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PERMIAN SPONGES FROM BRACHIOPOD CHERTS AT HORNSUND, SPITSBERGEN

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Fourteen species of sponges are identified from brachiopod cherts of the Kapp Starostin Formation at Hornsund area. The new genus *Spitsbergenia*, five new species, and one subspecies are established: *Haplistion hadrum* sp.n., *H. elongatum acremonicum* n. subsp., *Chaunactis kaera* sp.n., *Ch. malkowskii* sp.n., *Spitsbergenia patella* gen. et sp.n.. Members of the genus *Haplistion* predominate. The general appearance of the preserved sponges, often the lack of traces of attachment to the substratum, and the presence of papillae, suggest that the environmental conditions must have been quiet and stable.

K e y w o r d s: Spongiae, taxonomy, Permian, Spitsbergen.

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INTRODUCTION

In this paper are presented some results of studies on the Permian sponges from the Hornsund region, southern Spitsbergen. The specimens have ben collected during two subsequent Paleontological Expeditions to Spitsbergen in 1974, 1975 organized by the Institute of Palaeobiology of the Polish Academy of Sciences, Warsaw, under the leadership of Professor Gertruda Biernat.

This material was enriched by specimens collected during the Polish Spitsbergen Expedition (Birkenmajer 1960), led by Professor S. Siedlecki in 1960, and lent for study by Dr. S. Czarniecki (Institute of Geological Sciences in Cracow). Altogether, the whole collection considered here embraces 90 specimens thus being, up to now, the richest one from Spitsbergen and from the Hornsund area.

Fourteen species (five new) of three genera (one new) are here recognized.

A part of the collection is housed at the Institute of Palaeobiology of the Polish Academy of Sciences in Warsaw (ZPAL), and the second part at the Institute of Geological Sciences, Polish Academy of Sciences in Cracow (AI).

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The studies have been done at the Institute of Geography, University of Łódź. Thin sections were done by Mrs. Danuta Kościelska, the SEM preparations by Mrs. Mirosława Nowińska, both from the Institute of Paleobiology, Polish Academy of Sciences, Warszawa. The photographs of specimens and of thin sections were done by L. Jędrasik M. Sc. of the Institute of Geography, University of Łódź.

GEOLOGICAL AND HISTORICAL REMARKS

Sponges from the Permian sediments of Spitsbergen are not well known. Up to now, three publications have appeared (two of them in the 19th century, dealing with the same collection). Dunikowski, the author of the first paper (Dunikowski 1884) based his studies on the sponges collected in 1882 by the members of the Swedish Expedition to Spitsbergen under the leadership of Nathorst and de Geer. The collection mentioned comes from the Permian of the Bellsund and Isfjord areas. Dunikowski described the following species of his new genus *Pemmatites* (= *Haplistion* Young and Young, 1873): *P. verrucosus*, *P. arcticus*, var. *macroporus*, *P. arcticus* var. *latituba*. He also includes some information about the skeleton of the sponges including some remarks on the canal system with interpretation of its functional morphology. The next papers, constituting some revision of the first one, was done by Hinde (1888, 1896). Unfortunately, that collection is lost.

The next paper on the Permian sponges of Spitsbergen is that of Siedlecka (1970). The collection (54 specimens) derived from several localities of southern and central Spitsbergen — but included only 3 specimens from the Hornsund area. Siedlecka gives descriptions of 5 species (two new ones) of two genera, *Haplistion* and *Scheiia*: *H. arcticus* (Dun.), *H. macroporus* (Dun.), *H. elongatus* Siedlecka, *H. festningensis* Siedlecka,

Scheiia tuberosa Tshernyshev et Stiepanov and some forms *incertae sedis*.

The sponges described here come from cherts of the Kapp Starostin Formation of Hyrnefjellet and Treskelen in the Burgebukta-Treskelen area at Hornsund (fig. 1). These sediments containing sponges stretch from Treskelen to Kopernikusfjellet and further north (Birkenmajer 1964, Czarniecki 1969). Their thickness varies from 6 meters at Kopernikusfjellet, 6.5—66 m at Hyrnefjellet, to 4m at Treskelen and in some places only 1m. The cherts in the Hornsund region were determined as brachiopod cherty limestone (Birkenmajer 1964, 1977). For stratigraphy of the Kapp Starostin Fm. see also Szaniawski and Małkowski (1979), for facies model — Małkowski and Hoffmann (1979).

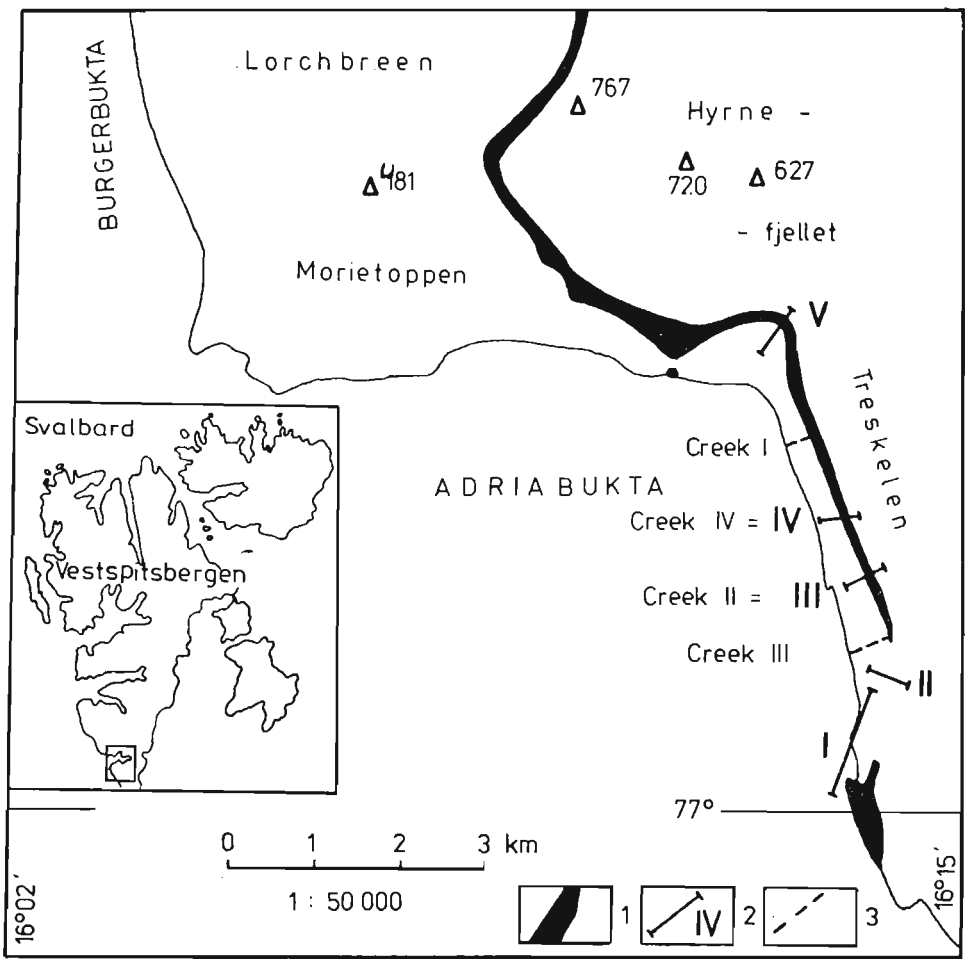

Fig. 1. Distribution of Upper Permian beds and creeks on the coast Treskelen, after Czarniecki (1969). *1* Brachiopod Cherty Limestone, *2* creek and geological profile.

Cherts of the Kapp Starostin Fm. contain a rich fauna with brachiopods which predominate. The sponges are in a minority. The following species, not known up to now, are recognized from the Hornsund area: *Haplistion aeluroglossa* Finks, *H.* aff. *orientale* Tshernyshev, *H. hadrum* sp. n., *H. artiense* (Tshernyshev), *H. skinneri* (King), *H. acremonicum* sp. n., *H.* cf. *elongatum* Siedlecka, *Chaunactis foliata* Finks, *Ch. kaera* sp. n., *Ch. malkowski* sp. n., *Spitsbergenia patella* gen. and sp. n. The representatives of the genus *Haplistion* prevail (10 species). The genus *Chaunactis* is found in 3 species. Genus *Spitsbergenia* (1 species) is very rare. It possesses a skeleton of monaxon spicules that are not interconnected. This is a reason, why complete specimens are rarely found. Possibly their spicules constitute the main component of the spiculites (Siedlecka 1970).

In the assemblage of sponges from Hornsund there occur species common with North America, such as: *H. aeluroglossa* known from the Leonard Formation and *Chaunactis foliata* from the Upper Carboniferous (Pennsylvanian) strata (Finks 1960), and with the USSR such as *H. arcticum*, *H. macroporum*, *H. orientale* from the Upper Carboniferous to Permian of the Central Ural Mts. (Tshernyshev 1899).

REMARKS ON THE SPONGES

The specimens are, to a great degree, nonweathered, black to gray in colour and silicified. They all are of medium size, of diameter 11×16 to 40×90 mm, and their height reaches often to 140 mm. The thickness of the walls in bowl-shaped forms attains at maximum 10—12 mm.

Attempts to treat them in HCl, HF of various concentrations, or in KOH did not give satisfactory results, because the spicules and their fragments embedded in silica broke into pieces during preparation in most cases.

The morphological-structural investigations (e.g., canal system, details of the skeleton) are based on analyses of longitudinal and transverse thin sections of specimens. The cortical skeleton was analysed in the optical microscope and partially in the scanning EM.

The shape of the specimens seems to be slightly altered. Some of them are axially compresed to a small degree, as for example a specimen of *H. macroporum* (ZPAL PfIV/40), and *H. skinneri* (AI-69/55, pl. 37: 5a) All the sponges under consideration show some differentiation in their size and shape. Loaf-shaped forms, subspherical or, in some cases, with a tendency to lateral digital development, predominate (i.e., *H. macroporum*, *H.* aff. *orientale*): straight, rod-shaped or somewhat branching forms occur in *H. elongatum*, bowl-shaped and cup-shaped specimens in the members of *Chaunactis* and *Spitsbergenia* (pl. 40).

The spicules of the studied sponges are relatively long and numerous, mainly of the monaxon group. They are represented by rhizoclones, oxeas

(straight), amphioxeas (arcuate), and diactines — mainly styles, the latter usually smooth, less frequently spinous or spherical. They are broad- or narrow-canalled, and of various sizes. The sclerites seen in thin section at 100× magnification are transparent and their outlines are not always distinct. Monaxons are observable, being better preserved in contrast to the usually indistinct rhizoclones.

The distribution of spicules, as seen in thin sections is variable. Monaxons are numerous in places and randomly distributed. Sometimes they overlap, adjoin or are criss-crossed, thus looking like hexactine structures. Axials canals, visible in many spicules, are straight, thread-like or broad when infilled with sediment less frequently with constrictions of catenulate type. Rhizoclones that are interlocked by processes are arranged parallel or transversely, in some cases obliquely, to the direction of sponge growth. Their pattern of distribution differs slightly among the studied forms. In *Haplistion* the rhizoclones are arranged parallel and in series around the exhalant radial and horizontal canals forming cylindrical tracts within the parenchymal skeleton. These tracts can be entirely rhizoclonous in *H. arcticum*, *H. artiense*, *H. elongatum*, *H. aeluroglossa*, *H. hadrum*, *H.* aff. *orientale*, *H. elongatum acremonicum*. In *Chaunactis* the mutually interlocked rhizoclones are arranged transversely and form a squared system (fig. 2).

The outer surface of the sponges, and the papillae, seem to be submerged in sediment which is usually secondarily silicified. In most specimens the papillae were subjected to chemical decomposition and replaced by openings deceptively similar to apopores.

Based upon observations, the papillae on the outer surface of sponges in the genus *Haplistion* are prolongations of exhalant canals (= radial tracts) stiffened by spicules. Terminations of those canals can be open, terminated by one oval pore (= apopores) or sieve-like. Thus these observations seem to support Dunikowski's opinion on the function of canals (rejected by Hinde 1888*b*). Exhalatory function of these tracts seems to be supported by their permeability, porosity of their walls (pl. 32: 1b, 5b), open apex of canals (pl. 32: 4), longitudinal pattern of spicules in the tract walls. Both Dunikowski (1884) and Finks (1960: 89) define the tracts as cylindrical, hollow or not with small pores. It points to their exhalant function. Internal structure of sponges of the genus *Haplistion* shows alternating radial pattern of inhalation canals located in between the tracts and exhalatory canals stiffened with spiculae canalaria.

The pores on the papillae should be regarded as secondary order apertures of the exhalant system. The intra-fibroidal space can be interpreted as the inhalant system. The genus *Haplistion* does not possess a paragaster (= spongocoel), nor is its internal structure differentiated into inhalant and exhalant systems. The canals are almost parallel and their openings distributed over the entire surface of the sponge. In *Chaunactis* and

Spitsbergenia the upper surface plays the role of a paragastral cavity and the prosopores are distributed over the lower (external) surface of the sponge.

The presence of not very uniformly distributed papillae in well preserved specimens of *Haplistion*, points to favourable and very stable environmental conditions. As is shown by some students (Koltun 1959, 1968; Nestler 1961) rudimentary papillae are to be observed in forms living in a more turbulent environment. The function assigned to the papillae is to carry away the particles excreted by the animal; thus it would be some defense of the animal against fouling itself. In addition, the transverse-longitudinal tracts eased the inhalant-exhalant circulation inside the sponges. Their usually undisturbed arrangement could also point to rather long-lasting environmental conditions.

Trace of attachment to the substratum is lacking in almost all specimens, due in part to the damaged basal portion of the specimens.

SYSTEMATIC PART

Order **Epipolasida** Sollas, 1888
Family **Heliospongiidae** Finks, 1960

Diagnosis. — Finks 1960: 40.

Genus *Spitsbergenia* gen.n.

Type species: Spitsbergenia patella sp. n.
Derivation of the name: from the name of the island — Spitsbergen.

Diagnosis. — Platy or bowl-shaped sponges. Channel water system not separated within the parenchymal skeleton. Reticular skeleton contains numerous smooth diactinas, sharply terminated, straight or slightly bent, weakly differentiated.

Discussion. — Chemical and mineralogical investigations of the skeletal elements have revealed ferritisation around the particular spicules. Diactinas in bundles which in turn are disposed in longitudinal and transverse tracts thus making reticular structure of the skeleton. The sponges described here as *S. pattella* sp. n. are closest to *Heliospongia* Girty (Finks 1960) in regard of their spicule composition and dimensions. Nevertheless, their non-separated water system, round not star-like prosopores as well as different shape of body make considerable differences. They differ from *Coelocladia* Girty 1908, and *Coelocladiella* Finks, 1960 belonging to the same family in lacking papillae on outer surface, in shape, width of body and spicule dimensions. They resemble the genus *Climacospongia* Hinde, 1883 known from the Silurian sediments in the pattern and composition of spicules as well as *Haliclona* Grant, 1841 (*H. gracilis* Miklucho-Maklay) occurring at present in the seas of the Northern Arctic Ocean (Koltun 1959). The proved differences allow one to distinguish a new genus.

Spitsbergenia patella sp. n.

(pl. 38: 6, 7; fig. 2)

Type specimen: AI-69/66; pl. 38: 7.
Type horizon: Brachiopod cherts. Kapp Starostin Fm., Permian.
Type locality: Spitsbergen, Hornsund, Treskelen, creek IV.
Derivation of the name: Latin: *patella* — flat pot.

Diagnosis. — Bowl- or plate-shaped forms with rounded margin. Prosopores round, small. Canals narrower than the mesh spaces. Diactines smooth, feebly differentiated, their series arranged in belts, forming net-like skeleton of parenchyma. Dermal layer thin, aspicular.

Material. — Four specimens. AI-69/31 in one piece of rock with specimen of *Haplistion* AI-69/66. Thin section.

Dimensions in mm:	diameter	wall thickness	
		margin	maximum
	40—90	6	10

Description. — Bowl-shaped sponges with uniformly thick walls. Top surface depressed with small processes and smooth underside. Trace of attachment lacking. Preserved prosopores round and small. Apopores not visible. Meandrous canals narrower than the mesh spaces. Cortical skeleton not developed. Dermal layer

Fig. 2. *Spitsbergenia patella* gen. et sp. n. Drawing of spicules from thin section. Specimen AI-69/31, tract pattern of diactins in parenchymal skeleton; *a* spicules transversely cut, *b* diactines in longitudinal tract, *c* in transverse tract, *d* pors.

0.1 mm thick with sporadic diactines 0.1—0.15 mm long, tangential in depressions and almost vertical on processes. In parenchymal skeleton, numerous, almost of one type, sharp pointed diactines 0.3—0.4 mm long as a rule and ca 0.05 mm thick. Diactines rare 0.8—2.6 mm long, 0.06—0.13 mm thick in some specimens. Some preserved spicule axial canal 0.02—0.04 mm in diameter or less. Amphioxeas may be present. Diactines (oxeas and amphioxeas) are rather regularly spaced in bundles arranged in longitudinal and transversal belts forming a mesh-like skeleton. Transverse belts show 1—3 oxeas in part side by side and non parallel. Sporadic tylostyles occur and probably strengthened the belt pattern of loose spicules.

Remarks. — *Spitsbergenia pattella* sp. n. differs from *Heliospongia* Girty 1908 — (*H. excavata* King, 1943, *H. ramosa* Girty 1908. *H. vokesi* King 1943) and from *Coe-*

locladella Finks 1960 (*C. lissa, C. philoconcha* Finks) in the mode of growth. The genera mentioned above are either branching or cylindrical with appendices or cylindrical-conical. Their spiculae are joined by secondary silica (Finks 1960). *S. patella* sp. n. is feebly similar in shape to *Coelocladia spinosa* Girty from which it differs by lack of papillae on outer surface, thicker walls and greater body width. *Spitsbergenia does* not possess a funnel-shape nor does it branch like *Coelocladia spinosa.*

Occurrence. — Type locality and horizon.

Order **Rhizomorina** Zittel, 1878
Family **Haplistidae** Laubenfels, 1955
Genus *Haplistion* Young et Young, 1877

Type species: *Haplistion armstrongi* Young et Young, 1877.

Among the species described so far from the Carboniferous and Permian the oldest are *H. armstrongi* and *H. vermiculatum.* A few species were described by Finks from clayey limestones of the Pennsylvanian (Desmoinesian?) in Texas, USA. Tshernyshev described in 1899 five species from the Artinsk Stage in the vicinity of Krasnoufimsk, Central Ural Mts and in the Timan and recognized the existence of that genus in the coal-bearing Carboniferous limestone also in Timan. (Table 1)

In Spitsbergen *Haplistion* is a chief component of sponges in Permian sediments from Hornsund to Askeløya. It is represented by 10 species. All the species possess numerous spicules which make up the cortical, parenchymal (mesenchymal) skeletons and the inhalant part (monaxons) as well as exhalant canals (rhizoclones, monaxons). Sponges belonging to the genus *Haplistion* have no separated inhalant and exhalant zones. Ostia and postica, inhalant and exhalant canals are interspersed inside and over the whole surface of the sponge. The classification has been done according to the proposals by Finks (1960).

Haplistion arcticum (Dunikowski, 1884)
(pl. 30: 1—4; pl. 31: 1—5; figs. 3—5)

1970. *Haplistion arcticum* (Dunikowski); Siedlecka: 74, pls. 1—4 (here older synonymy).

Material. — Fifteen specimens from the collection ZPAL Pf./IV/1, 2, 3, 9 and from AI-69/17, 19, 28, 39, 43, 50, 51, 54, 60, 67, 79.

Dimensions in mm:

	height	diameters
specimen AI-69/19	15	25×29
specimen AI-69/43	40	40×68

Description. — Lack of attachment trace. Specimens oval, transversely to longitudinally flattened, of variable shape. Some are bowl-, cone-, or loaf-shaped, or flat (fig. 4). Outer surface sometimes with small nodes. Lack of paragastral cavity. Papillae, *sensu* Siedlecka (1970) "rugae", ca. 1 mm in diameter rarely preserved. When abraded — they leave openings. Ostia (= prosopores), if preserved, are oval 0.04—0.06 mm in diameter. Skeleton fibroidal, composed of tubular tracts forming radial and concentric nets. Mesh spaces rectangular 1.5—4 mm in diameter. Thickness of radial tracts from 0.5 up to 1.5 mm and spaces are 0.5—2.5 mm. Transverse tracts (= horizontal) are perpendicular to the radial ones, 0.3—1.0 mm thick and spaced 0.5—1.6 mm.

Table 1

Comparison of the known species of *Haplistion* Young et Young from the brachiopod cherts of Vestspitsbergen

Species	thickness of tracts		mesh spaces		kind of mesh
	long.	transvers.	long.	transvers.	
H. arcticum	0.5—1.5	0.3—1.0	0.5—2.5	0.5—1.6	radial and concentric
H. macroporum	1.5—2.0	0.5	2.0—4.0 variable in size and shape, rectangular 4 mm, trapezoidal elongated		loose, less regular, radial without concentricity
H. hadrum sp.n.	0.4—1.5	0.4—0.5	variable, straight to bent		dense, not very regularly radial
H. artiense	1.5	0.5	spaces 2.0—5.4 mm		radial zones straight
H. elongatum elongatum	0.7—1.0	variable	4-side or multisided spaces 1.0—2.0 mm		irregular mesh
H. aeuroglossa	0.2—0.3	0.1—0.2	pentagonal, rounded broad 1.0—3.0 mm		indistinct radial mesh-like skeleton
H. skinneri	0.2—0.3	0.3—0.5	rectangular, 0.7—1.0 mm		dense, weak concentricity
H. aff. *orientale*	0.2—1.0 (up to 2 mm at outer surface)	ca 0.5			dense, irregular anastomosing

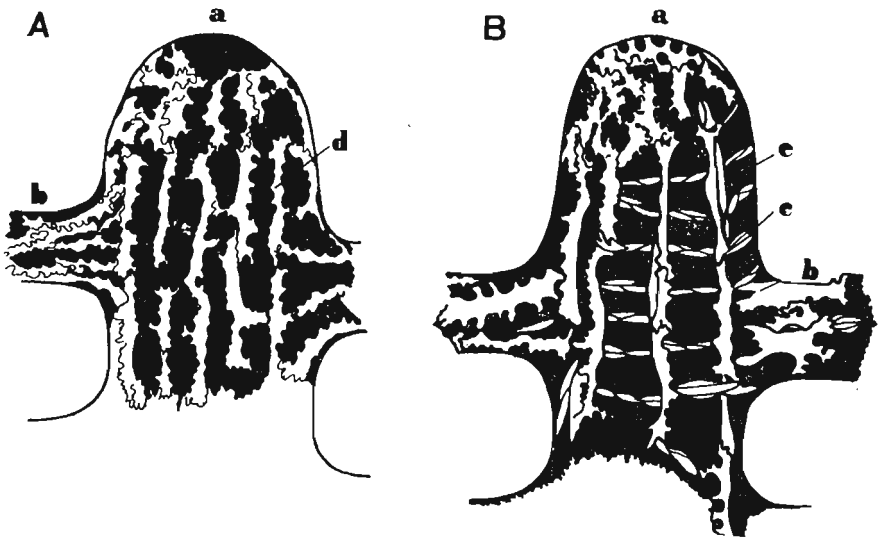

Fig. 3 Cylindrical tracts in genus *Haplistion* Young et Young. *A*—*H. arcticum*, lack of monaxon bands, *B* — *H. macroporum* — transverse bands composed of monaxons are present; *a* radial tracts, *b* horizontal (= transverse) tracts, *c* transverse fibre of monaxon spicules in the radial tracts, *d* rhizoclones arranged in the longitudinal rows, *e* monaxons between rhizoclones;

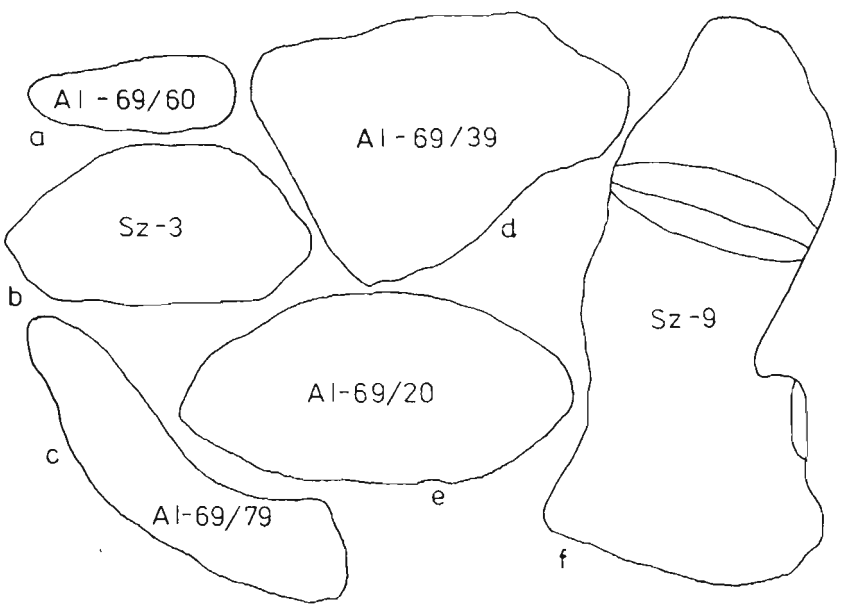

Fig. 4. *Haplistion arcticum* (Dunikowski). Outlines of shape of different specimens, natural size: *a*, *b*, *e* forms attached to a large boulder, *c* on small boulder, *d* in between boulder, *f* in a fissure, rather horizontal, reptant form, ×0.5.

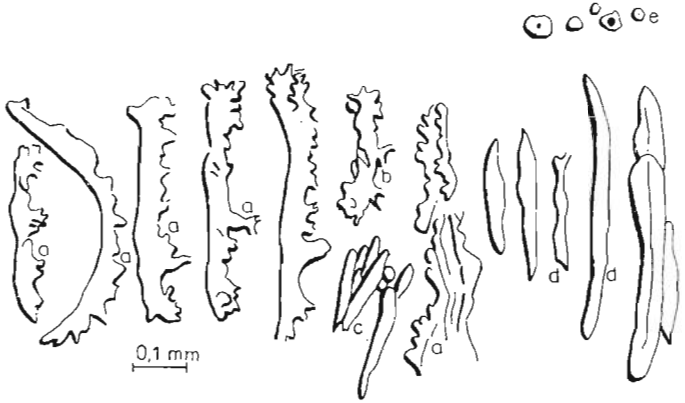

Fig. 5. *Haplistion arcticum* (Dunikowski). Drawing of spicules from thin sections. Specimen ZPAL Pf IV/2 *a* rhizoclones from radial tract; Specimen ZPAL Pf IV/3a: *b* rhizoclones from horizontal tract; thin section No 2: *c* monaxons from cortex, *d* monaxons from inhalant canals and *e* cross section of monaxons showing axial canal.

In some specimens (adult forms), in the fibroidal network one can notice: a) a central part of netlike structure, of thinner and densely spaced tracts (juvenile stage), b) a concentrically radial zone, and c) a zone of cortical skeleton in which the zones are parallel and perpendicular to the external surface (specimen AI-69/39).

Spiculation: rhizoclones arranged in 3—4 or as much as 6 rows according to the direction of tracts. Apical terminations of zygomes are blunt (fig. 5). Monaxons are present in space between radial tracts and cortex and lacking in radial tracts, inhalant canals and cortex. According to Dunikowski (1884) "Deckschicht" composed of monaxons (= cortical layer), 0.5—1.2 mm thick. Hinde (1888 *a*,*b*) had not found it in *Haplistion*. In some specimens examined the cortical layer is preserved only on the bottom side. In SEM, spiny monaxons (style) and microscleres of sigma type have been observed (pl. 31: 5 and 1 respectively).

Remarks. — The Permian specimens from Vestspistsbergen as compared to the Carboniferous specimens of this species (Tshernyshev 1899) show longer rhizoclones and a well developed cortex around the basal part. In other aspects it is roughly similar.

Occurrence. — Vestspistbergen: Permian, Kapp Starostin Fm. at Treskelen (creeks II, III, IV), Hyrnefjellet, and other sites within a belt from Treskelen to Isfjord. USRR: Upper Carboniferous and Lower Permian.

Haplistion macroporum (Dunikowski, 1884)

(pl. 32: 2—5; pl. 33: 1, 2; fig. 6)

1970. *Haplistion macroporum* (Dun.); Siedlecka: 76, pl. 2: 4, 6 (here older synonymy).

Material. — Ten complete specimens and 4 damaged ones: ZPAL. Pf. IV/6, 13 and AI-69/16, 23, 27, 30, 33, 38, 40, 47, 48, 52, 56, 64.

Dimensions in mm:

	height	diameters
largest specimen	—	52×70
smalest specimen	14	29×30

Diagnosis. — *vide* Siedlecka 1970: 77.

Description. — Specimens spherical or subspherical. Digital due to unilateral development (specimen AI-69/23). Specimen loaf-like, flat with small bud (AI-69/56). Radial tracts are preserved. Horizontal tracts are exceptional, hence the fibroidal skeletal net is less regular, and more loose, with meshes of variable size and shape. Meshes quadrangular (4 mm²) trapezoidal, more or less oval (8—10 mm²).

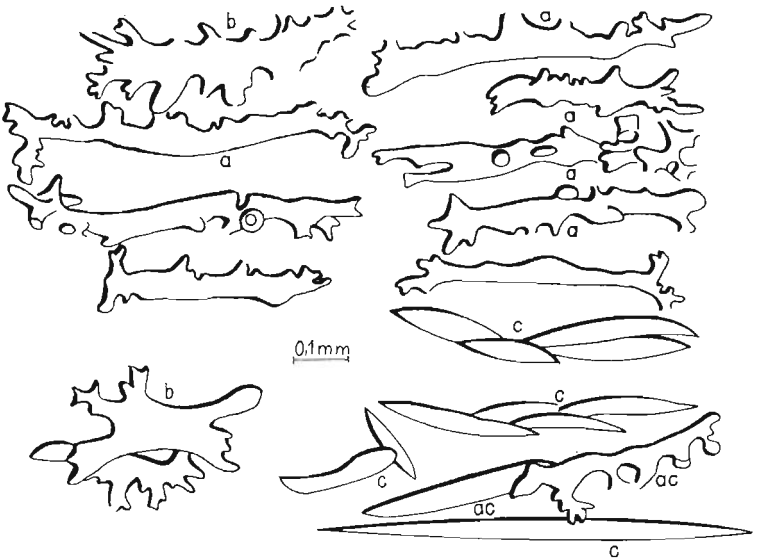

Fig. 6. *Haplistion macroporum* (Dunikowski). Drawing of spicules from thin sections. Specimen AI-69/23 and 38; *a* rhizoclones from radial tract of peripheral part, *b* rhizoclones from transverse tract of central part, *c* oxeas arranges in fibres crossing the radial tracts, *ac* oxeas and rhizoclones associated along radial tracts.

Spiculation: both rhizoclones and monaxons are present in radial tracts, smooth or delicately spiny, longitudinally or more frequently perpendicularly distributed. Rhizoclones (thin sections 6 and 23) are elongated, simple 0.25—0.8 mm long, arranged along the tracts, joined with zygomes and transversely supported with bundles of oxeas. They are more zygome-like in central part of a sponge than at the periphery. Numerous amphioxeas, oxeas and styles occur within the inhalant spaces. They are 0.1—1.5 mm long and 0.06 mm thick, and are arranged in bundles and netlike (specimen AI-69/33). Under very high scanning magnification microxeas (pl. 33: 2c) are observable. In the cortex spicules are also in elongated belt-like bundles making a net-like pattern.

Remarks. — *H. macroporum* differs from *H. arcticum* in lack of distinct concentricity in the parenchymal net and presence of transverse fibres from oxeas within the radial tracts.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Treskelen, Hyrnefjellet, Middlehook at Bellsund, Tempelbay-Gipshook. USSR: Lower Permian.

Haplistion hadrum sp. n.

(pl. 32: 1; fig. 7)

Type specimen: ZPAL Pf. IV/8, two thin sections: 8a, b; pl. 32: 1.

Type horizon: Brachiopod cherts, Kapp Starostin Fm., Permian.

Type locality: Spitsbergen Hornsund, Hyrnefjellet southern slope.
Derivation of the name: Greek *hadros* — thick, swollen.

Diagnosis. — Shape variable, reptant with spherical swellings. Longitudinal tracts bifurcating, subparallel, thicker and thicker toward the surface. Transverse tracts thin, straight or arcuate inside. Rhizoclones elongated, variably bifurcating. Oxeas and amphioxeas longitudinally and transversely arranged in parenchymal tracts.

Material. — Two specimens ZPAL. Pf. IV/8 and AI-69/26.

Dimensions in mm:

	heigth	length	max. thickness	min. thickness
Specimen ZPAL Pf. IV/8	32	over 92	32	13
Specimen AI-69/26	67	—	38×23	12×7

Description. — Thickness of longitudinal tracts (in external part) increases toward periphery from 0.4 up to 1.5 mm and of horizontal 0.4—0.6 mm. Numerous rhizoclones, oxeas and amphioxeas in the radial tracts. Longer oxeas 2 mm long are longitudinally arranged in between rows of the rhizoclones. Shorter ones (0.6—1.0 mm) arranged in transverse fibres, spaced 0.3—1.2 mm apart, strengthen the radial tracts and make the internal skeleton of the exhalant canals. Numerous rhizoclones are 0.8 up to 1.3 mm long and ca 0.1 mm thick. Bluntly spinose zygomes are short and are locally concentrated on epirhabds. There are rhizoclones up to 1.5 mm long with weak zygomes arranged in rows along the tracts. Lack of paragastral cavity and osculae. Papillae conical 2.5 mm high with apopores on apex.

Remarks. — *Haplistion hadrum* sp. n. differs from *H. artiense* Tshernyshev in lacking tracts of uniform thickness and in having oxeas and amphioxeas (see Tshernyshev 1899: 17, pl. 2: 13, 16). In *H. hadrum* the mesh is dense, and the tracts are subradial, in *H. artiense* are straight and radial. Differences between *H. arcticum* (Dunikowski) and *H. hadrum* pertain chiefly to the kind of mesh, tract thickness and spacing of horizontal tracts constituing the mesh. Besides, in *H. arcticum* the monaxons occur only within the zone of inhalation canals and in the cortex, whereas in *H. hadrum* monaxons (oxea and amphioxea) are abundant in radial tracts and are longitudinally and transversely oriented. As compared to *H. aeluroglossa* Finks (1960: 89, pl. 26: 9—12), *H. hadrum* shows thicker fibroidal tracts and larger spicules.

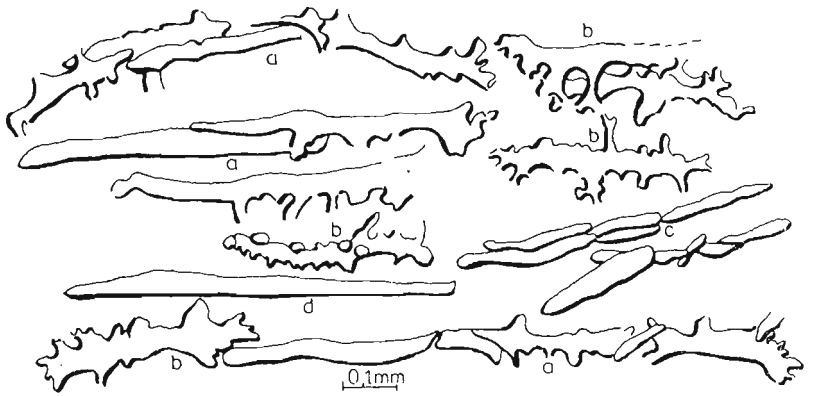

Fig. 7. *Haplistion hadrum* sp. n. Drawing of spicules from thin section. Specimen ZPAL Pf IV/8b: *a* ropelike pattern of rhizoclones and monaxons in radial tract, *b* rhizoclones from radial tracts, *c* oxeas arranged in fibres crossing the radial tracts, *d* oxeas longitudinally arranged among rhizoclones.

H. hadrum exhibits thicker fibrous tracts, variable density of mesh (table 1), larger spicules without strongyles and no oscula. In *H. aeluroglossa* Finks the thickness of tracts is smaller, the mesh spaces are pentagonal and rounded, there are rounded oscula and among the spicules one may see rhizoclones, amphioxea and strongyles 0.4 mm long. It seems possible that the new species derives from *H. aeluroglossa* which is supported by similar spiculation and structure of central part.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Hyrnefjellet and Treskelen (creek IV).

Haplistion artiense (Tshernyshev, 1899)

(pl. 37: 4; fig. 8)

1899. *Pemmatites artiensis* Tshernyshev; 17, pl. 2: 13, 16; pl. 4: 1, 2.

Material. — One specimen AI-69/37 of diameter 32×52 mm.

Remarks. — In its morphology and structure of the tracts the specimen from Spitsbergen corresponds to the species of Tshernyshev. It is subspherical: papillae cylindrical 2 mm high. Tract pattern regular almost parallel, net dense. Radial tracts 1.5 mm in diameter, dichotomously separating in spaces every 0.9—1.2 mm. No trichotomous division was noticed as reported by Tshernyshev (1899: 17). Numerous transverse tracts 0.4—0.6 mm thick, half as thick as the radial ones, arcuate inside. Rhizoclones 0.6—1.4 mm long present in radial and transverse tracts are the main skeletal component. They are nor associated with oxeas or amphioxeas. Monaxons sporadic in tracts, and are more numerous in inhalant canals. They are 0.2—0.6 mm long, and ca 0.1 mm thick. Lack of typical cortex. The specimen studied differs from *H. hadrum* in lack of monaxon spicules arranged transversely within radial tracts.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Treskelen (creeks II—IV). USSR: Lower Permian.

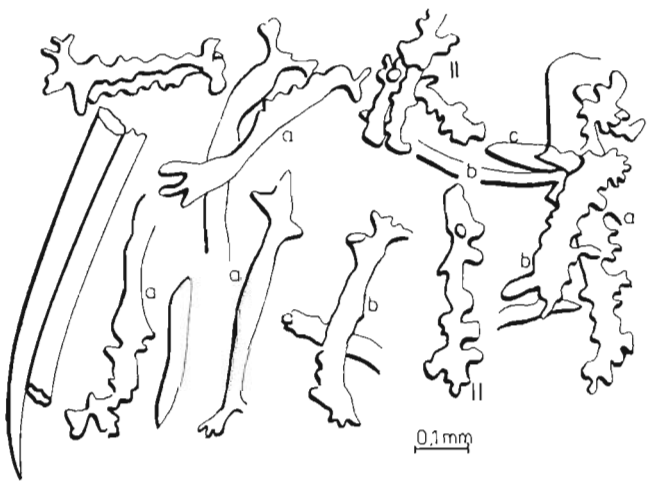

Fig. 8. *Haplistion artiense* (Tshernyshev). Drawing from thin section. Specimen AI-69/37: *a* rhizoclones from longitudinal tract, *b* from transverse tracts, *c* sporadic oxeas from tracts. II rhizoclones after Tshernyshev (no scale).

Haplistion elongatum elongatum Siedlecka, 1970

(pl. 34: 1, 2; pl. 35: 1a—d; fig. 9)

1970. *Haplistion elongatum* Siedlecka: 77, pl. 2: 1—3; pl. 4: 5, 6; fig. 3.

Material. — 13 specimens: ZPAL Pf. IV/7, 10, 12, and AI-69/21, 22, 26, 41, 46, 57, 61, 65, 68, 69.

Dimensions in mm:

Specimen AI-69/	height	diameters		
		max.	apex	basal part
largest No. 61	100	47×22	24×10	8×10
"bifurcating" No. 57	60	37×24	31×22	?
cudgel-shaped No. 22	87	37×22	?	?
cudgel-shaped No. 21	40	19×16	16×15	10×9

Diagnosis. — Siedlecka 1970: 78.

It should be added that there are also branching specimens, tubular and with or without depressions at tops of branches. Rhizoclones large and of variable length. Spaces in between the tracts ca 1—2 mm in diameter, rectangular and irregular.

Description. — The specimens studied do not possess a paragastral cavity. A depression is present at the apex of some of them. Specimens AI-69/22, 41, 61 correspond to the type specimen in their outline (Siedlecka 1970: pl. 4: 5, 6). Others (ZPAL. Pf. IV/7 and AI-69/21) are smaller, cylindrical (pl. 35, fig. 1a—d), branching (ZPAL Pf. IV/12, AI-69/57, 68) elliptical, with lateral tubercles that suggest a branching tendency; or cudgel-shaped (AI-69/69). Papillae on lateral surface show one oval apopore or are sieve-like. Variable thickness of tracts from 0.7 up to 1.2 mm is a common feature of the specimens investigated. Most of them show a distinct axial zone of the skeleton (vide thin sections No. 7, 10, 12; pl. 34: 1 and 2) as well as the lateral (marginal) zone. In the axial zone there prevail radial tracts branching irregularly (thin sections 7, 10) of variable thickness terminating in an apical depres-

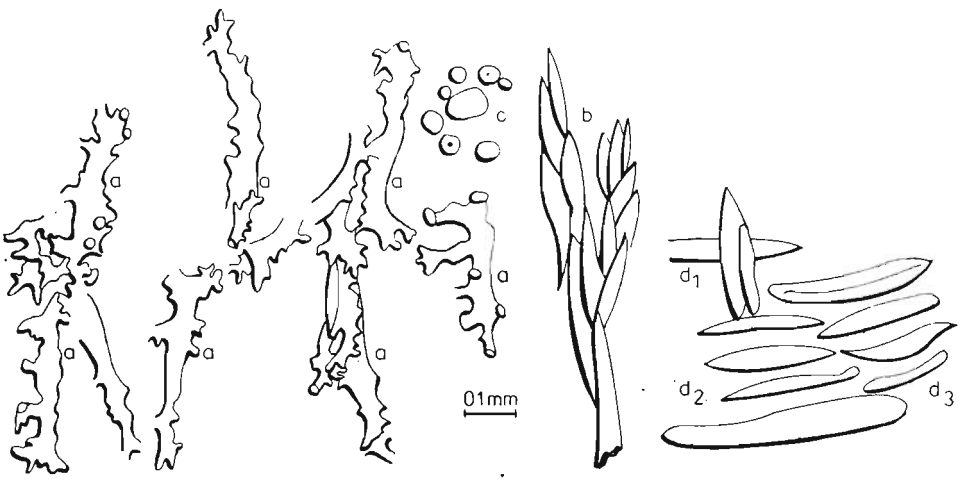

Fig. 9. *Haplistion elongatum elongatum* Siedlecka. Drawing of spicules from thin sections. Specimen ZPAL Pf IV/12: *a* rhizoclones, *b* oxeas in bundles arranged into transverse fibres inside radial tracts. Specimen ZPAL Pf IV/7a: *c* transverse sections of monaxons with canals, d_1 oxeas crosswise arranged, d_2 variability of oxeas, d_3 amphioxeas.

Table 2

Thickness and spacing of tracts in *Haplistion elongatum elongatum* Siedlecka (in mm)

No of specimen	diameter of radial tracts	spacing	diameter of transverse tracts	spacing:	Occurrence
ZPAL.Pf.IV/7	0.7	small	thinner than radial	0.3—0.7	Hyrnefjellet
ZPAL.Pf.IV/10	1.2	variable	0.7	—	Treskelen
ZPAL.Pf.IV/12 core	1.0—0.3				
marginal	0.7—1.0	1.0	0.5	0.5—0.7	Treskelen
AI-69/21	0.5—0.7	—	0.3	—	creek IV
AI-69/22	0.5—1.2	?	0.3	?	creek III
AI-69/26 top	0.7—1.0				
at the middle	0.8—1.0	1.8—2.5	0.3—0.5	0.5	creek IV
AI-69/41	0.5—0.8		0.2—0.3	—	creek II-1
AI-69/46	0.5—1.2	1.0	0.5—1.0	0.6—1.0	creek IV-II
AI-69/57	0.7—1.0	0.2	0.4—0.6	?	Treskelen S
AI-69/61	0.8—1.2				Treskelen S
AI-69/65	1.0—1.5	1.0—1.5	0.3	0.8—1.2	Hyrnefjellet
AI-69/68	0.7—2.0	1.2—2.0	lack	—	Hyrnefjellet
AI-69/69	0.7	0.7—1.0	0.2—0.3	0.7—1.0	Hyrnefjellet

sion or at the apex of the sponge. Thickness of the axial zone varies in different specimens and spaces are irregular (pl. 35: 1c; pl. 34: 1b, 2b). In the marginal zone the radial tracts are regularly distributed, vertical to the outer surface 0.7—1.0 mm in thickness. Transverse tracts perpendicular to the radial ones accentuate the concentricity of the skeleton. Spaces rectangular, ca 1—2 mm.

Tracts of the skeleton consist of rhizoclones with spiny zygomes: thin sections Nos. 7, 10, 12. Monaxons of unequal length and thickness. Their quantity and mode of distribution varies among the individual specimens. There are amphioxeas 0.1—1.5 mm long and up to 0.2 mm thick (thin section No. 10) and fibrous oxeas (thin section No. 7b). (Table 2)

Remarks. — Despite the variable shape and sizes of the specimens, as well as the branching of tracts in the axial zone, all the investigated specimens have been classified as *Haplistion elongatum elongatum* Siedlecka.

Sponges of that species occur in Spitsbergen with attached brachiopods (specimens Nos. 10, 12, 61). *H. elongatum elongatum* may be regarded as a species characteristic of the chert horizon.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Askeløya, Bellsund, Treskellen (creeks III, IV) and Hyrnefjellet.

Haplistion elongatum acremonicum subsp.n.

(pl. 36: 2; fig. 10)

Type specimen: AI-69/25; pl. 36: 2.
Type horizon: Brachiopod cherts. Kapp Starostin Fm., Permian.
Type locality: Spitsbergen, Hornsund, Hyrnefjellet.
Derivation of the name: Greek *akremon* — branch.

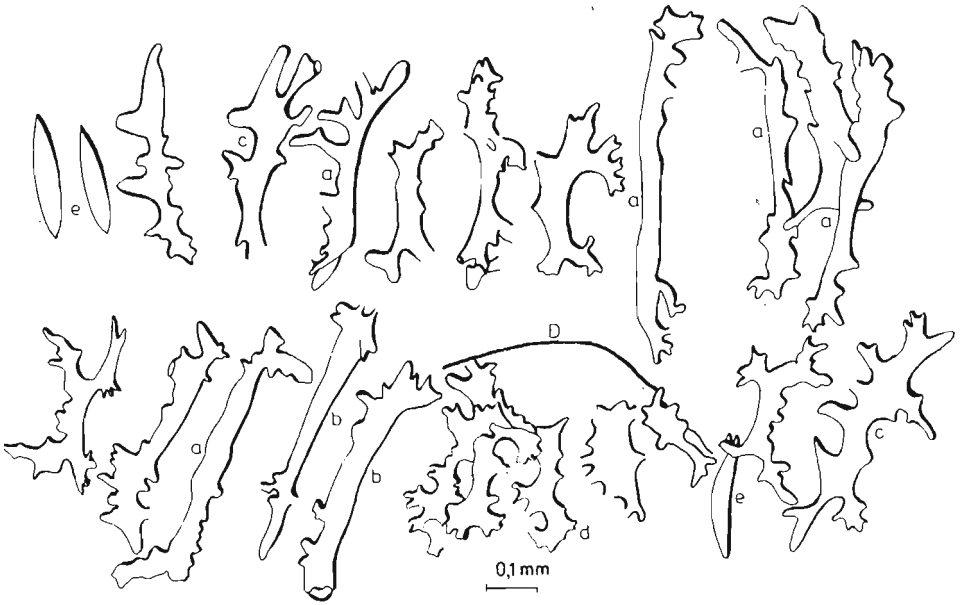

Fig. 10. *Haplistion elongatum acremonicum* subsp. n. Drawing of spicules from thin sections. Specimens AI-69/25a and 25b; *a*, *b*, *c* rhizoclones from tracts, *a* from radial part in peripheral zone, *b* from transverse part, *c* from central part, *d* around apopora in papilla, *e* sporadic oxeas.

Diagnosis. — Cudgel-shaped, branching irregularly. Branches simple or club-shaped. Tracts thin, net dense, rhizoclones of variable length, long processes. Oxeas sporadic.

Material. — Four specimens, Nos. AI-69/20, 24, 25, 45.

Dimensions in mm:

Specimen AI-69/	height	max. diameters
largest No. 24	81	31×45
medium No. 20	66	44×23
bud No. 25	25	11×16

Remarks. — The specimens studied differ from *H. elongatum elongatum* in: 1) much smaller thicknes (= width) of radial tracts 0.3—0.5 mm, spaced 1.0—1.2 mm; 2) narrower central-axial zone, 3) sporadic monaxons in tracts, and 4) more branching rhizoclones 0.5—1.8 mm in length. Near apex, in papillae, rhizoclones are shorter, more massive and more spiny; inside the specimen — elongated and sometimes almost smooth. Remarkable is specimen AI-69/25 which is cudgel-shaped with two small club-shaped branches resembling some single specimens of *H. elongatum elongatum* (e.g., AI-69/61).

Branching. In transverse section, the main part of stock(?) shows several centres of growth: one main centre and three others representing initial stages of branches. The walls of new individuals are within the mother sponge not well defined thus representing a very early stage of development prior to the separation of an offset from the stem. Other specimens show only one axial centre.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Treskelen (creeks III, IV).

Haplistion cf. *elongatum* Siedlecka, 1970
(pl. 36: 1; fig. 11)

Material. — One fragmentarily preserved specimen AI-69/63, of surface 35× ×45 mm and thickness 15—18 mm.

Description. — Flattened specimen with a tendency to branching in horizontal plane. Branches short with smaller or larger depression at top. Thickness of tracts varies, thinner usually in axial part. Radial tracts, when branching make broader canals or cavedia?. In the centre of the sponge they attain 0.3 mm in width, on the surface they terminate as papillae 0.5—0.6 mm in diameter. Transverse tracts of unequal width 0.5—0.7 mm, at bifurcations — 1.0 mm. Mesh spaces on surface are irregularly pentagonal or quadrate, rounded inside. Canals in axial part tubular, on outer surface visible as sulcate, radially (fan-like) arranged furrows. Rhizoclones 0.6—1.0 mm long with numerous sharp-edged zygomes. Epirhabds straight, massive. Oxeas sharply terminated, mesh-like distribution makes small bundles on canal surfaces or fibres inside radial tracts.

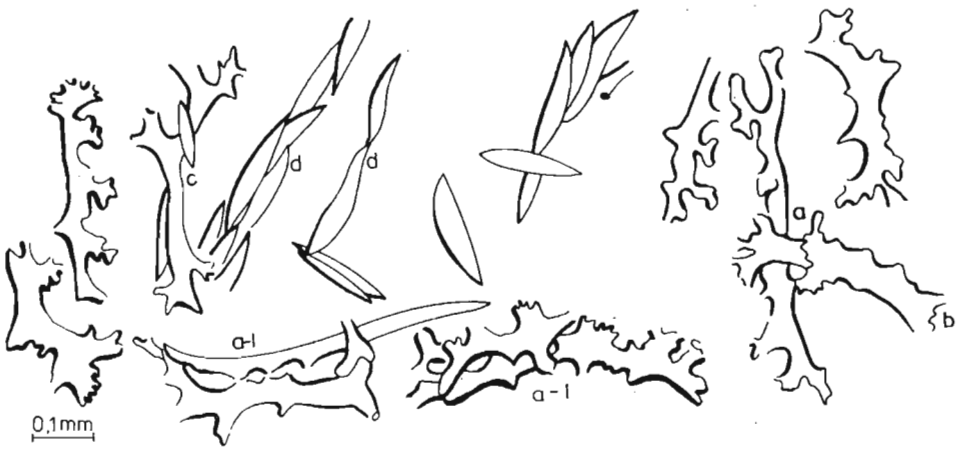

Fig. 11. *Haplistion* cf. *elongatum* Siedlecka. Specimen AI-69/63, thin section showing: *a* rhizoclones from longitudinal tracts, a_1 rhizoclones from one row, *b* rhizoclones from transverse tracts, *c* rhizoclones with adjacent oxeas, *d* fibres oxeas inside longitudinal tracts.

Remarks. — Possessing additional canals and branching of the radial tracts, the specimen stands close to *H. megalochetus* Finks (1960: pl. 28: 3—7) from the Wolfcamp Formation — Lowermost Leonardian, USA, in which the net is strongly irregular locally, tracts thicker and oscula are present. Structure in cross-section is almost identical to that of *H. elongatum*. It differs from the latter in: presence of cavedia? and grooves on outer surface, more massive rhizoclones and rare (non numerous) monaxons making fibres.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Hyrnefjellet.

Haplistion aeluroglossa Finks, 1960
(pl. 37: 1—3; fig. 12)

1960. *Haplistion aeluroglossa* Finks: 89, pl. 19: 8—10; pl. 26: 9—12; pl. 27: 1, 2.

Material. — Three complete specimens AI-69/15, 42, 59 from cherty limestones. Thin section AI-69/15.

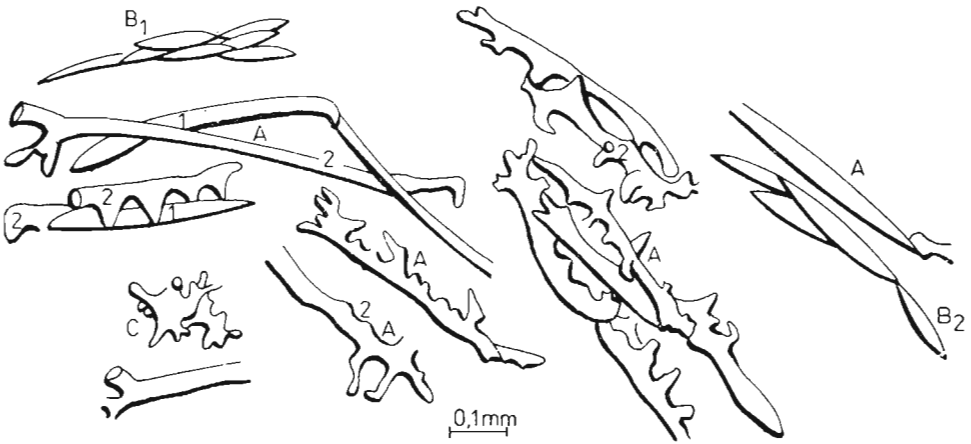

Fig. 12. *Haplistion aeluroglossa* Finks. Drawing of spicules from thin section. Specimen AI-68/15: *A* from radial tracts — 1 oxeas and 2 rhizoclones; *B* fibrous pattern of oxeas, B_1 transverse fibres in radial tracts, B_2 oxeas along radial tracts, *C* rhizoclones with shortened epirhabd.

Dimensions in mm:

subspherical with appendices		height	diameters
	AI-69/15	45	40×57
loaf-like	AI-69/42	32	41×40
fan-shaped	AI-69/59	45	18×36

Diagnosis. — Finks 1960: 89.

Remarks. — Size, shape and morphology correspond to Finks' species. Preserved in places, papillae are sharply conical 1 mm high (specimen AI-69/59) of fan-like outline. Small depressions on the surface of specimen AI-69/15 resemble rather caverns 3 mm wide than oscula of the American specimen (Finks 1960: pl. 27: 1, 2).

Radial tracts are more or less distinct. The radial tracts 0.2—0.3 mm and horizontal tracts 0.1—0.2 mm form net like skeleton of usually pentagonal mesh-spaces (1—3 mm in width). Tracts seem to be hollow, without "coring spiculae" in the center, filled with transparent mineral substance and surrounded by rhizoclones. Spicules are located within walls of tracts longitudinally and transversely. In places, there are three layers of rhizoclones arranged in the longitudinal rows. According to Finks, in *H. aeluroglossa* from the USA, the tracts are not hollow and have no specialized coring spicules.

Rhizoclones are bar-shaped, straight or slightly bent, with short bluntly terminated zygomes. Sporadically, rhizoclones show a shortened epirhabd with several longer zygomes. Rhizoclones of the forms from the Leonardian are 0.3—0.8 mm long and 0.05 mm thick. In addition there are oxeas, strongyles and dendroclones (Finks 1960). In the Spitsbergen specimen rhizoclones dominate, 0.5—0.8 mm in length and 0.04 mm in thickness. No strongyles or dendroclones were observed. In some cases oxeas occur together with the rhizoclones in longitudinal tracts (= radial) or are coupled in small fibres across radial tracts.

One can distinguish: a) skeleton of exhalant system with rhizoclones prevailing around radial and horizontal tracts; rhizoclones associated with oxeas, b) skeleton of inhalant system, net-like, in which oxeas and amphioxeas prevail; according to some authors (Dunikowski 1884; Hinde 1888 a, b) these are of foreign origin, c) cortical skeleton seldom preserved (e.g. specimen AI-69/15).

The investigated specimens differ from other species of *Haplistion* in: a) small thickness of tracts, b) their mutual binding into a dense network of polygonal meshes densely spaced, c) digital shape. As compared to the forms from the Leonardian, Texas, USA (Finks 1960) strongyles and osculae are absent, papillae are enlarged, and tracts are thinner: 0.2—0.3 mm, not 0.15—0.3 mm in the center of sponges and near the base 0.5 mm.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Treskelen (creek IV—III). USA: Leonardian Series.

Haplistion skinneri (King, 1943)

(pl. 37: 5, 6; fig. 13)

1960. *Haplistion skinneri* (King); Finks 90, pl. 27: 5; pl. 28: 1, 2; figs. 65—72 (here older synonymy).

Material. — Three specimens: AI-69/31, 55 and 58, of diameters 15×33 mm and 30×50 mm.

Fig. 13. *Haplistion skinnerri* (King). Drawing of spicules from thin section. Specimen AI-69/58: I — from transverse tracts — *a* rhizoclones and *b* oxeas; II — from longitudinal tract — rhizoclones *a* from tracts of central part and *b* from peripheral part, *c* oxeas *d* strongyle.

Remarks. — Structurally the specimens studied correspond to *H. skinneri* (King). They are subspherical, flattened without depression or osculi. There exist cavedia inside the sponge (AI-69/58). Preserved papillae are delicate, conical, not high. Network dense, consisting of tracts of equal thickness, dichotomous branching ca every 4 rows. Longitudinal tracts (= radial) 0.2—0.5 mm in diameter are spaced 0.7—1.0 mm, transverse tracts 0.3—0.5 mm in diameter, at surface of sponge — 1 mm. Concentricity scarcely observable in places. Meshes rectangular. Rhizoclones similar as those in *H. skinneri* 0.6—0.9 mm in length and 0.03—0.05 mm in thickness, zygomes variable, usually short. Epirhabd simple (straight?). Sporadically preserved strongyles (thin section 58), amphioxeas and oxeas (thin sections 31, 55 and 58). Transverse thin sections (55 and 58) reveal central part in which thickness of tracts is much smaller than near outer surface. In the central part spicules shorter and more spinose than in the periphery. In the peripheral part rhizoclones and oxeas are longer and more slender and their processes (= zygomes) are longer at terminations of epirhabd.

Tracts of central part in *H. skinneri* and in *H. aeluroglossa* are similar both in size and structure. Near surface in *H. aerluroglossa* tracts are 0.15—0.30 in diameter and 0.25—0.8 mm apart, and in *H. skinneri* are 0.25—0.60 mm thick, and 0.5—0.2 mm apart.

Remarks. — A concentration of spherical algae is observable in thin section No. 58 in longitudinal tracts. Specimen AI-69/31 is associated with a specimen of *Spitsbergenia patella* gen. et sp. n., at the surface of which it has grown. A cross-section shows less regular structure at the contact of the two forms, without intergrowths.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Treskelen (creek IV). USA: Leonardian Series.

Haplistion aff. *orientale* Tshernyshev, 1899

(pl. 36: 3—4; fig. 14)

Material. — Two specimens AI-69/70 and 72.

Dimensions in mm:

			appendices		
	length	thickness	width	length	diameters
specimen AI-69/72	140	45	116	a/23	27×29
				b/19	29×37
				c/35	17×18

Description. — Specimens correspond to the description of the species. One specimen is flatly digital with three appendices, the second one — almost spherical with appendices without trace of attachment or depressions, or hollows (spongocoel). Surface verrucose. Papillae sharply terminated, 2—3 mm high. Tracts of skeleton hollow, tubular without "coring spicules". Longitudinal tracts 0.5—1.0 mm in diameter, but 2 mm thick at variably spaced points of branching and anastomosis. In some places 2—3 or more tracts join at one point. Transverse tracts of unequal length, ca 0.5 mm thick, more numerous near outer surface, where they are spaced 1—2 mm. Fibroidal network dense, of irregular meshes. Rhizoclones with numerous spiny zygomes bifurcating at elongated terminations, straight ones prevail, 0.4—0.5 mm long inside the sponge and up to 1 mm near the surface. Monaxon spicules less numerous than in other species of this genus; oxeas, amphioxeas, smooth styles and spiny styles, of various sizes, 0.15—0.8 mm long and 0.06 mm thick. Longer ones are present in longitudinal tracts near surface.

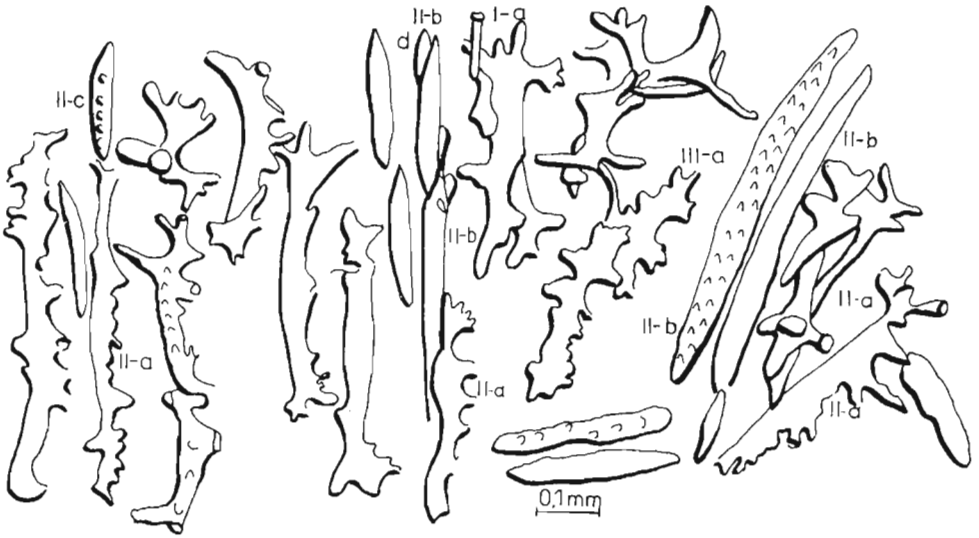

Fig. 14. *Haplistion* aff. *orientale* Tshernyshev. Drawing of spicules from thin section. Specimen AI-69/72b—1: *I—a* rhizoclones from transverse tract, *II—a* rhizoclones from radial tract, *II—b* amphioxeas smooth and spiny from longitudinal (= radial) tracts, *II—c* strongyles, *III—a* rhizoclones from marginal part around papillae.

Remarks. — Structure of skeletal network well observable in thin section No. 72, is similar to that of *H. festningense* Siedlecka (Siedlecka 1970: 79, pl. 3) but thickness of tracts is twice smaller (not 1.5—4.0 mm), and their pattern less regular. Rhizoclones are larger. The shape is different as well. In biometrics and morphology the investigated specimens stand close to *H. orientale* Tshernyshev (1899: 31, pl. 2: 23; pl. 3: 2; pl. 4: 6, 7).

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Treskelen (creek IV south).

Genus *Chaunactis* Finks, 1960

Type species: *Chaunactis foliata* Finks, 1960 (Missourian).

This genus is known so far only from North America and Spitsbergen. Sponges are foliate or flabellate; separation of inhalant and exhalant surfaces is a characteristic feature of this genus. Spicules are arranged in radial tracts that extend from basal part. Tracts exhibit lamellar structure. Rhizoclones, irregularly distributed and non parallel, are associated with monaxons. Dermal skeleton is net-like and of rectangular meshes. Prosochetes and apochetes are distinguishable in the skeletal network. Spicules are poorly known due to their poor state of preservation. This genus is represented in the Missourian of Texas (Upper Carboniferous) by *Ch. foliata* Finks. Two other species — *Chaunactis* sp. 1 and *Chaunactis* sp. 2 were described by Finks (1960: 95—96) from the Guadalupian (Upper Permian) of Mexico and Texas, respectively.

In the Brachiopod cherts of Spitsbergen aside from sporadically occurring *Ch. foliata* (2 specimens) two other species have been recognized: *Ch. kaera* sp. n. and *Ch. malkowskii* sp. n.

The species classified in the genus *Chaunactis* are not only foliate or flabellate ones but also cylindrical, cup-shaped and funnel-shaped ones.

Chaunactis foliata Finks, 1960

(pl. 38: 1—2; fig. 15)

1960. *Chaunactis foliata* Finks: 94, pl. 28: 9, 10 and pl. 29: 1—7.

Diagnosis. — Finks 1960: 94.

Material. — Two fragments Nos. AI-69/4 and 5, silicified, lightgray, two sections — transverse and longitudinal.

Dimensions in mm:

	height	width	max. thickness of wall
larger fragment AI-69/4 = 0.5 of the sponge diameter	90	75	10—18
Holotype after Finks	25—30	60	6—10

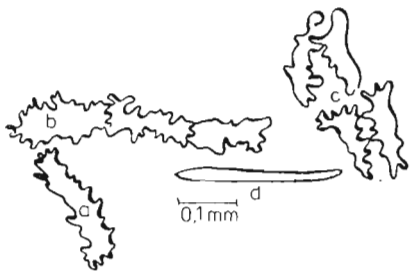

Fig. 15. *Chaunactis foliata* Finks. Drawing of spicules from thin section. Specimen AI-69/5, longitudinal section: *a* outline of rhizoclones from transverse tract, *b* rhizoclones arranged in longitudinal tract, *c* corroded rhizoclones facing each other, *d* oxeas.

Remarks. — Fibroidal structure of skeleton, tract distribution, mode of their connections and sizes as well as general shape, correspond to *Ch. foliata* but the dimensions of sponge are thrice larger. Fragmentary rhizoclones are preserved in places as seen in thin sections (transverse and longitudinal). Probably they are short, massive 0.05—0.75 mm thick, branching and more or less spiny. They are not associated with oxeas. The latter are rare. Cortical skeleton not visible.

Ch. foliata from Spitsbergen shows general shape and dimensions of the radial tracts more similar to *Chaunactis* sp. 2 (Finks 1960), but differs from the latter in: a) shape which in *Chaunactis* sp. 2 is blade-like, b) more delicate dermal layer with small pores, c) single osculum, d) shape of openings of exhalant canals which in our species are round or oval in shape and not polygonal.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Treskelen (creek IV south). USSR: Lower Permian.

Chaunactis kaera sp. n.

(pl. 38: 3, 4, 5, pl. 39: 1—4; fig. 16)

Type specimen: ZPAL Pf. IV/5; pl. 38: 5.

Paratype: AI-67/7; pl. 38: 3.

Type horizon: Brachiopod cherts, Kapp Starostin Fm., Permian.

Type locality: Spitsbergen, Hornsund, Hyrnefjellet.

Derivation of the name: Greek *kaer* — important.

Material. — 14 specimens (8 complete): ZPAL Pf. IV/5, 4 and AI-69/1, 2, 3, 6, 7 to 14.

Dimensions in mm:	height	maximum diameters	spongocoel diameters	thickness of wall total	margin.
holotype Pf. IV/5	ca 110	48×26	38×12	8—10	5
paratype AI-69/7	93	45×23		6—11	2

Diagnosis. — Cylindrical, cup-shaped. Prosochetes and apochetes vertically located. Paragaster deep. Rhizoclones and monaxons numerous, arranged in tracts perpendicular one to another forming a subcortical network. Cortex dependent and independent.

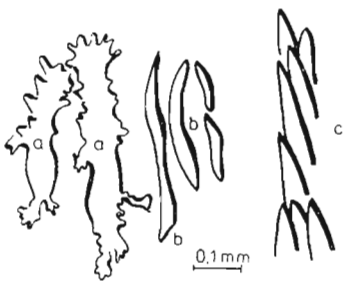

Fig. 16. *Chaunactis kaera* sp. n. Drawing of spicules from thin section. Specimen ZPAL Pf. IV/5: *a* rhizoclones, *b* oxeas and amphioxeas, *c* tract pattern of monaxons.

Description. — Cylindrical, cup-shaped sponges, laterally flattened. Basal part conical without pedicle. Walls of almost equal thickness, thinner around osculum. Apex oval. Outer surface delicately squared. Paragastral cavity deep, variable in size. Prosochetes and apocletes tubular. Canal system gives rise to a three-zoned structure of the wall — inhalant, exhalant and intermediate. Prosopores subcortical, round ca 0.09 mm wide, arranged inbetween skeletal tracts, not visible on cortex Apopores oval, ca 0.6 mm wide, superposed on surface of paragaster.

Skeleton consists of numerous rhizoclones and monaxons. Rhizoclones massive, usually straight. Epirhabd thick with short spiny processes, which are more numerous at the terminations of the rhizoclone. Rhizoclones 0.15—0,4 mm long, and in holotype up to 1.3 mm. Monaxons are oxeas, and amphioxeas which are smooth or slightly annular, of variable length up to 1.5 mm and 0.05 mm thick in specimen AI-69/6, usually 0.4—0.7 mm, several of them concentrated into oblique bundles. Tylostyles not numerous.

Parenchymal skeleton strongly developed, fibroidal. Tracts straight, massive, protruding on the sponge surface as ribs. Crests of those ribs are "indented" due to the oblique arrangement of the spicules. Tracts consist of transversely arranged rhizoclones and numerous, long monaxons, bundles of which intertwine with the rhizoclone zygomes. Isolated rhizoclones are transverse or forming short transverse tracts which make up the walls of the canals. Cortex of two layers: independent cortex, delicate, fragmentarily preserved, contains tylostyles, microstyles, microxeas, entangled in fibres, protruding ca 0.6 mm. Their presence and distribution suggest a bristling surface of the sponge when alive. Dependent cortex structurally similar to parenchymal skeleton; differs in smaller thickness and spacing of spicule fibres.

Variability. Ch. kaera sp. n. shows limited variability both in size and shape as well as some differences in wall thickness. Pores on surface are of two kinds. In the dependent cortex the prosopores are in places small, in the lower part of sponge 0.03—0.08 mm in diameter, in the upper — 0.1—0.4 mm and in the parenchymal skeleton 0.7—0.8 mm. Apopores are ca 1.2 mm. In the skeleton the longitudinal tracts run almost parallel to the base of the sponge. During growth the tracts become thicker and thicker. Thickness and spacing of the tracts are similar in all the stu-

died specimens of this species. Thickness and spacing of tracts are diagnostic of species in the genus *Chaunactis* Finks (1960: 93).

Remarks. — The peculiar aspect of the surface, and the composition and pattern of the spicules are characteristic of *Chaunactis* Finks. The cylindrical shape, the presence of deep paragaster, the smaller tracts, the numerous rhizoclones and the bristled surface, make the specimens studied different from *Ch. foliata* from the Missourian of Texas (Finks 1960) which possesses a net-like cortex, of one layer, built of tracts consisting of monaxons.

The specimens studied differ from *Chaunactis* sp. 1 and sp. 2 (Finks 1960) by their cylindrical shape, presence of rather deep single depression at top, single osculum and more numerous spicules.

Occurrence. — Vestspitsbergen: Permian, Kapp Starostin Fm. at Hyrnefiellet and Treskelen (creek II—III, IV).

Chaunactis malkowskii sp. n.

(pl. 33: 3; pl. 40: 1—4)

Type specimen: ZPAL. Pf. IV/11; pl. 33: 3.

Type horizon: Brachiopod cherts, Kapp Starostin Fm., Permian.

Type locality: Spitsbergen, Hornsund. Treskelen.

Derivation of the name: dedicated to K. Małkowski M.Sc., who found the specimen of this species in 1974.

Diagnosis. — Bowl-shaped, thick-walled, canals vertical. Skeleton tract-like. Rhizoclones, oxeas, tylostyles and cricotylostyles present.

Material. — One specimen ZPAL Pf. IV/11, 2.7 mm in diameter, wall thickness 10 mm.

Description. — Bowl-shaped, resembling a bent plate without attachment. Walls of equal thickness. Margin smooth, thick, rounded. Outer surface finely porous with mesh-like skeleton. Mesh-like depressions hardly noticeable. Wall structure in vertical section similar to that of *Ch. kaera*. Outer zone 3.2 mm thick; internal zone 1—2 mm thick makes a more or less distinct rim on the lateral wall. Third zone of wall both in structure and thickness similar to the first one.

Canals 1.0 mm in diameter are vertical. 8—9 prosopyles were counted in prosochetes. Prosopores sometimes visible as rounded single pores 0.3—0.5 mm in diameter, gathered in a small depression. Apochetes' rounded in proximal part, shorter than prosochetes, terminated by an apopore 1.2 mm wide.

Skeleton parenchymal and cortical. Parenchymal network regular, of square meshes containing rhizoclones, oxeas, amphioxeas, tylostyles, cricotylostyles, sporadic strongyles, and microxeas. Rhizoclones strongly altered by diagenesis. They were probably straight, or arcuate, with short zygomes. Oxeas and amphioxeas loosely scattered or arranged in tracts, smooth, very numerous, sharply terminated, of unequal length (0.1—1.0 mm) and 0.05—0.3 mm thick. Tylostyles smooth or finely spiny, axial canal straight, filiform or catenulate?. Cricostyles more numerous in independent cortex. Their distal part is broadened, rounded and very finely granulated, proximal part — sharply terminated. At 2000× magnification one may observe that they are ring-shaped, narrowed, and point the head vertically outward. They are elements of the subdermal skeleton.

Remarks. — The fibro-lamellar pattern of rhizoclones and the outer structure of the wall suggest classification of this species in the genus *Chaunactis* Finks. Bowl-shape, wall thickness and numerous spicules of monaxon type such as tylostyles and cricotylostyles make it different from the other species known so far.

Tracts crossing at 90° are delusively similar to triaxons. In fact these are monaxons in tracts. At 4000× magnification small spheres are observable that may be microplankton or pellets of matrix.

Occurrence. — Type locality and type horizon.

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HELENA HURCEWICZ

PERMSKIE GĄBKI Z CZERTÓW BRACHIOPODOWYCH Z HORNSUNDU, SPITSBERGEN

Streszczenie

Przedmiotem badań jest kolekcja gąbek z czertów brachiopodowych górnego permu zebranych przez uczestników polskich wypraw geologiczno-paleontologicznych na Spitsbergen (1960, 1974, 1975). Czerty brachiopodowe zawierają bogatą faunę, m.in. gąbki o szkielecie krzemionkowym. Ich obecność stwierdzono w SE Hyrnefjellet oraz w SE Treskelen w pobliżu brzegów Adriabukta w Hornsundzie.

Łącznie opisano 14 gatunków. Oprócz opisanych przez Siedlecką (1970), jak: *Haplistion arcticum* (Dunikowski), *H. elongatum elongatum* Siedlecka, *H. macroporum* (Dunikowski), stwierdzono tu następujące gatunki: *H. aeluroglossa* Finks, *H.* aff. *orientale* Czernyszew, *H. artiense* Czernyszew, *H.* aff. *skinneri* (King), *H.* cf. *elongatum* Siedlecka, *H. elongatum acremonicum* subsp. n., *H. hadrum* sp. n., *Chaunactis foliata* Finks, *Ch. kaera* sp. n., *Ch. malkowskii* sp. n., oraz gatunek nowego rodzaju z rzędu Epipolasida — *Spitsbergenia patella* gen. et sp. n.

Budowę gąbek badano w cienkich szlifach w przekroju podłużnym i poprzecznym. Szkielet kortykalny, oprócz badań w mikroskopie optycznym, badano wycinkowo w mikroskopie skanningowym. Spikule przeważnie uległy przeobrażeniu: skalcytowaniu bądź ferytyzacji. Ich morfologia nie została zmieniona. Aktiny rizoklonów są mniej lub bardziej wyraźne. Monaksony miejscami licznie zachowane, leżą w układzie pierwotnym. W niektórych z nich widoczny jest kanał osiowy. U *Haplistion arcticum* i *H. artiense* pasma odpowiadające kanałom ekshalacyjnym są zbudowane z rizoklonów, zaś u innych gatunków tego rodzaju z rizoklonów i monaksonów.

Większość opisanych gatunków jest znana z permu z półkuli północnej, część sięga górnego karbonu.

EXPLANATION OF THE PLATES 30—40

All specimens are from the Kapp Starostin Fm., Permian, of Spitsbergen

Plate 30

Haplistion arcticum (Dunikowski, 1884)

1. Specimen ZPAL Pf. IV/3: *a* upper view, papillae well preserved, nat, size; *b* papilla in section, prosopores well marked, ×4; *c* papillae in section, ×4.
2. Specimen ZPAL Pf. IV/9, reptant sponge in upper view, destroyed papillae are visible, nat. size.
3. Specimen ZPAL Pf. IV/2: *a*×0.8, *b* radial-concentric pattern of fibres seen in section, ×3.
4. Specimen ZPAL Pf. IV/1, conical sponge of uneven surface, nat. size.

Plate 31

Haplistion arcticum (Dunikowski, 1884)

All SEM micrographs

1. Preparation no. 1b: sigma and monaxon tract, ×2000.
2. Preparation no. 1a: delicate, spiny spicula (style?), ×1500; s ornamentation.
3. Preparation no. 1: prosopores in cortex, ×1000.
4. Preparation no. 2: tract pattern of monaxons in cortex and plates of inorganic origin, ×2000.
5. The same preparation: tracts composed of spiny monaxons and rhizoclones. ×2000.

Plate 32

Haplistion hadrum sp. n.

1. Specimen ZPAL Pf. IV/8, holotype: *a* irregular sponge with abraded papillae visible, ×0.8; *b* thin section showing arcuate, transvere tracts and radial tracts with rhizoclones and transverse fibers, ×4.

Haplistion macroporum (Dunikowski, 1884)

2. Specimen AI-69/56: lense-like specimen seen from the top side, destroyed openings of papillae are visible, nat. size.
3. Specimen ZPAL Pf. IV/6; irregular, laterally concave sponge: destroyed papillae visible, nat. size.
4. Specimen AI-69/38 in thin section, ×1.5.
5. Specimen AI-69/23: *a* digital sponge seen from top side, ×0.7; *b* slightly oblique section, ×1.4.

Plate 33

Haplistion macroporum (Dunikowski, 1884)

1. Specimen AI-69/40, surface of natural split, visible, ×0.8.
2. Specimen ZPAL Pf. IV/6, SEM micrographs: *a* rhizoclones, strongyle (*s*) and microoxeas (*m*), ×2000; *b* style with mould of an axial canal (?), ×1500, *c* tracts of oxeas and microoxeas (*m*), ×1500.

Chaunactis malkowskii sp. n.

3. Specimen ZPAL Pf. IV/11, holotype: longitudinal thin section shifted at 90° from natural position, ×4.

Plate 34

Haplistion elongatum elongatum Siedlecka, 1970

1. Branching spoinge, specimen ZPAL Pf. IV/10: *a* apical depression visible, ×0.9; *b* longitudinal thin section, ×4.
2. Branching sponge, specimen ZPAL Pf. IV/12: *a* side view, ×85; *b* transverse section with two zones well differentiated — axial (*ax*) and marginal (*ma*) ones, ×4.
3. Specimen AI-69/68; nat size.
4. Specimen AI-69/22, side view. Specimen cudgel-shaped, irregularly bent, ×0.75, with destroyed papille visible.

Plate 35

Haplistion elongatum elongatum Siedlecka, 1970

1. Specimen ZPAL Pf. IV/7: *a* side view, nat. size; *b* thin longitudinal section showing asymmetry of skeleton, ×3; *c* the same, *a* fragment with irregularly branching longitudinal tracts, prosopyles (*p*) and monaxons (*m*) visible, ×10; *d* transverse section through the convex side of the specimen, ×3.

Plate 36

Haplistion cf. *elongatum* Siedlecka, 1970

1. Specimen AI-69/63, *a* reptant form, side view, nat. size; *b* upper side, nat. size; *c* transverse section, ×2.

Haplistion elongatum acremonicum subsp. n.

2. Specimen AI-69/25: *a* side view of a sponge with several offsets visible, nat. size; *b* polished surface of a sponge in transverse section with three centres of growth (*I—III*) and two offsets (*IV*, *V*); *c* transverse section of a sponge with an offset (upper left), ×2.

Haplistion aff. *orientale* Tshernyshev 1899

3. *a* Specimen AI-/72, reptant form in top view, ×0.5; *b* longitudinal section, ×2; *c* transverse section, ×2.
4. Specimen AI-69/70 of irregular shape, destroyed papillae are visible, nat. size.

Plate 37

Haplistion skinneri Finks, 1960

1. Specimen AI-69/59, nat. size.
2. Specimen AI-69/15: *a* top view, delicate papillae visible, nat. size; *b* longitudinal section showing asymmetry of skeleton, ×2.
3. Specimen AI-69/42, destroyed papillae are visible, nat. size.

Haplistion artiense (Tshernyshev, 1899)

4. Specimen AI-69/37: *a* external view, nat. size; *b* transverse section, ×2.

Haplistion skinneri Finks, 1960

5. Specimen AI-69/55: *a* lense-like sponge, nat. size; *b* longitudinal section, ×2.
6. Specimen AI-69/31, transverse section, ×2 (see also pl. 38: 6*a*).

Plate 38

Chaunactis foliosa Finks, 1960

1. Specimen AI-69/4, seen from exhalant side, ×0.7.
2. Specimen AI-69/5, transverse section, ×3.

Chaunactis kaera sp. n.

3. Specimen AI-69/7, paratype, ×0.5.
4. Specimen ZPAL Pf. IV/4, side view, tracts of destroyed skeleton visible, nat. size.
5. Specimen ZPAL Pf. IV/5, holotype: *a* external view, ×0.7; *b* a fragment, ×2.

Spitsbergenia patella gen. et sp. n.

5. Specimen AI-69/31; *a* natural association of *S. patella* (S) overgrown by *Haplistion skinneri* (H), ×0.7; *b* transverse section, ×2 (see also pl. 37: 6).
7. Specimen AI-69/66, holotype, transverse section, ×3.

Plate 39

Chaunactis kaera sp. n.

All SEM micrographs

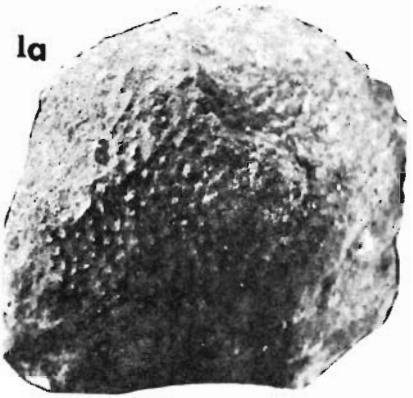
1. Preparation no. 4a: tracts of cortical skeleton, spicules diagenetically destroyed, ×1200.
2. Same preparation, tracts of dependent cortex skeleton with tylostyle (*t*), microoxeas (*m*) and amphioxeas (*a*), ×1000.
3. Preparation no. 5a: tracts of oxeas (o), ×2000.
4. Preparation no. 5: terminations of amphioxeas visible, ×600.

Plate 40

Chaunactis malkowskii sp. n.

All SEM micrographs, preparation no. 11a

1. Skeletal tracts of spicules diagenetically destroyed, ×1000.
2. Tracts composed of rhizoclones less destroyed, ×600.
3. Crest of tracts, ×600.
4. Cricotylostyle, spiny distal termination, ×2000.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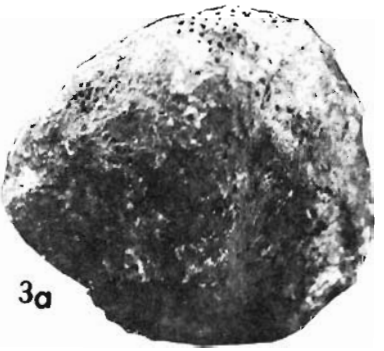
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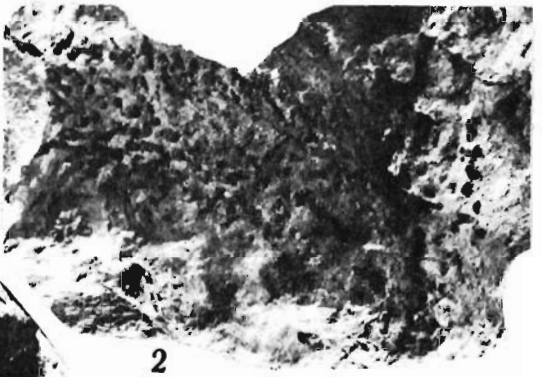
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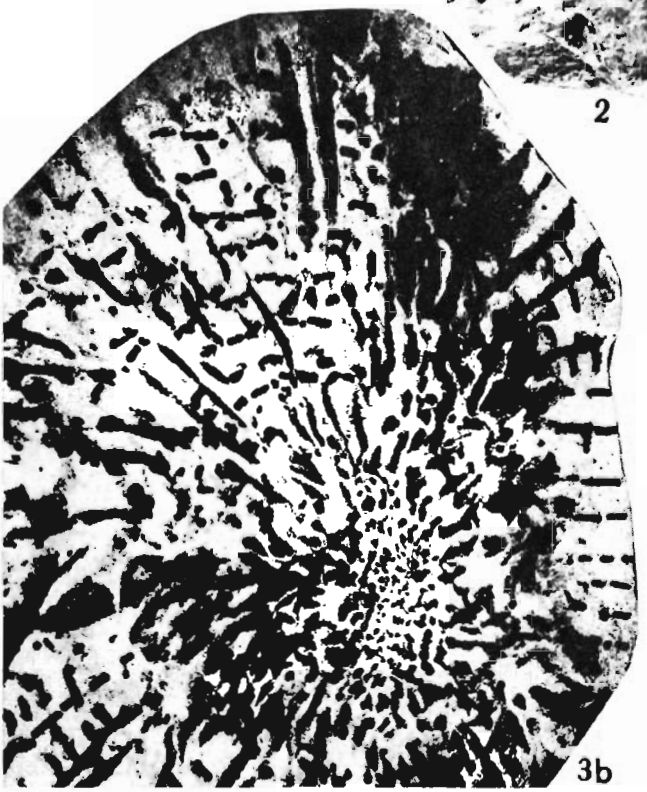
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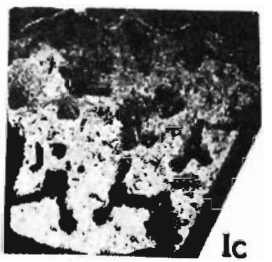
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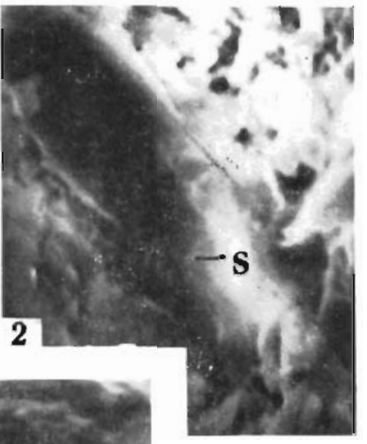

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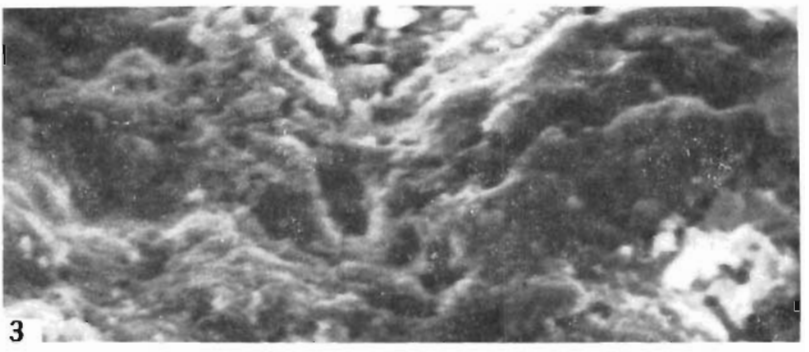

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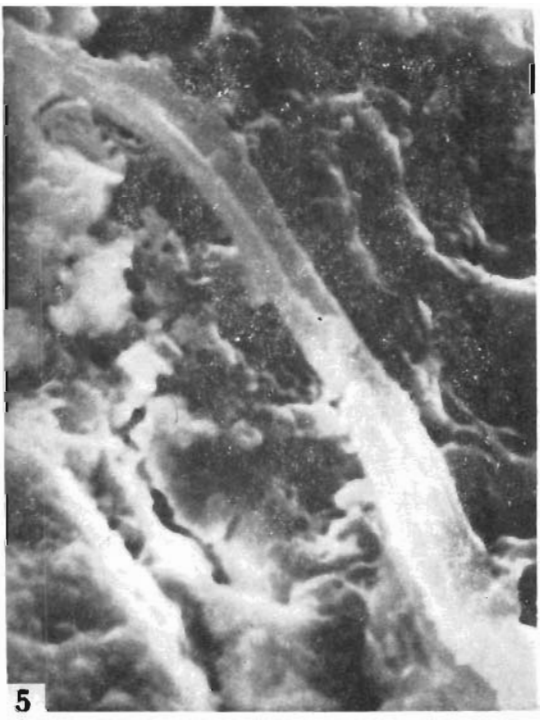

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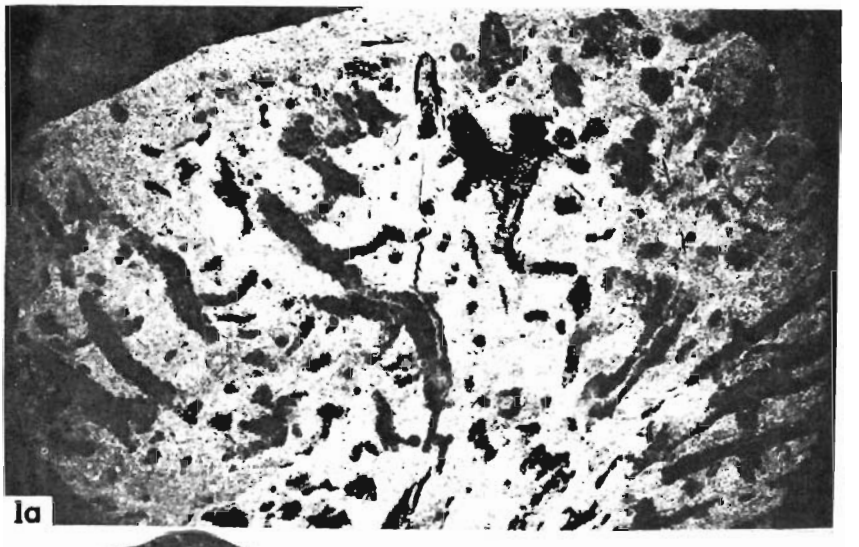
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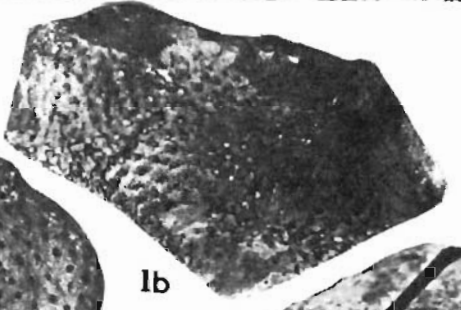
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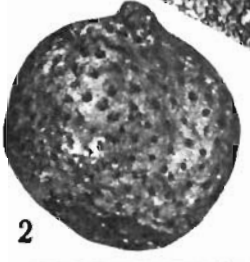
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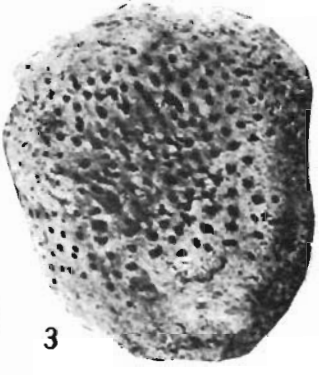
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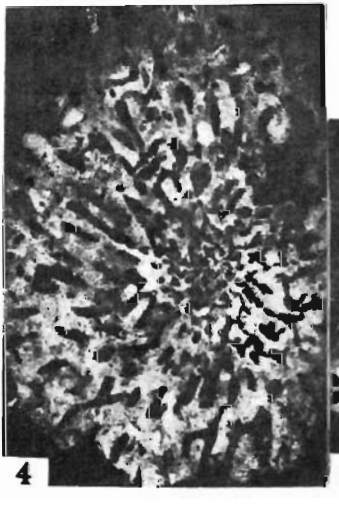
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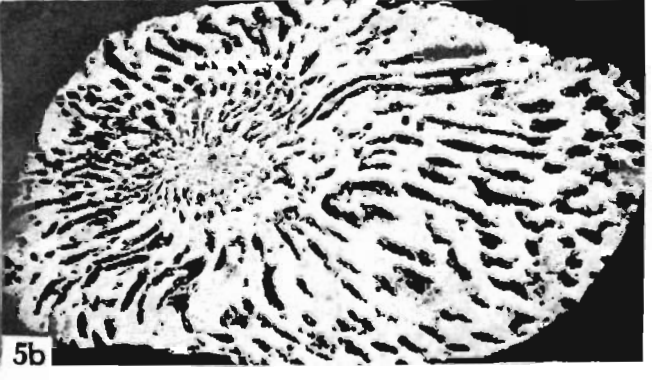
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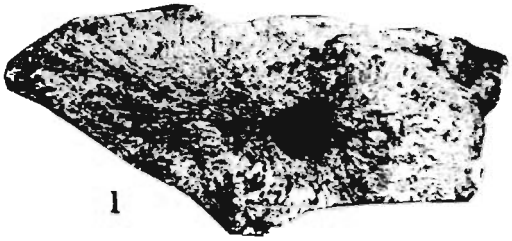
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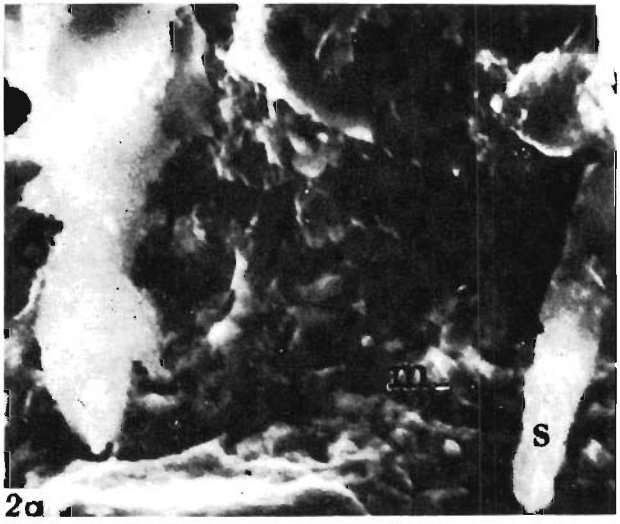

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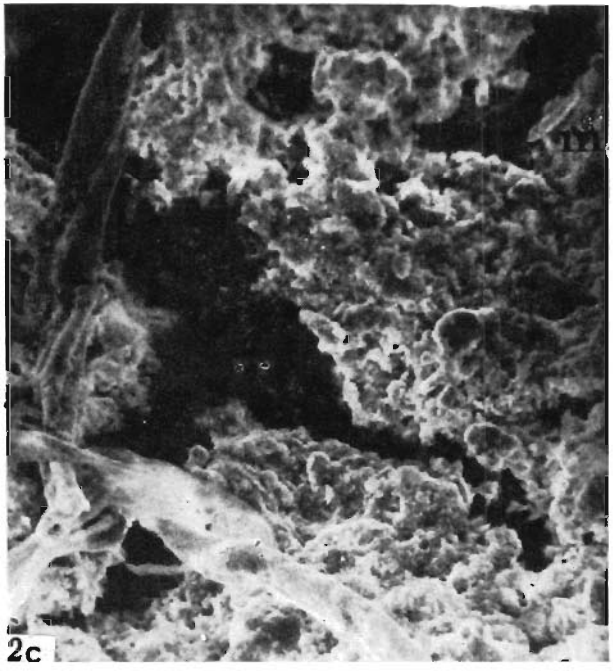
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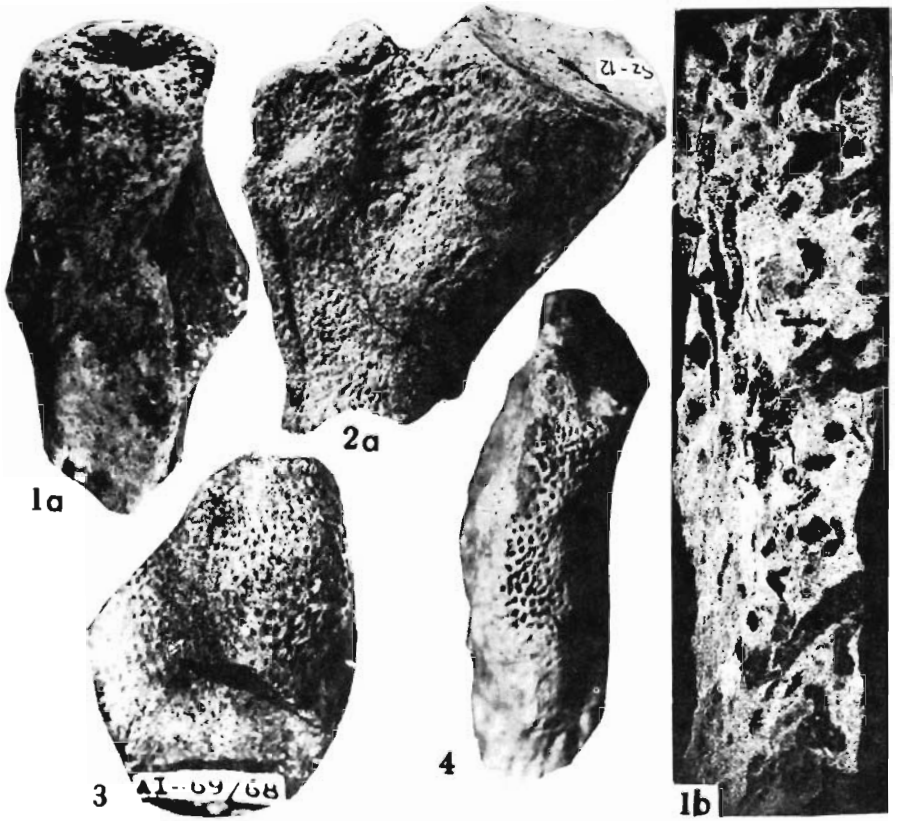
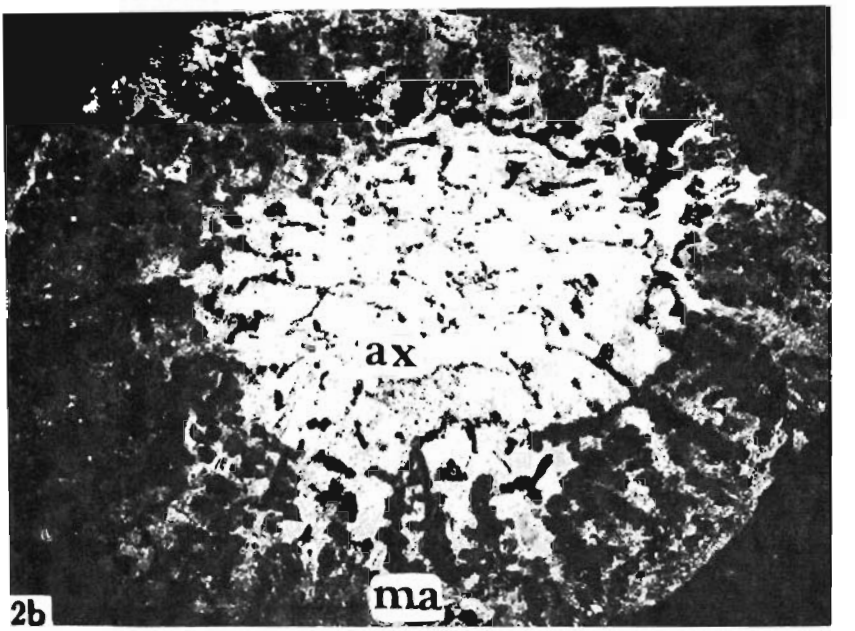
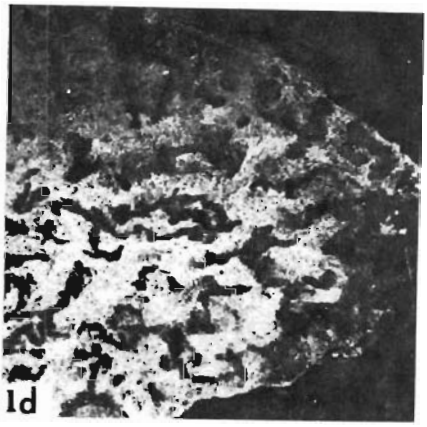

1a
2a
3
4
1b


ax
ma
2b

1a



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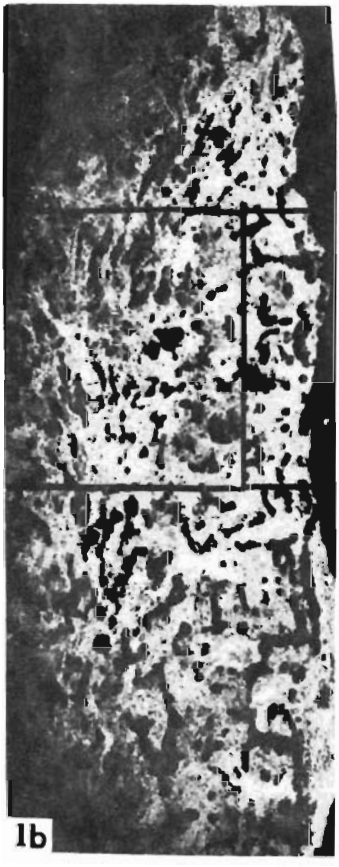

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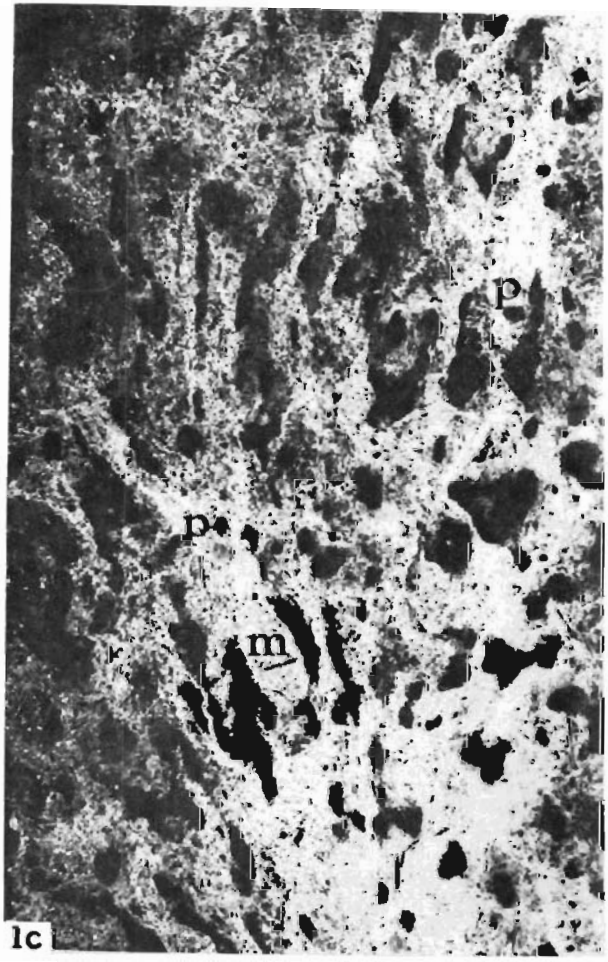

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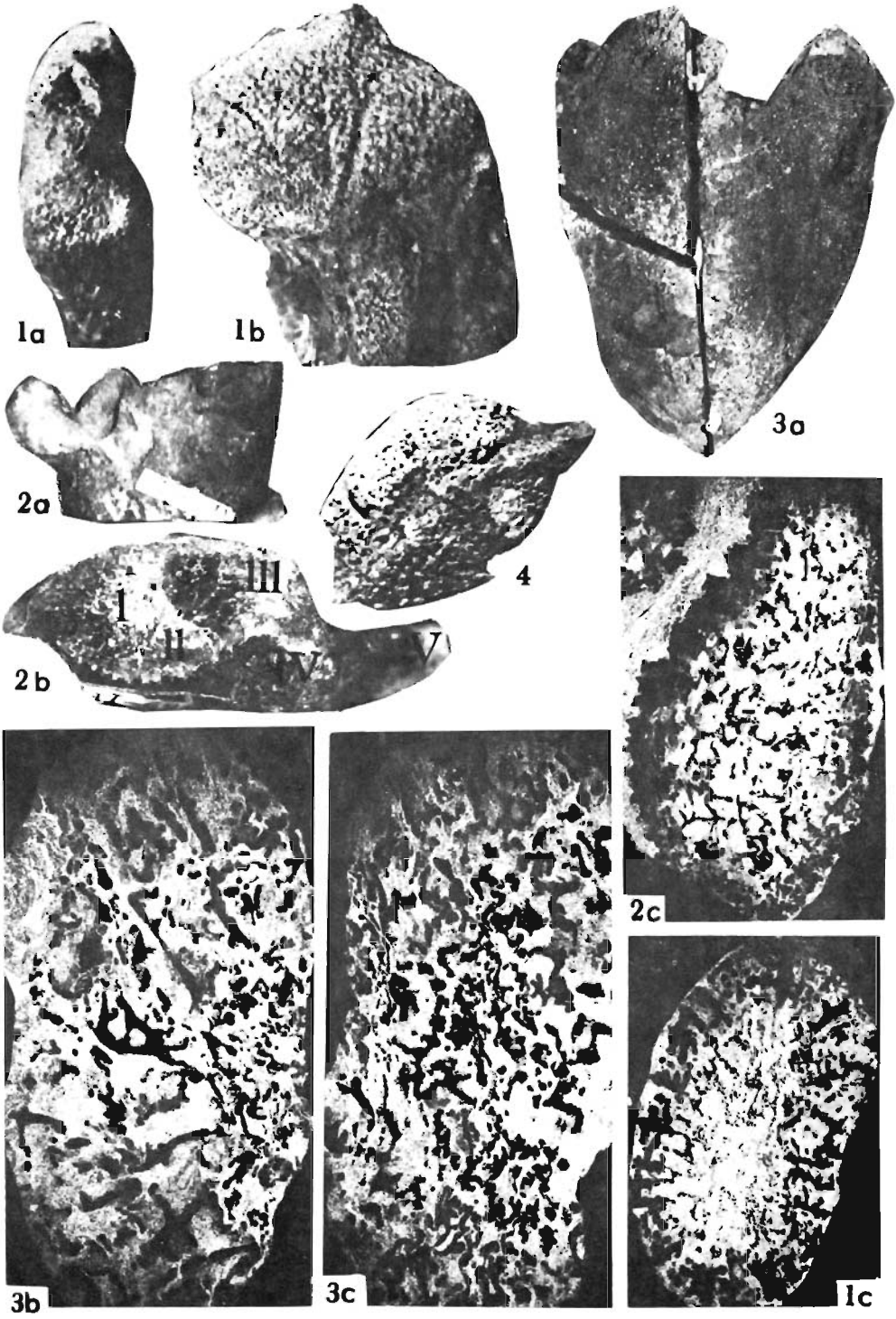
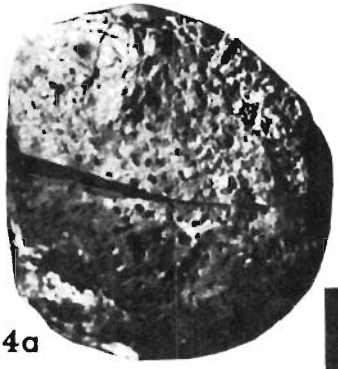

1a
1b
3a
2a
4
III
I
II
V
V
2b
2c
3b
3c
1c


1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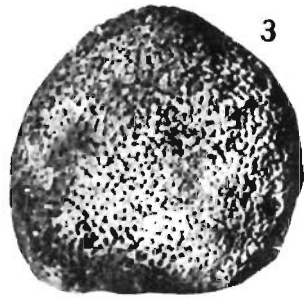
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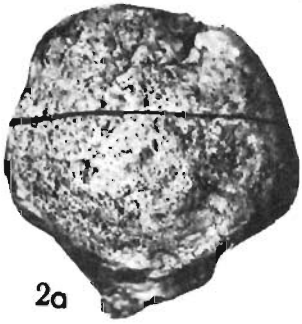
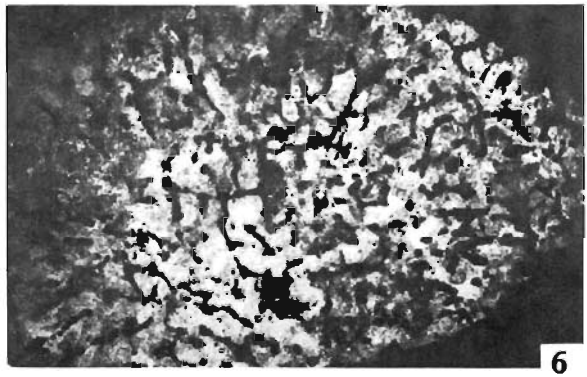

2a


5a


4b


2b


5b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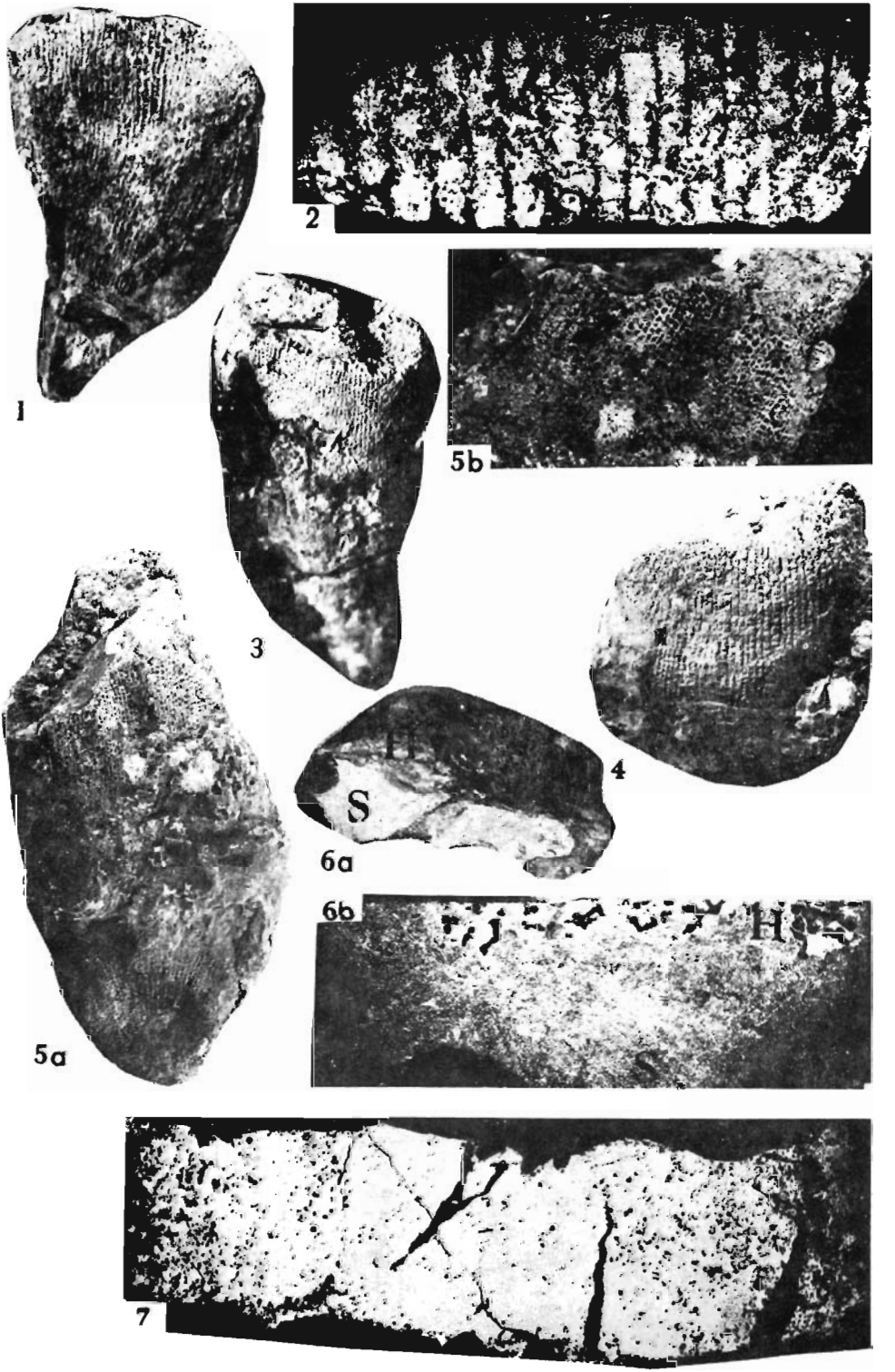
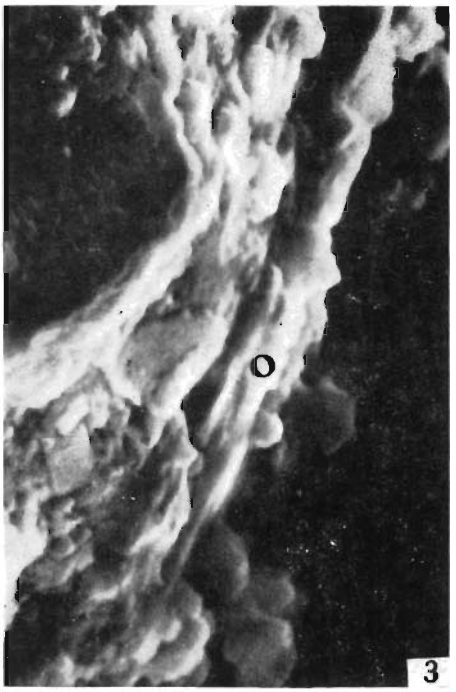

1
2
3
4
5a
5b
6a
S
6b
7


1



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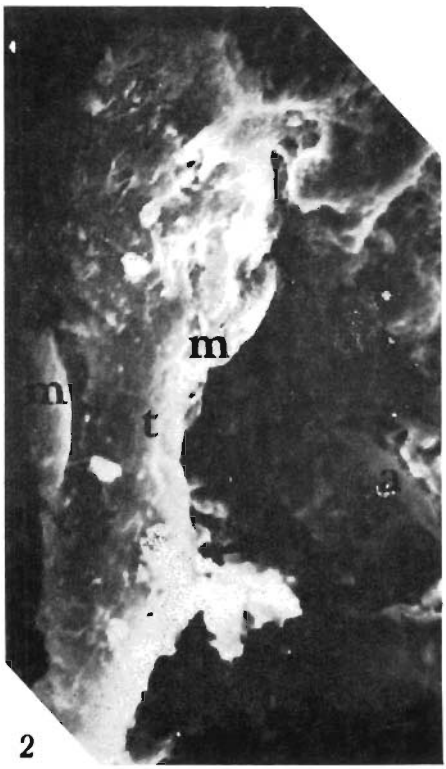

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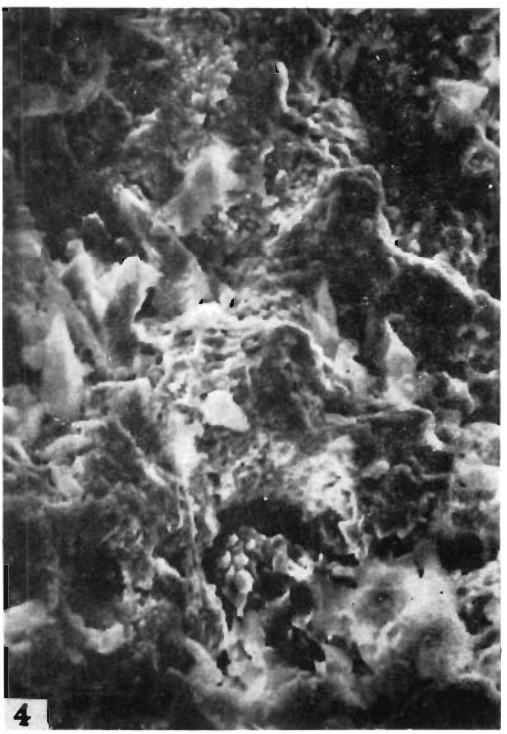
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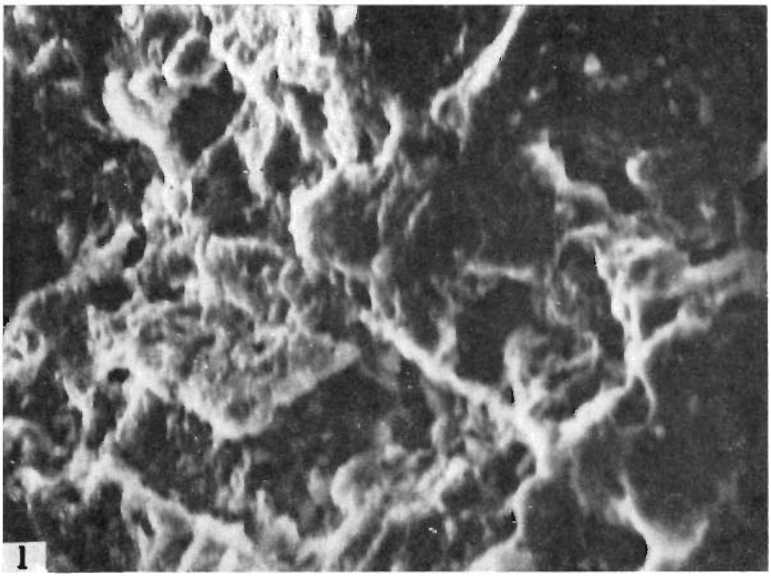
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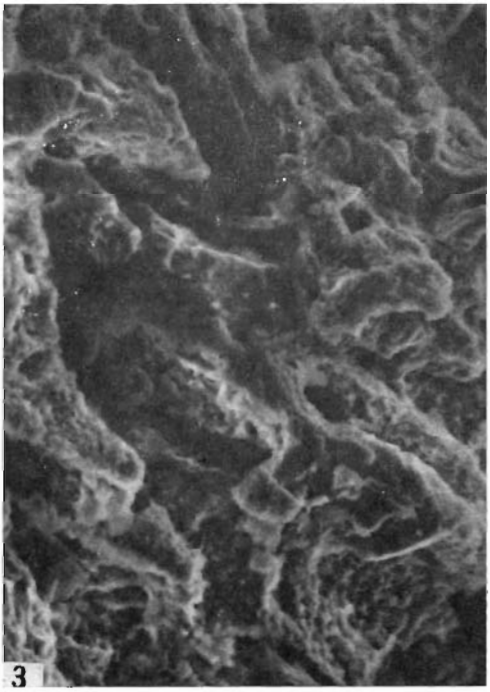
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