03 mm; commonly randomly offset between successive laminae, a few superposed over 2 to 4 laminae; spaced 8 to 13 per 2 mm, holotype GSC 108881 average 9.3 range 8 to 11, paratype GSC 108882 average 11.4 range 9 to 13 (each n=10); locally absent. Microstructure complex, highly variable; porous/cellular, fibrous, vermiculated, or compact; pores/cellules scattered, subspherical or vertically elongated, 15–20 μm diameter, where juxtaposed intervening microelements 5–15 μm thick. Astrorhizae poorly formed; rare short irregular vertical canals 0.10 mm diameter; subcircular or ovoid foramina ubiquitous, 0.3–0.6 mm lateral diameter. Dissepiments common, abundant in areas of skeletal repair; broadly convex, thin 0.01 mm. Included organisms (gastropods, brachiopods, ostracodes, worm tubes) common.

Tangential section: Laminae dense meandriform bands, discontinuous. Pillars isolated dots 0.04–0.10 mm diameter, or short thick 0.08–0.10 mm gently curved vermiform strands. In holotype (GSC 108881) about half visible area free laminae and pillars (thin element zones); remainder dense, clotted, amalgamate, little open gallery space (thick element zones). Astrorhizae common, widely dispersed; form rare irregularly branched aggregates; main/axial canals 0.25–0.30 mm diameter, secondary canals commonly 0.08–0.15 mm diameter; tabulae present, poorly preserved. Microstructure porous/tubulate, vermiculated, fibrous, irregularly melanospheric, or compact; pores scattered, locally clustered, circular to oval, 10–20 μm diameter, where section oblique plunge into shallow tubules.

Material.—Nine specimens, four of them well preserved. Holotype GSC 108881, paratypes GSC 108882, 108883. Other specimens listed in Appendix 3.

Discussion.—Thirty to 40 species of *Clathrocoilona* are previously known; the tally is imprecise because some species are probably redundant, others misassigned to genera such as *Stromatoporella.* The characteristic, extreme structural variability of *Clathrocoilona* species makes comparison and identification difficult. *Clathrocoilona vexata* n. sp. is distinguished by very narrowly spaced skeletal elements, 9 to 14 laminae and 8 to 13 pillars per 2 mm; most *Clathrocoilona* species average around 5 to 6 laminae and pillars per 2 mm. Only *Clathrocoilona saginata* (Lecompte, 1951) (Frasnian; Belgium) displays comparable spacing, with 9 to 14 laminae and 6 to 10 pillars per 2 mm. *C. saginata* differs from *C. vexata* n. sp. in its more regularly arranged laminae, fewer astrorhizal foramina, and much more pronounced and persistent mamelons. This new species was earlier referred to *Clathrocoilona* cf. *C. saginata* by Stearn (1983).

Another distinctive feature of *C. vexata* n. sp. is the alternation of zones of thin versus thick skeletal elements (laminae and pillars). Similar thickness alternation is also exhibited by *Clathrocoilona solida* Yavorsky, 1955, *C. solida* (Hall and Whitfield, 1873, redescribed by Stock, 1984) and *C. saginata* (Lecompte), and to a lesser degree by *C. crassitexta* (Lecompte, 1951), *C. crassum* (Yavorsky, 1963), *C. obliterata* (Lecompte, 1951), and *C. spissa* (Lecompte, 1951) (but strongly present in *C. spissa* of Zukalová, 1971). In *C. vexata* n. sp. and these other species the thickness alternation is pronounced, yet similar variation can be found in many, if not most species of *Clathrocoilona.*

Areas of good preservation in tangential sections of *C. vexata* n. sp. show small circular voids 10–20 μm across and distributed randomly (Pl. 11, fig. 1). One of us (ECP) postulates that these, among other criteria, are evidence that the microstructure is irregularly microreticulate, a microstructure described by Stock (1989) as akosmoreticulate. The other (CWS) would call this microstructure largely cellular, but the distinction between the two is mostly semantic. The voids or pores in tangential section would then be described by the former as microgalleries and by the latter as cellules. This porous skeletal material does not appear to have been secreted uniformly but originally was separated by skeletal elements of compact tissue. A much wider range of microstructures occurs, however, in *C. vexata* n. sp. This range (from cellular to melanospheric to tubulate to ordinicellular to tripartite to fibrous to compact) can be interpreted as caused by: 1) diagenetic filling of the voids that define the microstructure, or 2) to an original broad range of secreted skeletal material, or 3) to a combination of both.

Vertical sections (Pl. 11, figs. 2, 3) may show vertically elongate or tubular voids separated by similar fine skeletal tissue that would be called micropillars by one of us (ECP). Fine horizontal elements cross these voids, but whether they are solid plates (microlaminae) or rods (microcolliculi) is uncertain. Certain states interpreted as diagenetic by ECP exhibit a tangled mass of tubular voids and intervening skeletal material (Pl. 11, fig. 4). This is the microstructure recognized by Kossareva (1976) as "felted" (referred to as vermiculated herein). Further diagenetic alteration is postulated to result in coarsely fibrous microstructure and ultimately compact skeletal material (Pl. 11, fig. 5). In another diagenetic state, the vermiculated microstructure becomes "blocky" and in tangential section appears to be composed of melanospheres (Pl. 11, figs. 6, 7). In the opinion of CWS these myriad microstructures may not all be derived from originally akosmoreticulate microstructure, but indicate that the skeletal material as originally secreted may have locally been cellular or ordinicellular, locally compact or fibrous, and locally tubulate.

Very locally the laminae of this species are tripartite or ordinicellular (Pl. 11, fig. 8). In *C. vexata* n. sp. cellular or akosmoreticulate microstructure only develops in the skeletal elements thicker than 40 μm. Only laminae of about this thickness or greater can accommodate a single row of cellules/microgalleries 20 μm high. Where the slim partitions between the cellules are not preserved, the laminae appear to be tripartite. In the opinion of ECP, this local development of tripartite structure is fortuitous and a chance result of microreticular alignment, and therefore not analagous to the tripartite laminae of the Stromatoporellida.

A wide range of microstructures has been ascribed to other species of *Clathrocoilona.* Galloway (1957) and Galloway and St. Jean (1957) described the genus as coarsely maculate with thick tripartite laminae. The tangential section of *C. fibrosa* (Galloway and St. Jean, 1957; pl. 22, fig. 3b) shows a porous microstructure similar to that of *C. vexata* n. sp. The "coarse irregular maculae" of Galloway and St. Jean are areas of altered tubulate microstructure. Kossareva's (1976) description of *C. abeona* indicates a wide range of microstructures as noted above. Kossareva described laminae as cellular or joined by micropillars, apparently similar to the ordinicellular laminae of *C. vexata* n.

sp. Zukalová (1971) described microstructures as finely tubulate or cellular/porous; her illustrations resemble the tubulate tissue of *C. vexata* n. sp. Tubulate microstructures are also noted by Stock (1982) in *C. involuta* Stock, 1982 and Birkhead (1967) in *C. subclathrata* and in species he assigned to *Stromatoporella* (eg., *S. indubia* Birkhead), which should be transferred to *Clathrocoilona.*

The microstructure of *C. vexata* n. sp. suggests that the genus includes species with a very broad range of microstructures. One of us (ECP) attributes this range to diagenetic modification of an originally pervasive akosmoreticulate microstructure; the other (CWS) attributes it to variability in the original pattern of skeletal secretion. In recognition of this variability (regardless of origin), we both of us agree that microstructure should not be used as a taxonomic criterion in assigning species to *Clathrocoilona.* The example of the range of microstructures found in *C. vexata* n. sp. can be used as a guide in interpreting the variety of skeletal material that may occur in other species of this genus. The macrostructural criteria on which *Clathrocoilona* is defined are fully satisfactory in assigning species.

Etymology.—Latin *vexata,* vexacious or troublesome; referring to the confounding structural variability characteristic of species belonging to this genus.

Occurrence.—Blue Fiord Formation, lower member, Ellesmere Island; vicinity type section (seven specimens), Vendom Fiord (two specimens); lower Emsian (*dehiscens* Zone).

Family **HERMATOSTROMATIDAE**
Nestor, 1964

Genus **TRUPETOSTROMA** Parks, 1936

Type species.—*Trupetostroma warreni* Parks, 1936.

Trupetostroma sp.
Plate 12, figures 3,4

Description.—Skeleton laminar, highly undulate. Surface not preserved, but apparently bearing large, broad mamelons.

Vertical section: Laminae thick, tripartite, continuous, broadly undulate, consistently parallel; aggregate thickness 0.10–0.16 mm, consisting of median clear (hollow) zone 0.04–0.06 mm thick, bordered above and below by microlaminae 0.03–0.05 mm thick, exterior locally thickened; spaced very regularly, 5 to 6 laminae per 2 mm, average 5.5 (n=10); rarely interrupted by small foramina about 0.1 mm across; a few (generally thicker) laminae display third median microlamina over limited lengths. Pillars commonly spool-shaped, thick 0.06–0.15 mm (commonly 0.08–0.10 mm), spreading and thickening broadly to meet laminae; mostly randomly offset between successive laminae, locally superposed over 2 to 4 laminae; spaced variably, 5 to 8 per 2 mm average 6.3 (n=20), locally missing for lengths up to 0.1 cm; skeletal material generally solid (?compact microstructure), but a few pillars appear to be hollow (as laminae), vaguely vacuolate, or as if composed of vertical fibrils. Dissepiments common, not abundant, small, shallowly convex, very thin 0.01 mm, probably mostly removed by diagenesis; commonly bridging laminar foramina, towards mamelon axes, or within anomalously large galleries. Mamelons large, broad, vertically persistent; indicated in part by pillars crowding, thickening and becoming more strongly superposed; astrorhizal canals undefined. Microstructure ambiguous (due to poor preservation), probably compact. Rare, small vacuoles may occur at pillar-lamina junctions, or at thickened regions of external microlaminae.

Tangential section: Mamelons prominent, marked by large, well-defined bull's-eyes of concentric laminae; astrorhizae imperceptible. Laminae thick, dense, irregular bands with scattered vacuoles. Pillars short, thick (0.08–0.20 mm across), isolated vermiform strands or dots (mostly irregular), rarely linking or coalescing. Microstructure apparently compact. Astrorhizae absent.

Material.—Two specimens, one partially dolomitized, the second severely dolomitized (Bathurst Island), identified as *Trupetostroma* sp. and represented by hypotype GSC 108884 (Pl. 12, figs. 3,4). Two additional specimens, poorly preserved and identified as *Trupetostroma* sp.?, are questionably assigned to this species and represented by hypotype GSC 108885 (not illustrated).

Discussion.—The basic concept of *Trupetostroma* embraces species with thick, pronouncedly tripartite laminae, thick, spool-shaped, superposed pillars, generally vacuolate microstructure, and common cyst-like dissepiments (*cf.* Parks, 1936; Stock, 1982). Bathurst Island *Trupetostroma* sp. herein departs somewhat from the norm by demonstrating poor pillar superposition and comparatively wide laminar spacing. Its mamelon development is comparatively strong, and the total absence of definable astrorhizal canals is unusual. Both dissepiments and skeletal vacuoles are comparatively few, but their scarcity may be due to diagenetic loss.

Trupetostroma dominantly occurs in rocks of Givetian to Frasnian age (*e.g.,* Lecompte, 1952; Galloway and St. Jean, 1957; Zukalová, 1971; Stearn, 1975b). Only a few species are known from Eifelian strata (*e.g., T. spatiosum, T.* cf. *schelomense* , *T. ramulosum* of Yavorsky, 1963; Kuznetsk Basin, Mamontovo Horizon, mid-Eifelian). No definitively Lower Devonian species are previously known. Two species described by Lessovaya (1970) as *T. globosum* and *T. magnifica,* from the Bursykhirmanian Horizon (lowest Lochkovian) of Uzbekistan, are incorrectly assigned to *Trupetostroma*; they show a definite microreticulate microstructure, and more plausibly belong to either *Parallelostroma* or *Coenostroma.*

A species quite similar to *Trupetostroma* sp. herein is *Trupetostroma*(?) sp. of Fagerstrom (1982), from the lower Detroit River Group, southwestern Ontario. The Arctic and Ontario species have very similar laminar and pillar spacings, both lack obvious astrorhizae, and in both pillar-vacuoles and dissepiments are poorly developed. Dissimilarities include stronger pillar superposition in the Ontario species, and more prominent mamelons and thicker compound laminae in the Arctic form. For both the Arctic and Ontario species, the material presently known is too scarce and poor to draw firm conclusions, but from the available evidence a close relationship is plausible. The correlation of Prosh and Stearn (1993) suggests that the Detroit River *Trupetostroma*(?) sp. of Fagerstrom (1982) is Late Emsian (probably *serotinus* Zone).

Two additional, poorly preserved specimens from the Upper Emsian portion of the Blue Fiord Formation at Vendom Fiord, Ellesmere Island, are questionably included here as *Trupetostroma* sp.? The Vendom Fiord specimens display similar laminar dimensions and spacing to the younger Bathurst Island *Trupetostroma* sp., but have substantially thickened pillars and, consequently, very little open gallery space. In both the Bathurst Island and Vendom Fiord forms, the material is too poor and meager to determine if the they are conspecific variants or separate species. For biostratigraphic purposes (Text-fig. 3), the Vendom Fiord occurrence is treated as a questionable range extension of *Trupetostroma* sp. down into the upper Emsian (*inversus-serotinus* Zones).

Occurrence.—Northeastern Bathurst Island, unnamed limestone formation, lower 100 m; highest Emsian/basal Eifelian (undifferentiated *patulus* Zone). *Trupetostroma* sp.?: Vendom Fiord, Ellesmere Island, Blue Fiord Formation, upper member; upper Emsian (*inversus-serotinus* Zones).

Order **STROMATOPORIDA** Stearn, 1980

Family **STROMATOPORIDAE** Winchell, 1867

Genus **STROMATOPORA** Goldfuss, 1826

Type species.—*Stromatopora concentrica* Goldfuss, 1826.

Stromatopora polaris (Stearn, 1983)

Plate 14, figure 5

Ferestromatopora jacquesensis Galloway. Stearn and Mehrotra, 1970, p. 20, pl. 5, figs. 5, 6.

Ferestromatopora polaris Stearn, 1983, p. 551–552, figs. 5A–C, 5E; 1989, fig. 1D.

Stromatopora polaris Stearn, 1990, p. 507, fig. 3.8.

?*Stromatopora* aff. *polaris* Stearn. Webby, Stearn and Zhen, 1993, p. 158, 161, figs. 5F, 23A–F, 24A.

Material.—Thirty-six specimens, ranging from poor to well preserved. Hypotype GSC 108886. Other specimens listed in Appendix 3.

Discussion.—*Stromatopora polaris* has been previously recorded in the Arctic Islands from the lower Blue Fiord Formation (Stearn, 1983) and from Upper Lochkovian reefal blocks in the Stuart Bay Formation, Bathurst Island (Stearn, 1990). The species is described in full in Stearn (1983).

The new specimens of *S. polaris* recognized here, from the Blue Fiord and Disappointment Bay formations, extend the species' range through most of the Emsian Stage, up to the *serotinus* Zone. Specimens from the upper Eids Formation, Ellesmere Island, are lowest Emsian, possibly uppermost Pragian. The full species range in the Arctic is therefore upper Lochkovian to upper Emsian.

Specimens from the unnamed formation on Truro and Bathurst Islands (undifferentiated *patulus* Zone; highest Emsian/basal Eifelian), identified as *Stromatopora hensoni* n. sp., are similar to *S. polaris,* and probably represent a descendant species.

Occurrence.—Eids Formation, upper 100 m; Ellesmere Island, Sör Fiord (five specimens); lowest Emsian (*dehiscens* Zone), possibly uppermost Pragian. Blue Fiord Formation, lower member; Ellesmere Island, vicinity type section (10 specimens), Eids Fiord (nine specimens), Vendom Fiord (two specimens), Sör Fiord (one specimen); lower Emsian (*dehiscens* Zone). Disappointment Bay Formation, reefs low in formation, Truro Island (five specimens); mid-Emsian (*inversus* Zone). Blue Fiord Formation, upper member; Ellesmere Island, vicinity type section (four specimens); upper Emsian (*serotinus* Zone).

Stromatopora cf. **S. hupschii** (Bargatzky, 1881)

Plate 13, figures 1,2

cf. *Caunopora hupschii* Bargatzky, 1881, p. 290.

cf. *Stromatopora hupschii* (Bargatzky). Nicholson 1886, pl. 10, figs, 8, 9; 1891, p. 176; Lecompte, 1952, p. 268, pl. 52, figs. 2, 2a, 2b; Yavorsky, 1955, p. 106, pl. 56, figs. 3, 4.

Stromatopora cf. *S. hupschii* (Bargatzky). Galloway, 1960, p. 627–628, pl. 74, figs. 2a, 2b; Stearn, 1983, p. 552–553, figs. 5D, 5F.

Description.—Skeleton domal to hemispherical, up to 15 cm diameter. Surface undulate, but without defined mamelons or perceptible astrorhizae.

Vertical section: Thick, dominantly cassiculate structural elements; common thin latilaminae. Skeletal elements variable thickness, 0.15–0.30 mm, commonly 0.20 mm; specimen averages 20.6 (GSC 108887, n=20), 19.9 (GSC 108888, n=10), 20.9 (GSC 108889, n=10) mm; network dominantly cassiculate, a merging of short vertical or sub-vertical segments, rare oblique segments, and rare, slightly thicker horizontal segments; short, coalescent coenosteles may occur very locally; coenostroms absent. Galleries circular to irregularly vermiform. Dissepiments uncommon, may be locally clustered at specific levels, or about inconspicuous astrorhizae. Latilaminae conspicuous, 2–4 mm thick, defined by darkened elements or thin sediment interlayers. Microstructure coarsely cellular, cellules 0.02–0.04 mm diameter. Astrorhizae inconspicuous.

Tangential section: Skeletal elements form tightly-closed, amalgamate network; element thickness 0.15–0.25 mm, commonly 0.20 mm; microstructure cellular. Galleries labyrinthine, slightly thinner than elements; rarely circular to sub-circular. Astrorhizae rare, ill-defined clusters of short canal segments, 0.30–0.40 mm diameter.

Material.—Six specimens, moderately well preserved. Hypotypes GSC 108887 to 108889.

Discussion.—The systematic assignment of this species is unchanged from that of Stearn (1983), despite the additional six specimens from the Blue Fiord and Eids Formations. The species *Stromatopora hupschii* remains no more than a convenient receptacle for specimens such as these, with thick structural elements but few other distinguishing features.

Occurrence.—Eids Formation, upper 100 m; Ellesmere Island, Sör Fiord (one specimen); lowest Emsian (*dehiscens* Zone), possibly uppermost Pragian. Blue Fiord Formation, lower member, Ellesmere Island; Eids Fiord (four specimens), Vendom Fiord (one specimen); lower Emsian (*dehiscens* Zone).

Stromatopora hensoni, new species
Plate 13, figures 3–5

Diagnosis.—Conspicuously latilaminate; alternating phases of dominantly cassiculate structure and phases with abundant microlaminae; abundant, vertically persistent astrorhizae.

Description.—Skeleton domical, up to 15 cm diameter; surface smooth.

Vertical section: Skeletal elements cassiculate; thickness variable 0.10–0.25 mm, commonly 0.15 mm, holotype GSC 108890 average 0.16 range 0.10–0.25 (n=20); microstructure finely cellular. Galleries circular to vermiform, 0.10–0.25 mm diameter. Alternating phases of cassiculate versus microlaminar structure, subequally thick 3–5 mm, but commonly cassiculate phases thickest/dominant; latilaminae prominent, thick 0.5–1.0 cm, composed of paired cassiculate plus microlaminar phases. Microlaminae thin 0.01 mm, incomplete; variably densely spaced, to as much as 10 to 15 per mm; rare to absent in cassiculate phases; generally poorly preserved. Dissepiments rare to absent. Astrorhizae large, vertically persistent; axial canal 0.40–0.60 mm diameter; lateral canals turning gradually to horizontal, 0.20–0.30 mm diameter. Parasitic borings common.

Tangential section: Meandriform bands of alternating 1) thicker, darker, labyrinthine elements (cassiculate phases), and 2) thinner, lighter-toned, diffuse structure (microlaminar phases). Skeletal elements labyrinthine to vermiform, 0.10–0.20 mm thick; microstructure finely cellular; galleries vermiform to subcircular, occupy less than half total area. Astrorhizae moderately large, well-formed; comprise central disordered bundle of axial canals 0.20 mm diameter, extensive radial network of thicker lateral canals 0.30 mm diameter; center-to-center spacing roughly 1.0 cm.

Material.—Three specimens, moderately well to well preserved. Holotype GSC 108890; paratypes GSC 108891 and GSC 108892.

Discussion.—In terms of its structural elements, this new species is similar to *Stromatopora polaris* (Stearn, 1983). The size and disposition of cassiculate structural elements in both species is very similar, and in *S. polaris* periodic microlaminae impart banding to the skeleton in vertical section. *Stromatopora hensoni* n. sp. is distinguished from *S. polaris* by the gross arrangement of its skeletal elements, into alternating phases of cassiculate structure (like *S. polaris*) and subordinate phases with abundant microlaminae. Its well developed and persistent astrorhizae are also unlike *S. polaris,* in which astrorhizae are poorly developed. This comparison suggests that *S. hensoni* n. sp. is an immediate descendant of *S. polaris.* This conclusion is supported by the stratigraphic distribution of these species: *S. polaris* is last known from the *serotinus* Zone (Blue Fiord Formation), and *S. hensoni* n. sp. appears in the succeeding undifferentiated *patulus* Zone.

Etymology.—To honor Matthew Henson, Arctic explorer, companion of Peary.

Occurrence.—Unnamed formation; southeastern Bathurst Island (Dyke Ackland Bay) (two specimens), Truro Island (one specimen); highest Emsian/basal Eifelian (undifferentiated *patulus* Zone).

Genus **FERESTROMATOPORA** Yavorsky, 1955

Type species.—*Ferestromatopora krupennikovi* Yavorsky, 1955.

Ferestromatopora cf. **F. krupennikovi**
Yavorsky, 1955
Plate 14, figures 1,2

cf. *Ferestromatopora krupennikovi* Yavorsky, 1955, p. 109–110, pl. LVIII, figs. 1–5; Yang and Dong, 1979, p. 58, pl. 28, figs. 1, 2.

non *Ferestromatopora krupennikovi* Yavorsky. Fischbuch, 1969, p. 176–177, pl. IX, figs. 1–5.

?*Ferestromatopora krupennikovi* Yavorsky. Khromych, 1974, p. 52, pl. XIII, figs. 2a, 2b.

Description.—Skeleton domal, up to 8 cm diameter. Growth surfaces irregular, but without noticeable mamelons.

Vertical section: A highly irregular network of vertical-to-inclined elements and dissepiments, bounded by paralaminae. Paralaminae mostly continuous, undulate, thin 0.03–0.04 mm; spaced irregularly 0.3–1.4 mm apart, commonly 0.6–0.8 mm apart. Interlaminar network chaotic, consisting of short, vertical or inclined elements, 0.06–0.08 mm thick, merging with or bridged by abundant, convex dissepiments, 0.01–0.02 mm thick; where vertical elements abundant, spaced roughly 10 per 2 mm. Microstructure indeterminate. Galleries commonly squarish, arch-roofed, or irregular or sub-round; well-formed galleries 0.25–0.40 mm lateral diameter; galleries generally randomly offset, but immediately adjacent to paralaminae may align laterally. Basal layers thin, composed of stringy, sinuous, discontinuous vertical elements, and discontinuous paralaminae. Astrorhizae obscure; vertical systems imperceptible; lateral canals roughly 0.30 mm wide; dissepiments large and abundant within astrorhizae.

Tangential section: A tightly linked, cassiculate network; elements 0.03–0.06 mm thick, only rarely as isolated dots 0.03 mm diameter. Microstructure vaguely cellular. Paralaminae form thin, meandering bands, weak concentric arrangement. Astrorhizal canals numerous, appear as short, straight or simply branched segments, 0.20–0.35 mm wide; canals clustered, but otherwise without definable pattern.

Material.—One specimen, preservation mediocre. Hypotype GSC 108893.

Discussion.—This Blue Fiord specimen resembles *Ferestromatopora krupennikovi* Yavorsky, 1955 in a number of ways. Its cassiculate structural elements are similar in size and arrangement, and the wide range of spacing of paralaminae is identical. In the original description of the species, Yavorsky (1955) emphasized the cellular shape of the galleries, and characterized their arrangement relative to each other as "chess-like order", in other words alternately offset. In contrast, the galleries of the Blue Fiord specimen are more randomly arrayed, and a bit larger than in *F. krupennikovi.* The astrorhizal systems of the Blue Fiord specimen differ considerably from the type description, having somewhat wider canals, little discernable pattern, and no evident vertical component.

Of the few valid species of *Ferestromatopora* known (Stearn, 1993), all are Middle Devonian. *F. krupennikovi,* the type species of the genus, comes from the Givetian of the Kuznetsk Basin, Russia (Yavorsky, 1955). Therefore the Blue Fiord occurrence considerably extends the range of the genus to the lower Emsian.

Occurrence.—Ellesmere Island, Eids Fiord; Blue Fiord Formation, lower member; lowest Emsian (*dehiscens* Zone).

Genus **GLYPTOSTROMOIDES** Stearn, 1983

Type species.—*Glyptostroma simplex* Yang and Dong, 1979.

Glyptostromoides simplex (Yang and Dong, 1979)
Plate 14, figures 3, 4

Glyptostroma simplex Yang and Dong, 1979, p. 66, pl. 36, figs. 7, 8.

Glyptostromoides simplex (Yang and Dong). Stearn, 1983, p. 553, 555, figs. 6A–6C.

Discussion.—The Blue Fiord Formation occurrence of this species has been described by Stearn (1983).

Blue Fiord *Glyptostromoides simplex* displays a wide range of morphologies, as noted by Stearn (1983). Morphological variables include areas of cassiculate versus coenostromal structure, considerable variation in spacing of thick coenosteles, and abundance of dissepiments.

The eleven specimens of *G. simplex* referred to by Stearn (1983) came from strata low in the Blue Fiord Formation, in the vicinity of the type section. These strata are now regarded as lowest Emsian (*dehiscens* Zone) (Uyeno, 1990). Addition of the specimens considered here extends the range of Arctic *G. simplex* up to the *serotinus* Zone (upper Emsian).

Material.—Twelve specimens, moderately well to poorly preserved. Hypotypes GSC 108894, 108895. Other specimens listed in Appendix 3.

Occurrence.—Eids Formation, near formation top; Ellesmere Island, Eids Fiord (two specimens); lower Emsian (*dehiscens* Zone). Blue Fiord Formation, lower member, Ellesmere Island; vicinity type section (seven specimens), Eids Fiord (one specimen); lower Emsian (*dehiscens* Zone). Blue Fiord Formation, high in upper member; Ellesmere Island, vicinity type section; upper Emsian (*serotinus* Zone) (one specimen). Blue Fiord Formation, upper member, Vendom Fiord (Ellesmere Island), upper Emsian (*inversus* + *serotinus* Zones) (one specimen).

Family **SYRINGOSTROMELLIDAE** Stearn, 1980

Genus **SYRINGOSTROMELLA** Nestor, 1966

Type species.— Stromatopora borealis Nicholson, 1891.

Syringostromella zintchenkovi (Khalfina, 1961)
Plate 15, figures 1–3

Stromatopora aff. *hupschii* (Bargatzky). Ripper, 1937a, p. 186, pl. 8, figs. 7–8.

Stromatopora zintchenkovi Khalfina, 1960, p. 327–328, pl. D-3, figs. 1a, 1b.

Syringostromella zintchenkovi (Khalfina). Webby, Stearn and Zhen, 1993, p. 163, figs. 23E–F, 24A–C.

Description.—Skeleton laminar, thick; up to 15 cm lateral diameter. Surface not preserved.

Vertical section: Thick, persistent coenosteles, abundant dissepiments. Coenosteles vertically persistent, parallel to one another, straight or gently sinuous; may branch and coalesce vertically, but not commonly; thick, 0.20–0.40 mm, GSC 108896 range 0.21–0.35 mm average 0.27 mm (n=20), GSC 108897 range 0.20–0.40 mm average 0.27 mm (n=20); spacing 3 to 6 per 2 mm, commonly 4 to 5 per 2 mm, GSC 108896 range 3 to 4 average 3.8 per 2 mm (n=10), GSC 108897 range 4 to 6 average 4.7 per 2 mm (n=10). Short coenostromal segments locally present, up to 0.5 cm long, 0.25–0.30 mm thick. Dissepiments very abundant, thin, 0.02 mm; horizontal to gently convex, commonly spanning vertical galleries between coenosteles, but locally up to 0.5 mm long; commonly aligned laterally; vertical spacing 5 to 8 per mm. Microstructure finely cellular. Astrorhizae inconspicuous.

Tangential section: Coenosteles form tightly linked, labyrinthine network; galleries sausage-shaped rarely subcircular. Coenosteles 0.20–0.40 mm thick; microstructure finely cellular. Astrorhizae inconspicuous, evident only as short canal segments, 0.30 mm wide.

Material.—Two specimens. Hypotypes GSC 108896, 108897. Moderately well preserved.

Discussion.—*Syringostromella zintchenkovi* (Khalfina, 1961) is previously known from the Salair of south-central Russia, Krekovski horizon (upper Lochkovian). The Blue Fiord Formation specimens conform very closely to the original description of Khalfina (1961): coenosteles 0.17–0.32 mm, commonly 0.21–0.29 mm thick, rarely thicker, spacing 2 to 3 per mm. Khalfina (1961) characterized the "zooidal tubes" (intercoenostele galleries) as somewhat narrower than the coenosteles themselves, the same condition as in the Blue Fiord specimens. Although Khalfina (1961) gave dimensions for the astrorhizae, they are described as small and poorly-defined; in the Blue Fiord specimens astrorhizae are scarcely apparent.

Syringostromella zintchenkovi may be confused with certain specimens of *Salairella prima* Khromych, 1971, which both occur in the lower Emsian portion of the Blue Fiord Formation. In vertical section, the coenosteles of *Salairella prima* are generally thinner and more vertically coalescent, but a few specimens of *S. prima* have coenosteles approaching the condition of *Syringostromella zintchenkovi,* and if dissepiments are unusually abundant, the species may be difficult to distinguish. Ultimately, *Syringostromella* and *Salairella* must be discriminated in tangential section; *Syringostromella* forms a tight labyrinthine network, and in *Salairella* round coenotubes predominate.

Blue Fiord *Syringostromella zintchenkovi* is similar to *Syringostromella labyrinthea* Stearn, 1990 from Lochkovian reefal blocks on Bathurst Island (Stearn, 1990). In *S. labyrinthea,* however, the coenosteles are thinner and more closely spaced. Stearn (1990) synonomized *S. labyrinthea* and *S.* cf. *zintchenkovi tenuis* Khalfina, 1961 of Khromych (1976), a form found in the Emsian of eastern Siberia. *S. zintchenkovi tenuis* itself was established by Khalfina (1961), for specimens younger than *S. zintchenkovi* s.s, from the Malobachatski horizon (Pragian, overlies the Krekovski horizon), and with thinner and more closely spaced coenosteles than *S. zintchenkovi.* It therefore appears that in the arctic Lower Devonian, older *Syringostromella* has the thinner elements, and in Siberia the opposite occurs, with thinner elements in younger forms of *Syringostromella.* As such, this *Syringostromella zintchenkovi-labyrinthea* assemblage of species is of dubious biostratigraphic value.

Syringostromella zintchenkovi has also recently been recognized from the lower Pragian Lilydale Limestone of Victoria, Australia (Webby *et al.*, 1993).

Occurrence.—Blue Fiord Formation, lower member; Ellesmere Island, formation type area (one specimen), Sör Fiord (one specimen); lower Emsian (*dehiscens* Zone).

Genus **SALAIRELLA** Khalfina, 1961

Type species.—Salairella multicea Khalfina, 1961.

Salairella prima Khromych, 1971
Plate 15, figures 4, 5; Plate 16, figures 1–5

Salairella prima Khromych, 1971, p. 132, pl. 36, figs. 1a, 1b; Stearn, 1983, p. 555–556, figs. 6D–6G; Webby and Zhen, 1993, p. 342, 344, figs. 9C–E, 12A, B.

Material.—Twenty-nine specimens. Hypotypes GSC 108898 to 108901. Other specimens listed in Appendix 3. Poor to exceptionally well preserved.

Discussion.—The Blue Fiord Formation occurrence of this species is described by Stearn (1983).

The new specimens of *Salairella prima* recognized herein allow for some broadening of the concept of this species. Of the 29 specimens assigned to *S. prima,* 22 of them conform to the description of Stearn (1983). Four of the new specimens exhibit a greater abundance of dissepiments, but in all other features conform to the earlier description (Stearn, 1983). In vertical section (Pl. 16, fig. 1), the abundant dissepiments are arranged like tabulae, ascending the vertical galleries between the coenosteles. The dissepiments are small and very thin, so that in many specimens their scarcity may be due in some degree to diagenetic removal.

As noted by Stearn (1983), the majority of specimens of *S. prima* demonstrates only obscure and inconspicuous astrorhizae. Two of the new specimens, however, exhibit well formed, although widely scattered astrorhizae (Pl. 16, fig. 2). In these rare specimens the astrorhizae form radiating lateral branches 0.20–0.25 mm across.

Specimens of *S. prima* in the original collection of Stearn (1983) came from low in the Blue Fiord Formation, in lower Emsian strata (*dehiscens* Zone). The new specimens extend the species' range in the Arctic up to the upper Emsian (*serotinus* Zone). The type of *S. prima* is from the Neludimskaya suite in the Omulevski Range of Severo-Vostok, eastern Siberia (Khromych, 1971). Although Khromych (1971) indicated the age of these rocks as Middle Devonian (reiterated in Stearn, 1983), in a later publication (Khromych, 1976) the Neludimskaya suite is shown to be Early Devonian (probably Pragian) in age. *S. prima* has recently been described (Webby and Zhen, 1993) from the Jesse Limestone, New South Wales, Australia, where it is Emsian, probably early Emsian age.

A few of the new specimens of *S. prima* preserve microstructure in very fine detail (Pl. 16, figs. 3–5). For the most part, the microstructure of *S. prima* is finely cellular (*e.g.* Pl. 16, fig. 3). In some specimens (most notably GSC 108898, Pl. 16, fig. 5), however, the "cellules" are strongly aligned at certain levels, such that the microstructure becomes orthoreticulate. Stearn (1983) made a similar observation, noting the microstructure of *S. prima* as cellular with local traces of microreticulation. Webby and Zhen (1993) have also studied the microstructure of *S. prima,* suggesting that it is probably microreticulate rather than cellular. The distinction between skeletal tissue in which the cellules are aligned vertically and that in which micropillars and microcolliculi define the microarchitecture is a subtle one. In the recent phylogeny of the Stromatoporida proposed by Stearn (1993) microreticulate genera are grouped in the Order Syringostromatida and cellular genera are placed in the Stromatoporida. *Salairella* is placed here in the Stromatoporida because the microstructure of most of its species is dominantly cellular. If *Salairella prima* is interpreted as typically microreticulate, then its ancestry would be interpreted by Stearn (1993) as within the Syringostromatida and distant from that of the Stromatoporida. The species appears to show both microreticulate and cellular microstructure. If microstructure is taken as the sole criterion of membership in the Syringostromatida and the species is dominantly microreticulate, then *S. prima* should be transferred to the genus *Parallelopora* Bargatzky within this order.

The ambiguity of the microstructure of *S. prima* is made no clearer when specimens are viewed in tangential section (Pl. 16, figs. 3,4). Stearn (1993) has suggested that microreticulate and cellular microstructure may be discriminated when viewed in tangential section, by noting the character of microelements at the edge of skeletal (macro)galleries. Coenosteles with protruding microcolliculi at gallery edges should produce a ragged boundary; in contrast, coenosteles of cellular microstructure should have smooth gallery edges. Unfortunately such ragged edges may be easily corroded in diagenesis. Specimens of *Salairella prima* exhibit both these features in tangential section (Pl. 16, figs. 3,4), implying the genuine coexistence of both microstructures.

Detailed assessment of the classification of the Stromatoporida and the position of *Salairella prima* in it is beyond the scope of this study. If *S. prima* can be shown to be basically more microreticulate than cellular, then it should be transferred to a genus within the Syringostromatida. If, on the other hand, the suggestion of microreticulation is the result of occasional superposition of cellules (rather than a basic post-and-beam microarchitecture) then it can be retained within the Stromatoporida.

Occurrence.—Eids Formation, upper 100 m; Ellesmere Island, Eids Fiord (one specimen), Sör Fiord (five specimens); lower Emsian (*dehiscens* Zone), possibly uppermost Pragian. Blue Fiord Formation, Ellesmere Island; lower member, lower 150 m; vicinity type section (10 specimens); Eids Fiord (five specimens); Sör Fiord (two specimens); Vendom Fiord (three specimens); lower Emsian (*dehiscens* Zone). Disappointment Bay Formation, reefs near base of formation; Truro Island (one specimen), Lowther Island (one specimen); mid-Emsian (*inversus* Zone). Blue Fiord Formation, upper member, near top; Ellesmere Island, vicinity type section; upper Emsian (*serotinus* Zone) (one specimen).

Order **SYRINGOSTROMATIDA**
Bogoyavlenskaya, 1969

Family **SYRINGOSTROMATIDAE** Lecompte, 1951

Genus **ATOPOSTROMA** Yang and Dong, 1979

Type species.—*Atopostroma tuntouense* Yang and Dong. 1979.

Atopostroma distans (Ripper, 1937b)
Plate 18, figure 5

Actinostroma stellulatum var. *distans* Ripper, 1937b, p. 12, pl. 2, figs.1,2.

Trupetostroma cf. *T. ideale* Birkhead. Stearn and Mehrotra, 1970, p. 16–17, pl. 5, figs. 1, 2.

Atopostroma tuntouense Yang and Dong. Stearn, 1983, p. 548–549, figs. 4E–H.

Atopostroma distans (Ripper). Webby and Zhen, 1993, p. 346–348; figs. 11A–D, 12E; Webby, Stearn and Zhen, 1993, p. 171, 173, figs. 27F, 28A–D.

Material.—Four specimens. Hypotype GSC 108902. Preservation mediocre to moderately well preserved.

Discussion.—The Blue Fiord Formation occurrence of this species has been previously described by Stearn (1983) as *Atopostroma tuntouense* Yang and Dong, 1979. The four specimens of *Atopostroma distans* recorded here, including one from the Bird Fiord Formation, display the following measurements: laminar spacing 7 to 11 per 2 mm (averages n=10 each specimen: 8.4, 8.4, 9.5, 9.9); pillar spacing 8 to 10 per 2 mm (averages n=10 each specimen: 9.2, 8.6, 8.7, 9.0); laminar thickness 0.02–0.04 mm; pillar thickness 0.08–0.10 mm.

Blue Fiord specimens earlier assigned to *Atopostroma tuntouense* by Stearn (1983) have been referred to *Atopostroma distans* (Ripper) (Webby and Zhen, 1993). In Australia, *A. distans* is known from the Emsian Jesse Limestone, New South Wales (Webby and Zhen, 1993), and from the Buchan's Cave Limestone, Victoria (basal Emsian) (Webby *et al.*, 1993). As noted in Webby and Zhen (1993) and Webby *et al.* (1993), specimens referred to *Atopostroma tuntouense* from the upper Lochkovian Stuart Bay Formation of Bathurst Island (Stearn, 1990) are not conspecific with Blue Fiord specimens.

Occurrence.—Blue Fiord Formation, lower member, Ellesmere Island; Eids Fiord (two specimens), vicinity formation type section (one specimen); lower Emsian (*dehiscens* Zone). Bird Fiord Formation, near formation base; Ellesmere Island, Bird Fiord (near type locality) (one specimen); uppermost Emsian/basal Eifelian (undifferentiated *patulus* Zone).

Genus **HABROSTROMA** Fagerstrom, 1982

Type species.—*Stromatopora proxilaminata* Fagerstrom, 1961.

Habrostroma proxilaminatum (Fagerstrom, 1961)
Plate 17, figures 1–5

Stromatopora proxilaminata Fagerstrom, 1961, p. 8, pl. 1, figs. 4–6.

Habrostroma proxilaminata (Fagerstrom). Fagerstrom, 1982, p. 13–15, pl. 1, figs. 7, 8.

Description.—Skeleton hemispherical to subspherical, up to 10 cm diameter. Growth surfaces with barely perceptible mamelons of very low relief, astrorhizae present.

Vertical section: Structure a network of microlaminae and much thicker, diffuse pillars. Microlaminae continuous, very gently undulate, may coalesce laterally; 0.01–0.03 mm thick; readily obscured by diagenesis, may locally appear as a chain of fine dots or beads; spacing variable, 10 to 20 per 2 mm, average 14.6 (n=11). Latilamination irregular, marked by dark perithecal layers following growth interruption, thickness very variable, 2 mm to 2 cm. Pillars stout, 0.10–0.15 mm thick; mostly column-like, or may expand gently upward to coalesce at overlying microlamina, forming coenostroms; mostly vertical, some gently inclined; commonly confined to interlaminar space, irregularly offset, less than half total pillars superposed over two coenostroms, rarely superposed over 3 to 4; spaced 7 to 11 per 2 mm, average 8.4 (n=17). Pillar microstructure orthoreticular to clinoreticular, but preservation generally poor. Galleries commonly circular or oval (long-axis horizontal), mostly 0.2–0.3 mm across, rarely horizontally elongate to 0.5 mm or more. Astrorhizal systems well developed, large and vertically persistent; no axial canal, lateral canals 0.15–0.20 mm wide; inclined tabulae common along lateral branches, otherwise absent in skeleton.

Tangential section: A tangled, irregular network exhibiting very little open gallery space. Laminae (coenostroms) thick, diffuse, concentric bands. Microlaminae imperceptible. Pillars form irregular, interconnected chains, 0.10–0.15 mm thick; only very rarely as isolated irregular dots between laminae. Microstructure cellular (=irregular microreticular). Astrorhizae conspicuous, common; canals 0.20–0.25 mm diameter; comprised of about 8 to 10 radiating lateral canals, no axial canal; center-to-center distance fairly consistent, about 6 mm; present at mamelon summits, but not confined to them.

Material.—Seventeen specimens, moderately well to poorly preserved. Hypotypes GSC 108903 to 108905. Other specimens listed in Appendix 3.

Discussion.—*Habrostroma proxilaminatum* is previously known from the Devonian of southwestern Ontario (Fagerstrom, 1961, 1982), and the Arctic specimens differ very little from Fagerstrom's descriptions. Fagerstrom (1982) distinguished *H. proxilaminatum* from two similar species (*H. densilaminatum* and *H. formosense*) primarily on the basis of microlaminar spacing, recognizing a continuum of variation between the three species, with *H. proxilaminatum* intermediate in position, having microlaminar spacing on the order of 15 to 22 per 2 mm. The spacing of the Arctic specimens falls slightly lower (10 to 20 per 2 mm, average 14.6), thus approaching the field of *H. densilaminatum.* The poorer preservation of the Arctic specimens suggests some diagenetic loss of microlaminae, biasing the measurements towards artificially low values. Fagerstrom's (1961) original description of the species cites a wider pillar spacing (2 to 3 per 1 mm), but his photographs (1961, 1982) demonstrate pillar spacing comparable to that of the arctic specimens. In all other significant features the arctic and southern Ontario specimens are identical: pillar thickness and arrangement; gallery shape, size, and disposition; astrorhizal size, abundance, spacing, lack of axial canal, and exclusivity of tabulae.

In the Devonian of Ontario, *H. proxilaminatum* is long-ranging, occurring in the Detroit River Group through the upper Dundee Formation, and possibly in the underlying Bois Blanc Formation (Fagerstrom, 1982). In the Arctic, *H. proxilaminatum* is known to occur at two localities, in the lower Disappointment Bay Formation on Truro Island, in strata of mid-Emsian age, and in the lower unnamed formation on Bathurst Island, in strata spanning the Emsian–Eifelian boundary. Its observed range in the Arctic is therefore from the *inversus* Zone through the undifferentiated *patulus* Zone (Text-figure 3). The Arctic occurrence of *H. proxilaminatum* further strengthens the Blue Fiord-to-Detroit River correlation of Prosh and Stearn (1993), in which common stromatoporellid species are interpreted to give an *inversus*-age for the Bois Blanc Formation, and a *serotinus*-age for much of the Detroit River Group. By this correlation, the *inversus–patulus* range of Arctic *H. proxilaminatum* corresponds to the Bois Blanc through Detroit River interval of its range in Ontario. Also, the addition of *H. proxilaminatum* to the correlation indicates that a major migration of Arctic stromatoporoids to the midcontinent took place during late Emsian time.

Oddly, *H. proxilaminatum* is absent from our large Blue Fiord Formation collections, yet at Truro Island one-half of the specimens collected are *H. proxilaminatum.* That this is no sampling artifact is show by the large discrepancy in abundance of samples. It is interpreted to indicate a clear environmental preference. The depositional setting of Truro Island is quite unlike the large, shelf-margin reefs of the type Blue Fiord on Ellesmere Island; rather, very small reef knolls in a restricted, platformal setting are indicated for the Disappointment Bay Formation on Truro Island. Fagerstrom (1961) noted that *H. proxilaminatum* is the most abundant stromatoporoid species in the Formosa reefs (lower Detroit River Group) of southern Ontario.

Occurrence.—Truro Island; Disappointment Bay Formation, small reef knolls near base of formation; mid-Emsian (*inversus* Zone) (15 specimens). Bathurst Island, Dyke Ackland Bay; unnamed limestone formation, lower 100 m; highest Emsian/basal Eifelian (undifferentiated *patulus* Zone) (two specimens).

Genus **PARALLELOPORA** Bargatzky, 1881

Type species.—*Parallelopora ostiolata* Bargatzky, 1881.

Parallelopora campbelli
Galloway and St. Jean, 1957
Plate 18, figures 1–4

Parallelopora campbelli Galloway and St. Jean, 1957, p. 208–210, pl. 19, figs. 3a, b.

Description.—Skeleton tabular, up to 10 cm diameter. Growth surface undulating, but without defined mamelons.

Vertical section: An irregular network of branching and anastomosing coenosteles, with only short, discontinuous coenostroms. Coenosteles 0.05–0.15 mm thick, most commonly 0.10 mm thick; mostly vertically aligned, continuous over 1 to 4 coenostromal bands, or branching and coalescing; locally in small areas of irregular network vertical fabric is suppressed; spacing regular, 7 to 10 per 2 mm; specimen GSC 110314, 7 to 10 per 2 mm average 8.3 (n=20); specimen GSC 110315, 7 to 9 per 2 mm average 7.7 (n=10); specimen GSC 110316, 7 to 10 per 2 mm average 8.4 (n=10). Coenostele microstructure orthoreticulate, microgalleries 0.04 mm diameter. Horizontal fabric suppressed; locally coenosteles may merge laterally to produce short coenostromal segments about 5 mm long, 0.10–0.20 mm thick; where partial coenostroms occur in sequence, spacing roughly 6 to 8 per 2 mm. Dissepiments present, not abundant; common within and adjacent to astrorhizae; elsewhere dissepiments very flat, joining laterally over short lengths locally suggesting microlaminae. Latilaminae absent, although 3 to 5 mm thick bands of strongly aligned coenosteles alternating with cassiculate network suggest growth periodicity. Galleries subequally vertically elongate, roughly 0.15 mm wide by 0.30–0.40 mm long, or round, 0.15–0.25 mm diameter. Astrorhizae irregular, vertically persistent; canals wide, 0.25–0.40 mm; unassociated with any structural deflection within skeleton.

Tangential section: A dense network with little open gallery space. Horizontal fabric imperceptible, little suggestion of concentric banding apparent. Coenosteles chainlike, joined, not separate; thickness highly variable, 0.05–0.25 mm, commonly 0.10 mm, locally fused into thick clumps; occuping over half total area. Microgalleries 0.04 mm diameter. Galleries either short vermiform areas, 0.10 mm wide, or round coenotubes 0.10 mm diameter. Astrorhizae common; inconsistently formed, may consist of a loose central bundle of a few axial canals, surrounded by 3 to 6 irregular radiating lateral canals; lateral canal width variable, 0.20–0.30 mm; center-to-center spacing 5–8 mm.

Material.—Five specimens, moderately well preserved. Hypotypes GSC 110314 to 110316.

Discussion.—*Parallelopora campbelli* is previously known from the Devonian of Indiana and Ohio (Galloway and St. Jean, 1957). It is, unfortunately, known from only a few specimens, and Galloway and St. Jean's description is based on the unique holotype. Despite this, the Arctic specimens are identical to Galloway and St. Jean's description in every significant regard. Pillar thickness and spacing are identical in both the Arctic specimens and the holotype, and they have comparable microstructure. The discontinuous coenostroms of the Arctic specimens compare to what Galloway and St. Jean (1957, p. 209) described as "variable and discontinuous" laminae, and thicknesses and spacings are the same. Similarly, Galloway and St. Jean (1957, p. 209) noted "discontinuous microlaminae and curved plates", described as dissepiments herein. In tangential section, the holotype and Arctic specimens show the same subequal distribution of vermicular and round galleries (= coenotubes). Of particular note are the odd astrorhizae and complete lack of mamelons.

In their systematic description of the species, Galloway and St. Jean (1957, p. 210) mentioned the occurrence of only the holotype, from the Jeffersonville Limestone near Kent, Indiana. Elsewhere (p. 80) they noted its rare occurrence in the "Columbus limestone" at Kelleys Island, Ohio. This latter mention is important, because it permits a more precise appraisal of the age of *P. campbelli.* In a detailed study of the stromatoporoids of Kelleys Island, Bjerstedt and Feldmann (1985) indicated that Galloway and St. Jean's "Columbus" stromatoporoids in fact come from the upper Lucas Formation (Detroit River Group). *P. campbelli* is not recorded in Fagerstrom's (1982) large Detroit River Group collections.

P. campbelli therefore constitutes another element in a major exchange of stromatoporoid species between the Arctic and the midcontinent during the late Emsian. The limited occurrence of *P. campbelli* in both the Arctic and midwest precludes precise correlation, but the ages of these known occurrences are closely comparable. Following from the stromatoporellid-based correlation of Prosh and Stearn (1993), the upper Lucas Formation is either of *serotinus* or more probably *patulus* Zone assignment. The Arctic specimens come from one locality dated as undifferentiated *patulus* Zone (*patulus* + *partitus* Zones; *cf.* Text-fig. 3), but on the basis of regional stratigraphy (Prosh and Stearn, 1993), believed most probably to be of *patulus*-age. The foregoing suggests that the Arctic and midwest specimens are of identical age, but too much uncertainty remains concerning their respective stratigraphic ranges. It is also quite possible that the range of Arctic *P. campbelli* extends down into the *serotinus* Zone; the Blue Fiord Formation at this level is dolomitic and poorly fossiliferous, and we have few stromatoporoids collected from this interval.

Occurrence.—Bathurst Island, Dyke Ackland Bay; unnamed formation, lower 100 m; highest Emsian/basal Eifelian (undifferentiated *patulus* Zone).

Appendix 1.—Collection localities.

Number on text-fig. 1	*location of sections**	*latitude N*	*longitude W*
1	AD	77°20′2″	86°49′31″
2	AA	77°20′2″	86°46′26″
3	AB	77°20′2″	86°41′11″
4	AC	77°19′56″	86°36′26″
5	BC	77°14′21″	86°19′3″
6	CA	77°17′15″	85°45′28″
7	CB	77°15′0″	85°51′12″
8	CC	77°16′27″	85°47′9″
9	CD	77°17′18″	85°47′37″
10	CF	77°14′28″	85°51′26″
11	CH	77°16′7″	85°51′26″
12	IA	77°16′59″	86°1′26″
13	IB	77°17′9″	85°55′57″
14	IC	77°16′59″	86°7′8″
15	ID	77°17′5″	85°57′9″
16	Castle bioherm	77°16′0″	85°45′0″
17	EA	77°17′28″	85°7′8″
18	EC	77°17′34″	85°9′31″
19	K	77°17′12″	85°8′34″
20	Bird Fiord Type	77°12′30″	86°35′20″
21	(no section)	77°16′0″	85°54′0″
22	ED	77°29′41″	83°54′17″
23	U-9	77°20′0″	86°36′26″
24	FA	77°36′19″	88°29′3″
25	KB	76°37′36″	87°38′48″
26	GA	77°44′28″	83°29′3″
27	GB	77°42′42″	83°30′0″
28	HA	76°35′2″	83°42′23″
29	HB	77°31′59″	83°48′6″
30	Loc. 43	77°27′35″	83°45′43″
31	Vendom 1	77°39′45″	83°31′0″
32	Vendom 4	77°27′35″	83°45′93″
33	Lowther Island	74°33′30″	97°29′30″
34	Truro Island	75°23′45″	97°13′10″
35	B22 (Bathurst I.)	76°29′14″	98°14′42″
36	B42A (Bathurst I.)	75°3′51″	99°8′37″

* Letters (*e.g.*, AD) designate measured sections in Smith (1984).

Appendix 2.—Catalogue of type numbers and locations of type specimens. Specimens in type collection of the Geological Survey of Canada, Ottawa.

GSC #	*species name*	*type*	*formation*	*interval*	*loca-tion*	*lat. north*	*long. west*
108175	*Stromatoporella perannulata*	hypo	Blue Fiord	154.1 m	1	77°20′2″	86°49′31″
108176	*Stictostroma gorriense*	hypo	Blue Fiord	0 m	8	77°16′27″	85°47′9″
108177	*Stictostroma gorriense*	hypo	Blue Fiord	0 m	8	77°16′27″	85°47′9″
108852	*Actinostroma* sp. A	hypo	unnamed	base	34	75°17′0″	97°11′30″
108853	*Plectostroma salairicum*	hypo	unnamed	lower 100 m	36	75°3′51″	99°8′37″
108854	*Plectostroma salairicum*	hypo	unnamed	lower 100 m	36	75°3′51″	99°8′37″
108855	*Aculatostroma* cf. *A. kaljanum*	hypo	Blue Fiord	75.9 m	27	77°42′42″	83°30′0″
108856	*Clathrodictyon ellesmerense*	hypo	Blue Fiord	70 m	6	77°17′15″	85°45′28″
108857	*Clathrodictyon ellesmerense*	hypo	Blue Fiord	86 m	15	77°17′5″	85°57′9″
108858	*Clathrodictyon ellesmerense*	hypo	Blue Fiord	103.4 m	26	77°44′28″	83°29′3″
108859	*Gerronostroma septentrionalis*	holo	Blue Fiord	base	3	77°20′2″	86°41′11″
108860	*Gerronostroma septentrionalis*	para	Blue Fiord	lower 100 m	4	77°19′56″	86°36′26″
108861	*Gerronostroma septentrionalis*	para	Blue Fiord	91.2 m	27	77°42′42″	83°30′0″
108862	*Gerronostroma septentrionalis*	para	Blue Fiord	5.9 m	13	77°17′9″	85°55′57″
108863	*Petridiostroma* sp.	hypo	Blue Fiord	163.4 m	24	76°36′19″	88°29′3″
108864	*Petridiostroma* sp.	hypo	Blue Fiord	base upper mem.	27	77°39′45″	83°31′0″
108865	*Atelodictyon* cf. *A. solidum*	hypo	Blue Fiord	ca. 200 m	25	76°37′36″	87°38′48″
108866	*Anostylostroma anfractum*	holo	unnamed	lower 100 m	35	76°29′14″	98°14′42″
108867	*Anostylostroma anfractum*	para	unnamed	lower 100 m	35	76°29′14″	98°14′42″
108868	*Anostylostroma anfractum*	para	unnamed	lower 100 m	35	76°29′14″	98°14′42″
108869	*Anostylostroma anfractum*	para	unnamed	lower 100 m	35	76°29′14″	98°14′42″
108870	*Pseudoactinodictyon conglutinatum*	holo	Blue Fiord	120 m	5	77°14′21″	86°19′3″
108871	*Pseudoactinodictyon conglutinatum*	para	Blue Fiord	120 m	5	77°14′21″	86°19′3″
108872	*Schistodictyon*? sp.	hypo	Blue Fiord	77.1 m	7	77°15′0″	85°51′12″
108873	*Stictostroma gorriense*	hypo	Blue Fiord	0 m	8	77°16′27″	85°47′9″
108874	*Stictostroma gorriense*	hypo	Blue Fiord	0 m	8	77°16′27″	85°47′9″
108875	*Stictostroma gorriense*	hypo	Blue Fiord	11.4 m	3	77°20′2″	86°41′11″
108876	*Stictostroma*? *nunavutense*	holo	Blue Fiord	11.4 m	3	77°20′2″	86°41′11″
108877	*Stictostroma*? *nunavutense*	para	Blue Fiord	lower 100 m	4	77°19′56″	86°36′26″
108878	*Stictostroma*? *nunavutense*	para	Blue Fiord	lower 100 m	4	77°19′56″	86°36′26″
108879	*Stromatoporella perannulata*	hypo	Blue Fiord	157.4 m	18	77°17′34″	85°9′31″
108880	*Stromatoporella perannulata*	hypo	Blue Fiord	157.4 m	18	77°17′34″	85°9′31″
108881	*Clathrocoilona vexata*	holo	Blue Fiord	11.4 m	3	77°20′2″	86°41′11″
108882	*Clathrocoilona vexata*	para	Blue Fiord	29.4 m	2	77°20′2″	86°46′26″
108883	*Clathrocoilona vexata*	para	Blue Fiord	11.4 m	3	77°20′2″	86°41′11″
108884	*Trupetostroma* sp.	hypo	unnamed	lower 100 m	35	76°29′14″	98°14′42″
108885	*Trupetostroma* sp.?	hypo	Blue Fiord	upper mem.	31	77°39′45″	83°31′0″
108886	*Stromatopora polaris*	hypo	Disappointment Bay	basal	34	75°23′45″	97°13′10″
108887	*Stromatopora* cf. *S. hupschii*	hypo	Blue Fiord	33.9 m	3	77°20′2″	86°41′11″
108888	*Stromatopora* cf. *S. hupschii*	hypo	Blue Fiord	29.4 m	2	77°20′2″	86°46′26″
108889	*Stromatopora* cf. *S. hupschii*	hypo	Blue Fiord	11.4 m	3	77°20′2″	86°41′11″
108890	*Stromatopora hensoni*	holo	unnamed	base	34	75°17′0″	97°11′30″
108891	*Stromatopora hensoni*	para	unnamed	lower 100 m	36	75°3′51″	99°8′37″
108892	*Stromatopora hensoni*	para	unnamed	lower 100 m	36	75°3′51″	99°8′37″
108893	*Ferestromatopora* cf. *F. krupennikovi*	hypo	Blue Fiord	140 m	2	77°20′2″	86°46′26″
108894	*Glyptostromoides simplex*	hypo	Blue Fiord	upper mem.	5	77°39′45″	83°31′0″
108895	*Glyptostromoides simplex*	hypo	Blue Fiord	1403 m	5	77°14′21″	86°19′3″
108896	*Syringostromella zintchenkovi*	hypo	Blue Fiord	117 m	18	77°17′34″	85°9′31″
108897	*Syringostromella zintchenkovi*	hypo	Blue Fiord	34.5 m	15	77°17′5″	85°57′9″
108898	*Salairella prima*	hypo	Blue Fiord	5.9 m	13	77°17′9″	85°55′57″
108899	*Salairella prima*	hypo	Blue Fiord	137.9 m	19	77°17′12″	85°8′34″
108900	*Salairella prima*	hypo	Blue Fiord	lower 100 m	30	77°27′35″	83°45′43″
108901	*Salairella prima*	hypo	Blue Fiord	29.4 m	2	77°20′2″	86°46′26″
108902	*Atopostroma distans*	hypo	Blue Fiord	102 m	2	77°20′2″	86°46′26″
108903	*Habrostroma proxilaminatum*	hypo	Disappointment Bay	basal	34	75°23′45″	97°13′10″
108904	*Habrostroma proxilaminatum*	hypo	Disappointment Bay	basal	34	75°23′45″	97°13′10″
108905	*Habrostroma proxilaminatum*	hypo	Disappointment Bay	basal	34	75°23′45″	97°13′10″
110314	*Parallelopora campbelli*	hypo	unnamed	lower 100 m	36	75°3′51″	99°8′37″
110315	*Parallelopora campbelli*	hypo	unnamed	lower 100 m	36	75°3′51″	99°8′37″
110316	*Parallelopora campbelli*	hypo	unnamed	lower 100 m	36	75°3′51″	99°8′37″

Appendix 3.—Collecting locations and stratigraphic position of specimens identified in this study (other than type specimens). Specimens in general collections of the Geological Survey of Canada, Ottawa.

Species	*specimen no.*	*formation*	*interval*	*location*
Aculatostroma cf. *A. kaljanum*	110-132	Blue Fiord	76–89 m	1
Clathrodictyon ellesmerense	110-115	Blue Fiord	11.4 m	3
Clathrodictyon ellesmerense	110-119	Blue Fiord	67.7 m	2
Clathrodictyon ellesmerense	110-142	Blue Fiord	29.4 m	2
Clathrodictyon ellesmerense	110-263	Blue Fiord	0 m	28
Clathrodictyon ellesmerense	110-267	Blue Fiord	0 m	28
Clathrodictyon ellesmerense	110-289	Blue Fiord	5.9 m	13
Clathrodictyon ellesmerense	110-176	Blue Fiord	35 m	6
Clathrodictyon ellesmerense	110-286	Blue Fiord	44.5 m	15
Clathrodictyon ellesmerense	110-135	Blue Fiord	8.9 m	2
Clathrodictyon ellesmerense	110-177	Blue Fiord	near base	2
Clathrodictyon ellesmerense	110-248	Blue Fiord	39.6 m	12
Clathrodictyon ellesmerense	110-212	Blue Fiord	near base	2
Clathrodictyon ellesmerense	110-288	Blue Fiord	12 m	14
Clathrodictyon ellesmerense	110-x	Blue Fiord	near base	1
Clathrodictyon ellesmerense	111-15	Blue Fiord	upper mem.	31
Clathrodictyon ellesmerense	129-10	Disappointment Bay	basal	34
Clathrodictyon ellesmerense	111-24	Bird Fiord	near base	20
Clathrodictyon ellesmerense	110-372	unnamed	lower 100 m	36
Gerronostroma septentrionalis	110-128	Blue Fiord	lower 100 m	9
Gerronostroma septentrionalis	110-172	Blue Fiord	near base	4
Gerronostroma septentrionalis	110-179	Blue Fiord	near base	4
Gerronostroma septentrionalis	110-189	Blue Fiord	near base	4
Gerronostroma septentrionalis	110-191	Blue Fiord	near base	4
Gerronostroma septentrionalis	110-238	Blue Fiord	124.3 m	18
Gerronostroma septentrionalis	110-241	Blue Fiord	64.4 m	13
Gerronostroma septentrionalis	110-272	Blue Fiord	44.5 m	15
Gerronostroma septentrionalis	110-327	Blue Fiord	21 m	9
Gerronostroma septentrionalis	110-204	Blue Fiord	17 m	6
Gerronostroma septentrionalis	110-309	Blue Fiord	13 m	9
Gerronostroma septentrionalis	110-361	Blue Fiord	13 m	9
Gerronostroma septentrionalis	110-363	Blue Fiord	77.1 m	10
Gerronostroma septentrionalis	110-364	Blue Fiord	77.1 m	10
Gerronostroma septentrionalis	110-221	Blue Fiord	124.3 m	18
Gerronostroma septentrionalis	110-247	Blue Fiord	64.4 m	13
Gerronostroma septentrionalis	110-264	Blue Fiord	39.6 m	12
Gerronostroma septentrionalis	110-156	Blue Fiord	11.4 m	3
Gerronostroma septentrionalis	110-342	Blue Fiord	lower 100 m	27
Gerronostroma septentrionalis	110-308	Eids	uppermost	23
Petridiostroma sp.	111-1	Blue Fiord	base upper mem.	27
Atelodictyon cf. *A. solidum*	120-6	Blue Fiord	±100 m	25
Pseudoactinodictyon conglutinatum	111-19	Bird Fiord	near base	20
Stictostroma gorriense	110-195	Blue Fiord	0 m	8
Stictostroma gorriense	111-1	Blue Fiord	upper mem.	27
Stictostroma gorriense	111-17	Blue Fiord	upper mem.	27
Stictostroma? *nunavutense*	110-111	Blue Fiord	±20 m	2
Stictostroma? *nunavutense*	110-180	Blue Fiord	lower 100 m	4
Stictostroma? *nunavutense*	110-190	Blue Fiord	lower 100 m	4
Stromatoporella perannulata	110-236	Blue Fiord	73.5 m	22
Stromatoporella perannulata	120-3	Blue Fiord	163 m	24
Stromatoporella perannulata	120-7	Blue Fiord	175 m	25
Clathrocoilona vexata	110-152	Blue Fiord	11.4 m	3
Clathrocoilona vexata	110-182	Blue Fiord	35 m	6
Clathrocoilona vexata	110-322	Blue Fiord	70.3 m	27
Clathrocoilona vexata	110-331	Blue Fiord	70.3 m	27
Clathrocoilona vexata	110-356	Blue Fiord	104.7 m	10
Clathrocoilona vexata	110-362	Blue Fiord	104.7 m	10
Stromatopora polaris	110-117	Blue Fiord	±100 m	2
Stromatopora polaris	110-120	Blue Fiord	±100 m	2
Stromatopora polaris	110-129	Blue Fiord	29.4 m	2

Appendix 3.—Continued.

Species	*specimen no.*	*formation*	*interval*	*location*
Stromatopora polaris	110-139	Blue Fiord	154.4 m	2
Stromatopora polaris	110-143	Blue Fiord	±10 m	3
Stromatopora polaris	110-153	Blue Fiord	63.2 m	3
Stromatopora polaris	110-160	Blue Fiord	63.2 m	3
Stromatopora polaris	110-184	Blue Fiord	±15 m	1
Stromatopora polaris	110-202	Blue Fiord	86.7 m	8
Stromatopora polaris	110-213	Blue Fiord	71.8 m	6
Stromatopora polaris	110-225	Blue Fiord	1403.3 m	5
Stromatopora polaris	110-231	Blue Fiord	1200.3 m	5
Stromatopora polaris	110-233	Blue Fiord	64.4 m	13
Stromatopora polaris	110-251	Blue Fiord	39.6 m	12
Stromatopora polaris	110-252	Blue Fiord	—	21
Stromatopora polaris	110-274	Blue Fiord	1403.3 m	5
Stromatopora polaris	110-286	Blue Fiord	44.5 m	15
Stromatopora polaris	110-299	Blue Fiord	1200.3 m	5
Stromatopora polaris	110-305	Blue Fiord	85.6 m	10
Stromatopora polaris	110-314	Blue Fiord	137.9 m	19
Stromatopora polaris	110-317	Eids	78.8 m below top	17
Stromatopora polaris	110-318	Eids	67.2 m below top	17
Stromatopora polaris	110-320	Blue Fiord	79.1 m	10
Stromatopora polaris	110-324	Blue Fiord	75.9 m	27
Stromatopora polaris	110-333	Blue Fiord	70.3 m	27
Stromatopora polaris	110-338	Eids	65 m below top	17
Stromatopora polaris	110-343	Eids	67.2 m below top	17
Stromatopora polaris	110-347	Blue Fiord	53.8 m	11
Stromatopora polaris	110-354	Blue Fiord	79.1 m	10
Stromatopora polaris	110-367	Eids	85.4 m below top	17
Stromatopora polaris	110-368	Blue Fiord	53.8 m	11
Stromatopora polaris	129-2	Disappointment Bay	basal	34
Stromatopora polaris	129-6	Disappointment Bay	basal	34
Stromatopora polaris	129-7	Disappointment Bay	basal	34
Stromatopora polaris	129-22	Disappointment Bay	basal	34
Stromatopora cf. *S. hupschii*	110-166	Blue Fiord	63.2 m	3
Stromatopora cf. *S. hupschii*	110-291	Blue Fiord	66.2 m	29
Stromatopora cf. *S. hupschii*	110-304	Eids	71.7 m below top	17
Glyptostromoides simplex	110-113	Blue Fiord	8.9 m	2
Glyptostromoides simplex	110-201	Blue Fiord	77.1 m	7
Glyptostromoides simplex	110-319	Blue Fiord	146.6 m	10
Glyptostromoides simplex	110-329	Blue Fiord	146.6 m	10
Glyptostromoides simplex	110-341	Eids	uppermost	23
Glyptostromoides simplex	110-353	Eids	uppermost	23
Glyptostromoides simplex	110-357	Blue Fiord	146.6 m	10
Glyptostromoides simplex	110-358	Blue Fiord	±50 m	9
Glyptostromoides simplex	110-359	Blue Fiord	66.3 m	11
Glyptostromoides simplex	110-371	Blue Fiord	21.0 m	9
Salairella prima	110-112	Blue Fiord	46.6 m	2
Salairella prima	110-125	Blue Fiord	11.4 m	3
Salairella prima	110-131	Blue Fiord	50.5 m	9
Salairella prima	110-134	Blue Fiord	154.4 m	2
Salairella prima	110-183	Eids	98.4 m below top	4
Salairella prima	110-188	Blue Fiord	154.1 m	1
Salairella prima	110-214	Blue Fiord	71.8 m	6
Salairella prima	110-237	Blue Fiord	86 m	15
Salairella prima	110-250	Blue Fiord	86 m	15
Salairella prima	110-254	Blue Fiord	86 m	15
Salairella prima	110-271	Blue Fiord	±100 m	18
Salairella prima	110-301	Blue Fiord	1403.3 m	5
Salairella prima	110-309	Blue Fiord	21 m	9
Salairella prima	110-316	Blue Fiord	146.6 m	10
Salairella prima	110-334	Blue Fiord	70.3 m	27
Salairella prima	110-337	Blue Fiord	70.0 m	6

Appendix 3.—Continued.

Species	*specimen no.*	*formation*	*interval*	*location*
Salairella prima	110-339	Eids	60.6 m below top	17
Salairella prima	110-345	Eids	±65 m below top	17
Salairella prima	110-348	Eids	60.6 m below top	17
Salairella prima	110-349	Eids	±65 m below top	17
Salairella prima	110-365	Blue Fiord	±50 m	9
Salairella prima	110-366	Blue Fiord	±100 m	32
Salairella prima	110-367	Eids	85.4 m below top	17
Salairella prima	129-28	Disappointment Bay	basal	34
Salairella prima	Lowther	Disappointment Bay	lower 50 m	33
Atopostroma distans	110-116	Blue Fiord	basal	2
Atopostroma distans	110-175	Blue Fiord	basal	16
Atopostroma distans	111-25	Bird Fiord	basal	20
Habrostroma proxilaminatum	129-3	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-4	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-5	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-8	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-12	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-14	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-15	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-17	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-19	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-23	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-24	Disappointment Bay	basal	34
Habrostroma proxilaminatum	129-27	Disappointment Bay	basal	34
Habrostroma proxilaminatum	110-215	unnamed	lower 100 m	36
Habrostroma proxilaminatum	110-226	unnamed	lower 100 m	36
Parallelopora campbelli	110-244	unnamed	lower 100 m	36
Parallelopora campbelli	110-278	unnamed	lower 100 m	36

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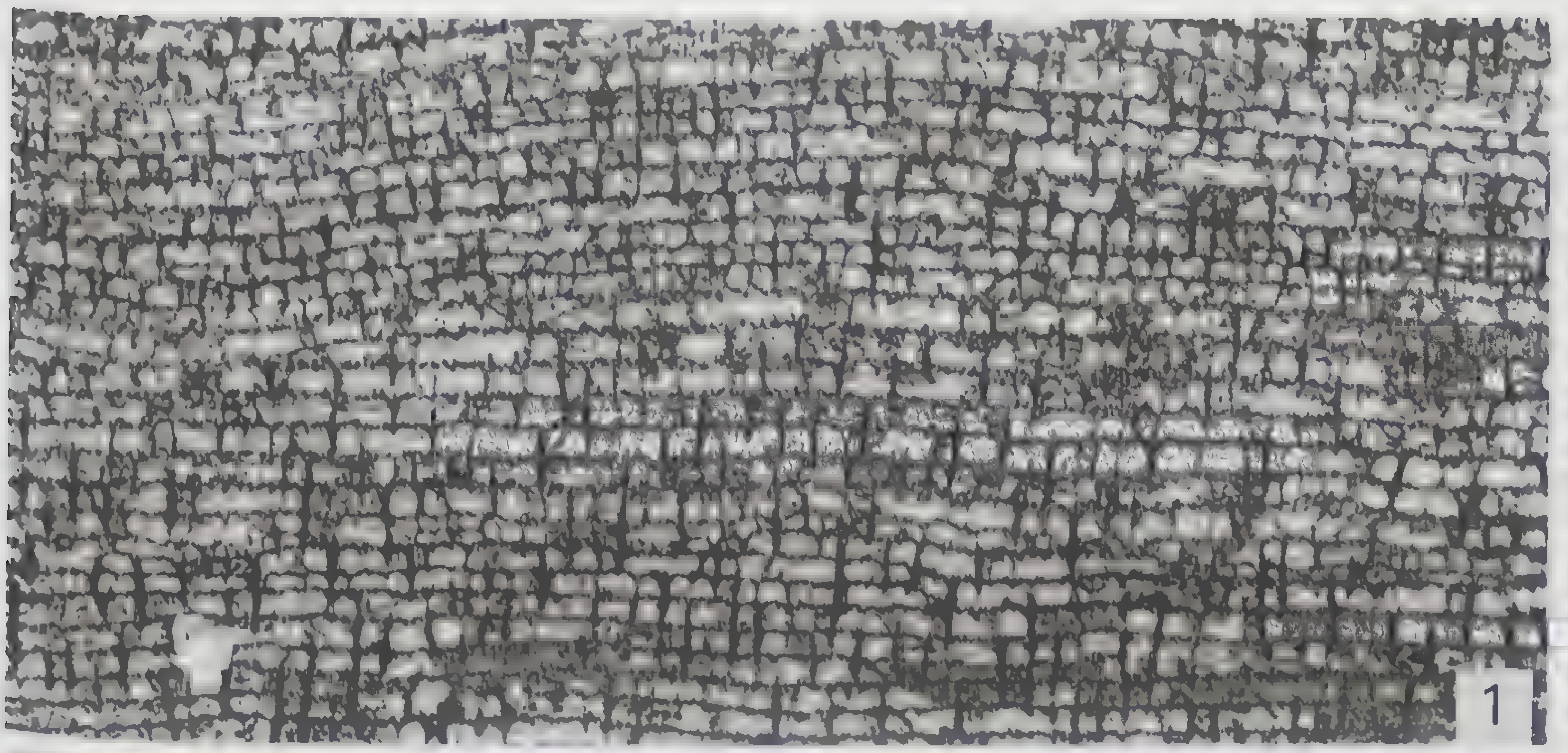
EXPLANATION OF PLATE 1

Figure .... Page

1–3. *Actinostroma* sp. A. 14
    Specimen GSC 108852.
    1. Vertical section; ×10.
    2. Vertical section, detail of pillars diverging from low mamelon; ×10.
    3. Tangential section; ×10.

4–5. *Plectostroma salairicum* (Yavorsky, 1930). 15
    Specimen GSC 108853.
    4. Vertical section; ×10.
    5. Tangential section; ×10.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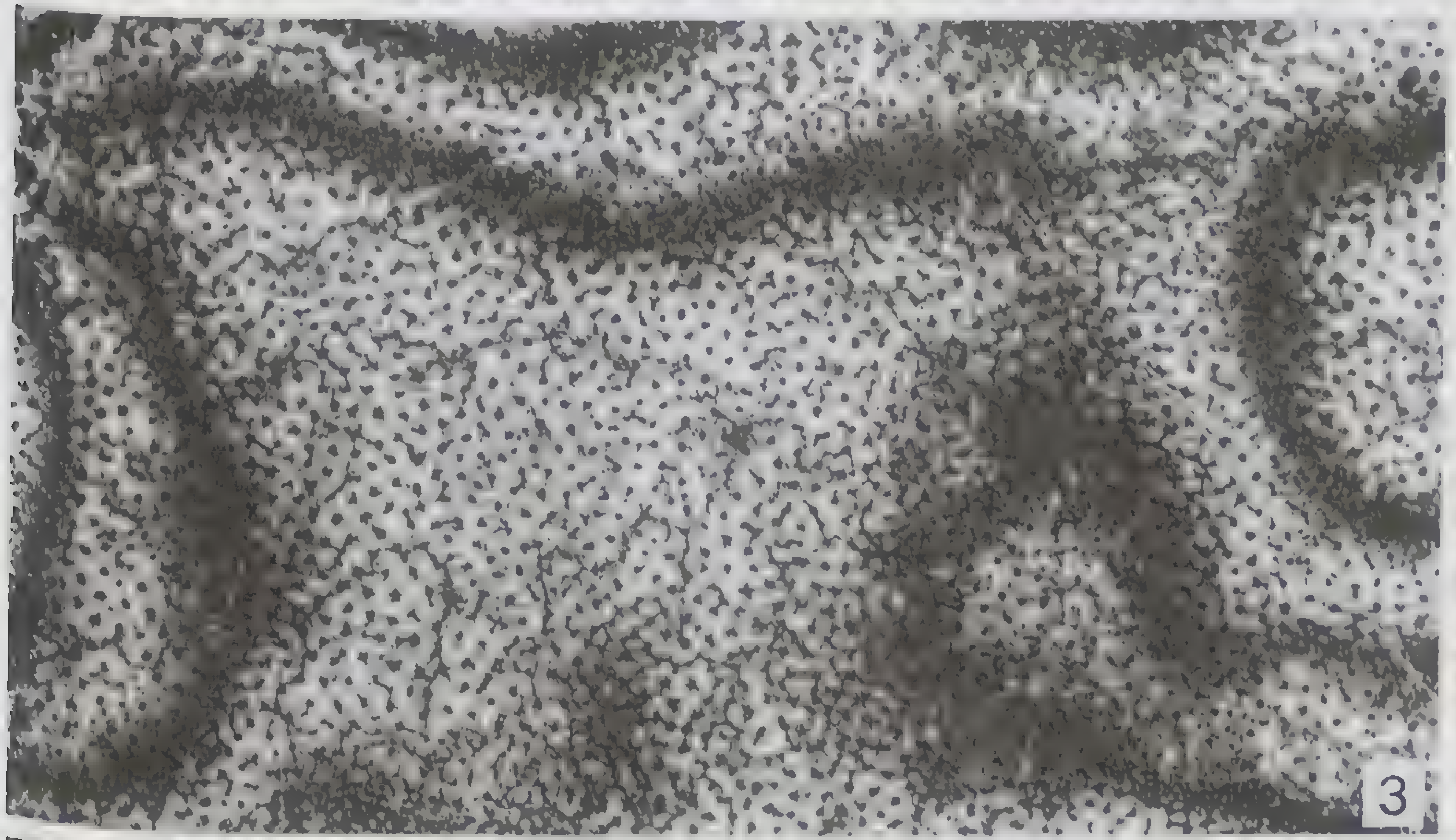
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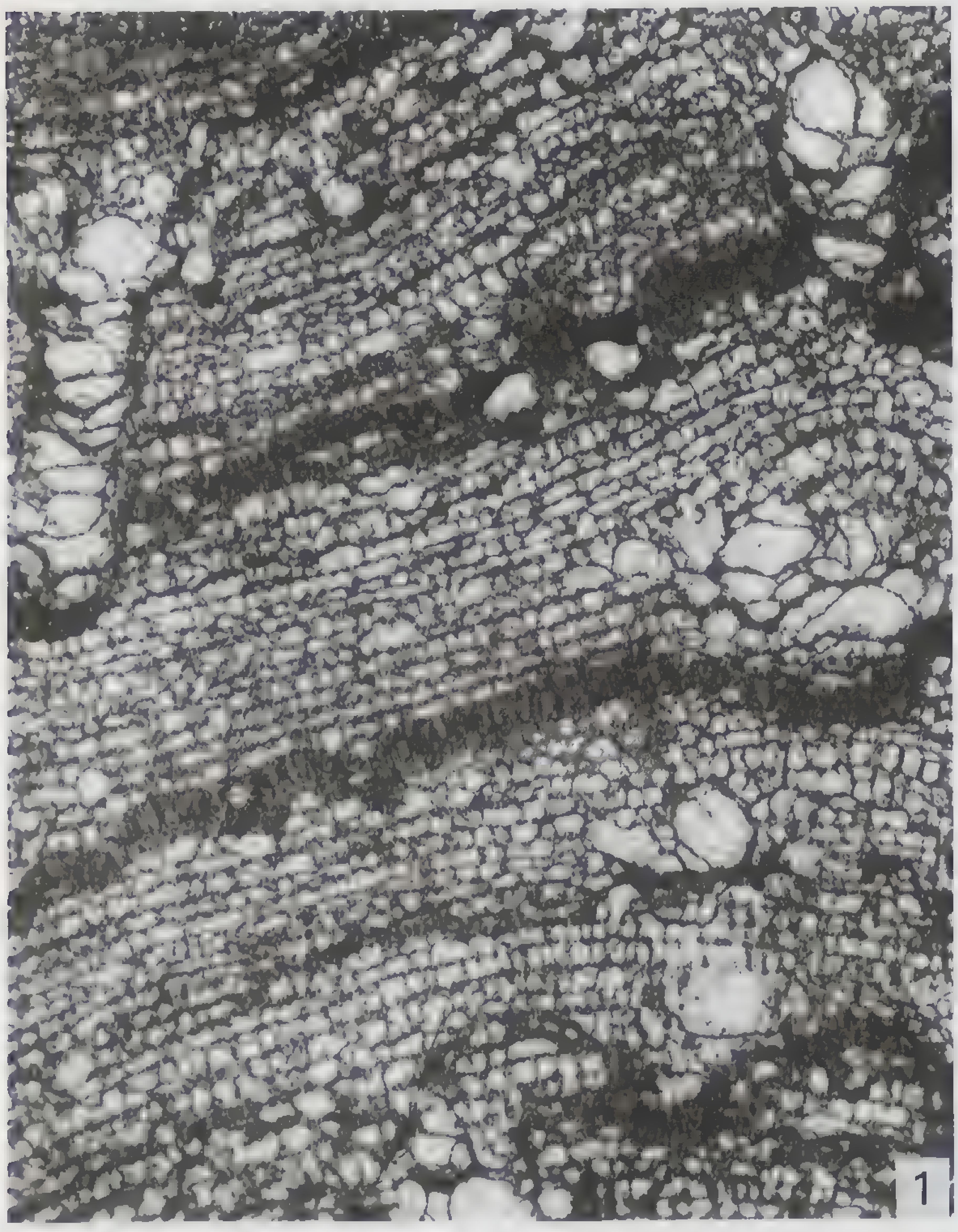
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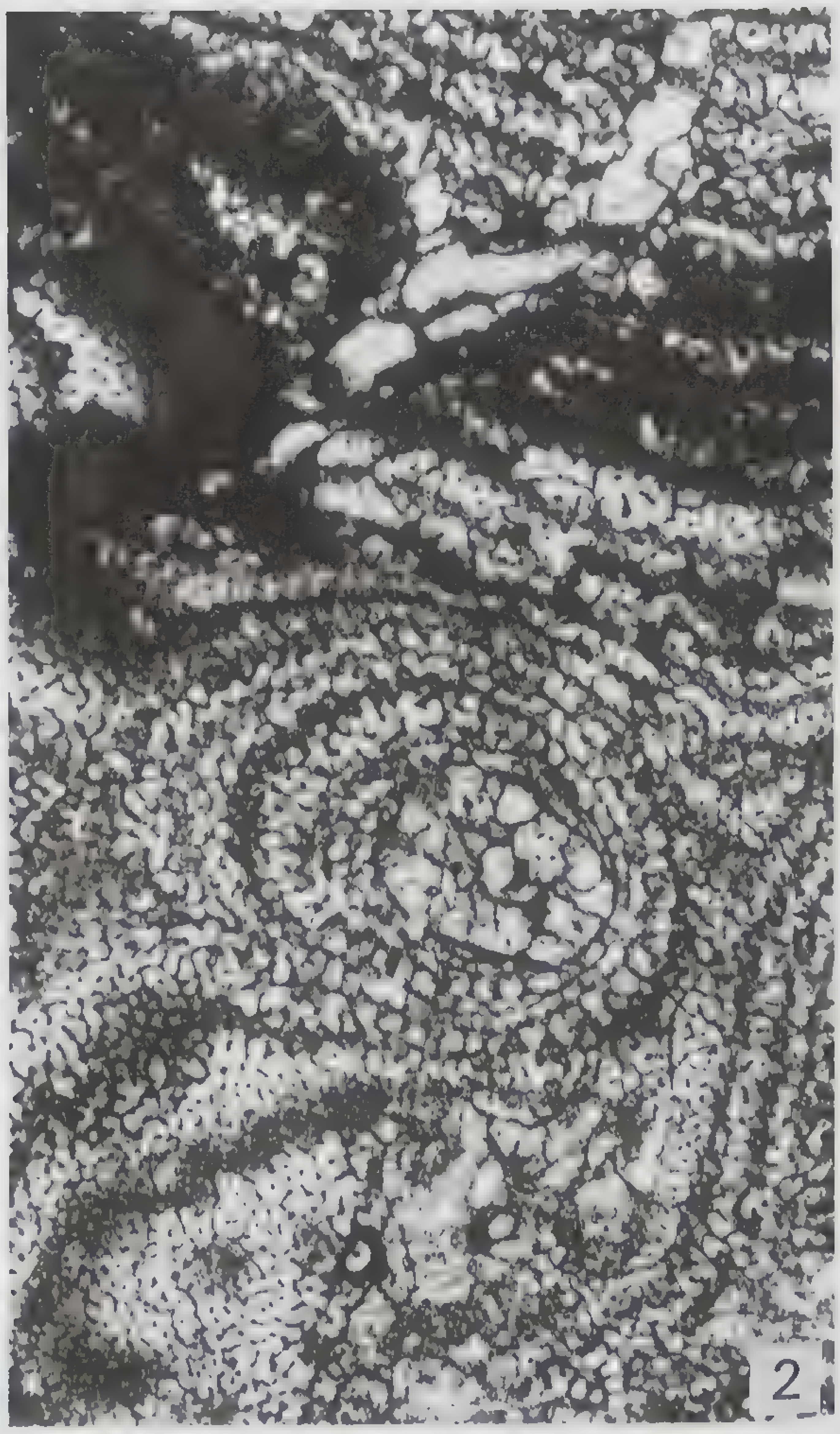
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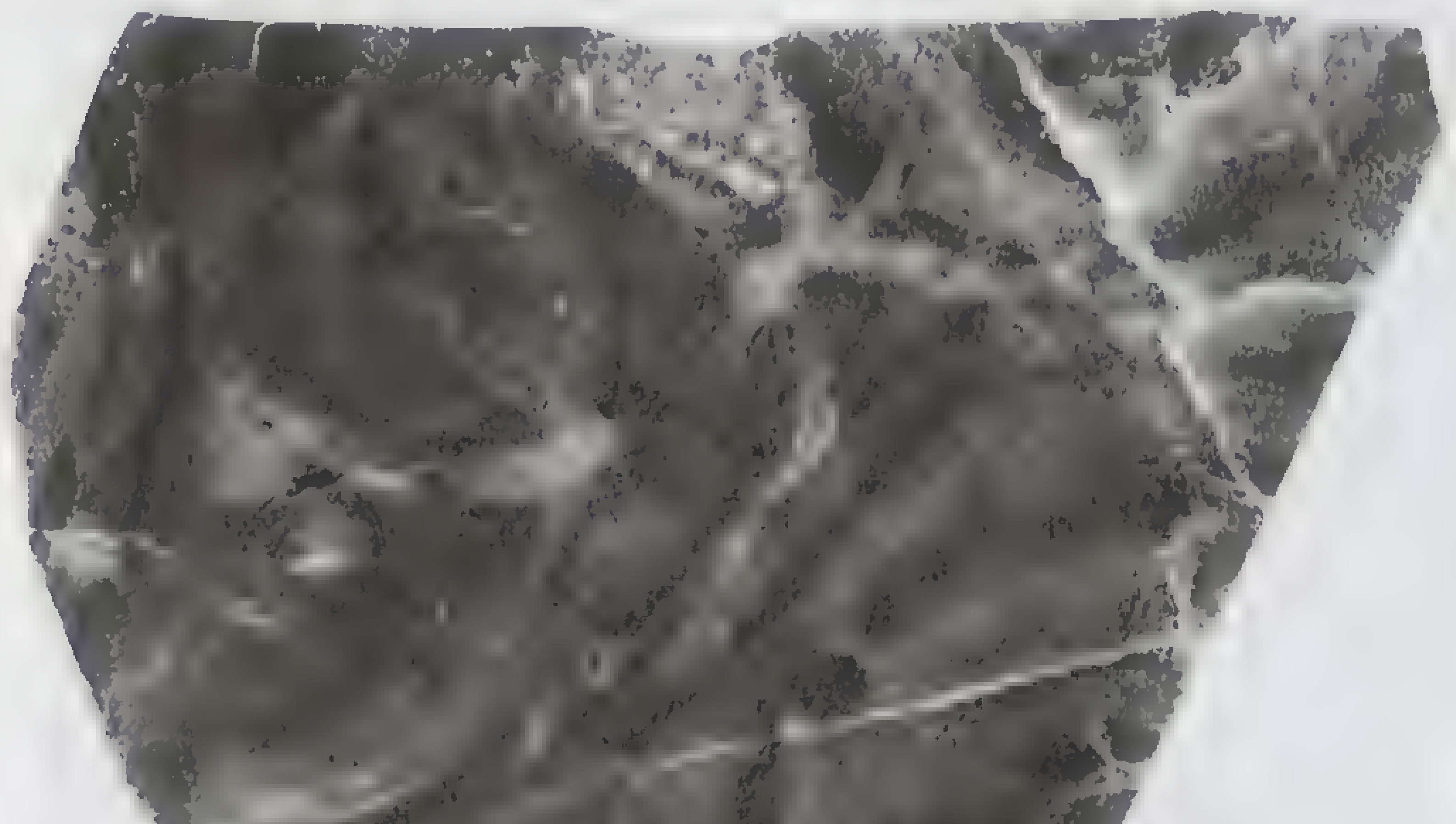
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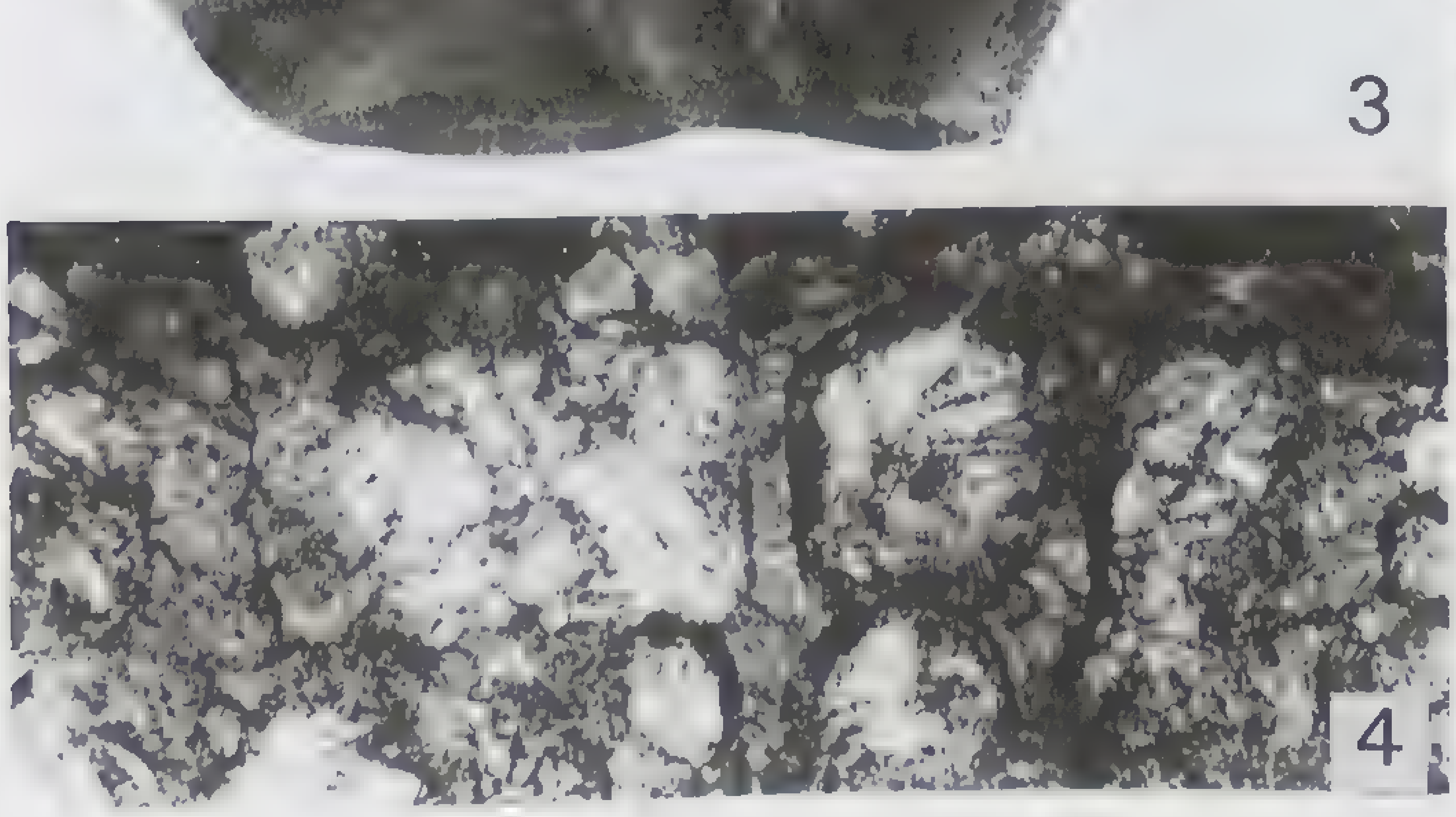
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EXPLANATION OF PLATE 2

Figure		Page
1–5.	*Aculatostroma* cf. *A. kaljanum* (Bogoyavlenskaya, 1977).	16

Specimen GSC 108855.

1. Vertical section; ×10.
2. Tangential section; ×10.
3. Hand-specimen, slabbed surface; ×2. Note pattern and distribution of astrorhizae.

4, 5. Vertical section, detail of colliculate pillars. Same view at ×100 (Fig. 4) and ×250 (Fig. 5).

EXPLANATION OF PLATE 3

Figure Page

1–3. *Clathrodictyon ellesmerense* Stearn, 1983. 17
  1. Vertical section; × 10. Specimen GSC 108857. Note successive phases of growth (rhythmic variation of laminar spacing).
  2. Vertical section; × 10. Specimen GSC 108856.
  3. Vertical section; × 6. Specimen GSC 108858. Note the impersistent protuberances, unlike mamelons.

4–5. *Gerronostroma septentrionalis,* new species. 18
  Paratype GSC 108860.
  4. Vertical section; × 10.
  5. Tangential section; × 10.

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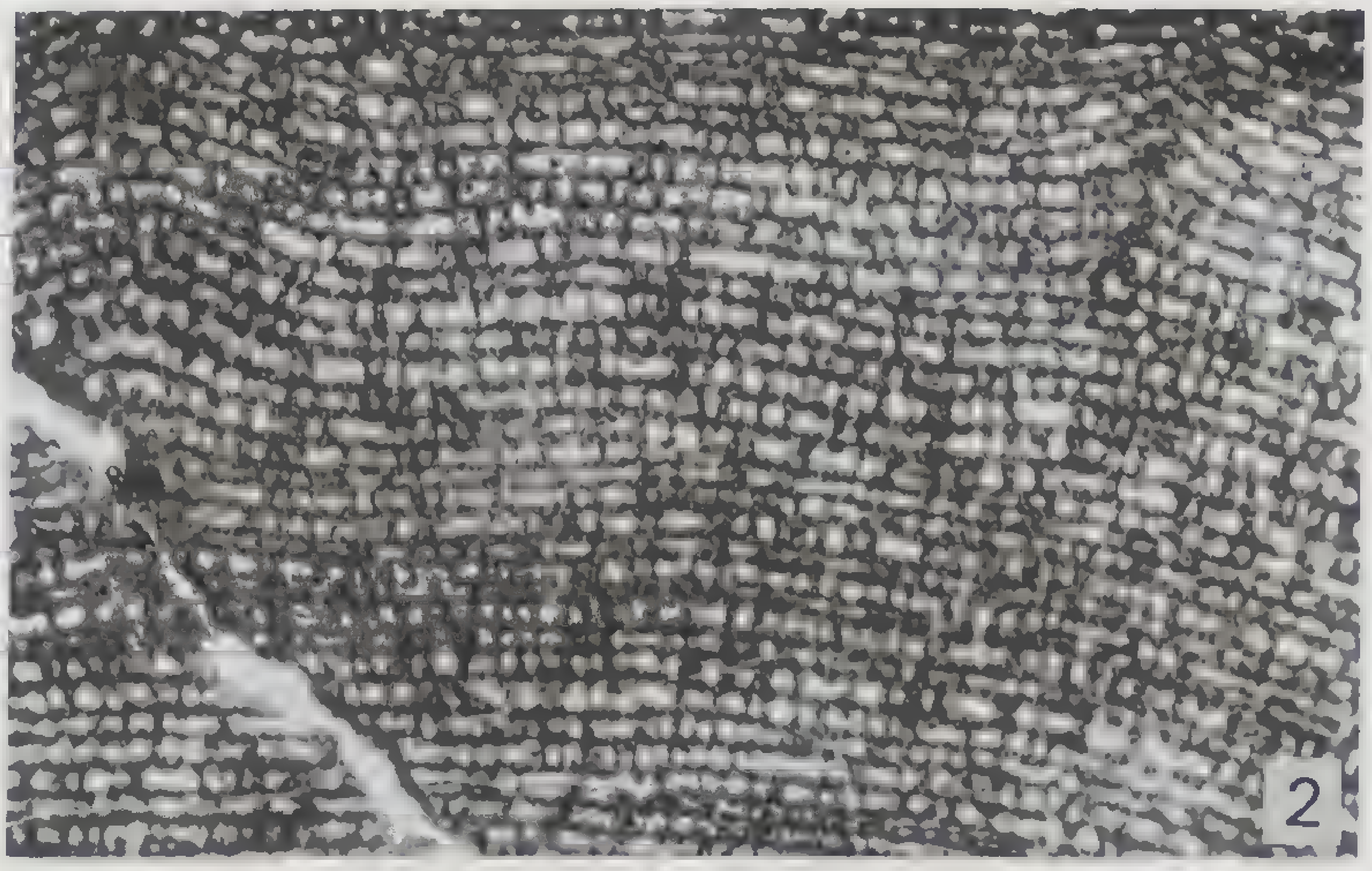

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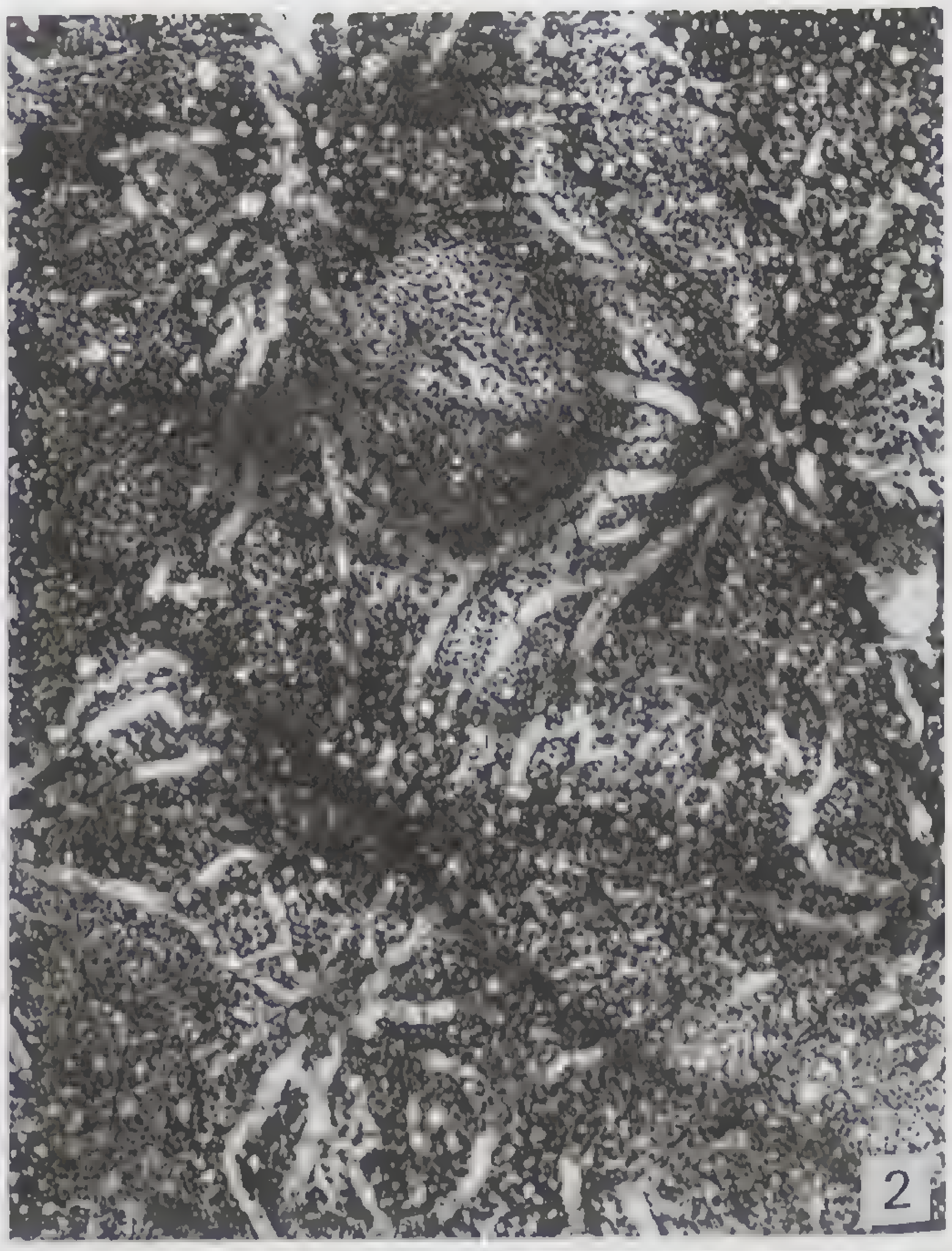
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EXPLANATION OF PLATE 4

Figure		Page
1–4.	*Gerronostroma septentrionalis,* new species.	18

1, 2. Holotype GSC 108859. Vertical section (Fig. 1) and tangential section (Fig. 2); ×10.

3. Paratype GSC 108862. Vertical section; ×10. Note abundant commensal syringoporids.

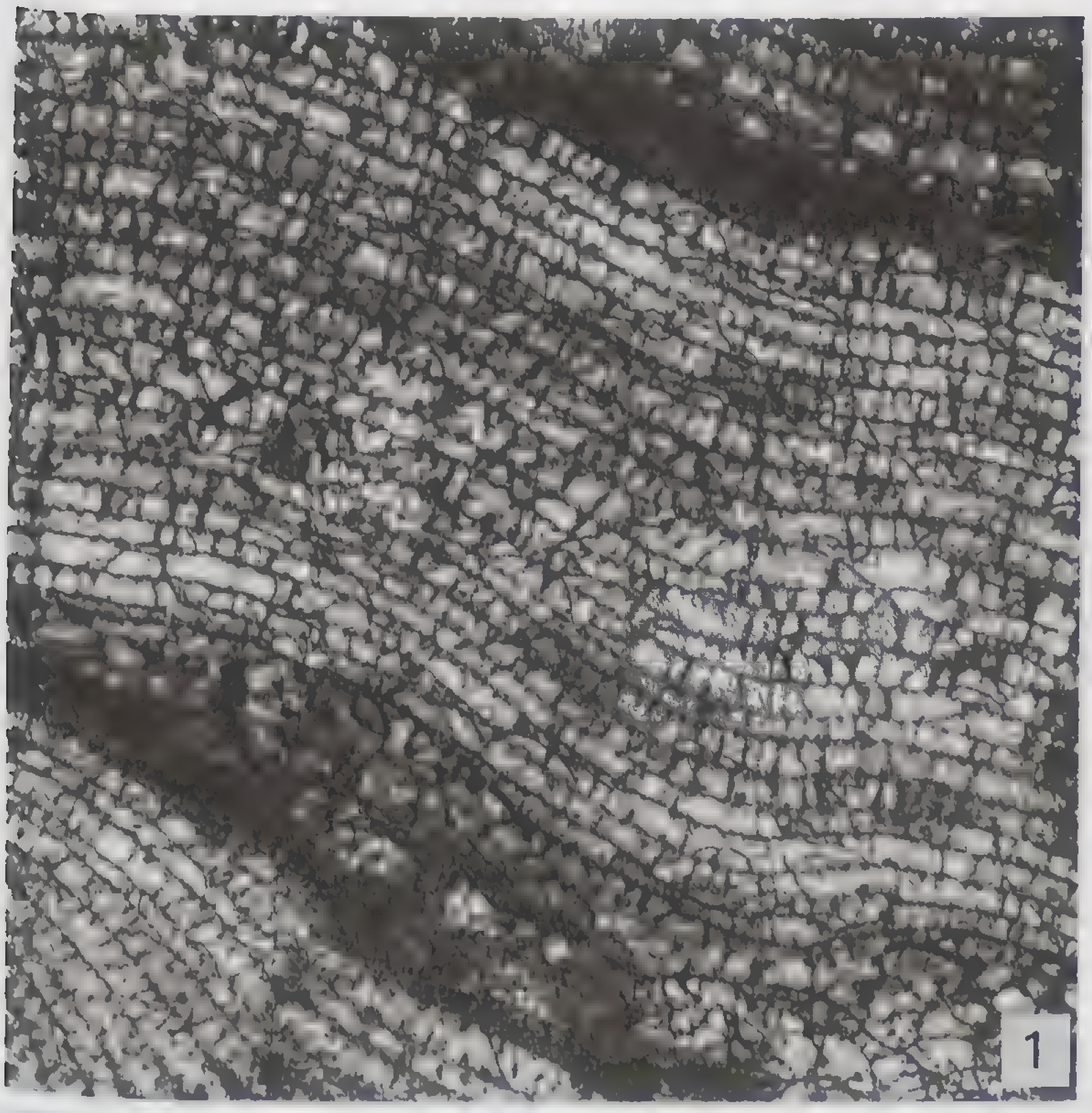
4. Competitive overgrowth relationship between holotype *G. septentrionalis* n. sp. (left, upper) and *Stromatopora polaris* (right, lower). GSC 108859. Vertical section; ×5.

EXPLANATION OF PLATE 5

Figure ... Page

1, 2. *Petridiostroma* sp. ... 19
Specimen GSC 108863.
1. Vertical section; ×10.
2. Tangential section; ×10.

3, 4. *Atelodictyon* cf. *A. solidum* Khromych, 1976. ... 20
Specimen GSC 108865. Note: thin-sections photographed under reflected light.
3. Vertical section; ×10.
4. Tangential section; ×10.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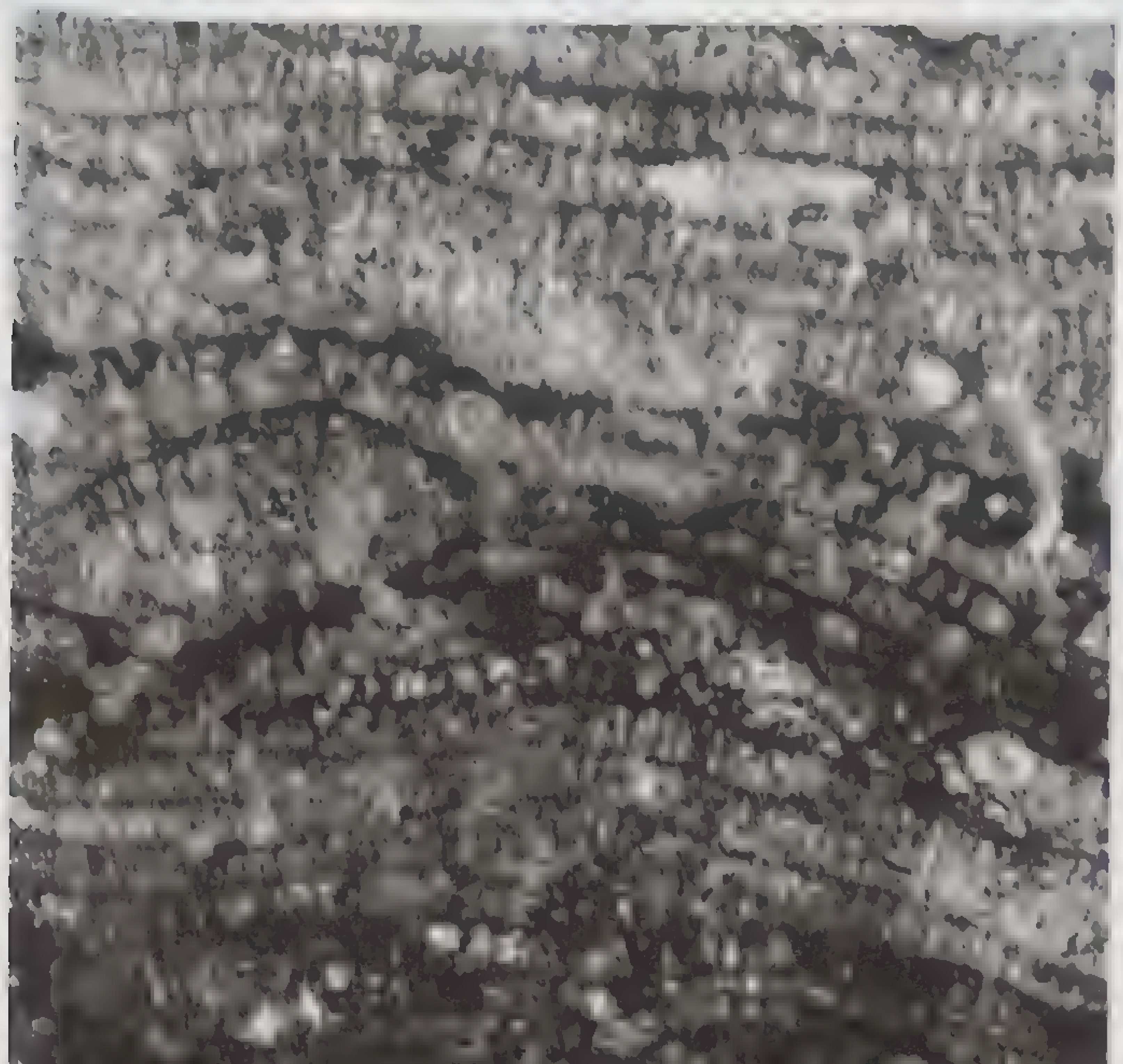
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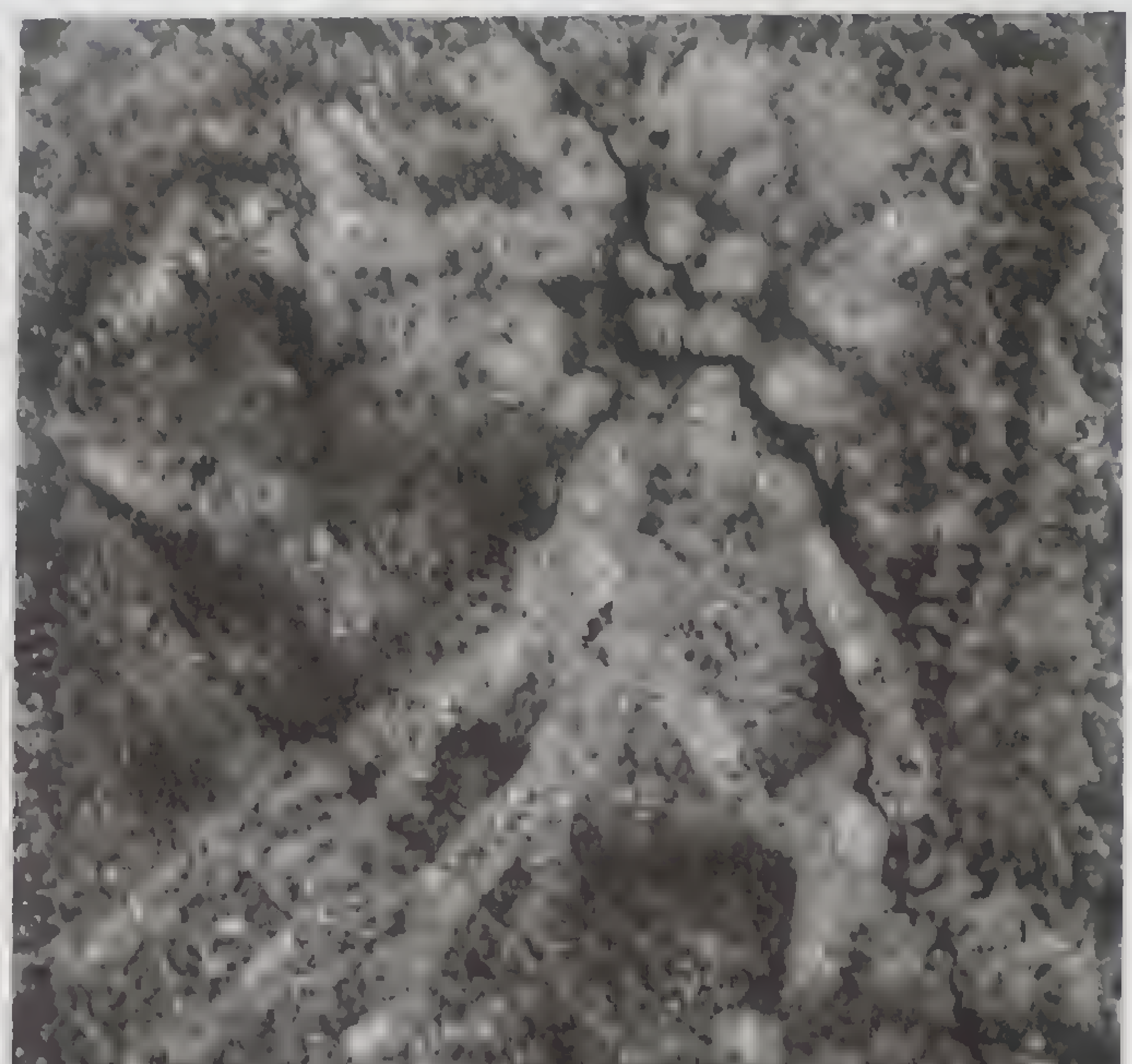
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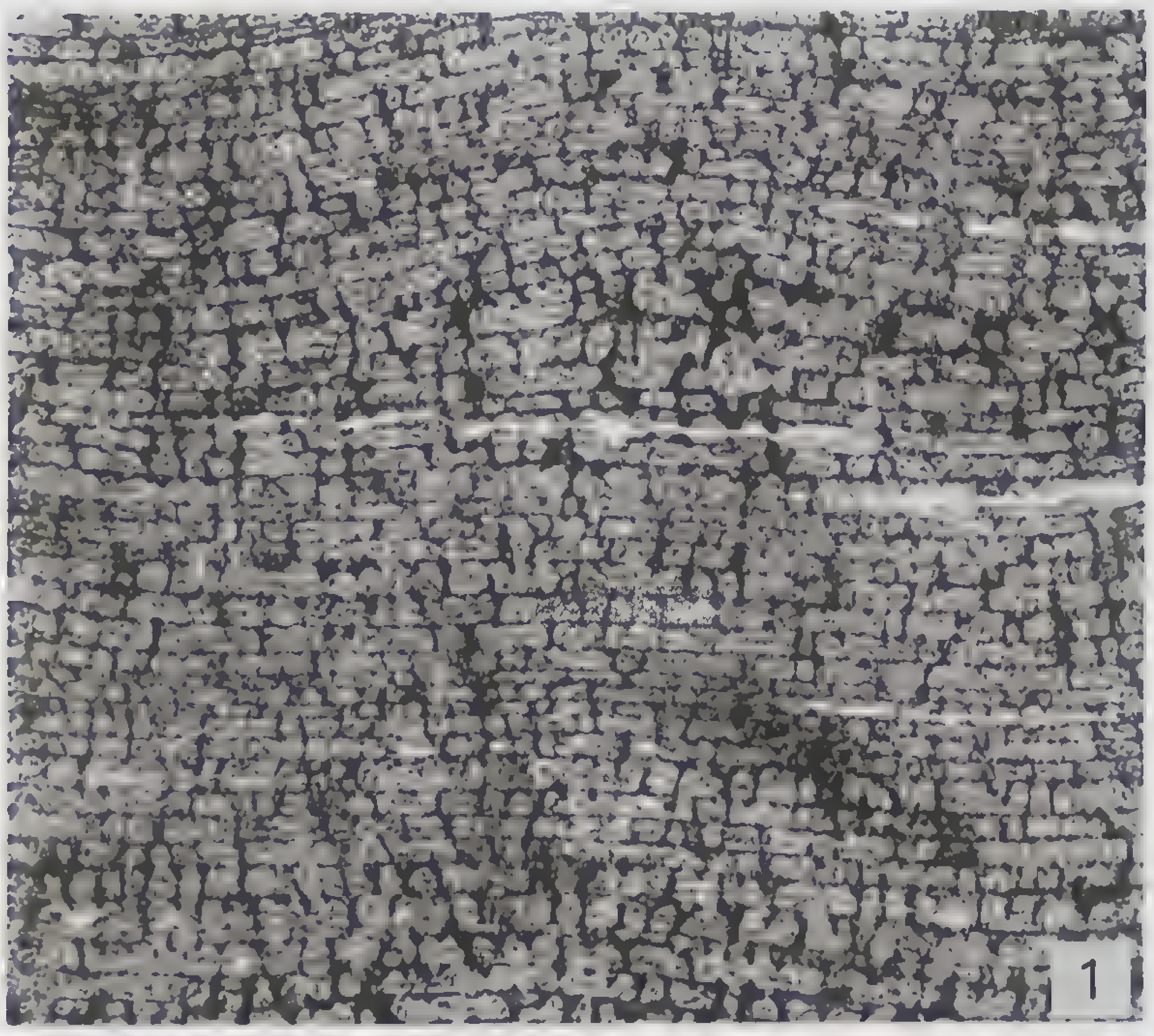
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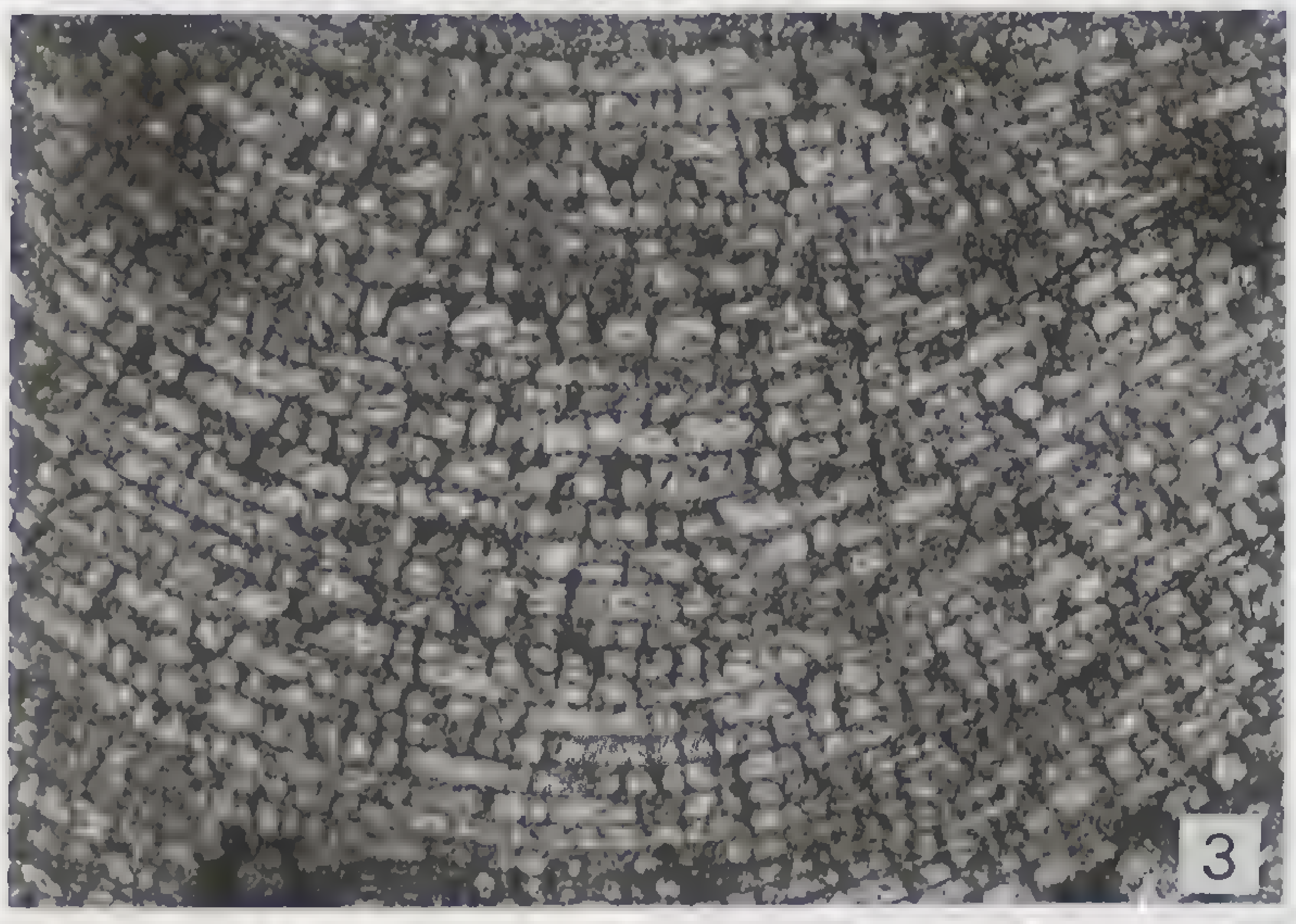
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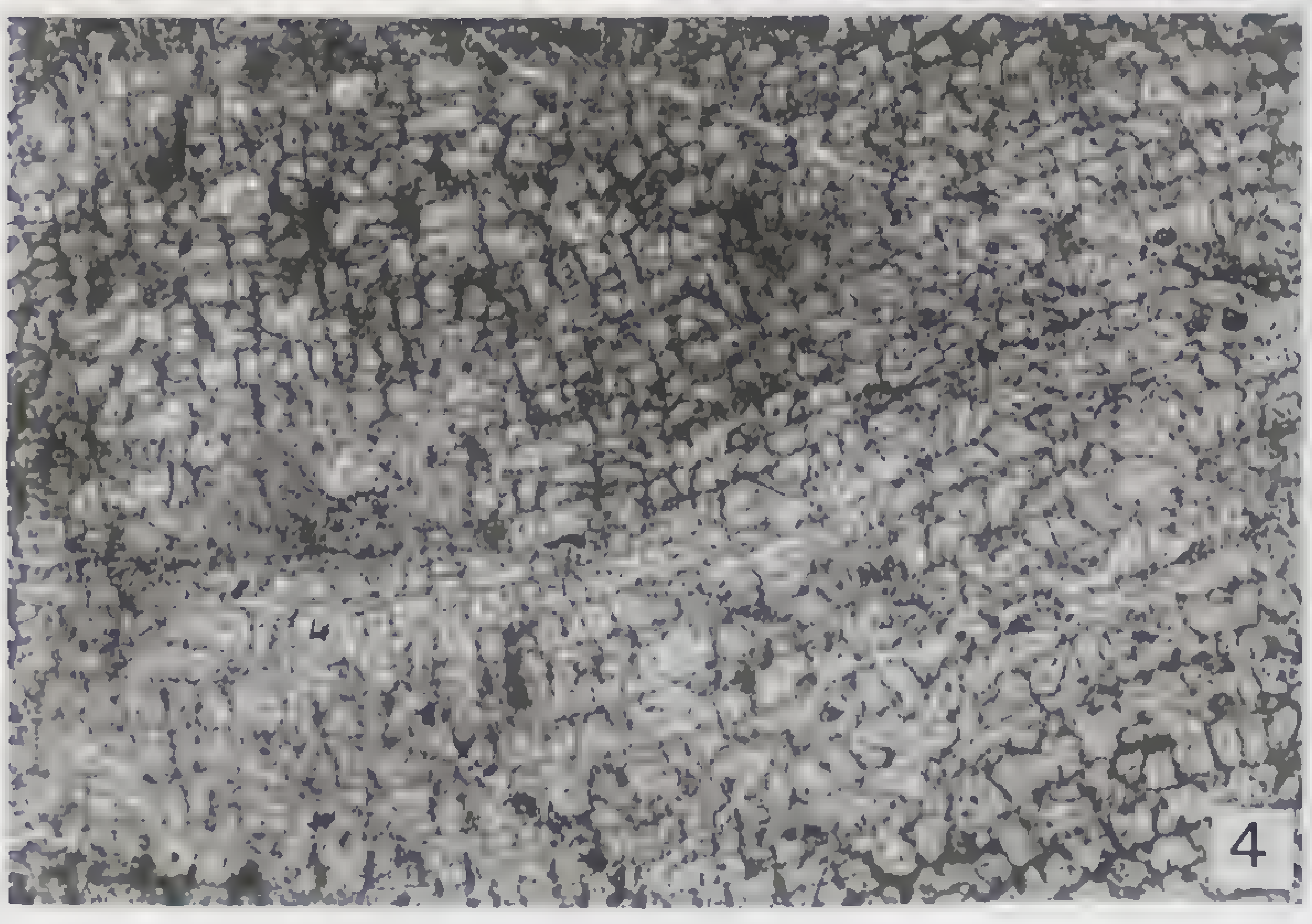
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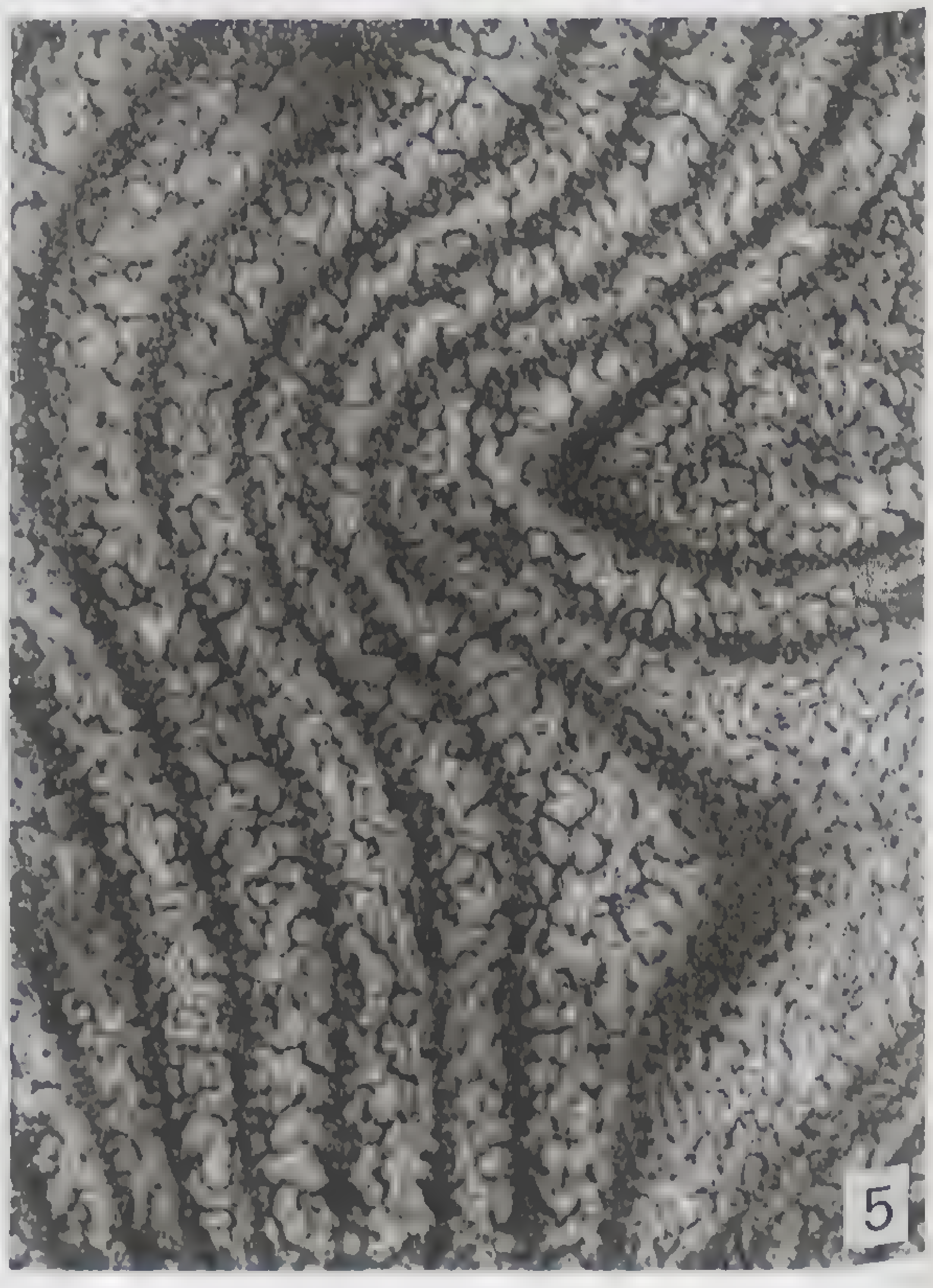
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EXPLANATION OF PLATE 6

Figure		Page
1–5.	*Anostylostroma anfractum,* new species.	21

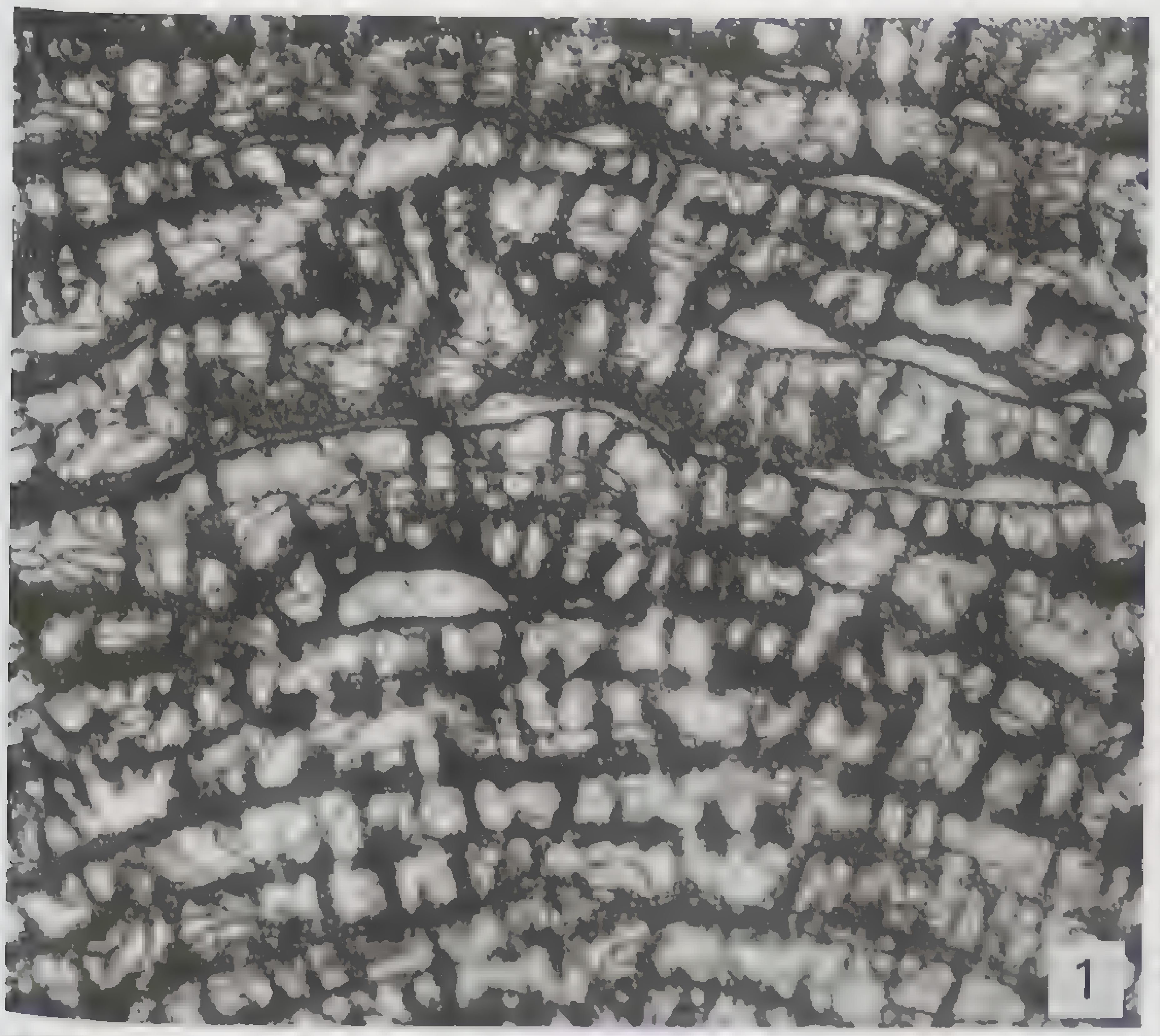
1. Holotype GSC 108866. Vertical section; ×10.
2. Holotype GSC 108866. Tangential section; ×10.
3. Paratype GSC 108867. Vertical section; ×10.
4. Paratype GSC 108869. Vertical section; ×10.
5. Paratype GSC 108868. Tangential section; ×10.

EXPLANATION OF PLATE 7

Figure .... Page

1–4. *Pseudoactinodictyon conglutinatum,* new species. 22
    1. Holotype GSC 108870. Vertical section; ×10.
    2. Holotype GSC 108870. Tangential section; ×10.
    3. Paratype GSC 108871. Vertical section; ×10.
    4. Paratype GSC 108871. Tangential section; ×10.

5–6. *Schistodictyon*? sp. 23
    Specimen GSC 108872.
    5. Vertical section; ×10.
    6. Tangential section; ×10.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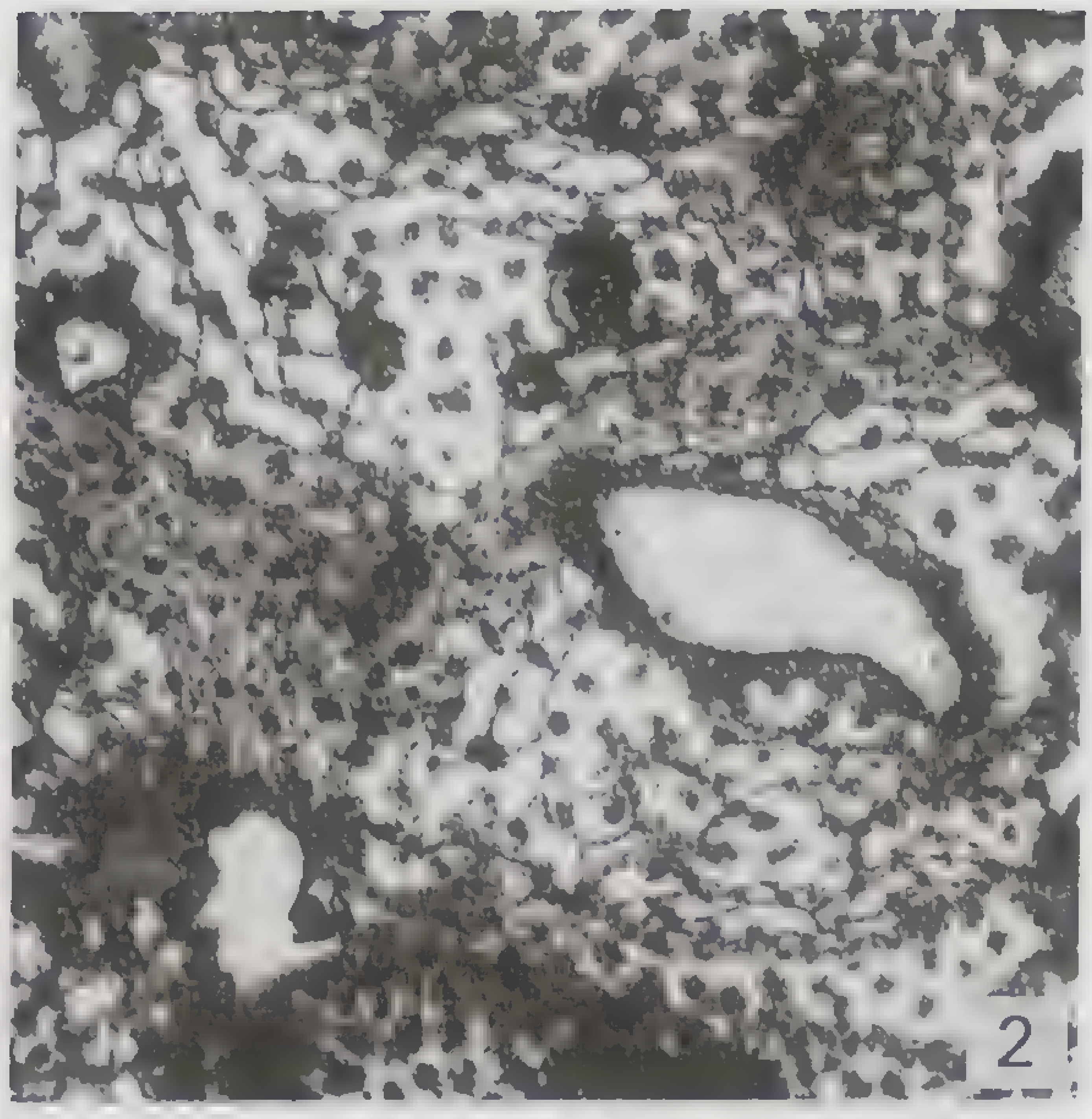
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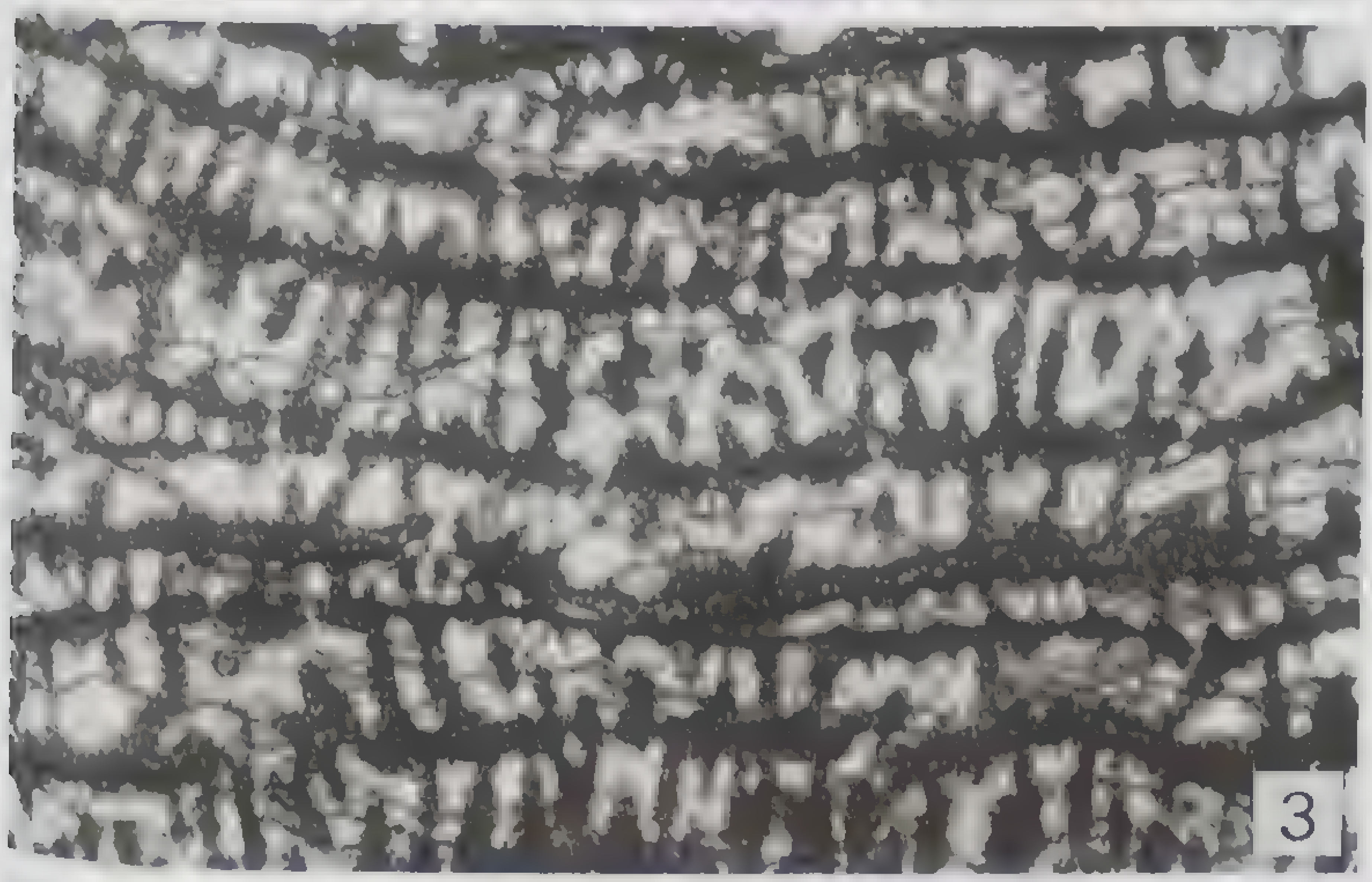
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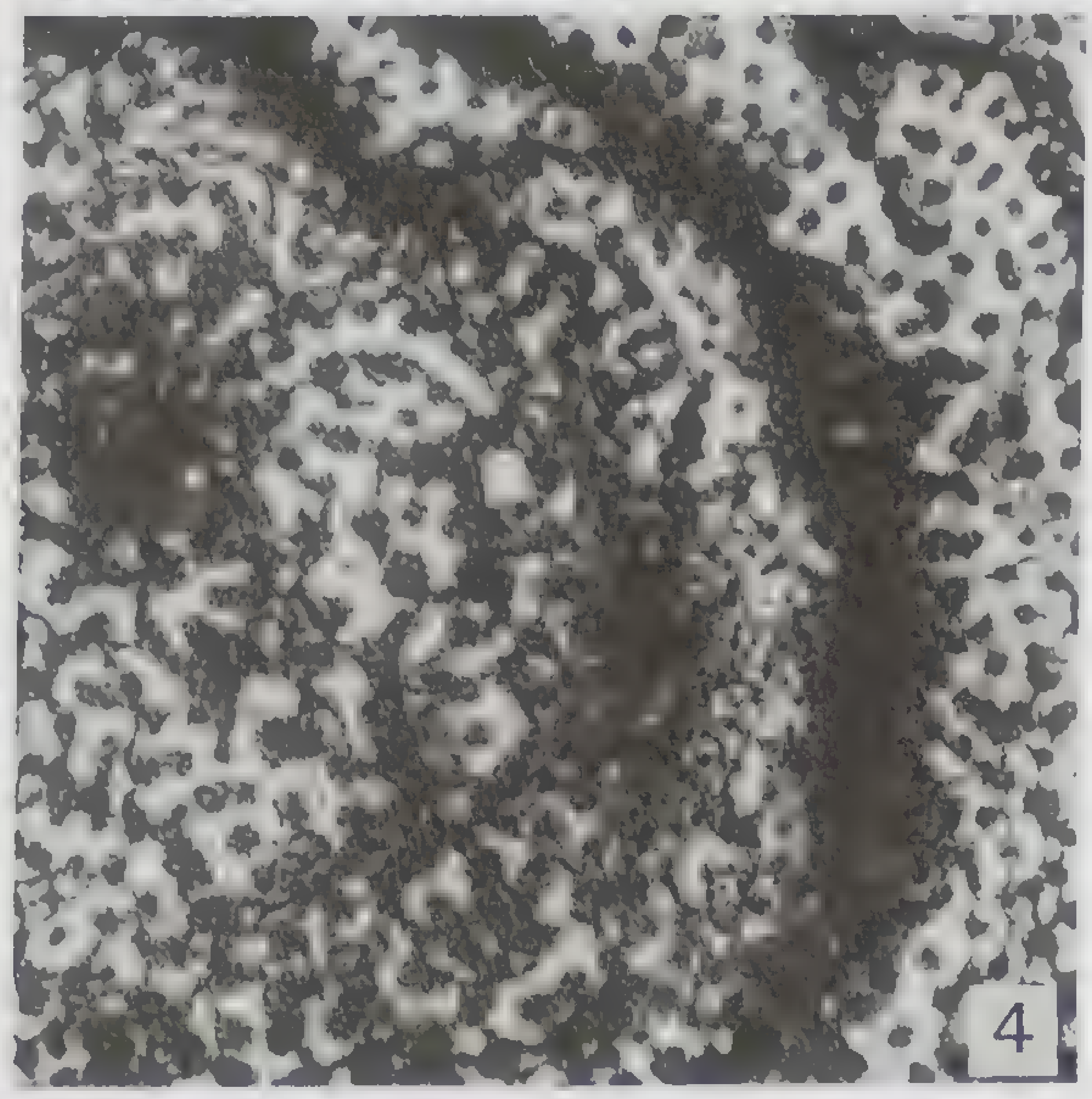
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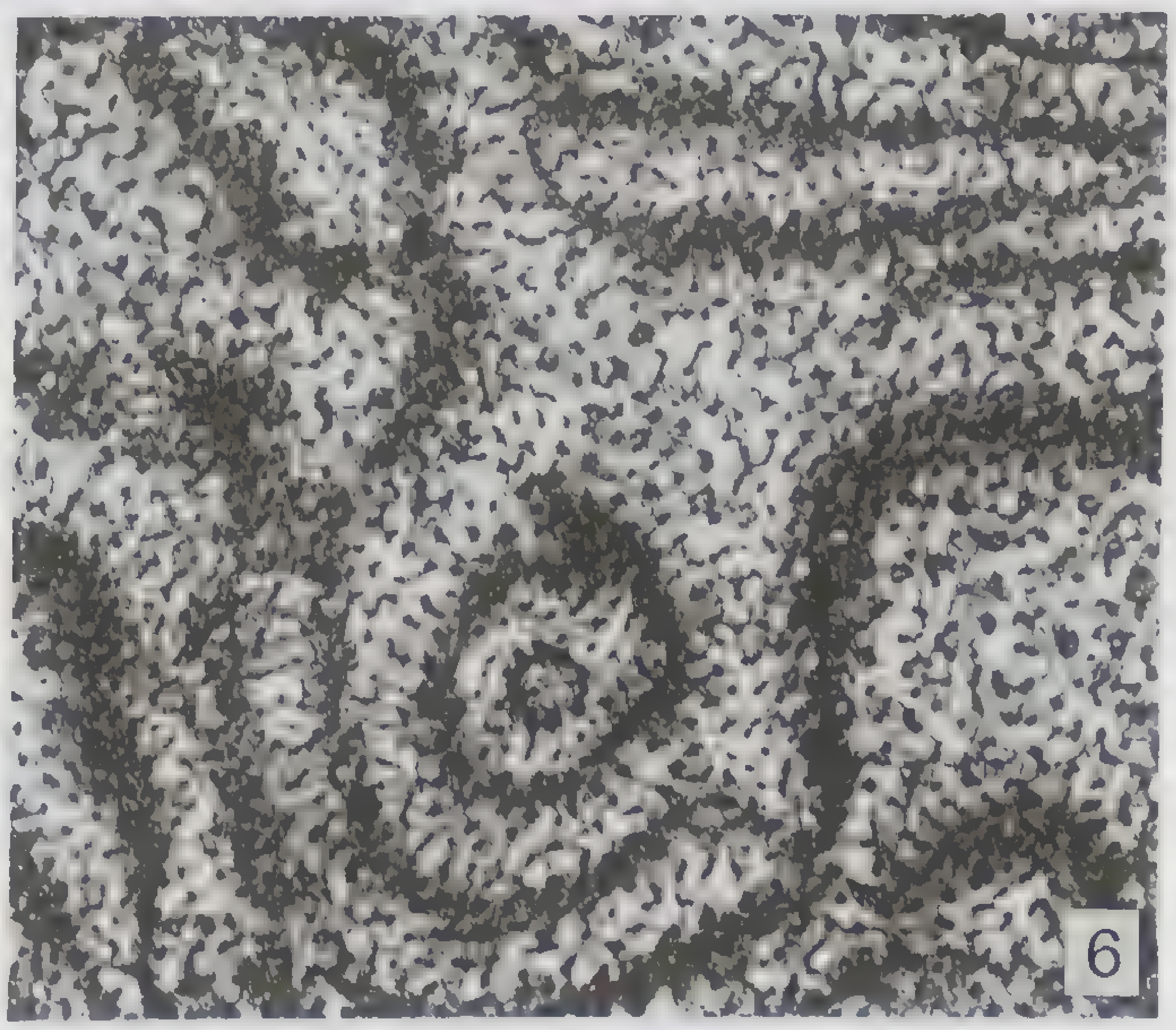
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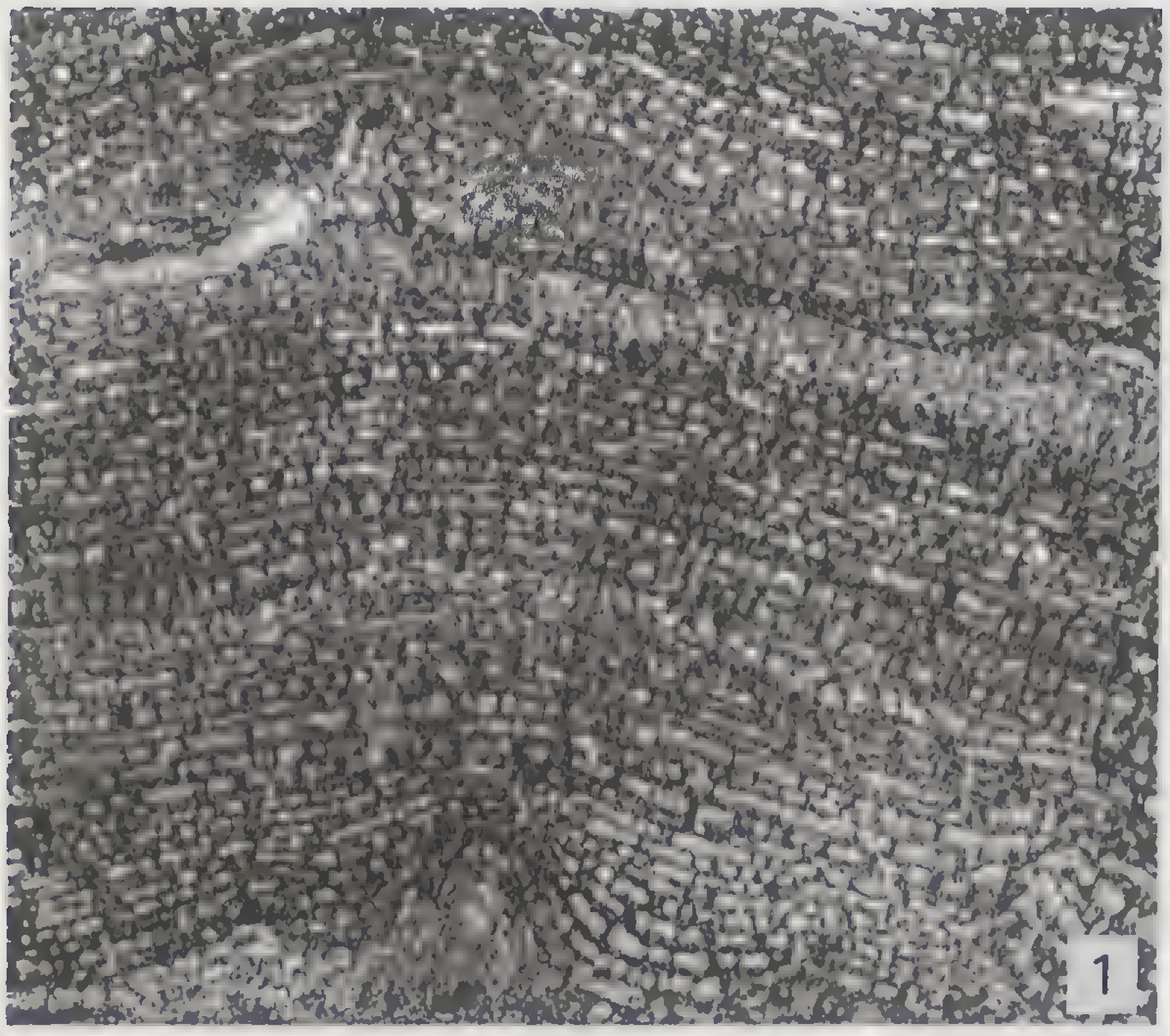
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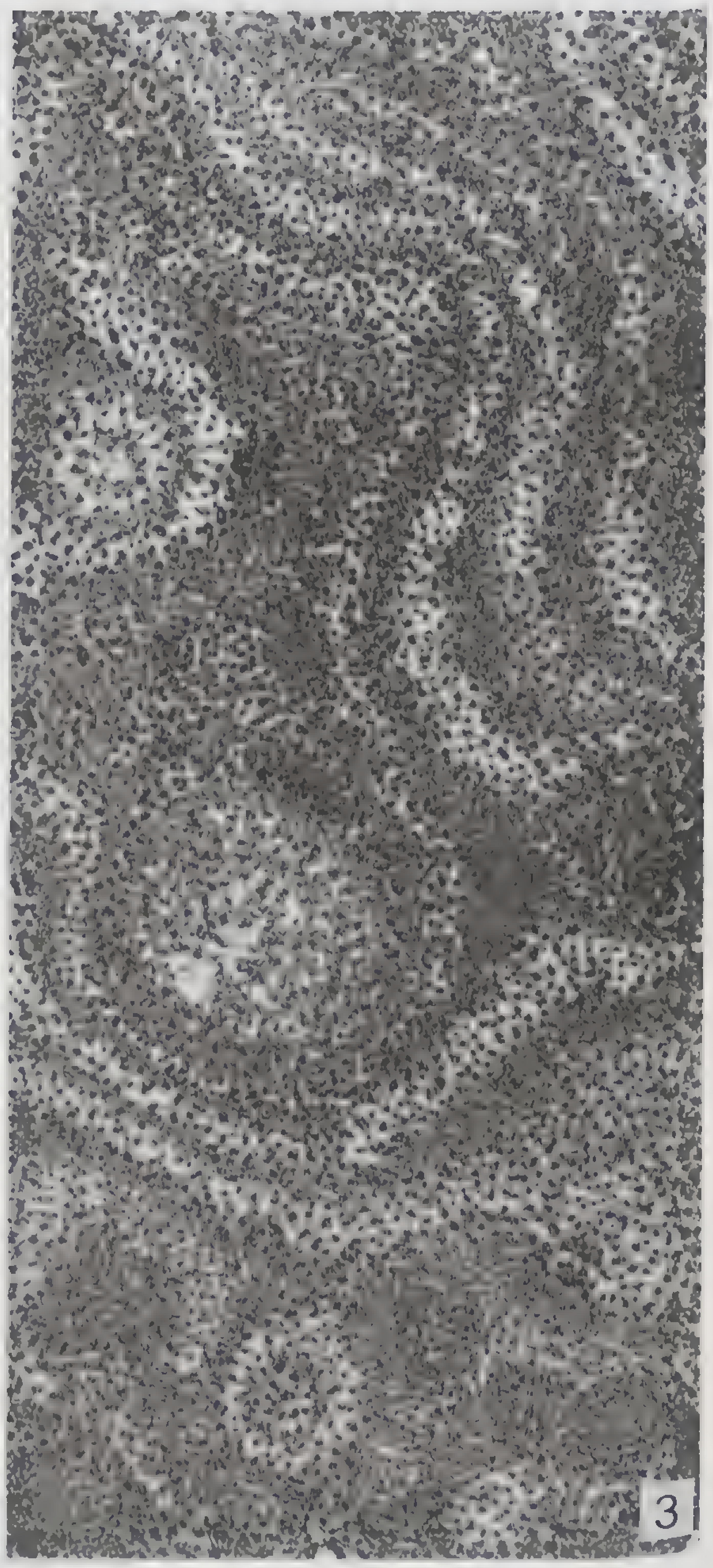
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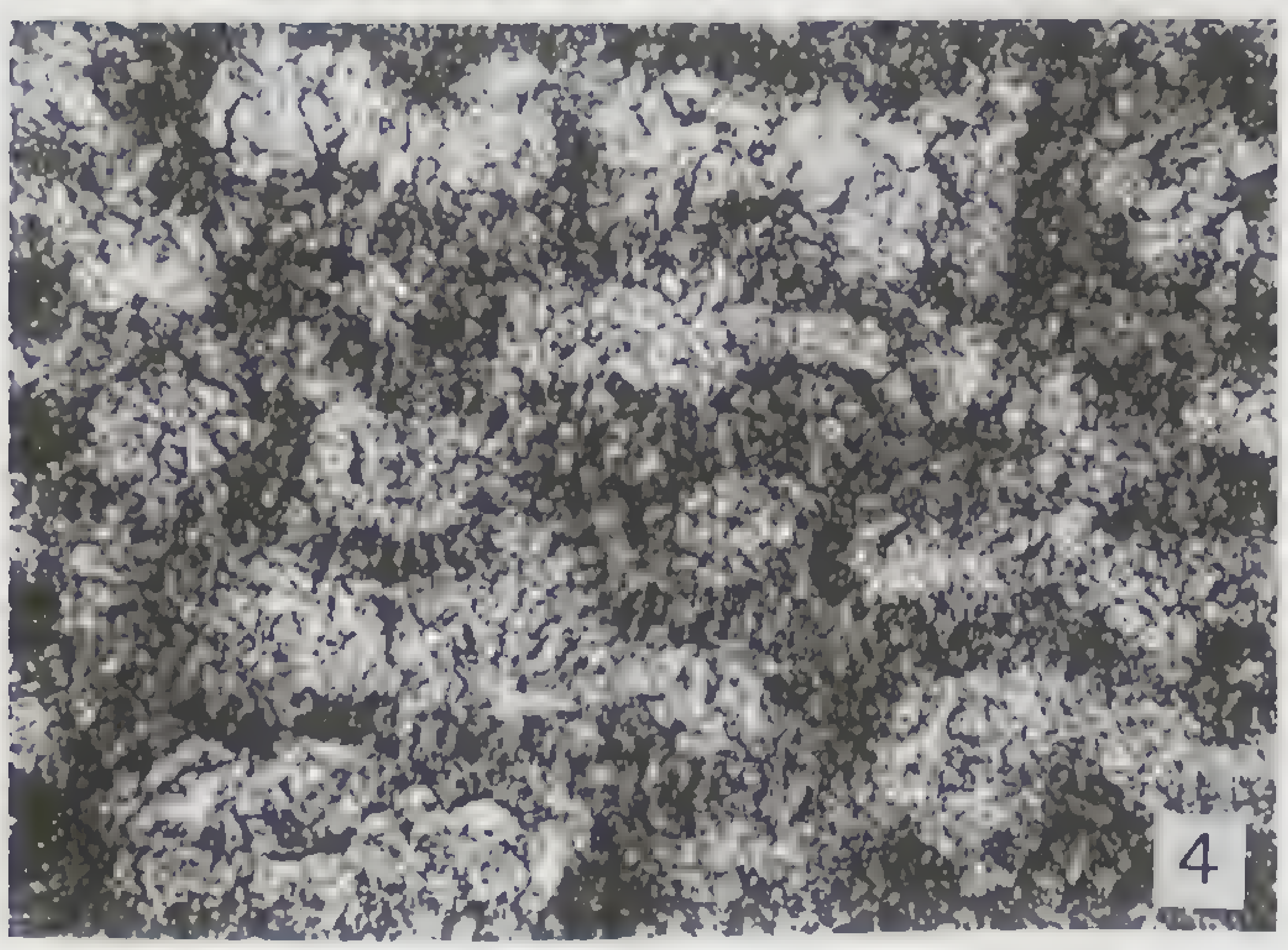
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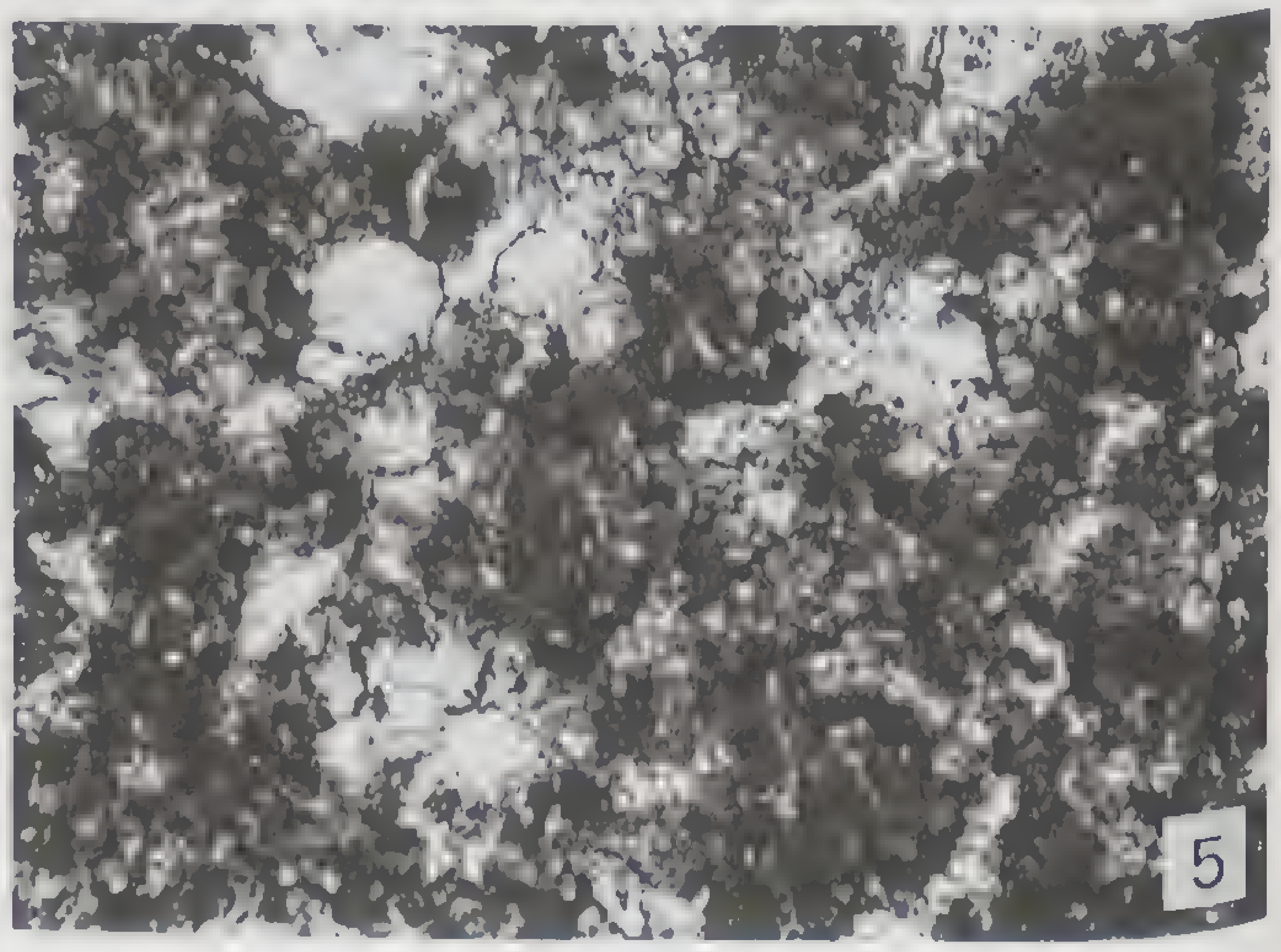
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EXPLANATION OF PLATE 8

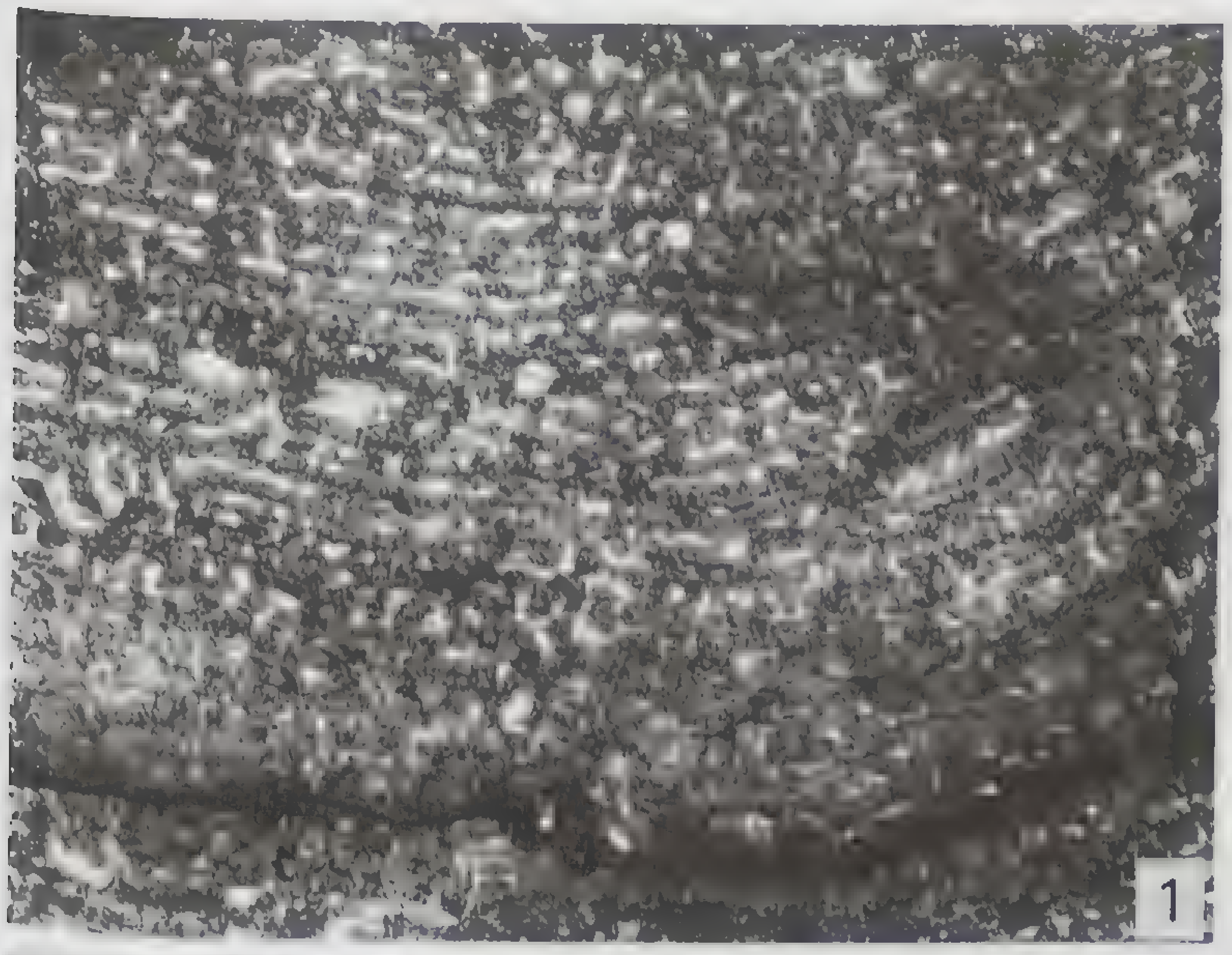
Figure		Page
1–5.	*Stictostroma gorriense* Stearn, 1995.	24

1. Vertical section; ×10. Specimen GSC 108177.
2. Vertical section; ×10. Specimen GSC 108874
3. Tangential section; ×10. Specimen GSC 108177.
4. Vertical section, detail of microstructure; ×50. Specimen GSC 108874.
5. Tangential section, detail of microstructure; ×50. Specimen GSC 108875.

EXPLANATION OF PLATE 9

Figure	Page
1–5. *Stictostroma*? *nunavutense*, new species.	25

1. Holotype GSC 108876. Vertical section; ×10.
2. Paratype GSC 108877. Vertical section; ×10.
3. Holotype GSC 108876. Tangential section; ×10.
4. Vertical section, detail of microstructure; ×25. Paratype GSC 108877.
5. Tangential section, detail of microstructure; ×25. Paratype GSC 108877.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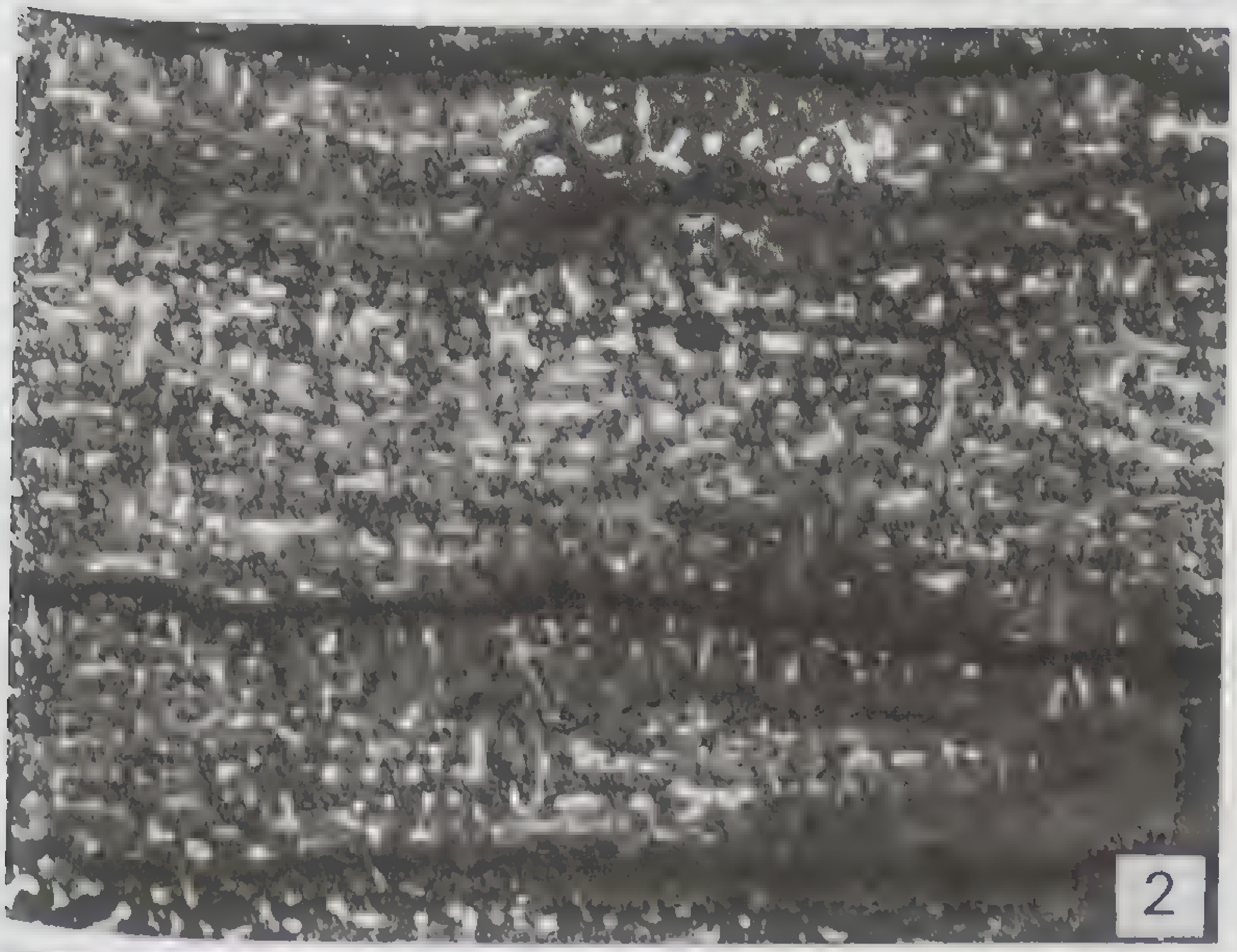
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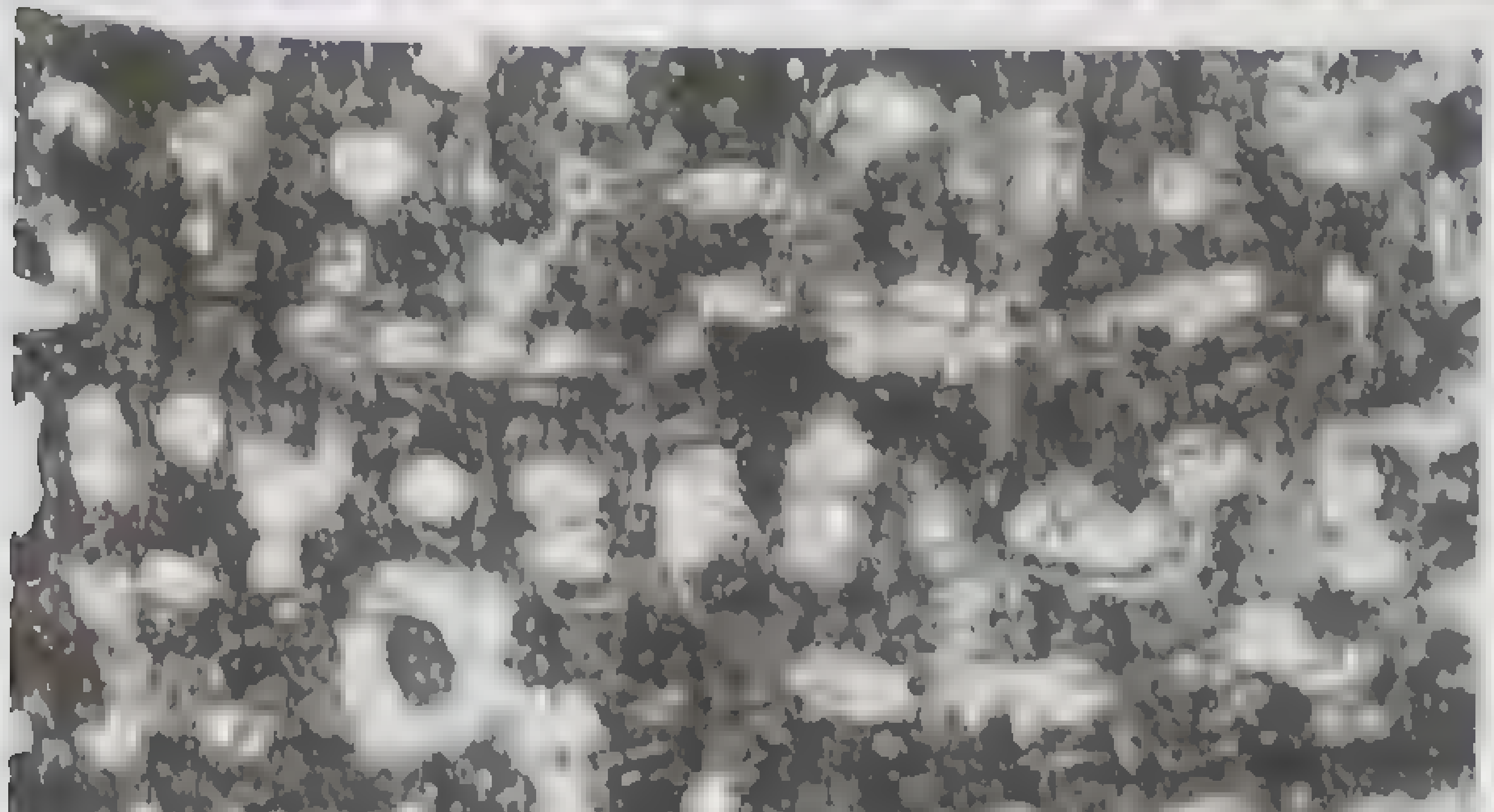
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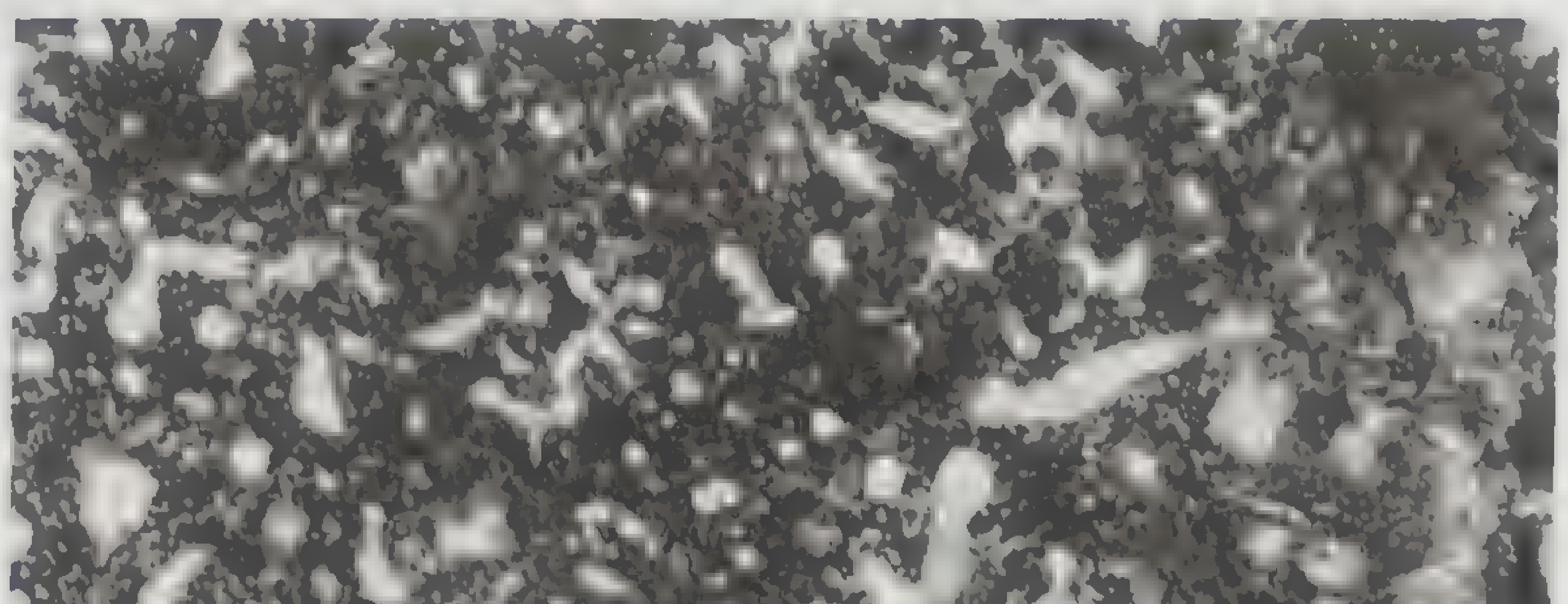
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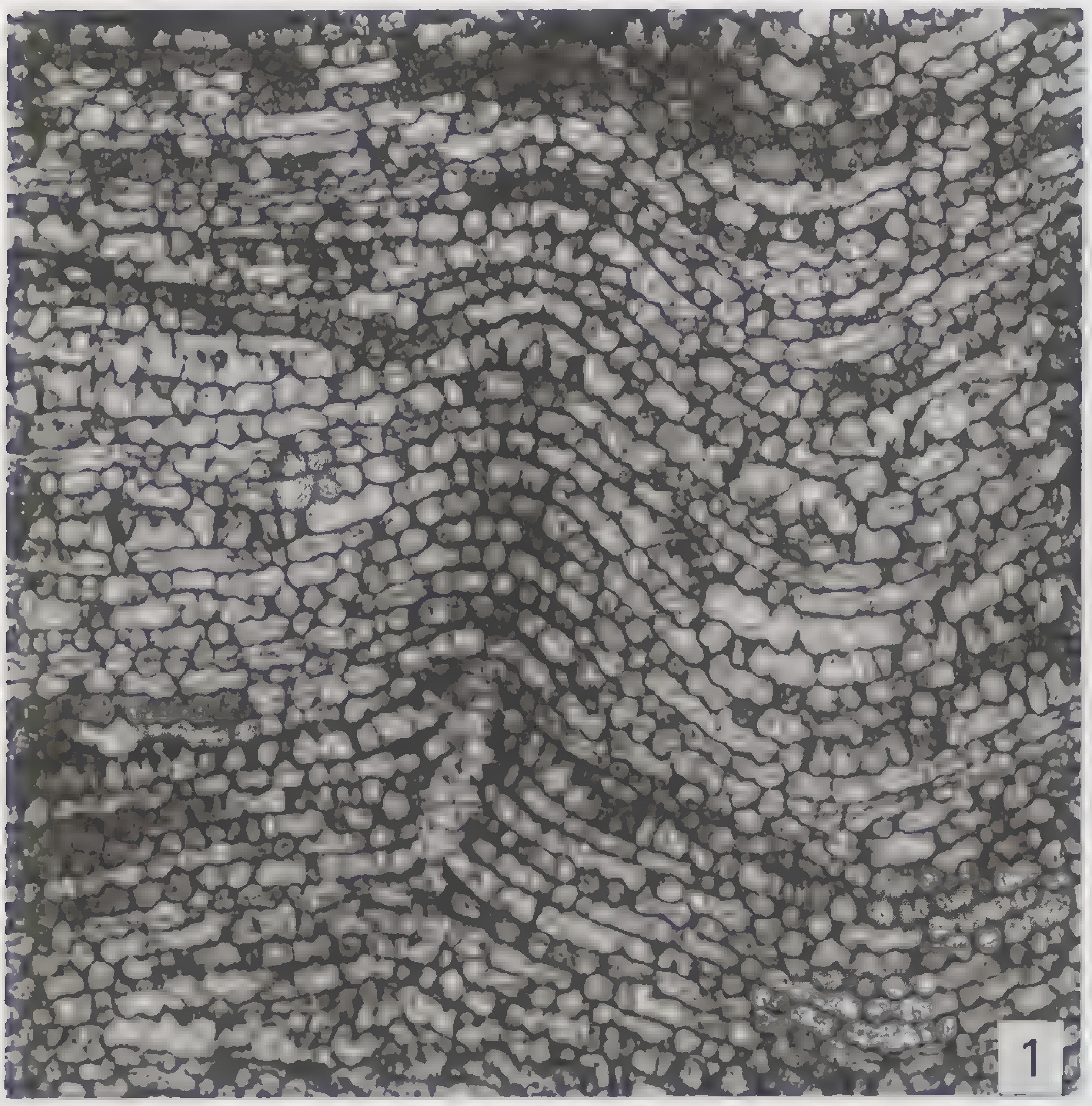
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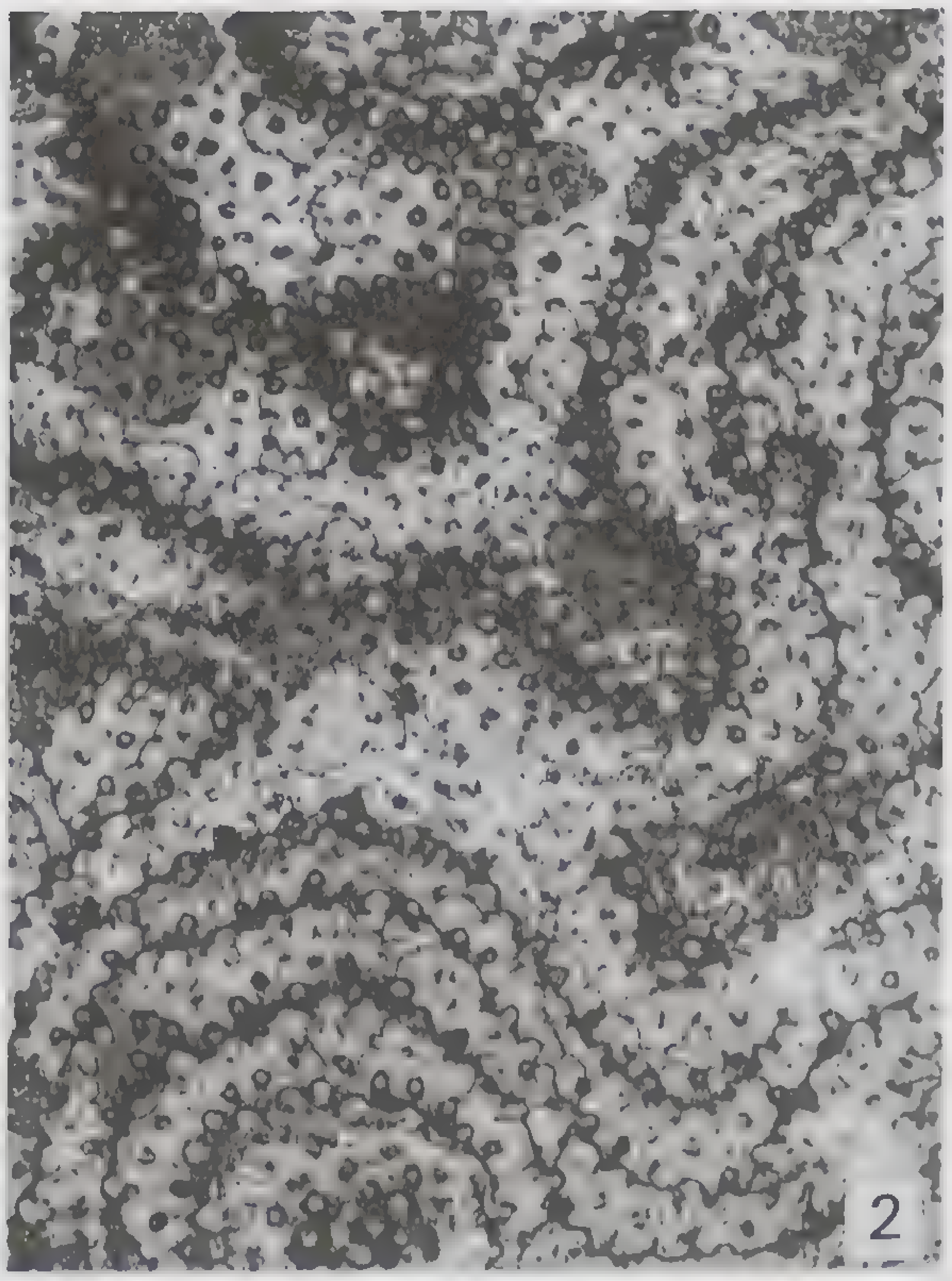
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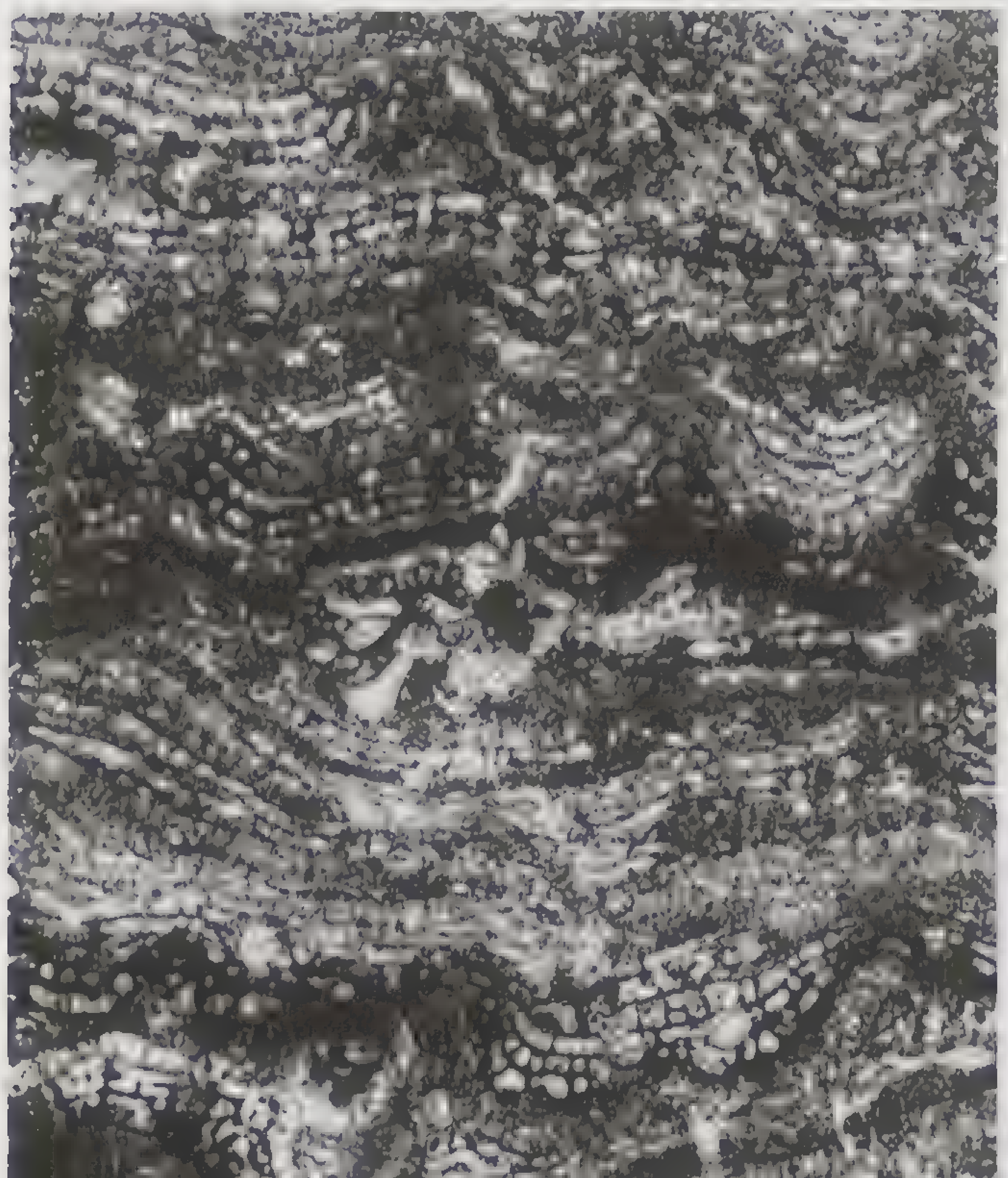
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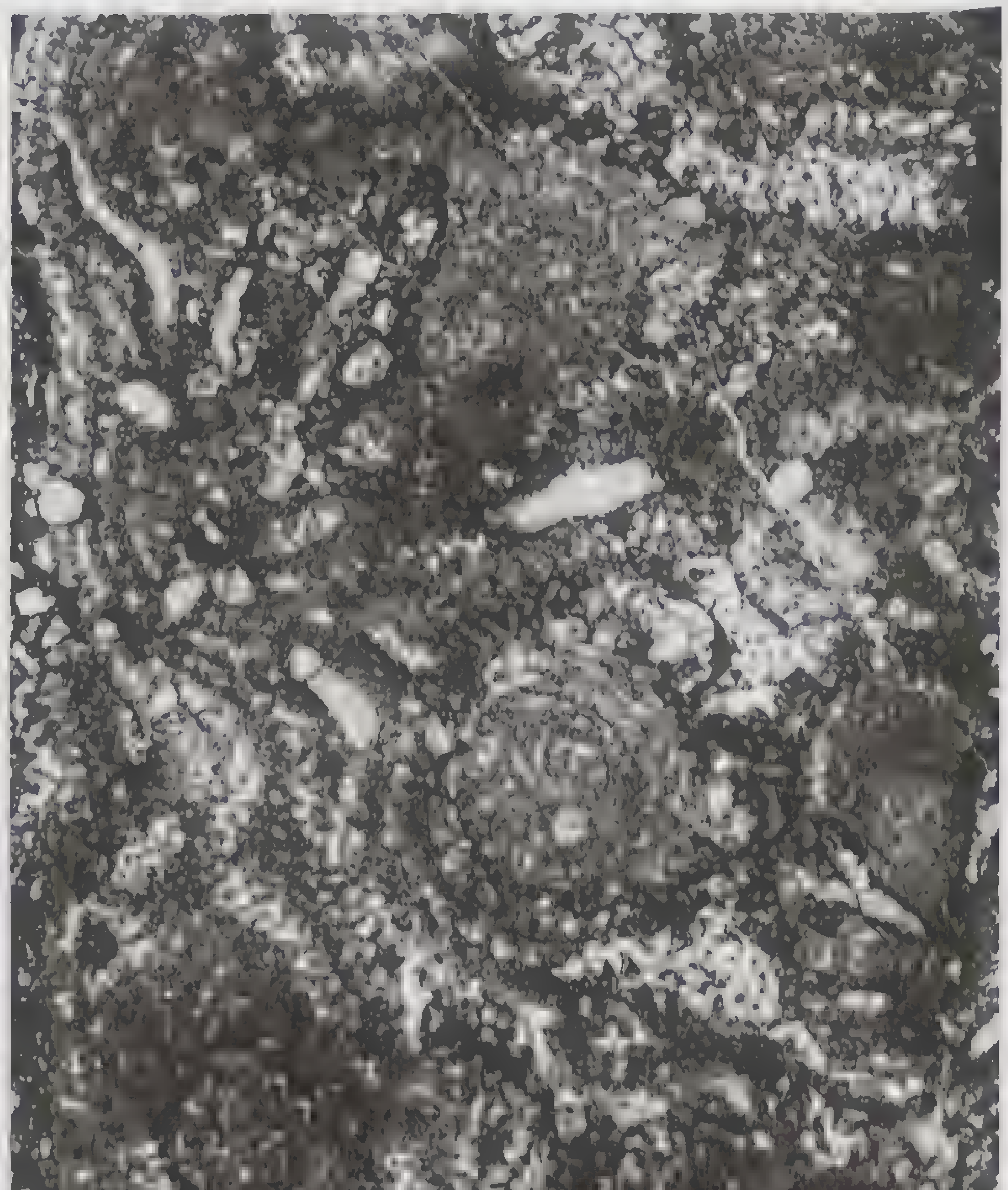
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EXPLANATION OF PLATE 10

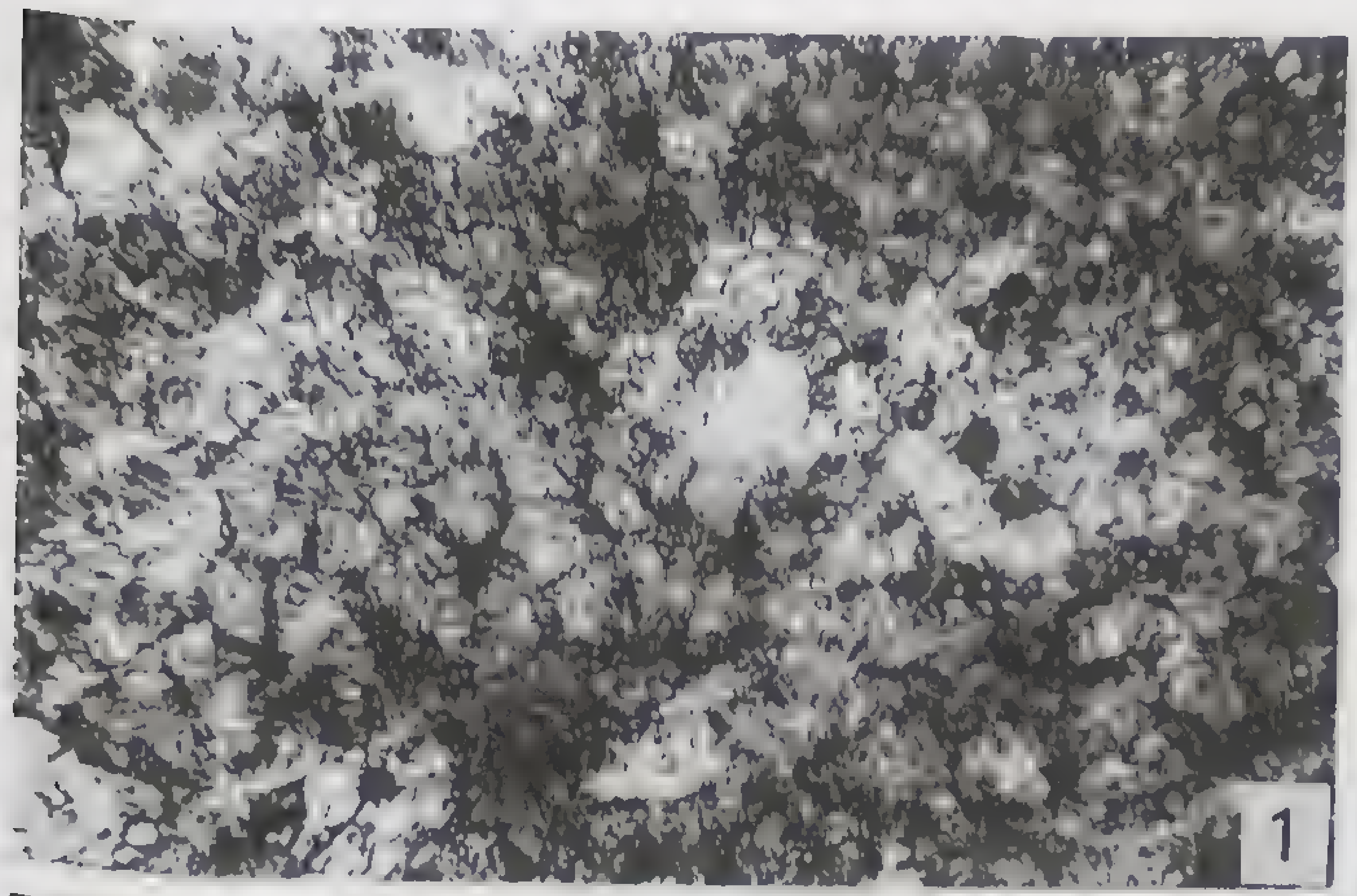
Figure		Page
1, 2.	*Stromatoporella perannulata* Galloway and St. Jean, 1957. Specimen GSC 108175. 1. Vertical section; ×10. 2. Tangential section; ×10.	26
3, 4.	*Clathrocoilona vexata,* new species. Holotype GSC 108881. 3. Vertical section; ×10. 4. Tangential section; ×10.	28

EXPLANATION OF PLATE 11

Figure		Page
1–8.	*Clathrocoilona vexata,* new species.	28

Detail of microstructures; all figures ×50.

1. Tubulate microstructure; tangential section. Holotype GSC 108881.
2. Tubulate microstructure; vertical section. Paratype GSC 108883.
3. Tubulate microstructure; vertical section. Holotype GSC 108881.
4. Vermiculated or felted microstructure; vertical section. Paratype GSC 108883.
5. Compact microstructure; vertical section. Paratype GSC 108883.
6. Blocky or melanospheric microstructure; vertical section. Paratype GSC 108882.
7. Melanospheric microstructure; tangential section. Paratype GSC 108882.
8. Ordinicellular microstructure (centre of field); vertical section. Holotype GSC 108881.



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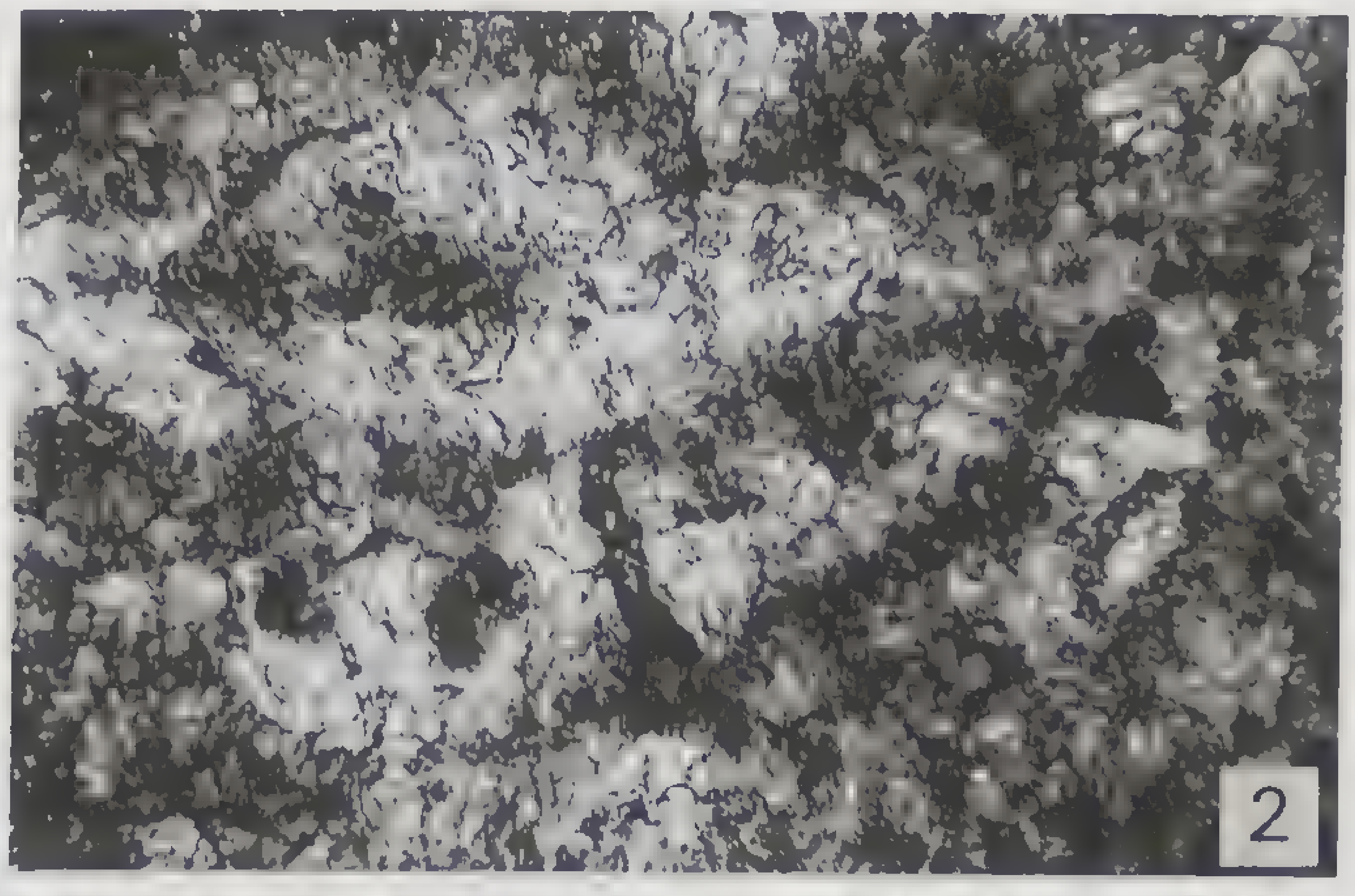

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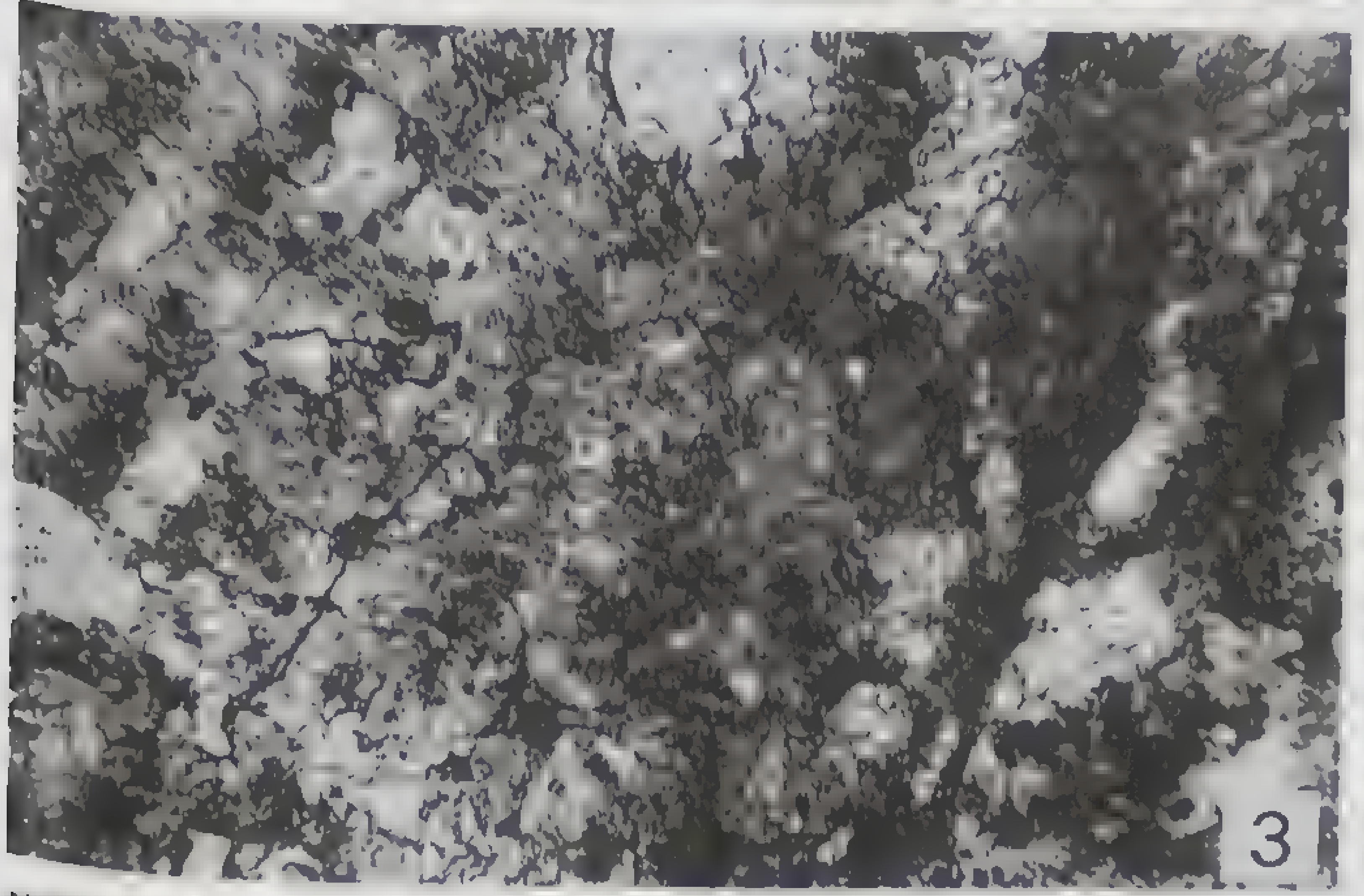

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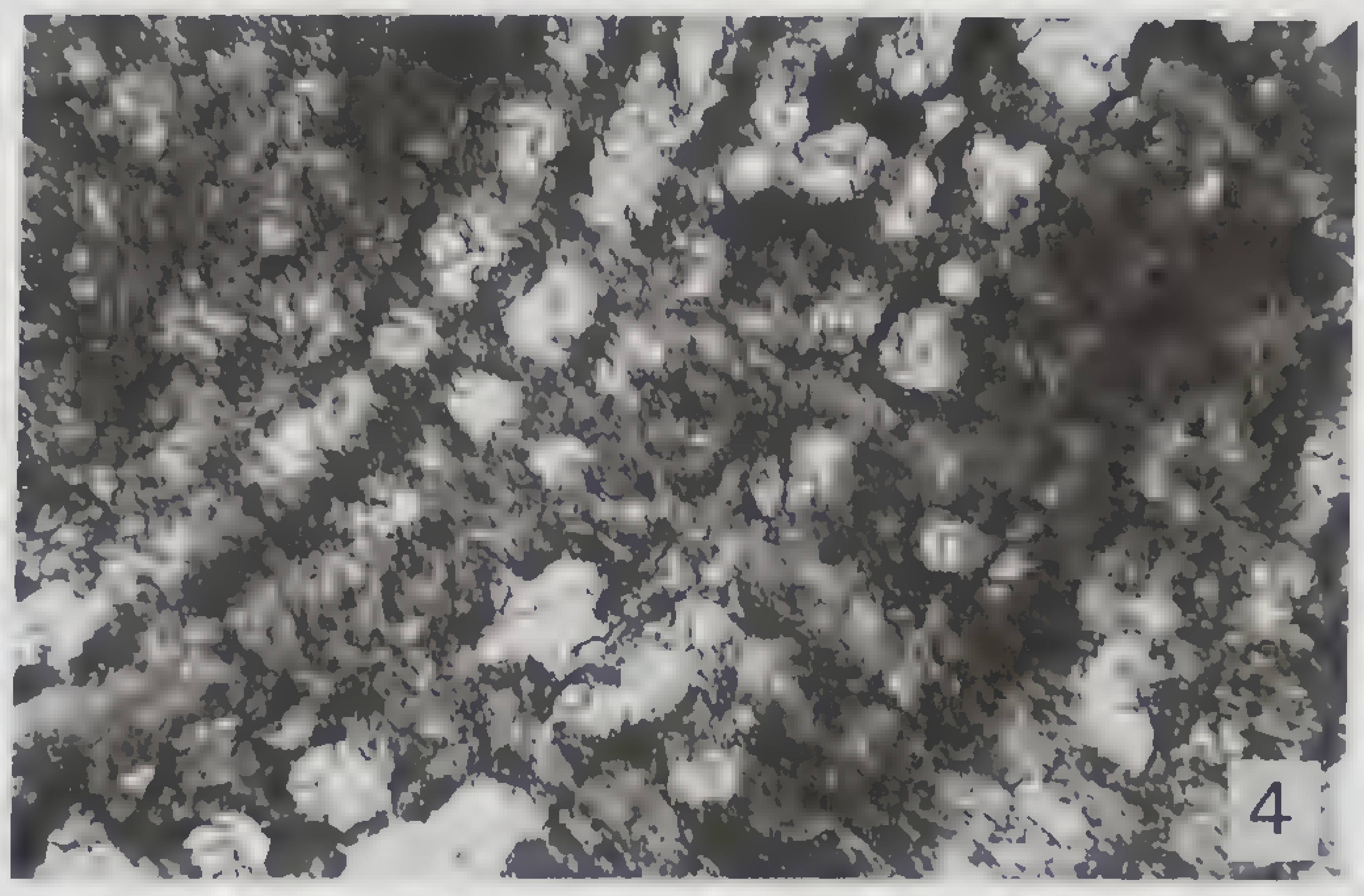

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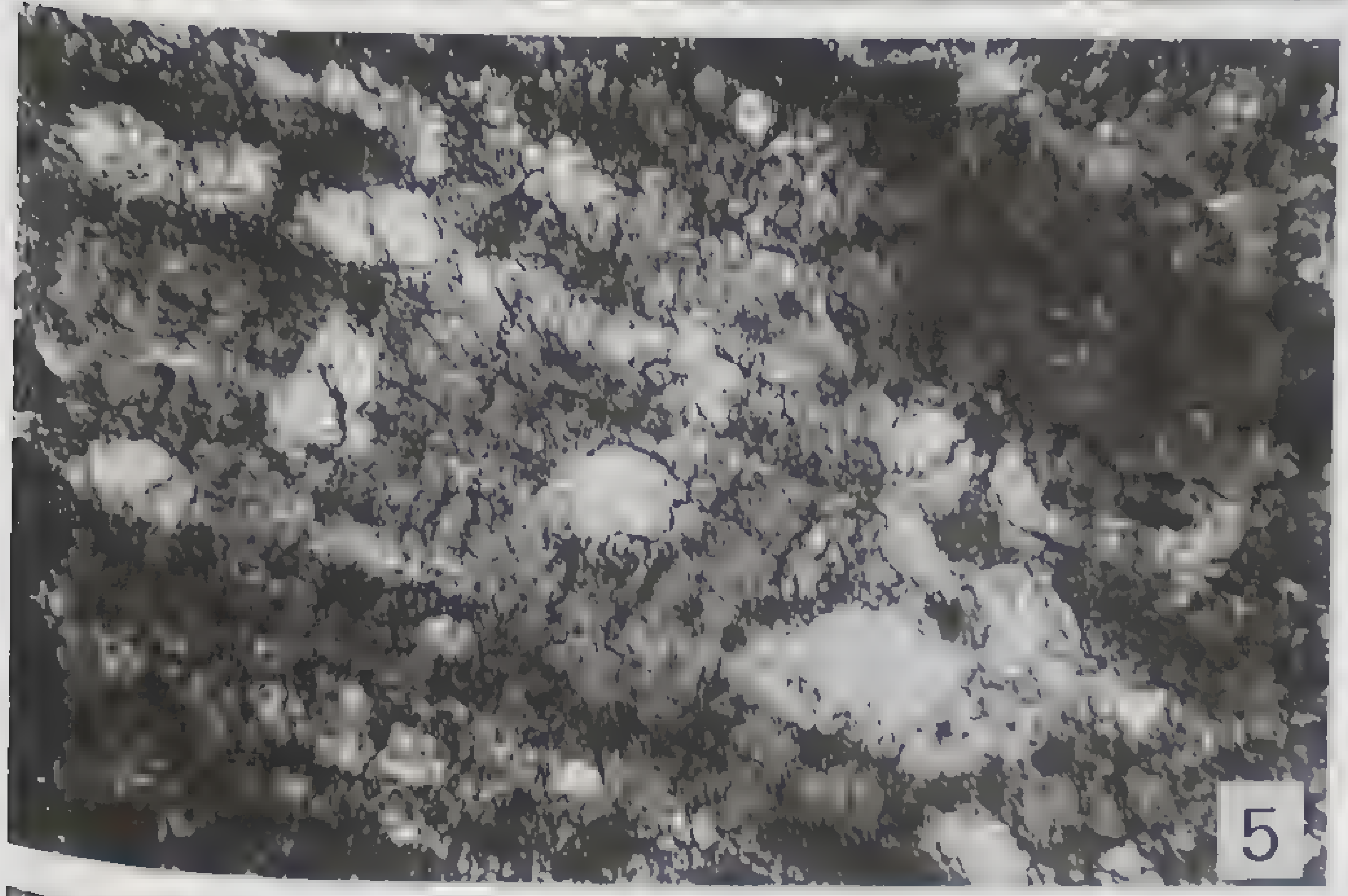

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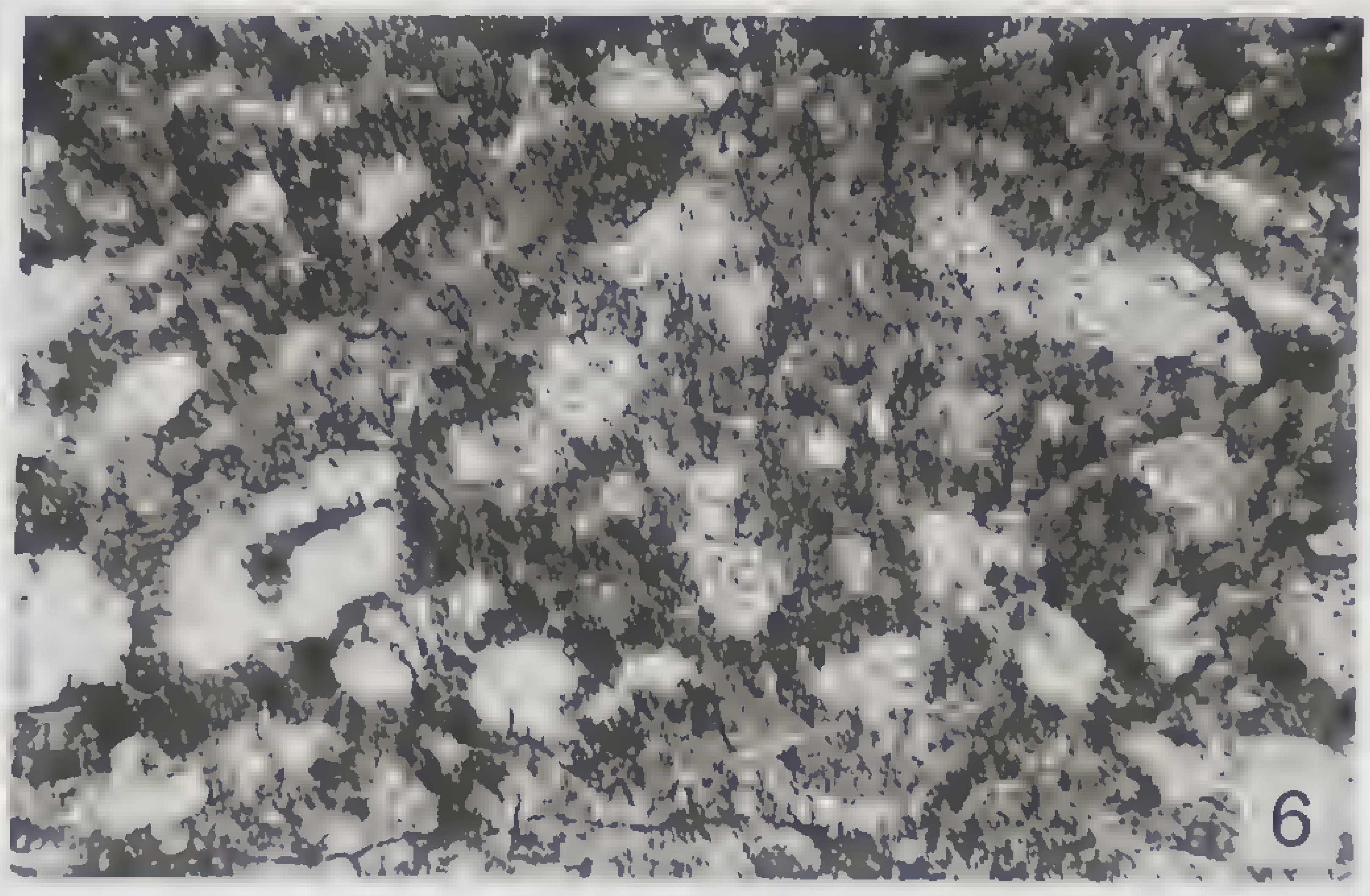

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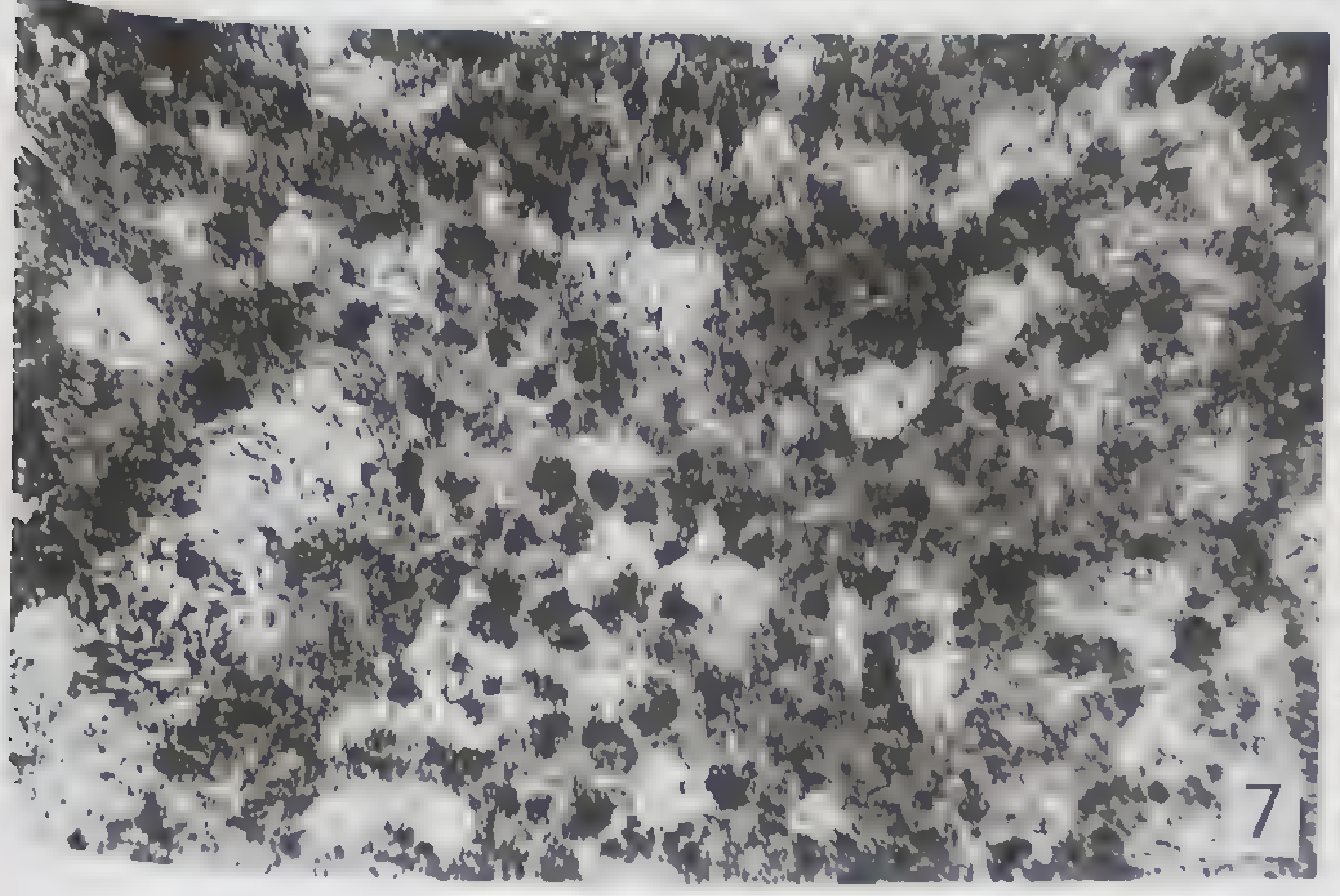

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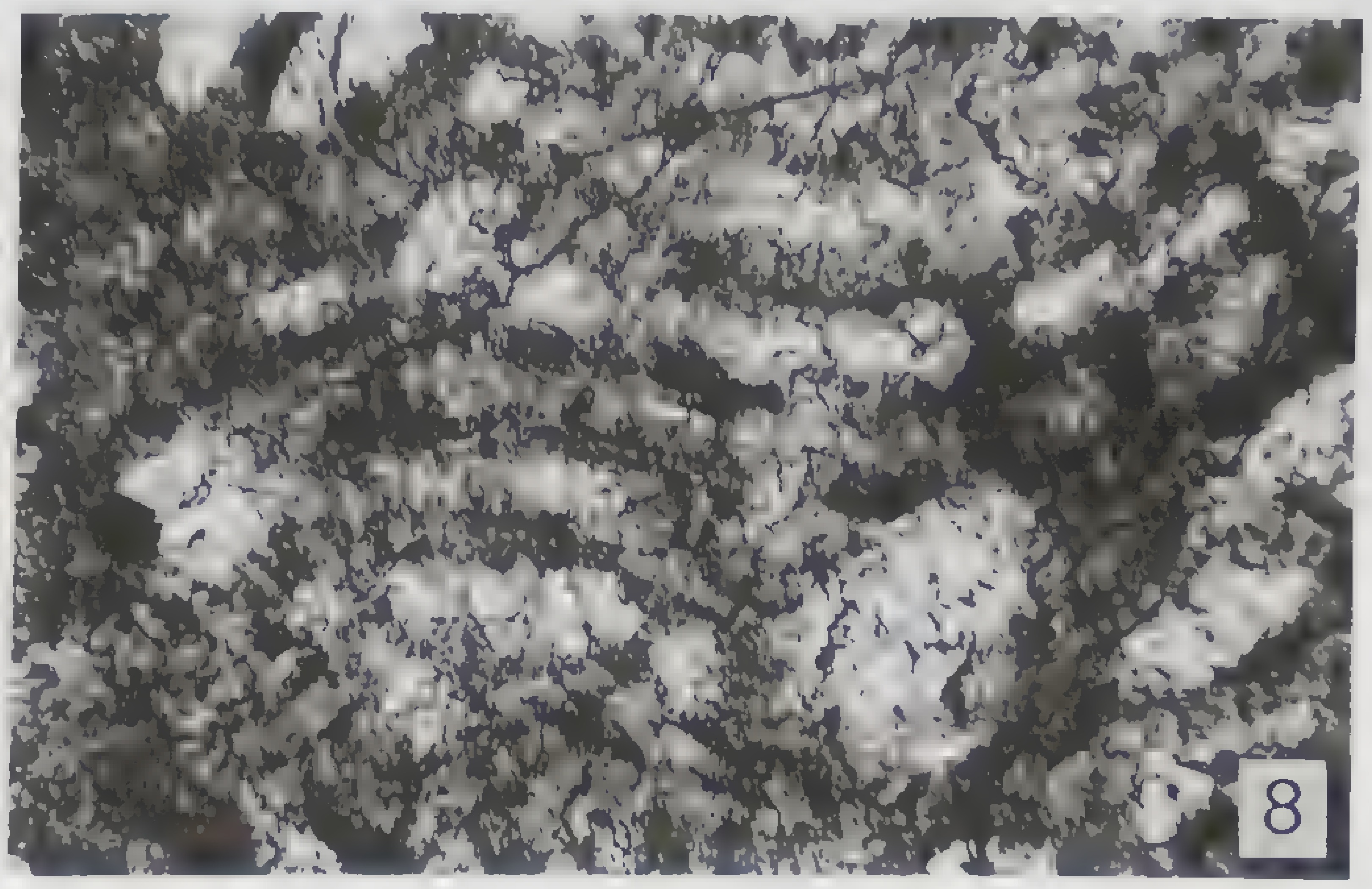

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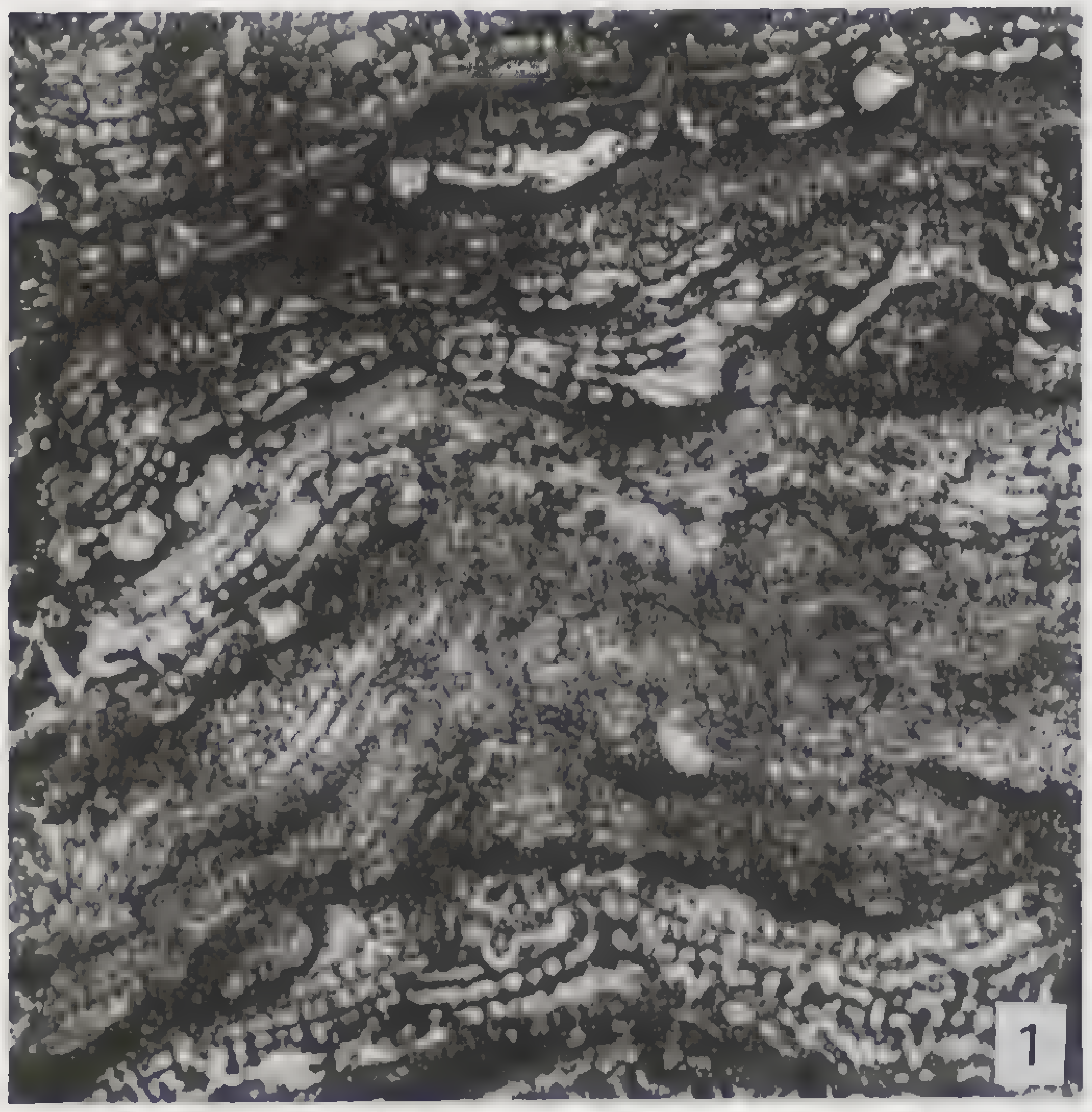
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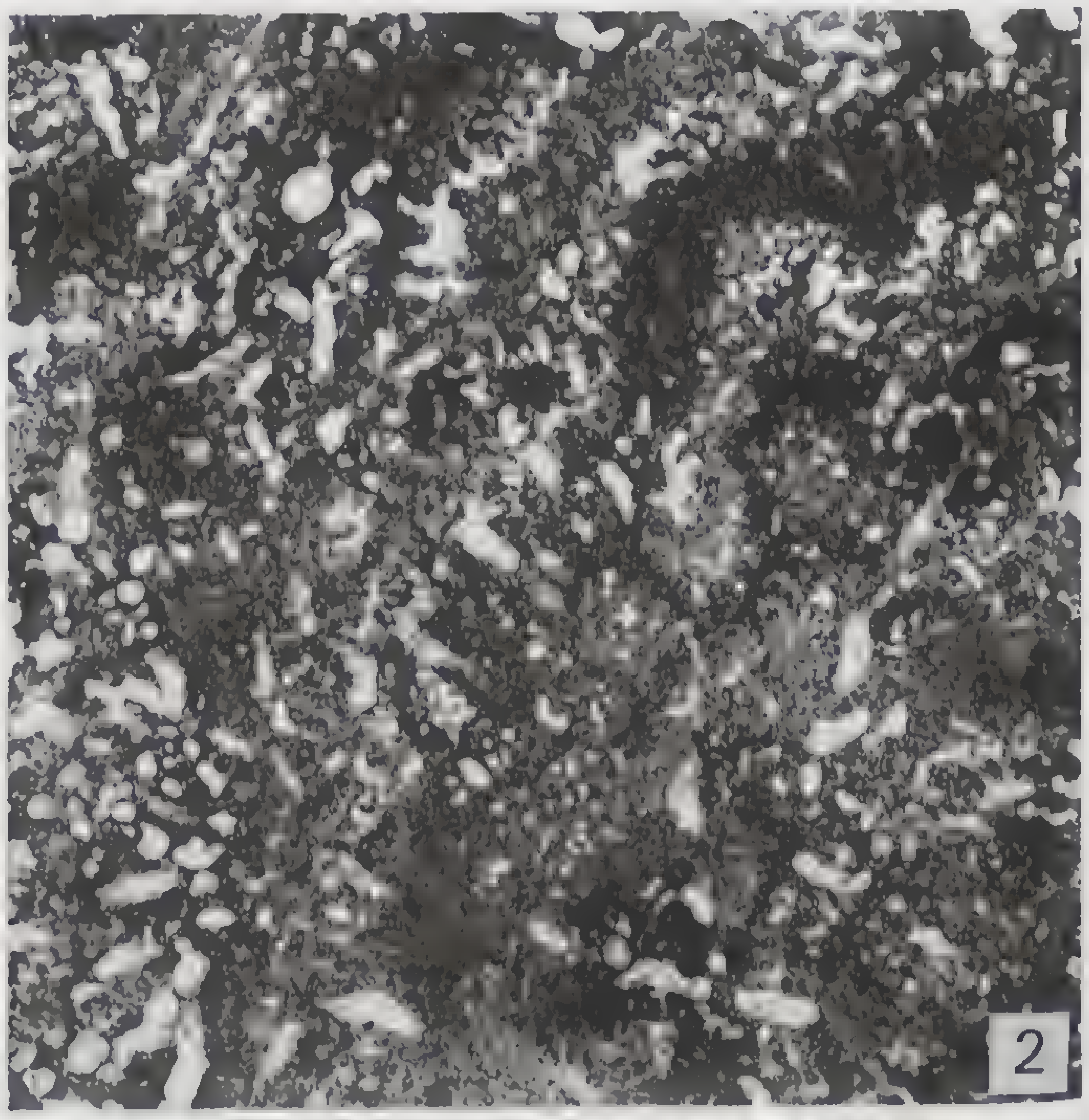
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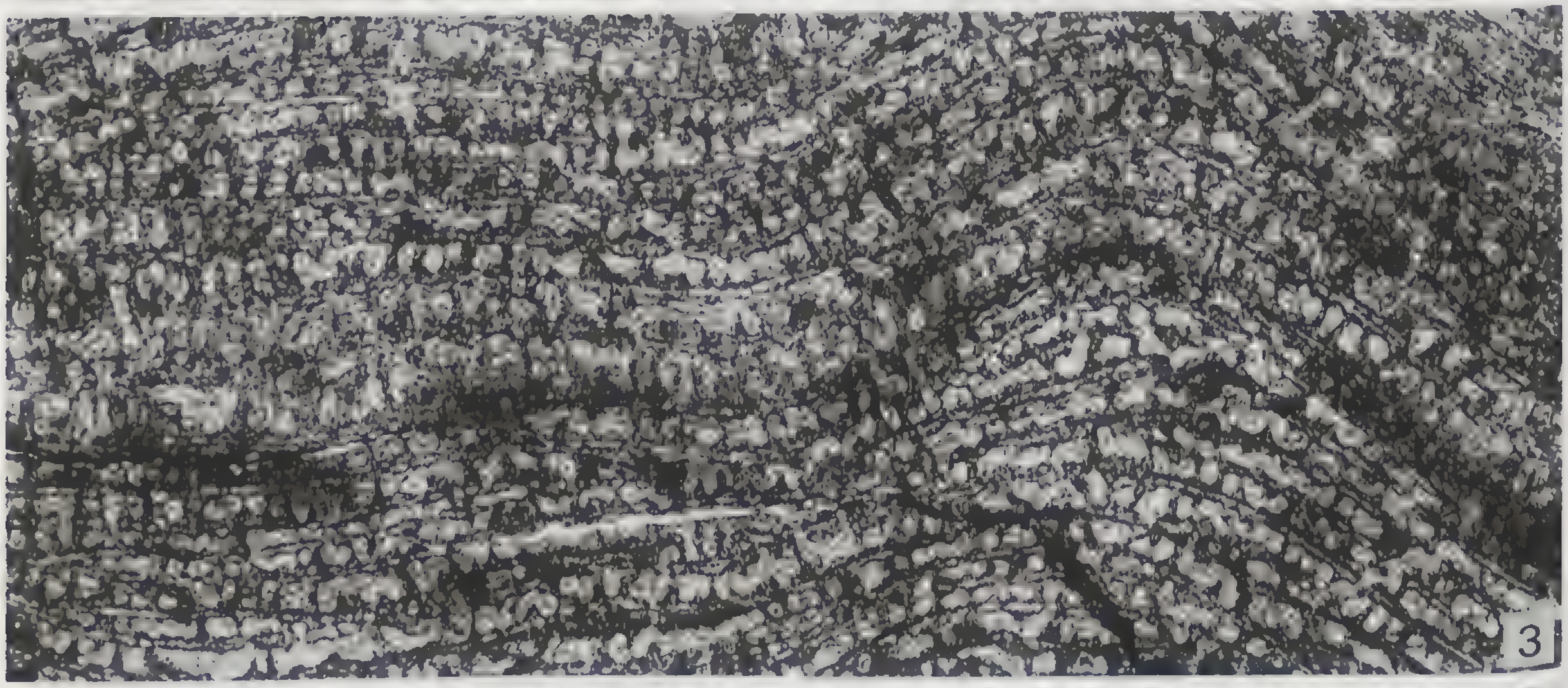
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3–5.	*Stromatopora hensoni,* new species.	32
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	4. Holotype GSC 108890. Tangential section; ×10.	
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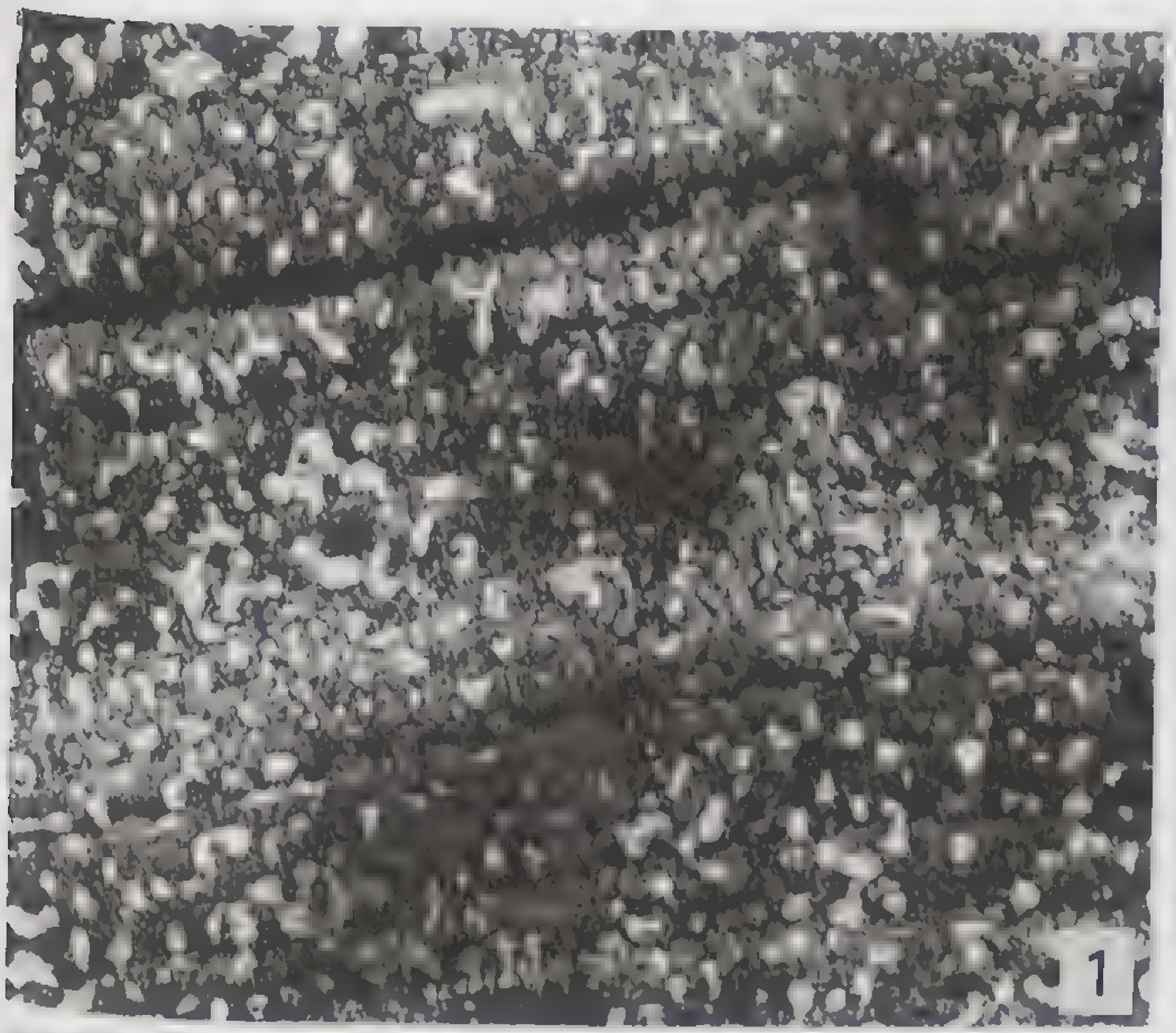
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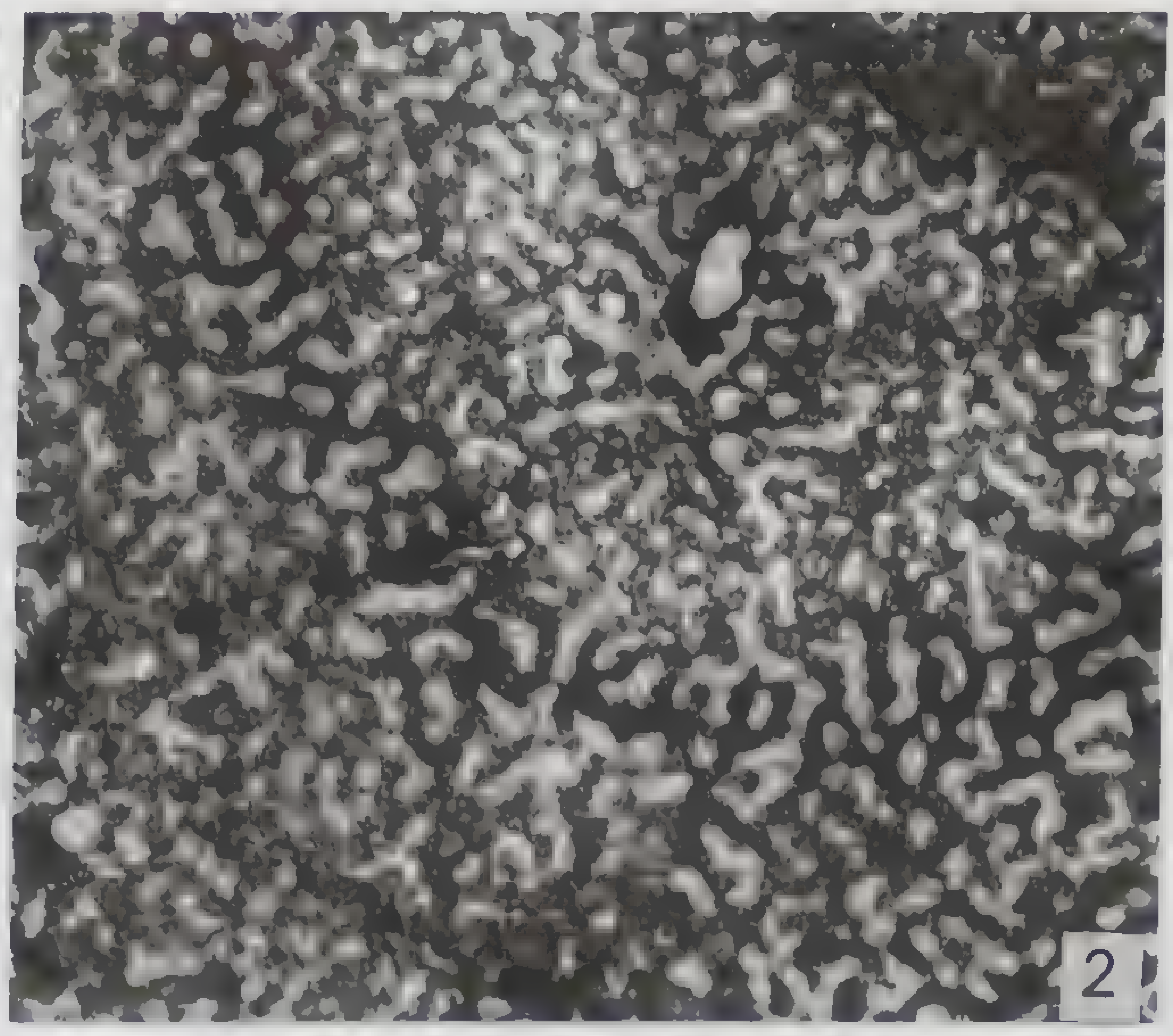
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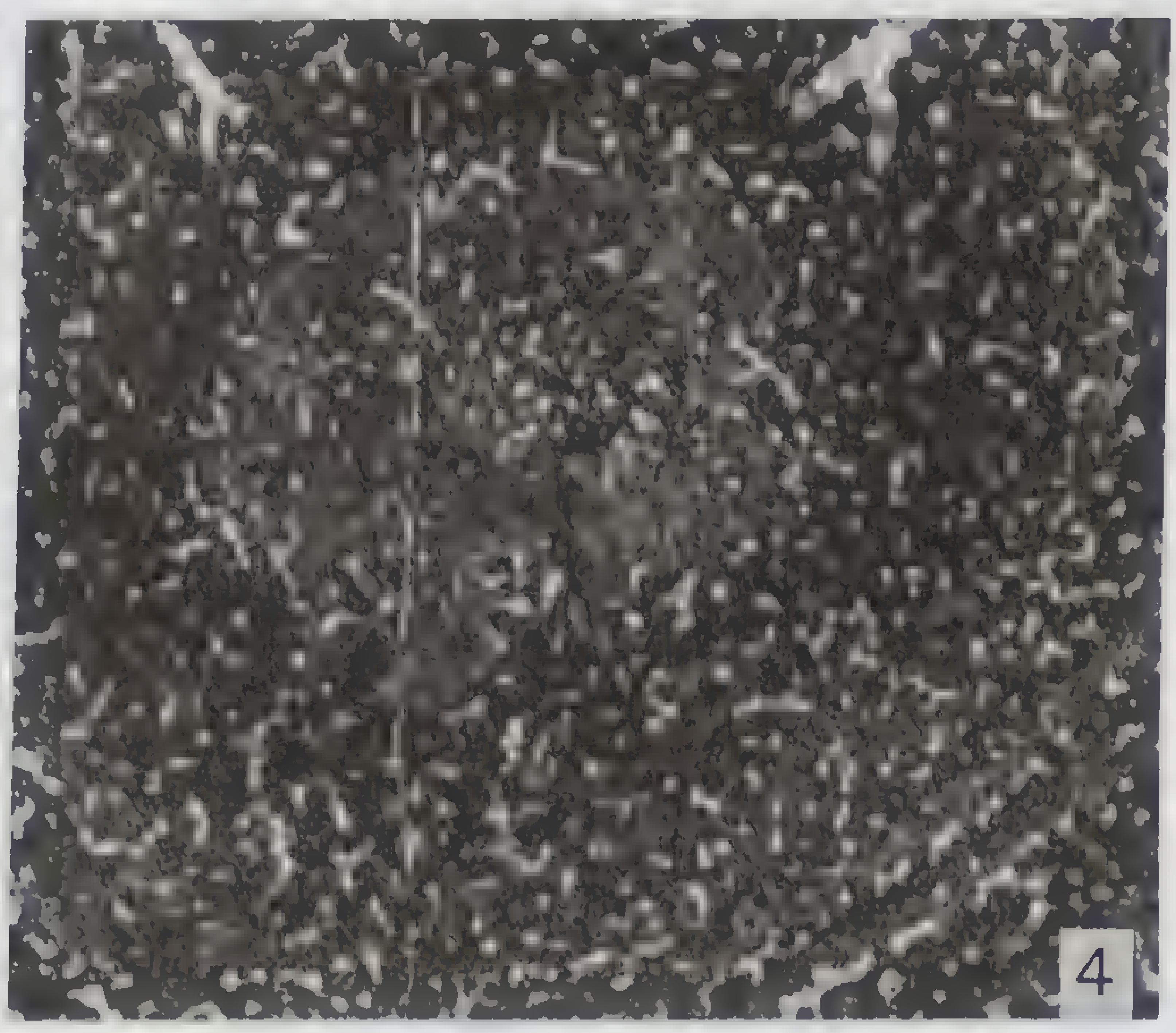
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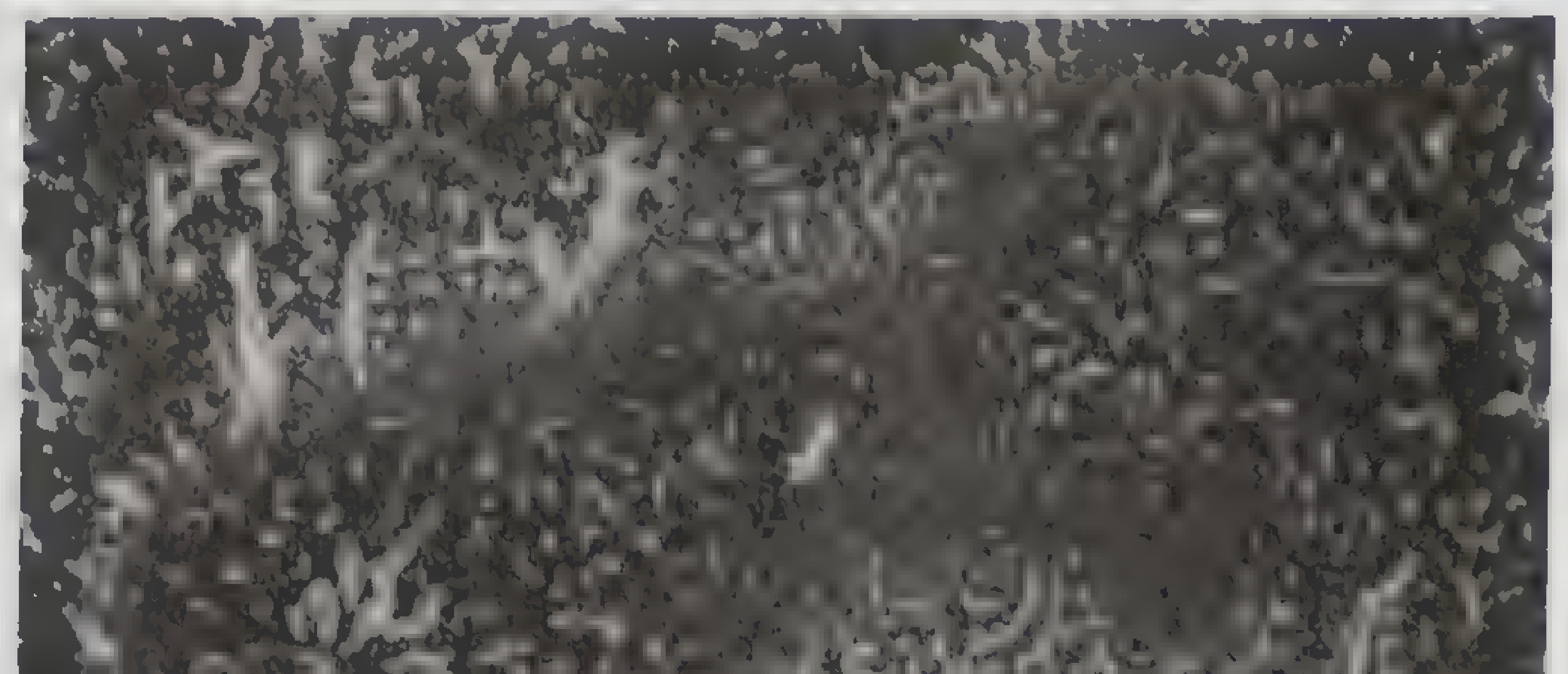
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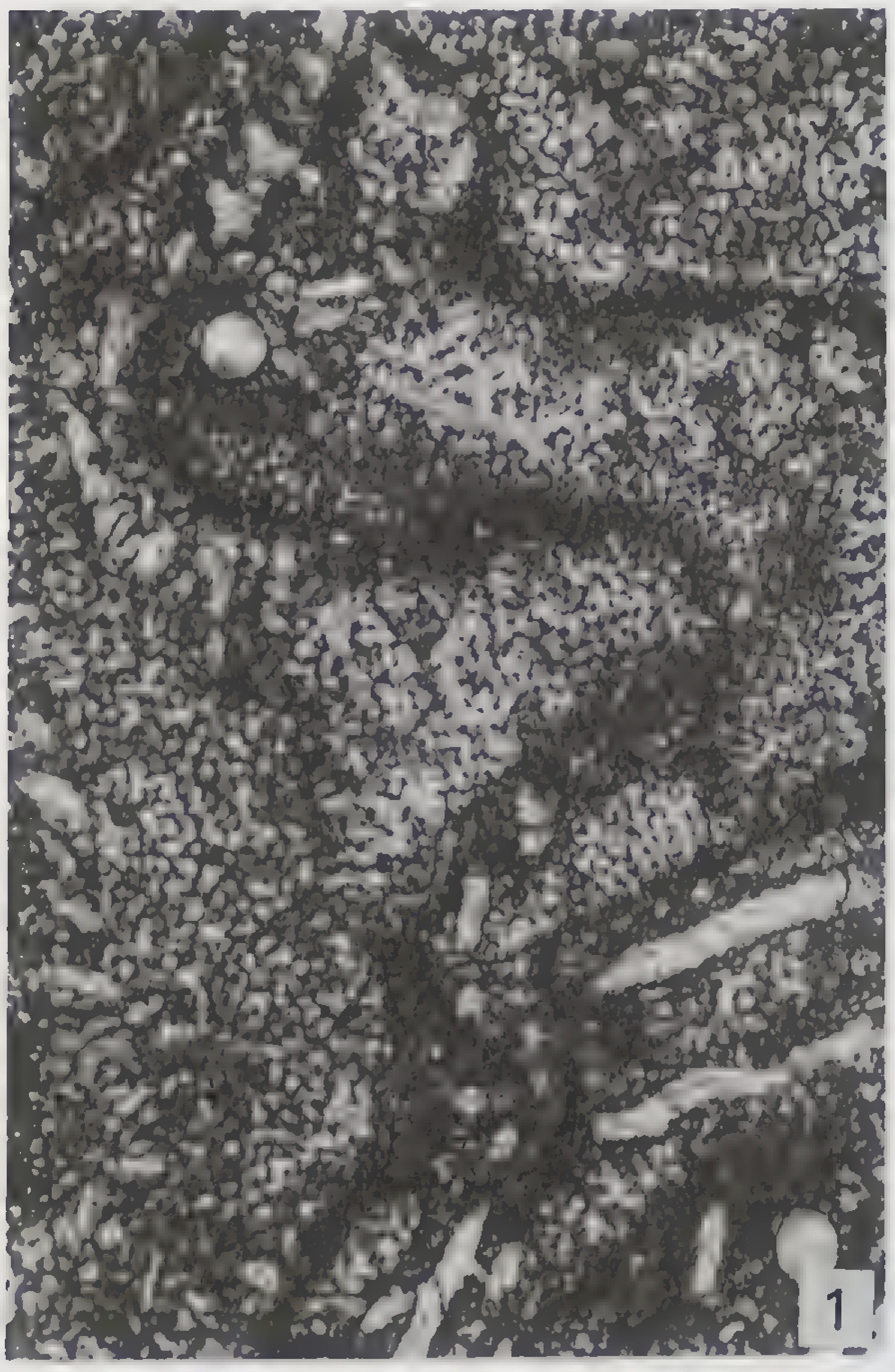
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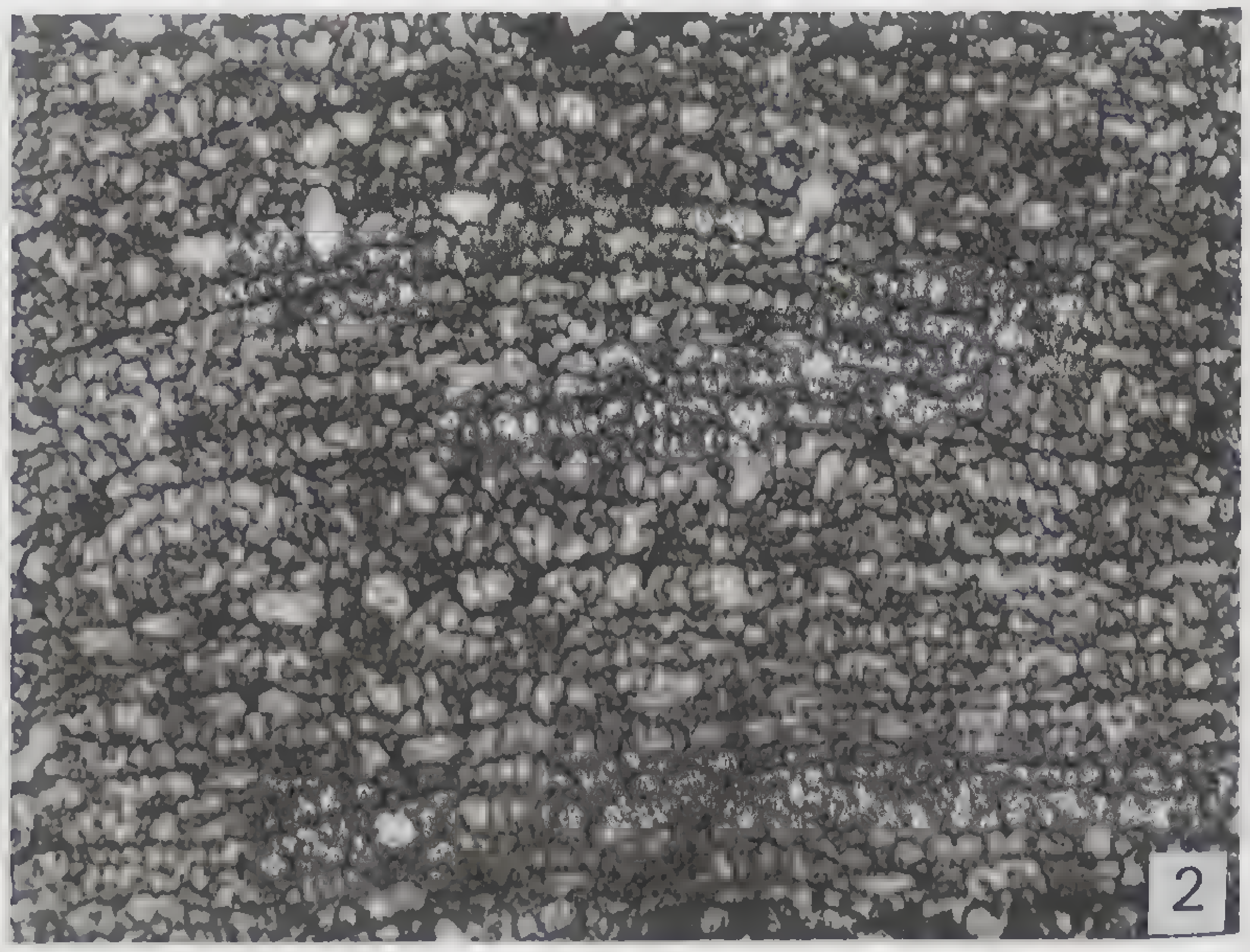
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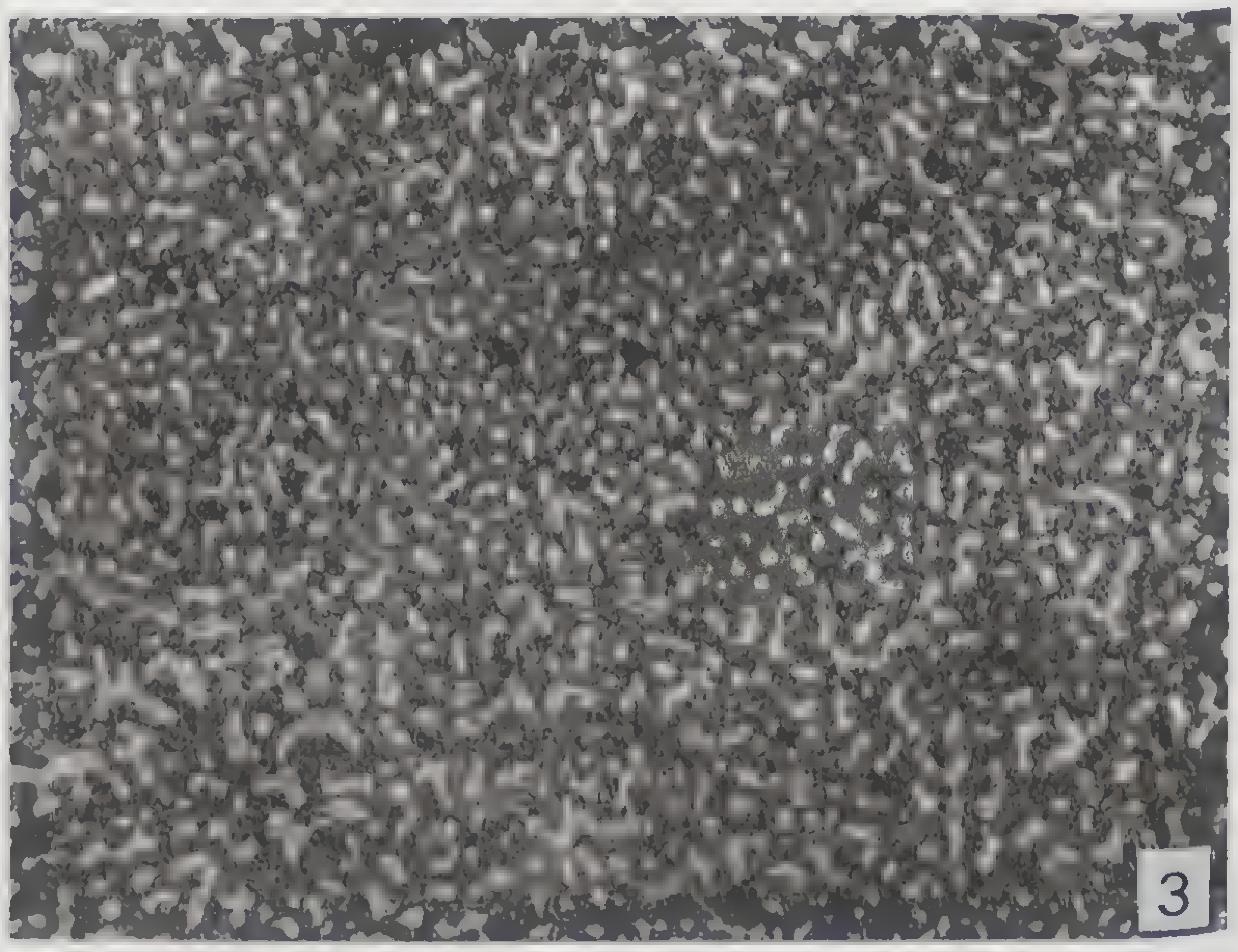
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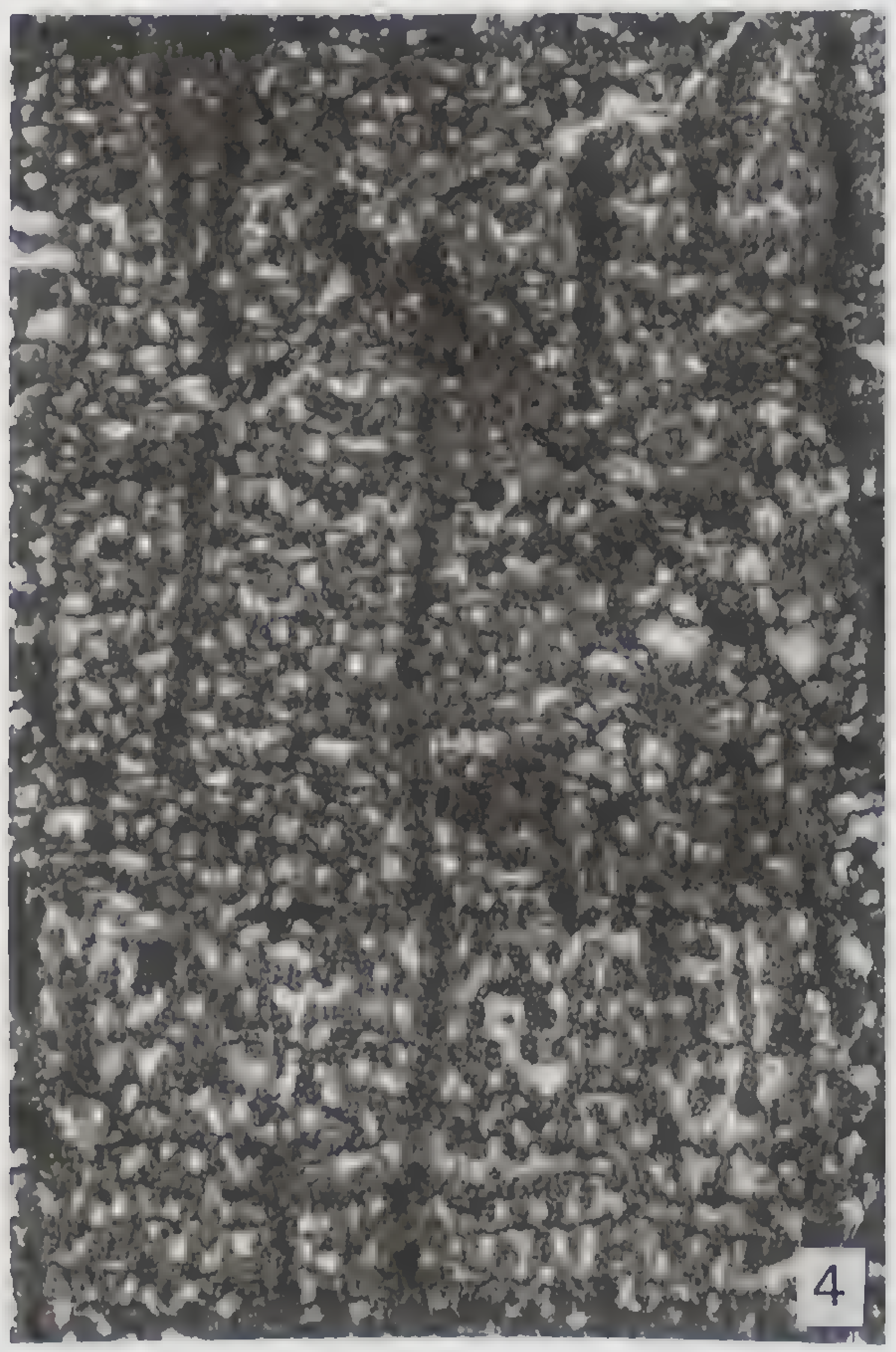
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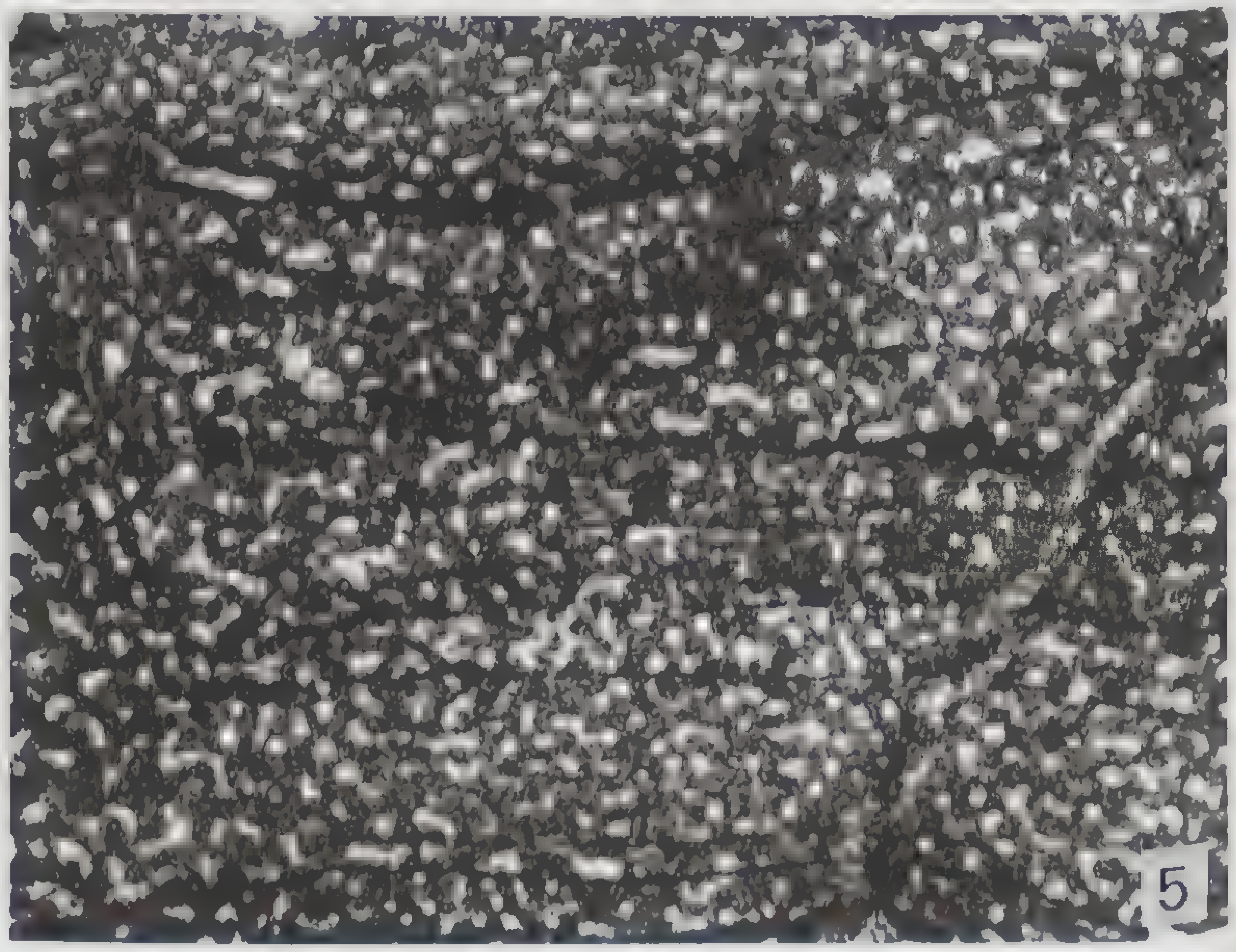
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4, 5. *Salairella prima* Khromych, 1971. 34
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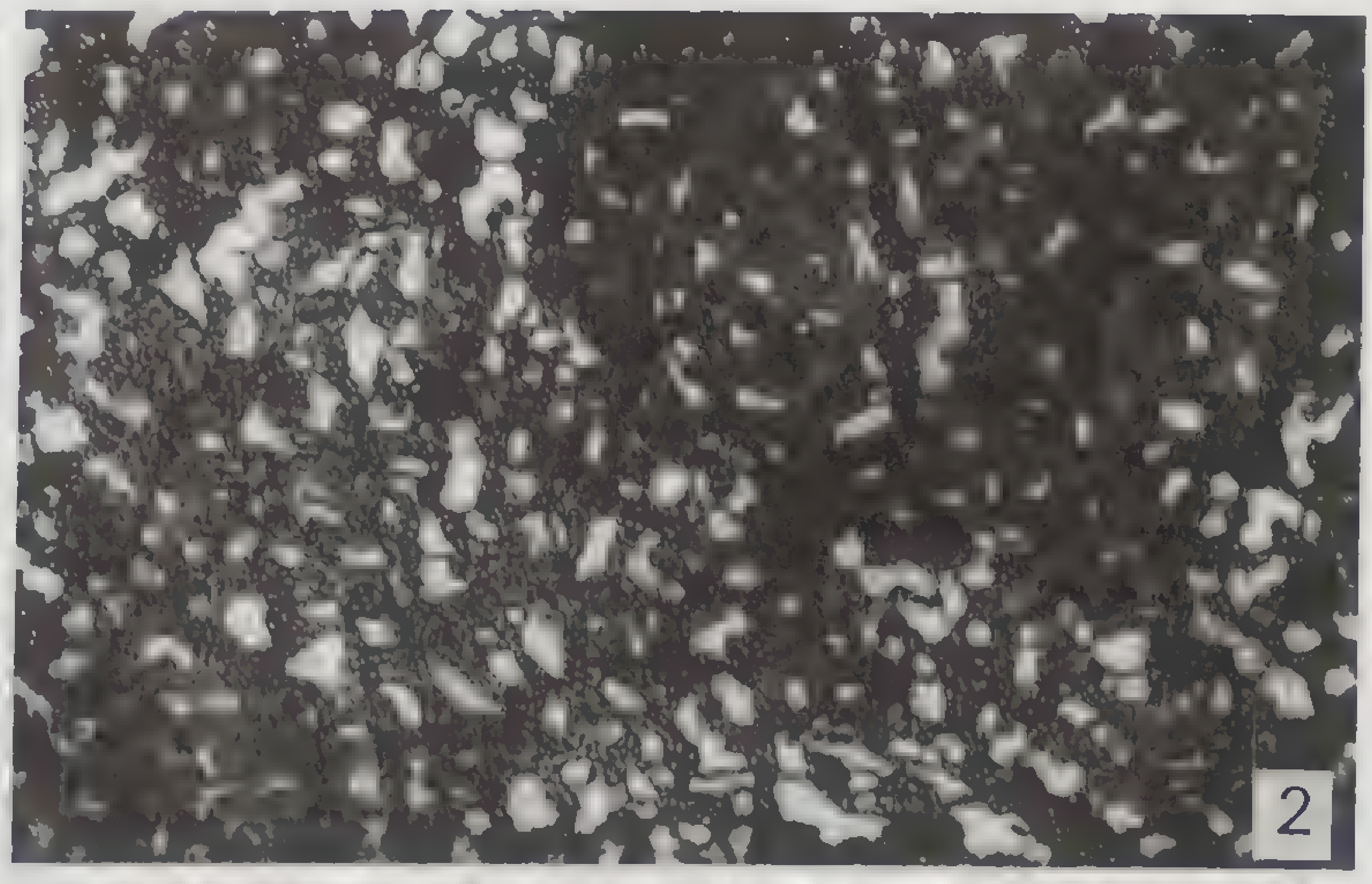
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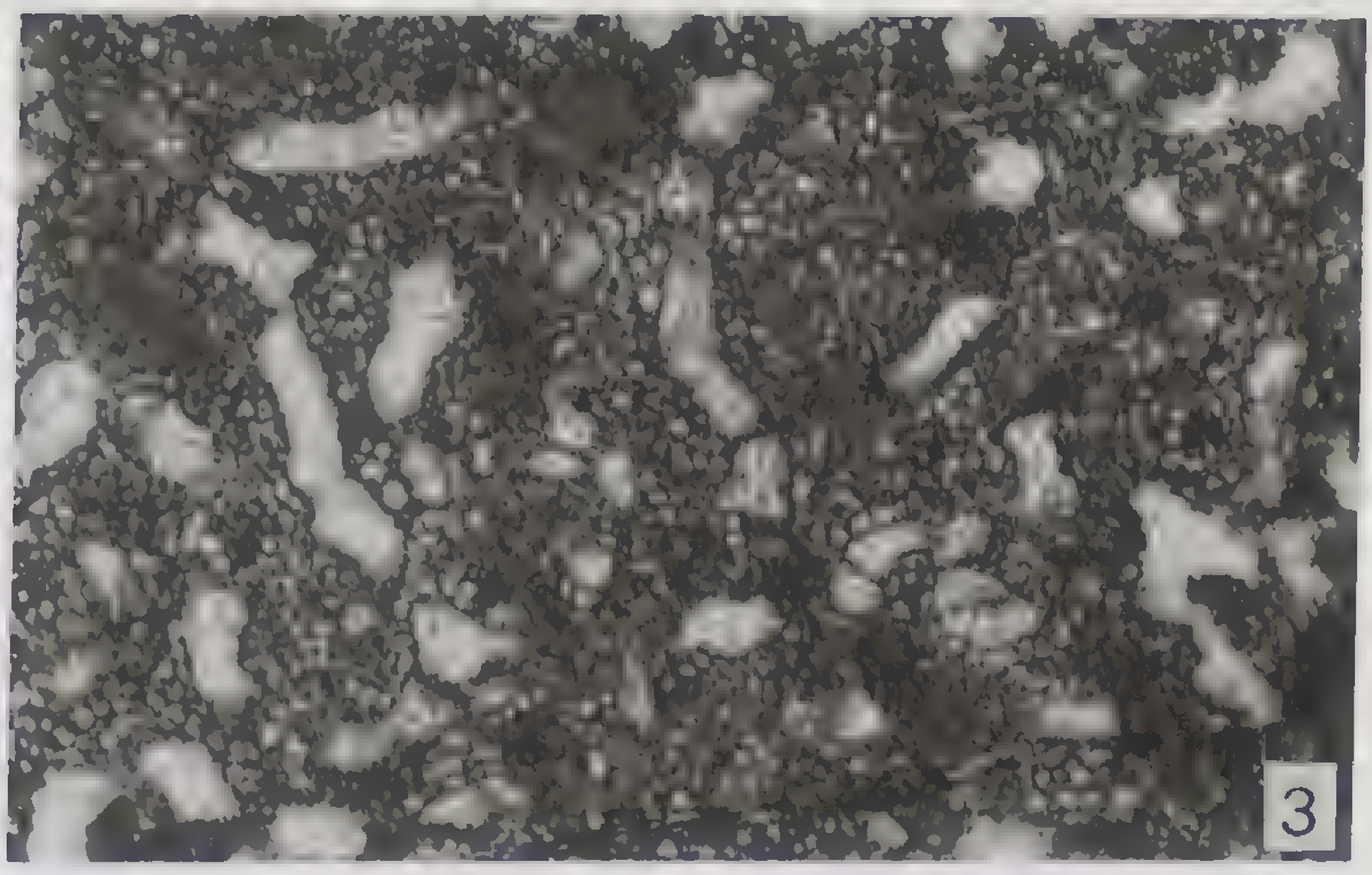
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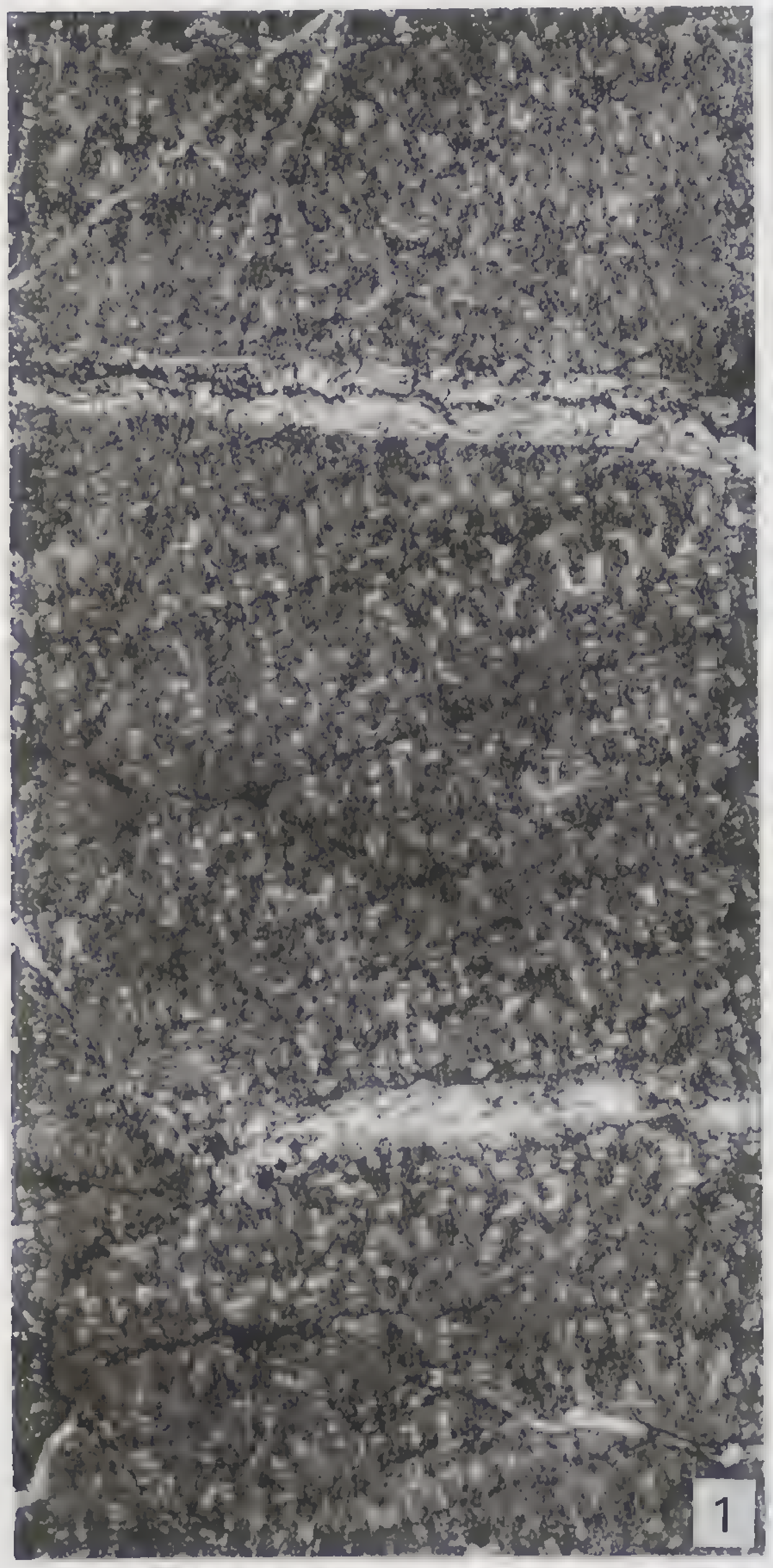
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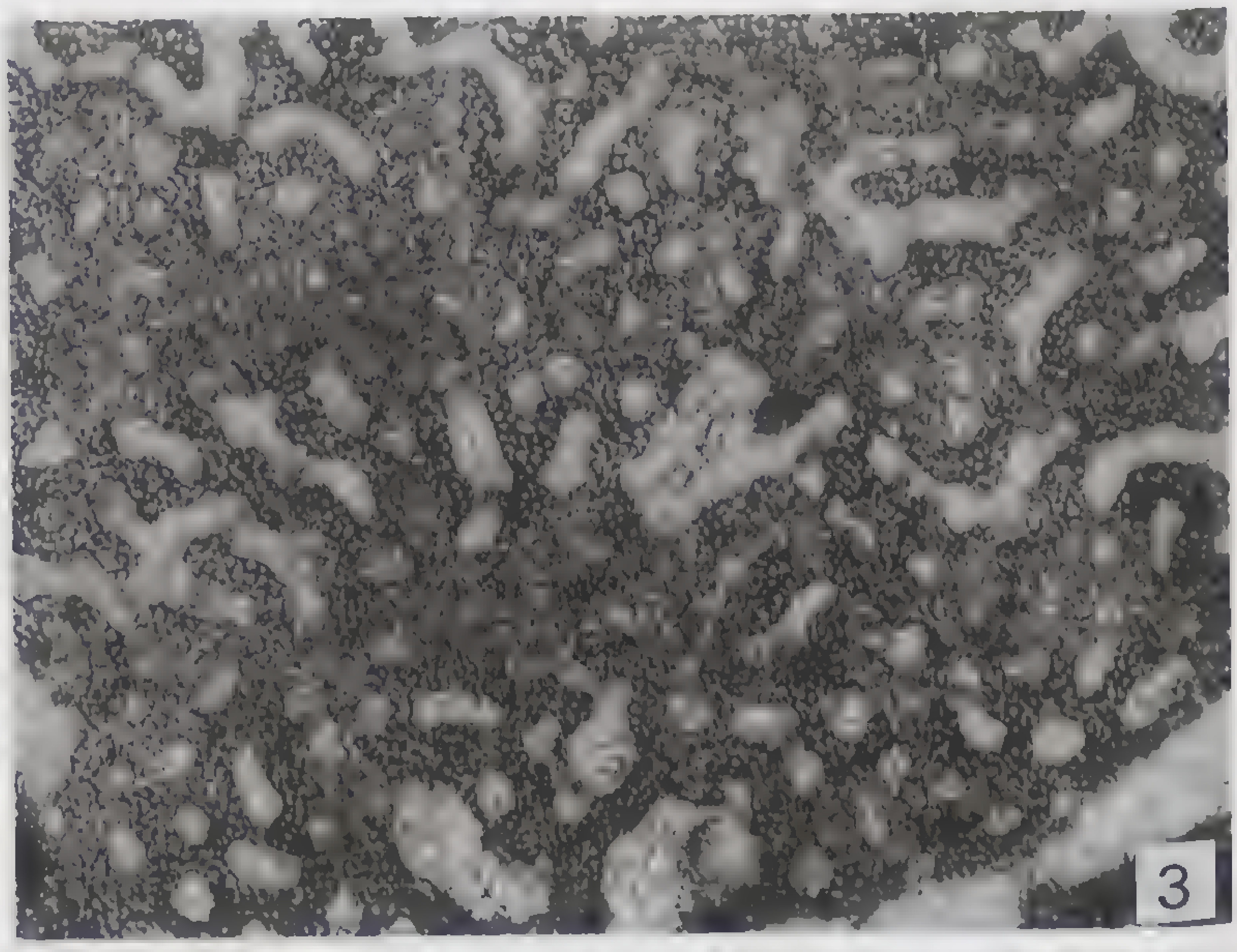
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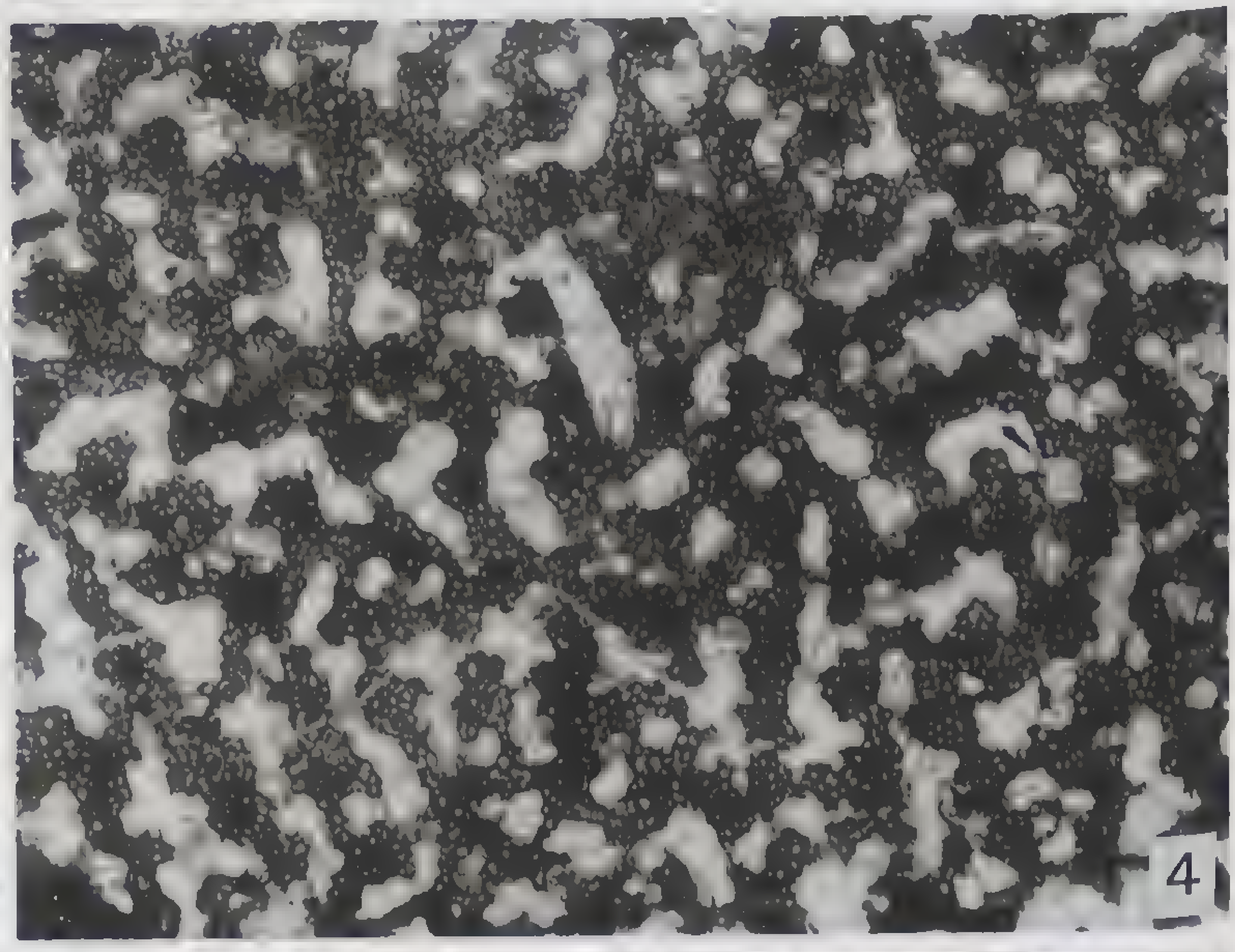
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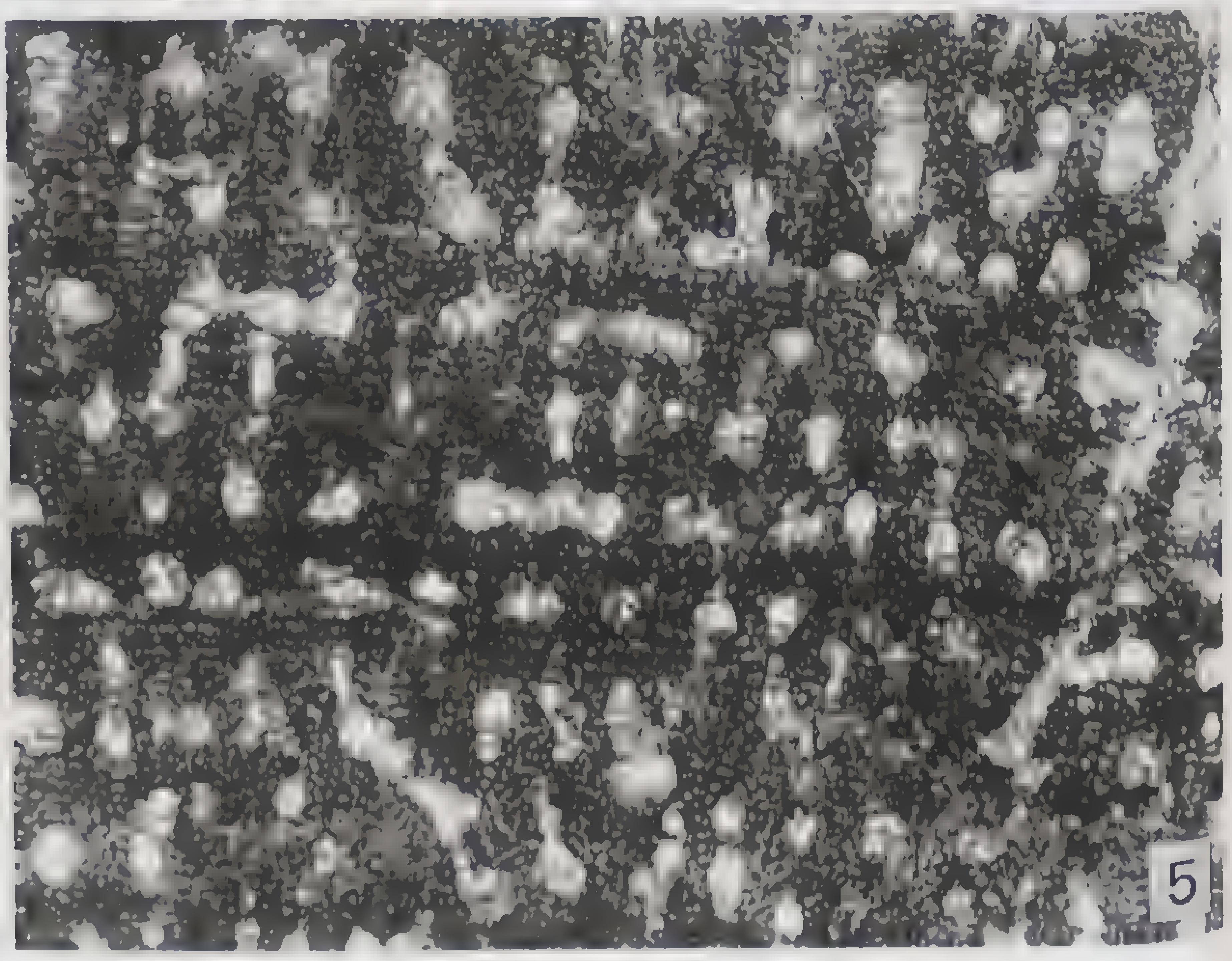
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1. Vertical section; ×10. Specimen GSC 108900.
2. Tangential section; ×10. Specimen GSC 108899.
3. Tangential section; ×25. Specimen GSC 108899. Note the smooth termination of cellules bordering skeletal galleries.
4. Tangential section; ×25. Specimen GSC 108901. Note the ragged termination of cellules bordering skeletal galleries.
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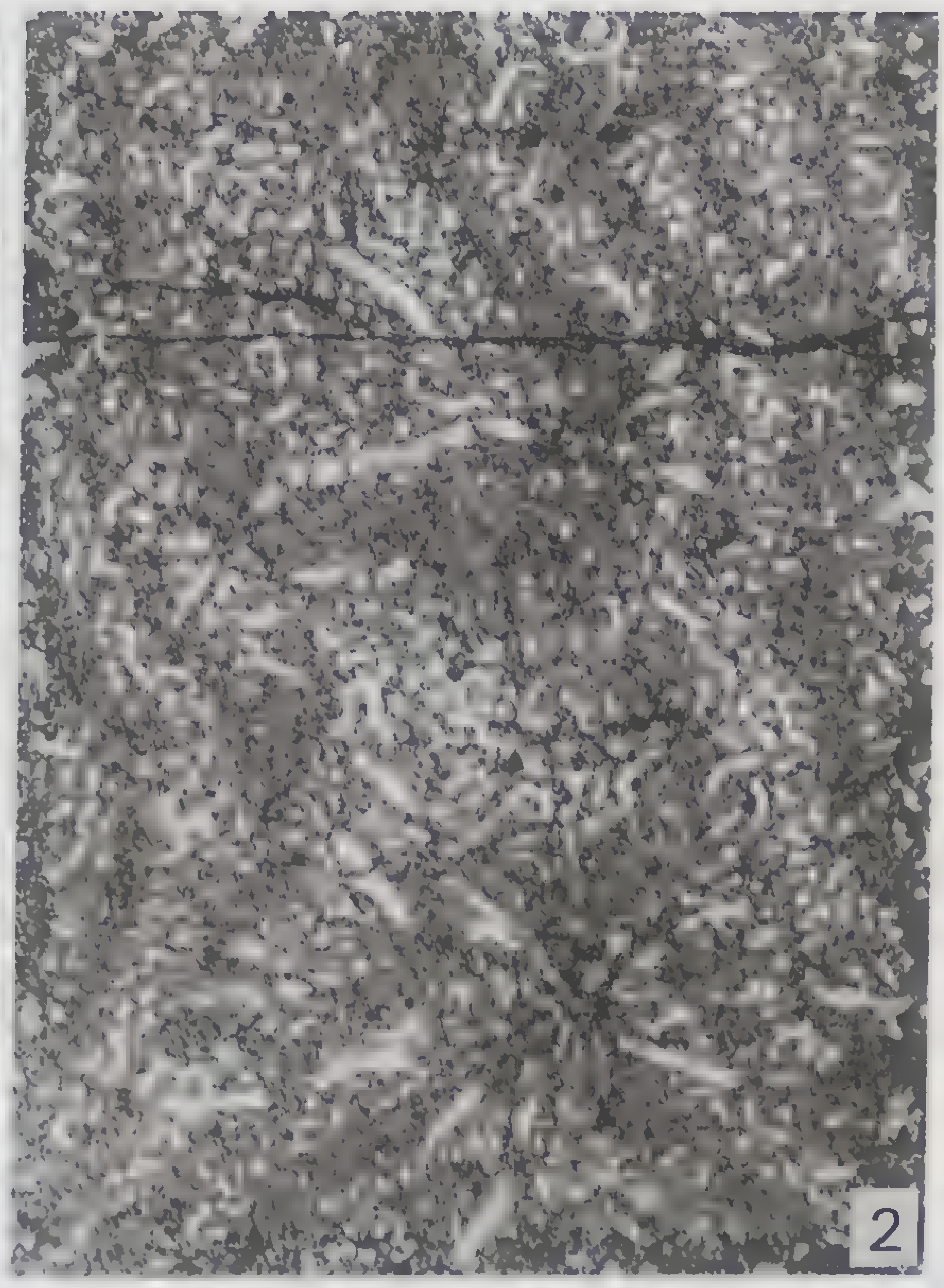
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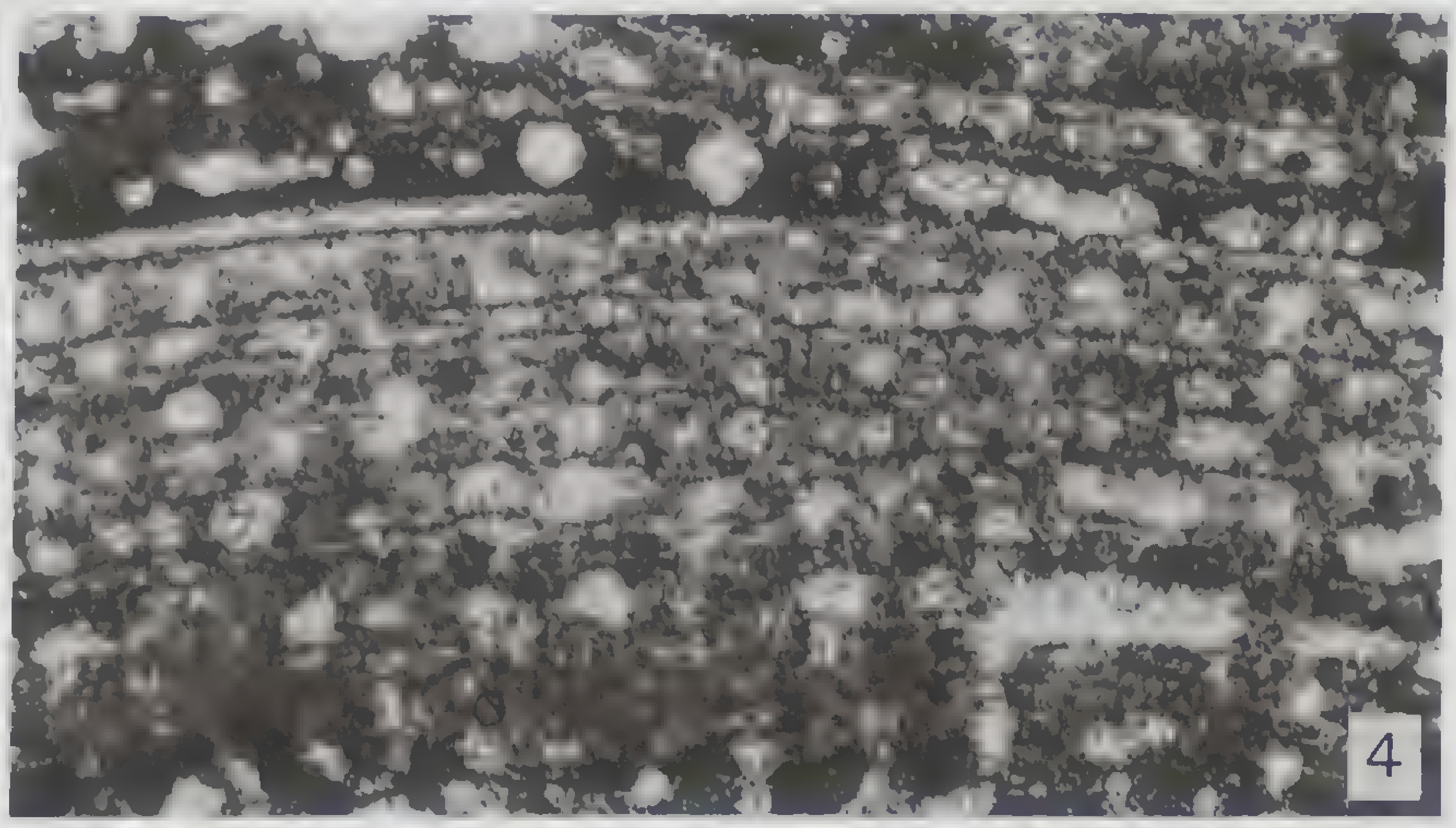
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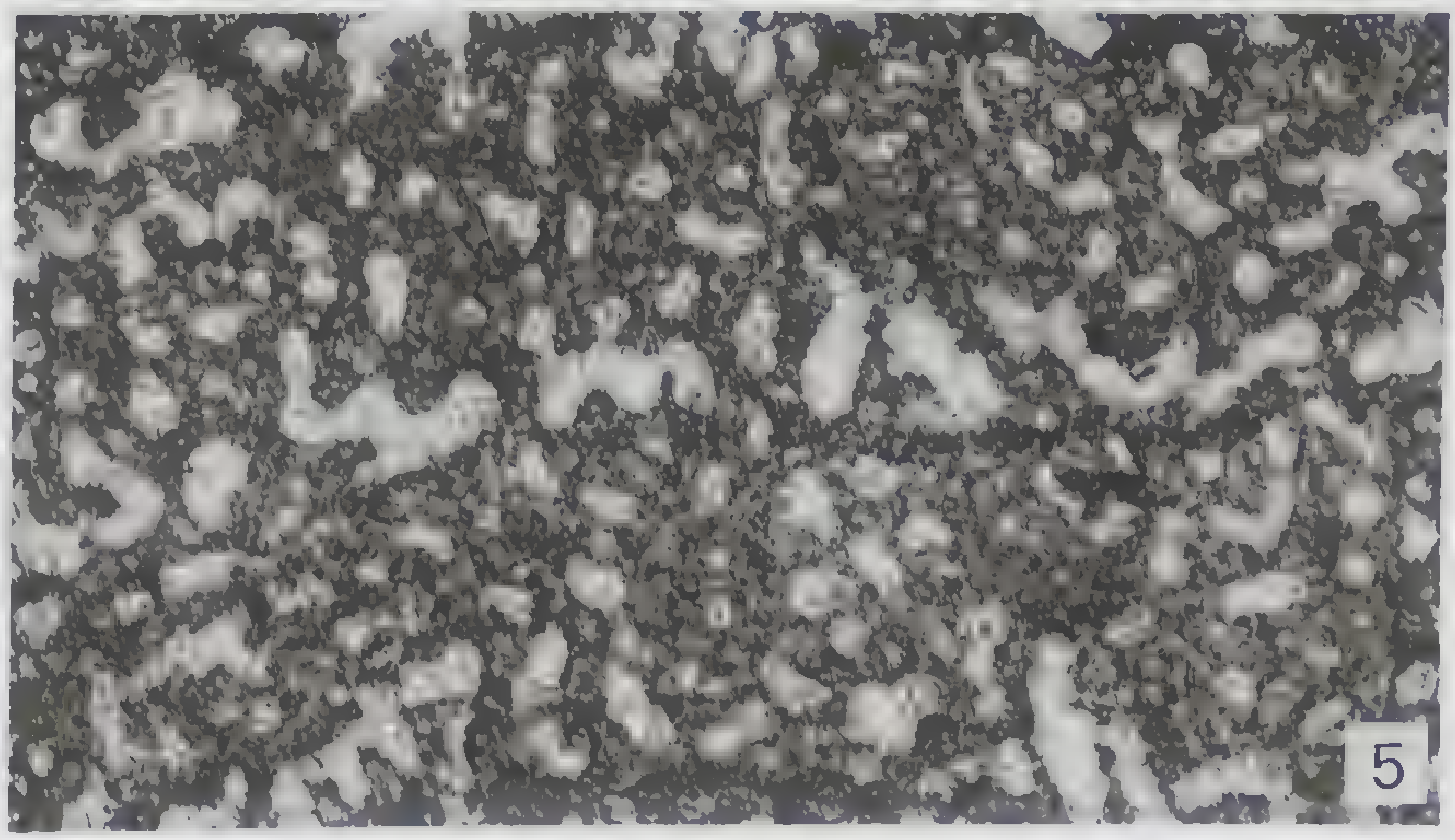
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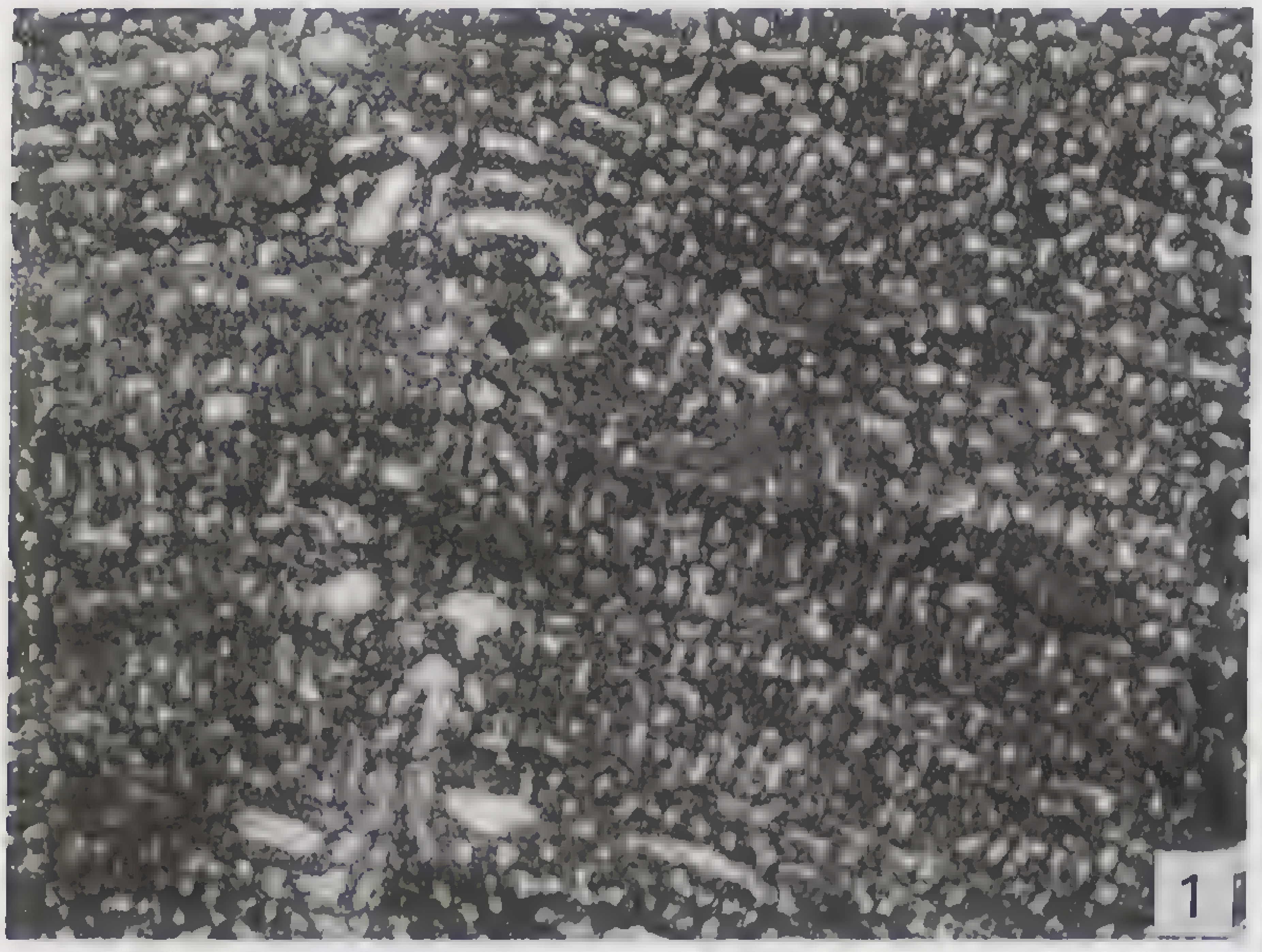
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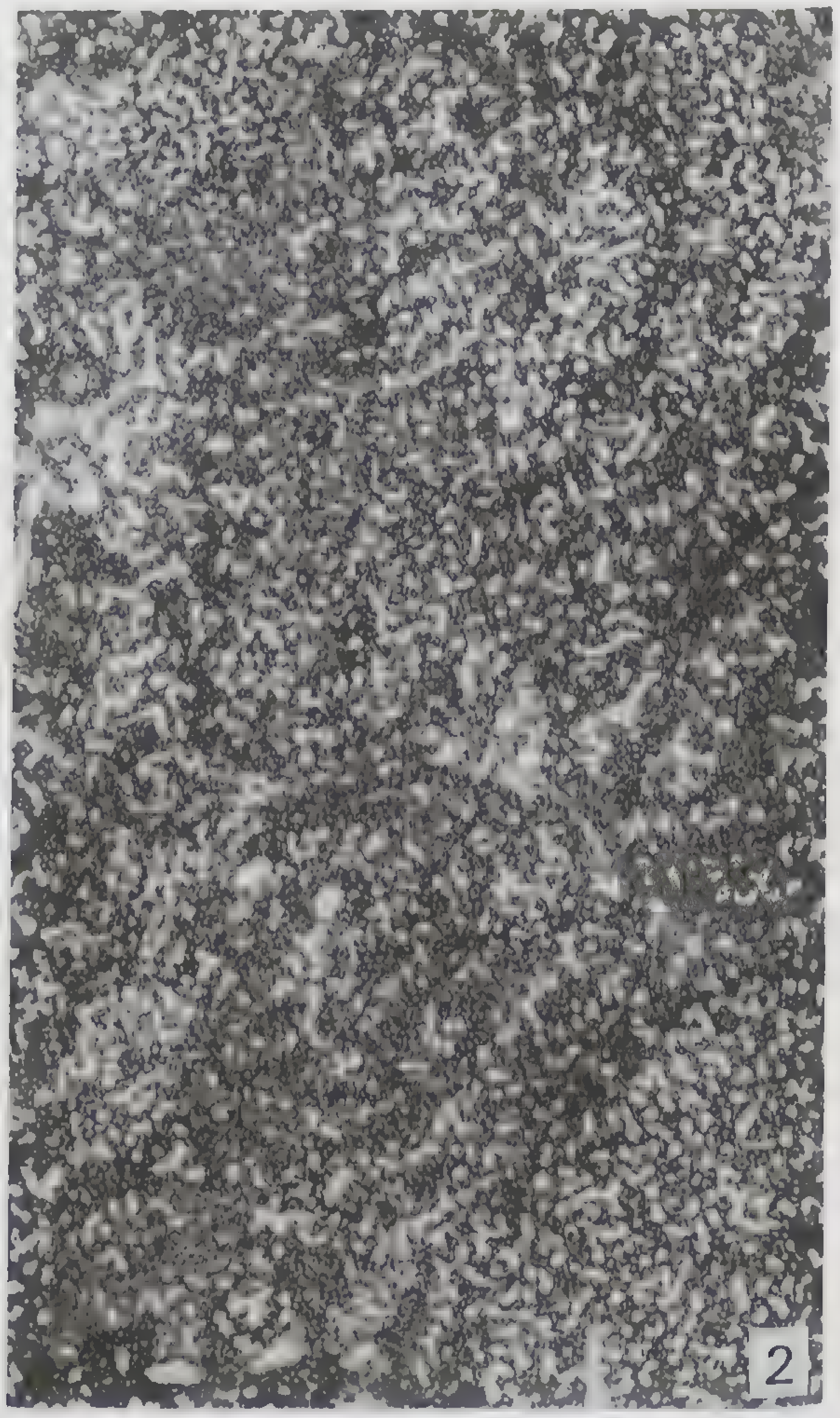
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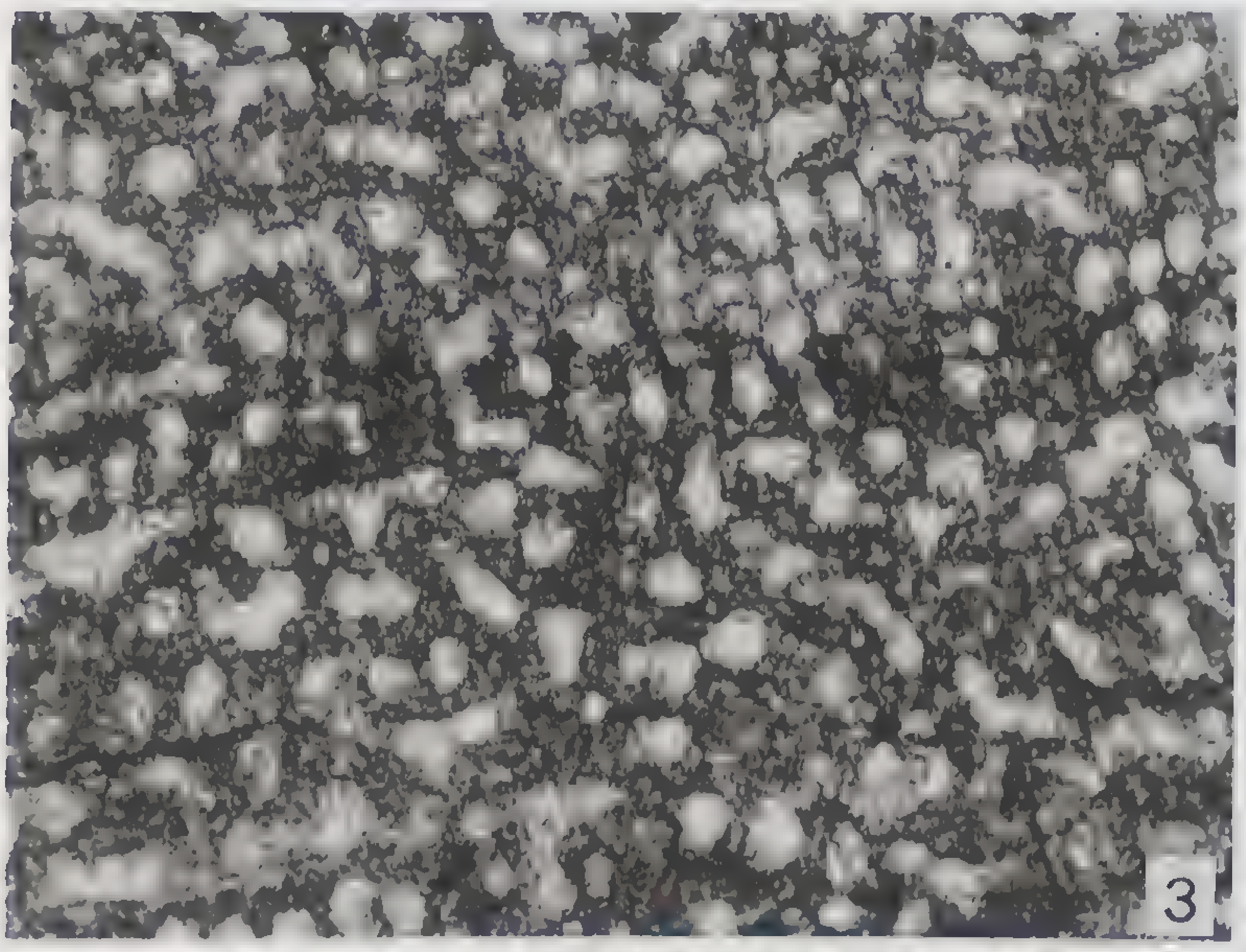
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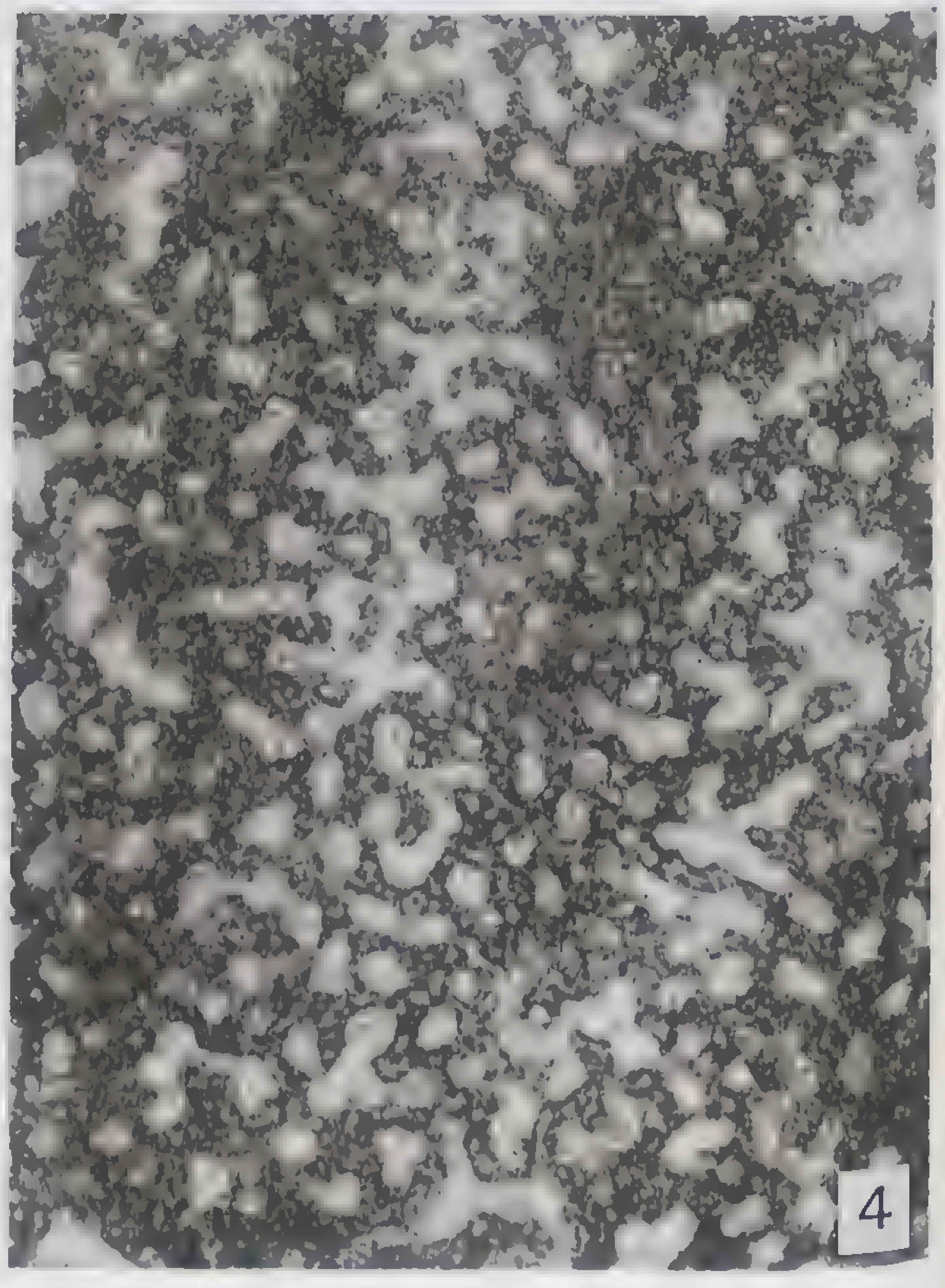
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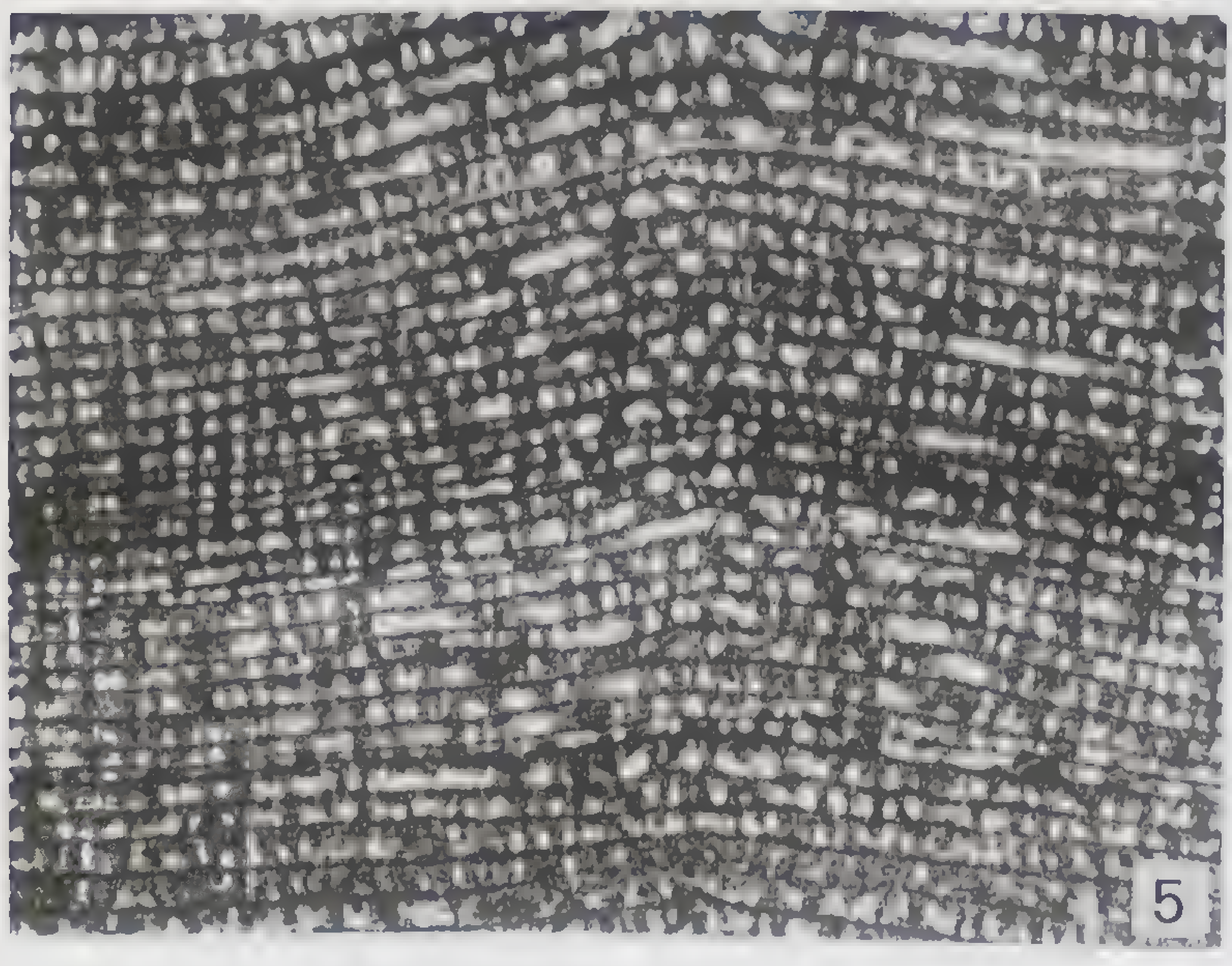
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