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J. KEITH RIGBY, GRZEGORZ RACKI & TOMASZ WRZOŁEK

Occurrence of dyctyid hexactinellid sponges in the Upper Devonian of the Holy Cross Mts

ABSTRACT: Hexactinellid sponges with rigid, laterally fused, dictyonine skeletons are reported from the Frasnian rocks of the Holy Cross Mts, Central Poland. This occurrence, with nearly contemporary undescribed forms from Belgium and Western Australia, extend the range of the Hexactinosora back from the Triassic, the previously earliest described sponges of the order.

INTRODUCTION

Hexactinellid sponges are relatively rare outside of North America where Hall & Clarke (1898) described the famous Devonian dictyosponges of northeastern United States. Recent collections from the Late Devonian Frasnian rocks of the Holy Mts in Central Poland (cf. Text-figs 1—2) include several specimens of hexactinellids of unusual significance. These fossils and other associated sponges are the subject of an extended paper now in preparation.

Devonian sponges of the Holy Cross Mts have been discovered at the beginning of this century. Gürich (1901, p. 356) reported a single specimen assigned as *Protospongia* from the Famennian of the Kielce region. Sobolev (1909, 1910, 1911, 1912) found numerous sponges in a small outcrop south of Kowala (Gałęzice syncline, Text-fig. 1). Due to the mass occurrence of sponges, Sobolev (1911, 1912) called the deposits the sponge facies, being a local variety of the biohermal facies of the Kadzielnia Limestone (lower part of the Upper Devonian). Sobolev did not investigate his collection paleontologically, but he only reported it as being strongly differentiated, composed of the Hexactinellida (sub-order Dictyonina), and similar to the assemblage described by Hall & Clarke (1898) from the Devonian of New York. There was given a list of associated fossils, mainly brachiopods and corals, and the illustration of a sponge-bearing limestone (Sobolev 1910, 1911).

Besides a few general remarks, sometimes illustrated, on the sponges of Kowala (Dembińska-Rózkowska 1948, Samszonowicz 1952, Kotański 1959, Filonowicz 1973), paleontological determinations have been offered by Siemiradzki (1922) who mentions "the peculiar limestone, containing sili-cified accumulations of sponges", belonging to such genera known from the Jurassic commonly and Cretaceous up until now as *Craticularia*, *Sporadopyle*, and *Tremadictyon*. On the other hand, Mayr (1929) gave a preliminary report of the paleontological research on sponges from Czarnocki's collection, and he emphasized also an unique character of the assemblage that contained both "Silurian" (*Pyritonema* — 3 new species, *Aulocopium* — 2 new species, *Rhopalospongia*, *Astylomanon*, *Caryomanon*) and "Mesozoic" types of sponges (*Craticularia*, *Sporadopyle*, *Tremadictyon*, *Cylindrophyma*, oldest representatives of *Ventriculitidae* — *Paraventriculites* — with strongly folded wall).

The collection of above 100 specimens, described preliminarily in the present note, comes mostly from the new outcrop of the Jaźwica Quarry in the southern limb of the Gałęzice syndline, about 3 km to the west from the Kowala sponge-bearing exposure (Text-fig. 1B). The last mentioned place yielded only few specimens, collected from road cut (ap-

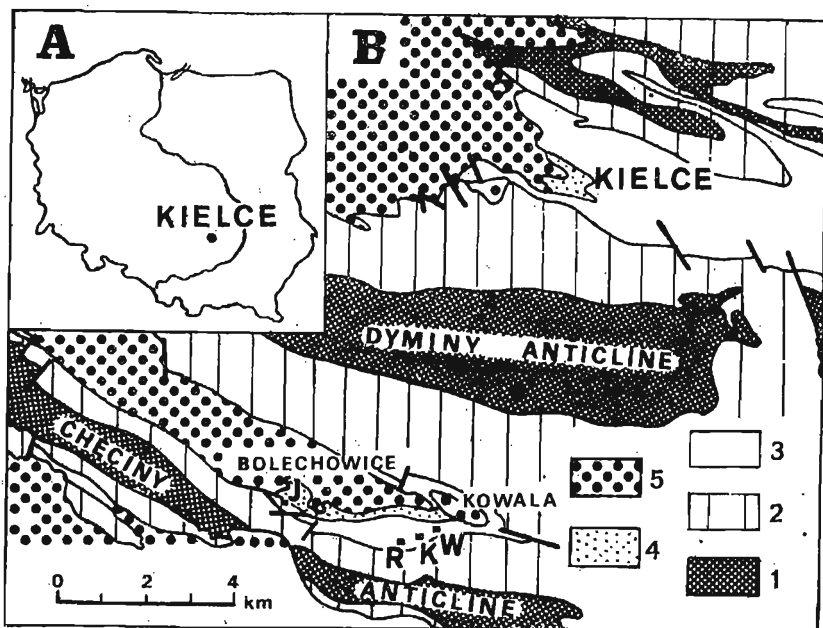
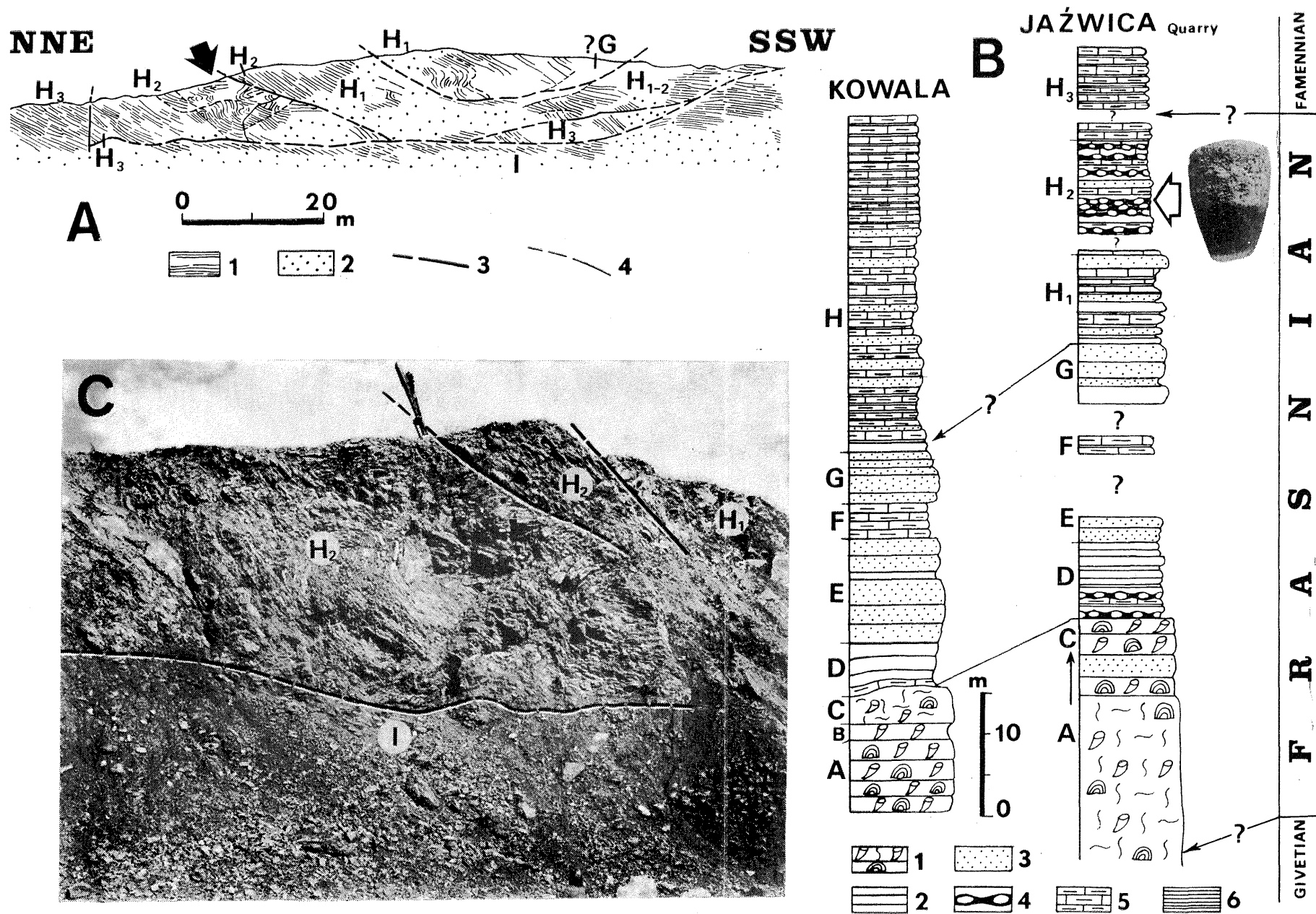


Fig. 1. Location of sponge-bearing exposures in Poland (A), and in the western part of the Holy Cross Mts (B); taken after Szulczewski (1971, Text-fig. 1; simplified)

1 Cambrian, Ordovician and Silurian, 2 Lower and Middle Devonian, 3 Upper Devonian, 4 Lower Carboniferous, 5 Post-Variscan cover (Zechstein — Jurassic)

J — Jaźwica Quarry, R — Kowala road cut, K — Kowala railroad cut, W Wola Quarry

Upper Devonian sponge-bearing deposits exposed at the Jaźwica Quarry



A — Sketch of the eastern wall, upper exploitation level at the Jaźwica Quarry (after Racki & Zapaśnik 1979); arrowed are the sponge-bearing nodular limestones (see Text-fig. 2C)

G-H — Frasnian lithologic complexes (see Text-fig. 2B), I — Upper Famennian shale-marly sequence
1 clearly marked bedding, 2 screens, 3 main faults and overthrusts, 4 subordinate faults and overthrusts

B — Lithostratigraphic sequence of the exposed Frasnian deposits and its correlation with the section along the railroad cut at Kowala (after Szulczewski 1971, simplified); the Upper Frasnian sponge-bearing layers are indicated

A-H — lithologic complexes; 1 stromatoporoid-coral limestones, 2 micritic limestones, 3 detrital limestones, 4 nodular limestones, 5 marly limestones, 6 marly shales

C — Northern part of the eastern wall, upper exploitation level at the Jaźwica Quarry, to show strongly folded sponge-bearing layers H₁₋₂, I — lithologic complexes (see Text-figs 2A-B).

proximately source outcrop for Sobolev's and Czarnocki's collections) and from the Wola Quarry (Text-fig. 1B). The collection has been gathered in the years 1976—1980 chiefly from the NE part of Jaźwica Quarry (see Text-fig. 2) :

The sponges from Jaźwica are derived from the greyish-reddish nodular-marly limestones with a few detrital intercalations, brachiopod coquinas and black cherts, and of the Late Frasnian age (mainly *Palmatolepis gigas* Zone; complex H_2 of Racki & Zapaśnik 1979, complex R of Racki 1981). The sponges occur chiefly in nodules and concretions weathering out from marly beds. They are found in a similar stratigraphic-facies position in the Kowala outcrops, but they are lacking in more marly or detrital Late Frasnian deposits in this part of the Gałęzice syncline (e.g. in the set H of railroad cut Kowala; cf. Szulczewski 1971). Sponges are unknown outside of the Bolechowice-Kowala area of the Gałęzice syncline up until now, even in very similar deposits of the Late Frasnian of the Kielce area (see Sobolev 1912).

The sponges at Jaźwica are important component of the strongly diversified fauna dominated by brachiopods (mainly rhynchonellids *Pamagetotherynchus*; see Sartenaer 1977), rugose (both solitary and colonial) and tabulate corals; associated are *Styliolina*, gastropods, nautiloids, oniatites, bivalves, crinoids, ?*Receptaculites*, as well as fish plates (see Racki 1981 for preliminary faunal list). In residuum numerous conodonts (mainly *Palmatolepis* and *Ancyrodella*) are found.

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OBSERVATIONS ON THE SPONGES

Specimens range from small sponges 1.5 to 2.5 cm across and tall to gigantic forms 8 to 10 cm in diameter and nearly 15 cm tall (Pls 1-2). They range from tiny low conical sponges that are wider than tall to large nearly subcylindrical ones. All have a simple, open, central spongocoel that may be shallow and broad in conical to funnel-shaped sponges or deep and tubular in largest cylindrical specimens. The spongocoel, at the osculum, is generally one half to two thirds the diameter of the sponge.

Walls are thick and pierced by vertically stacked rows of nearly horizontal radial canals (Pl. 3). Details of the canal patterns are yet to be studied in sections, but both large incurrent and excurrent segments are clearly defined in weathered specimens and in the few sections prepared to date.

The principal skeletal net is a fused, rigid dictyid net. Previous to the discovery of these sponges with dictyonal nets in the Devonian of Poland and related forms in Belgium (Dean 1980; but see also Fraipont 1911) and Western Australia (Rigby 1979; see Text-fig. 3), the earliest known undoubted hexactinosids were *Tremadictyon roemeri* (Eckleben) and *Caesaria* Quenstedt. These latter sponges were described from the Triassic Anisian lower Wellenkalk of Upper Silesia (Poland), according to Rauff (in Assmann 1937), as reported by Finks (1967, p. 336). The dictyid grade is characterized by fused, hexactine-based spicules (Text-fig. 4B) and contrasts with the unfused spicules of the lyssacine grade (Text-fig. 4A) or somewhat more complex lychniscid grade (Text-fig. 4C) in which diagonally cross-bracing buttresses produce small octahedral lanternlike structures at spicule centers.

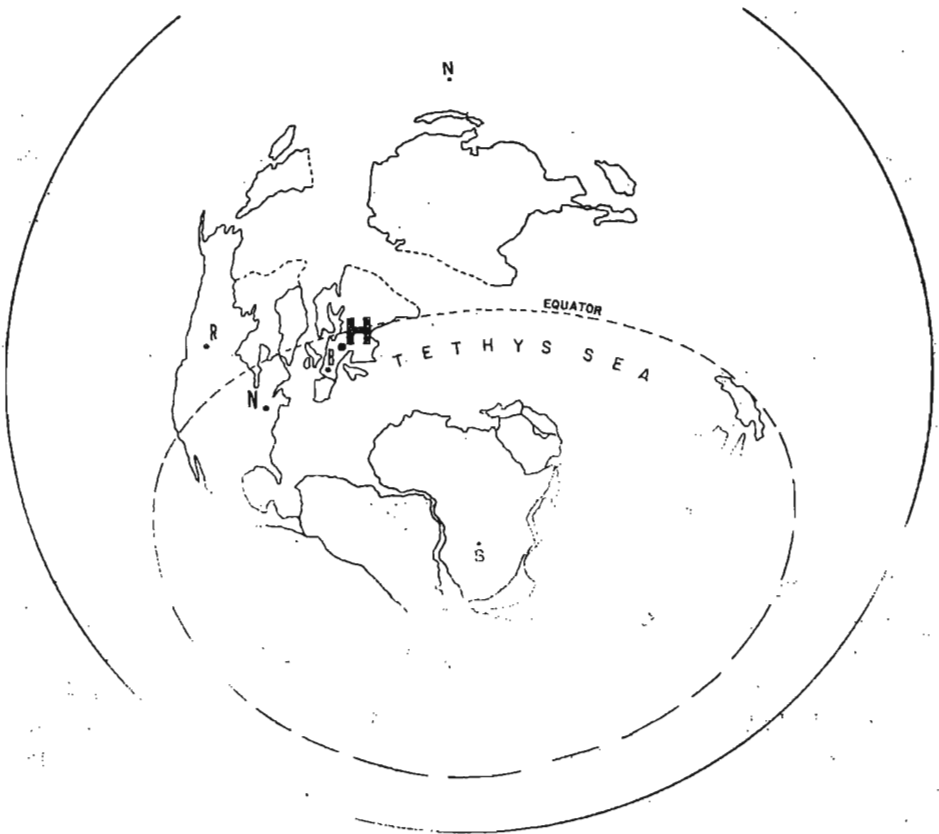


Fig. 3. Model of the position of continents in the Devonian showing distribution of major Late Devonian sponge localities (after Rigby 1979); N North Pole, S South Pole

H — Holy Cross Mts, R — Rocky Mountains of Canada, N — New York area
B — Belgium, C — Canning Basin of Western Australia

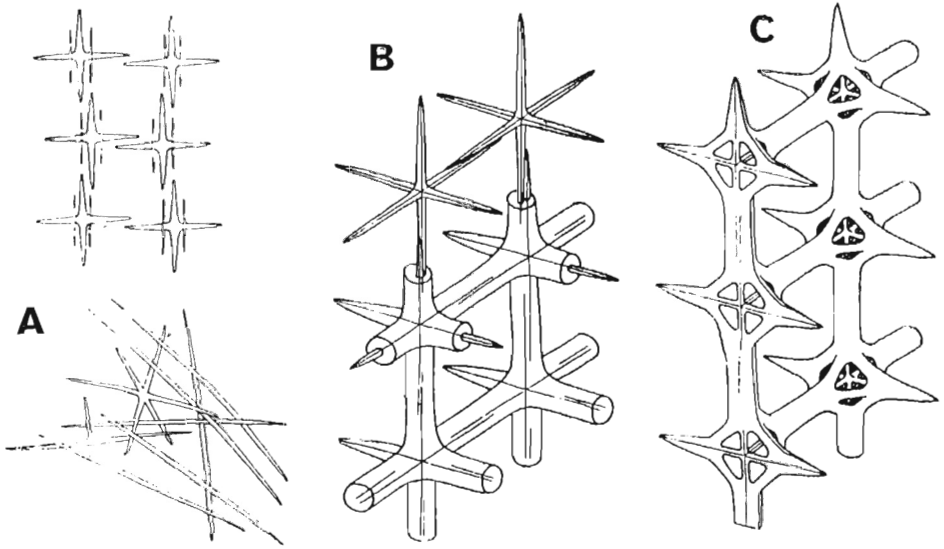


Fig. 4. Drawings of skeleton relationships in lyssacine (A), dictyonine (B), and lychniscid (C) grades of Hexactinellidae (modified from Reid 1958)

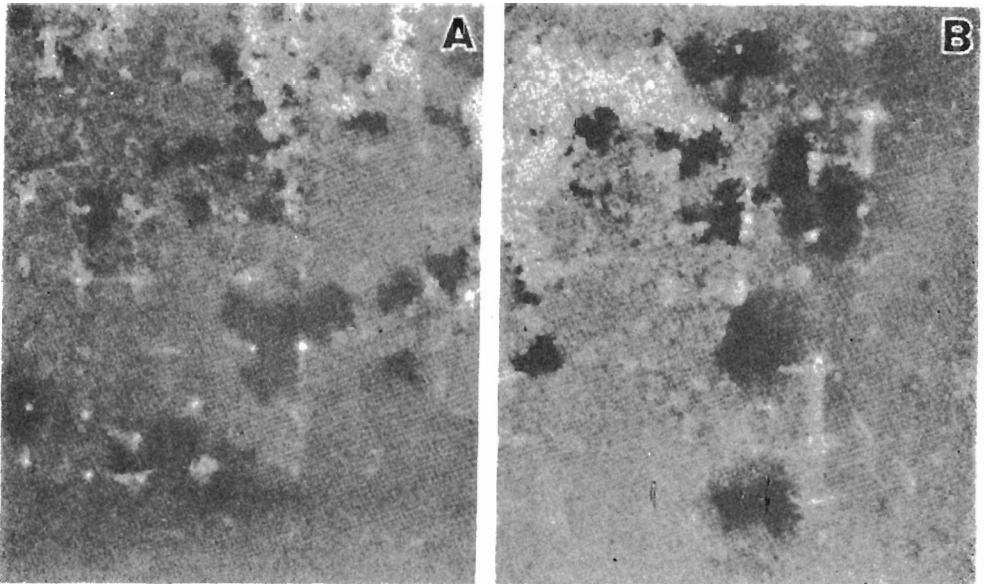


Fig. 5. Photomicrographs showing characteristic skeletal pattern in the investigated dictyoid sponges from the Upper Devonian of the Holy Cross Mts. Light areas are either calcareous or moderately coarse chalcedony replacing the skeleton, as seen in a horizontal section; dark areas are limonite stains in the matrix

A — outer part of the wall, with edge of the sponge toward the bottom; B — outer part of the wall, edge of the sponge to the right; both figures approximately $\times 25$

Nodes or centers of spicules (Text-fig. 5 and Pl. 3) are spaced 0.4 to 0.5 mm apart in a three-dimensional gridwork. Rectangular openings are dominant in the mesh, although triangular and polygonal openings also occur. Rays or beams are subcylindrical and generally 0.04 to 0.06 mm in diameter. Unattached rays are rare, at least rays large enough to be preserved in the moderately coarse chalcedony or calcareous replacement. Axial canals are not preserved in the spicules cut in sections prepared to date but there can be little doubt concerning the hexactine base to the skeleton because of the consistent mesh symmetry (Pl. 4).

The sponges are uncrushed and most have been totally or partially replaced by silica, generally chalcedony. Where silification is coarse there is little preserved of skeletal or canal details. In some specimens, however, the spicules have been preserved as moderately fine-grained calcite. Even in better preserved specimens, details of ray overlap, axial canals, and possibly smaller spicules are lost.

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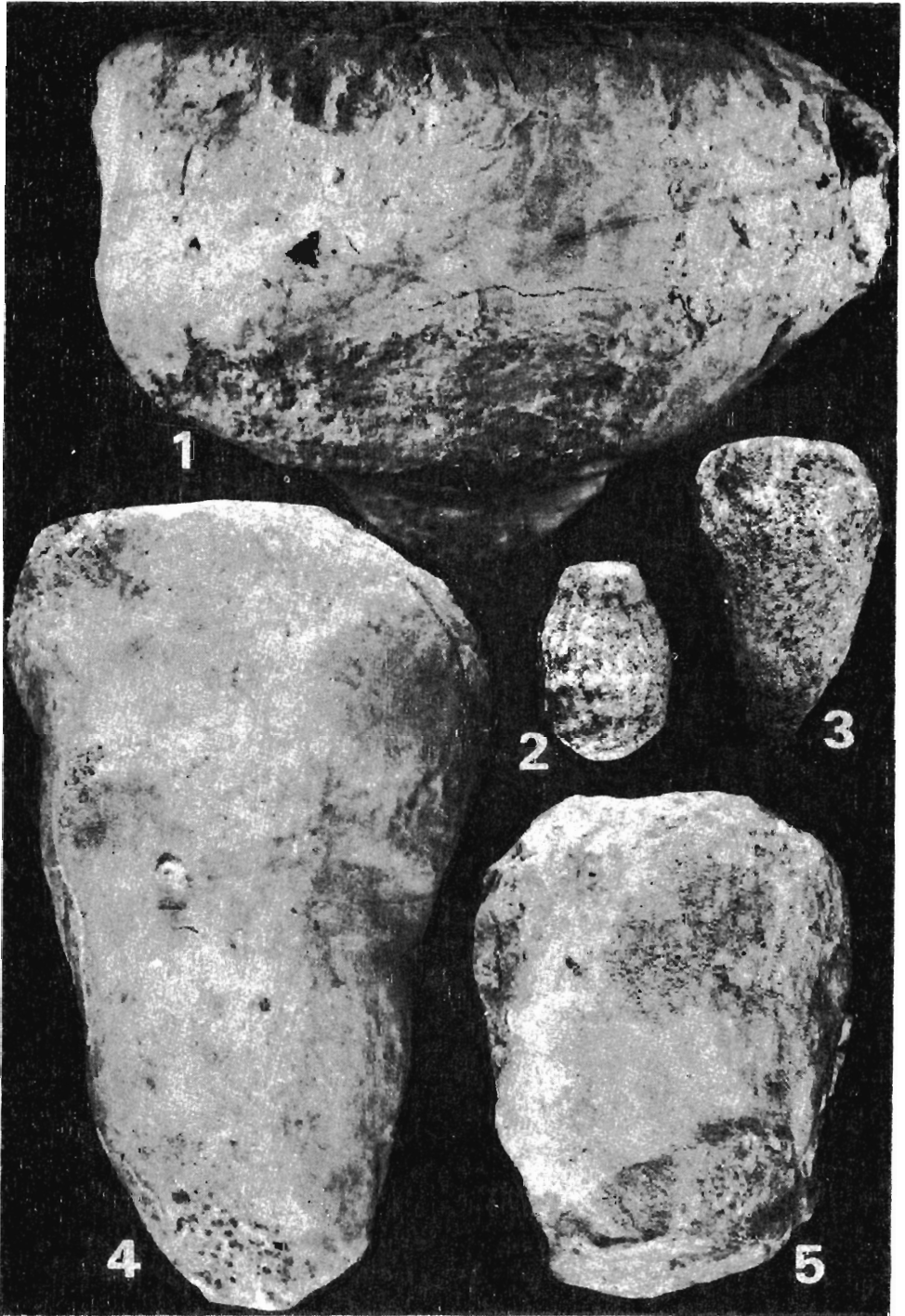
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WYSTĘPOWANIE GĄBEK HEXACTINELLIDA W GÓRNYM DEWONIE GÓR ŚWIĘTOKRZYSKICH

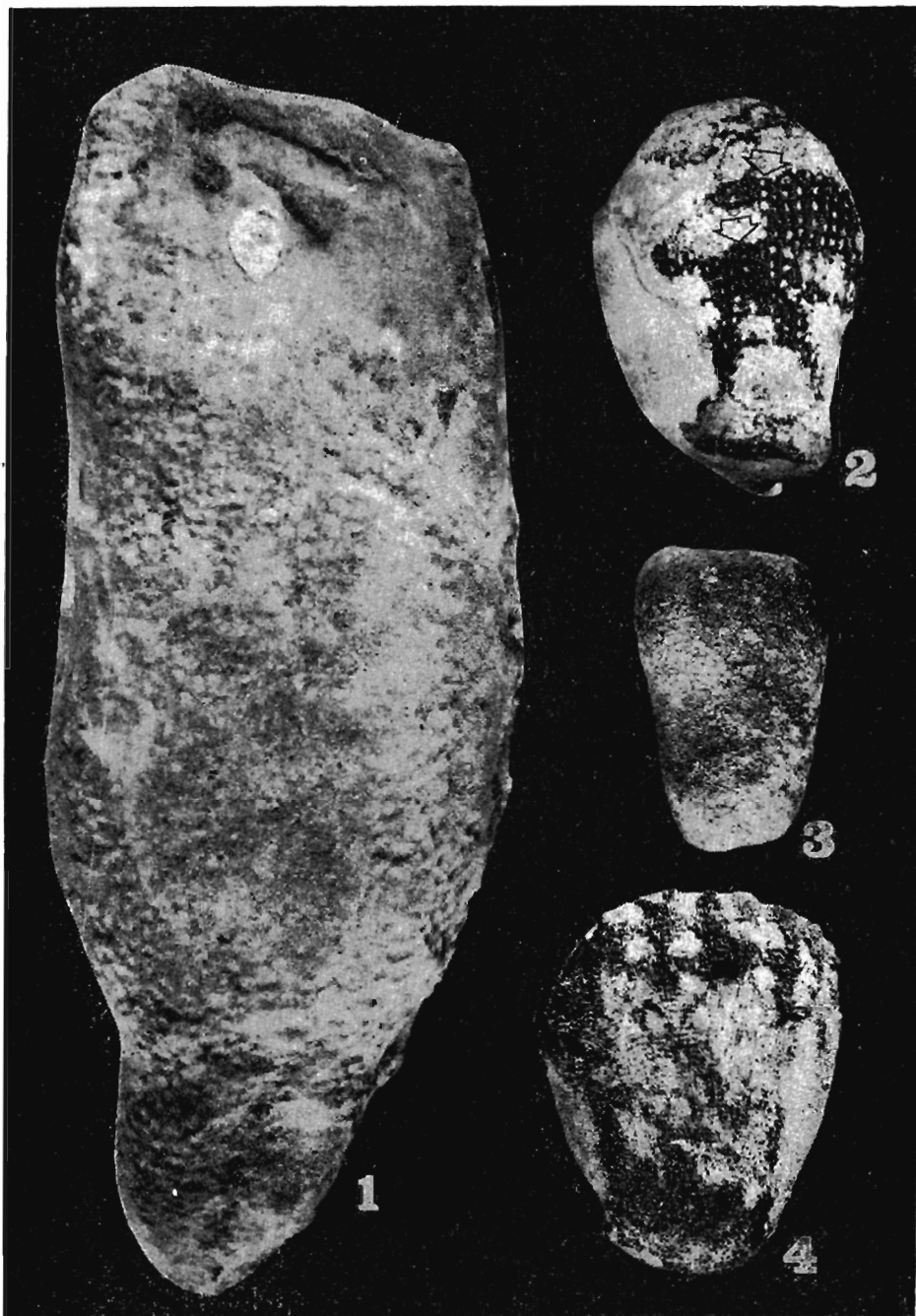
(Streszczenie)

Z utworów górnego tramu synkliny gałęzickiej (zachodnia część Gór Świętokrzyskich) zebrano bogatą kolekcję gąbek krzemionkowych (patrz fig. 1—5 oraz pl. 1—4), znanych stąd już od czasów D. Sobolewa. Gąbki te posiadają trwałe, bocznie połączone szkielety typu ditektoninowego. To stanowisko, razem z prawie jednowielkowymi i dotąd nieopracowanymi formami z Belgii i Zachodniej Australii przenosi do dewonu dolną granicę występowania rzędu Hexactinosa, znanego do tej pory najwcześniej z triasu.



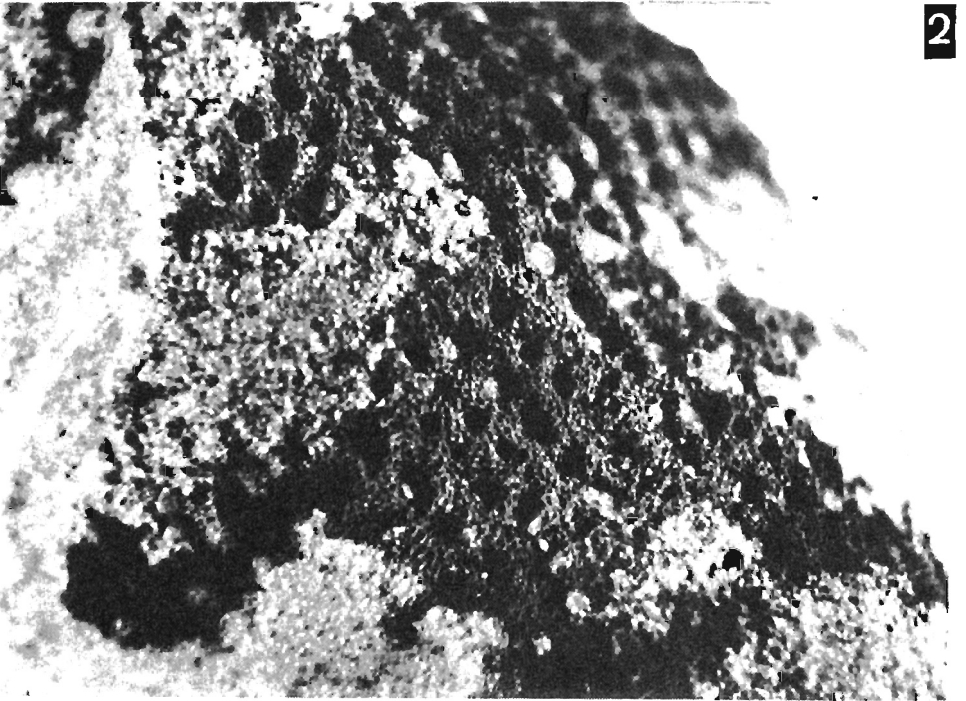
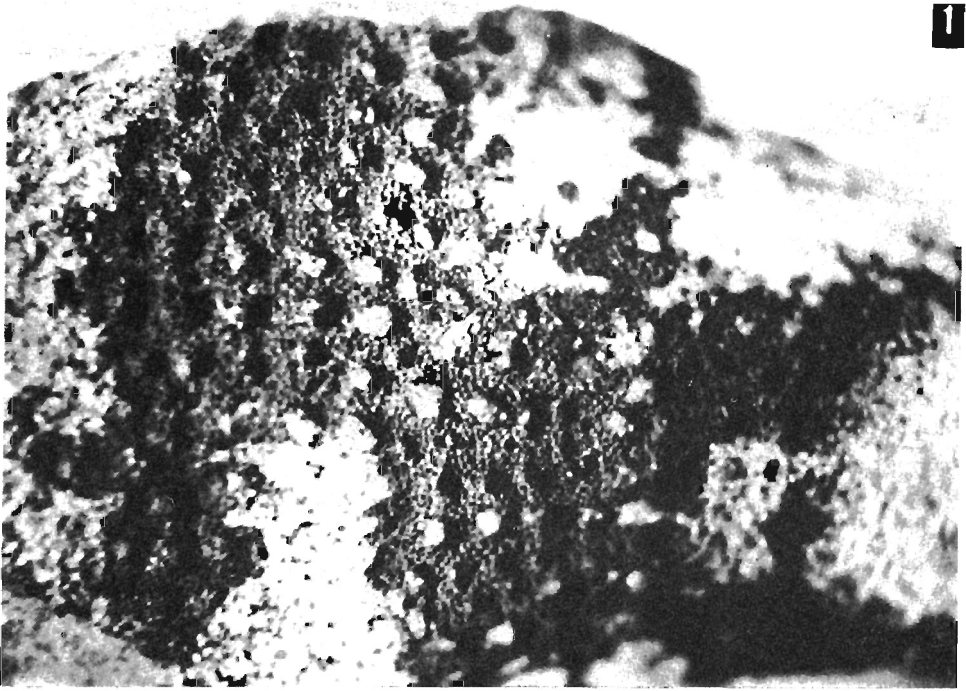
Upper Devonian sponges from the Holy Cross Mts

1--5 — Side views of characteristic forms showing different size, shape and surface sculpture; all specimens from the Jaźwica Quarry except one (Fig. 5) from the Wola Quarry; slightly reduced

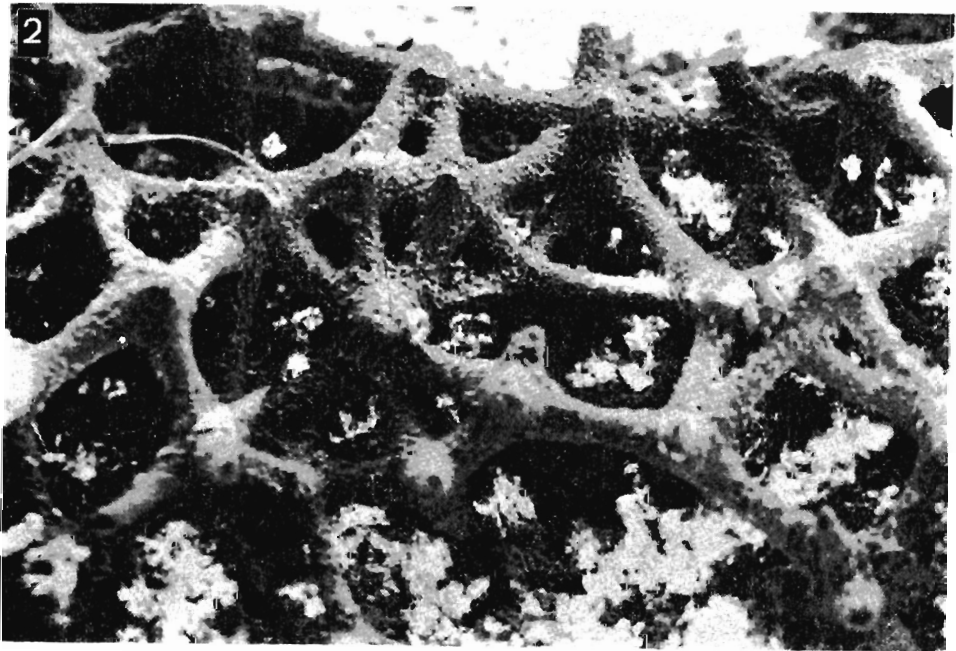
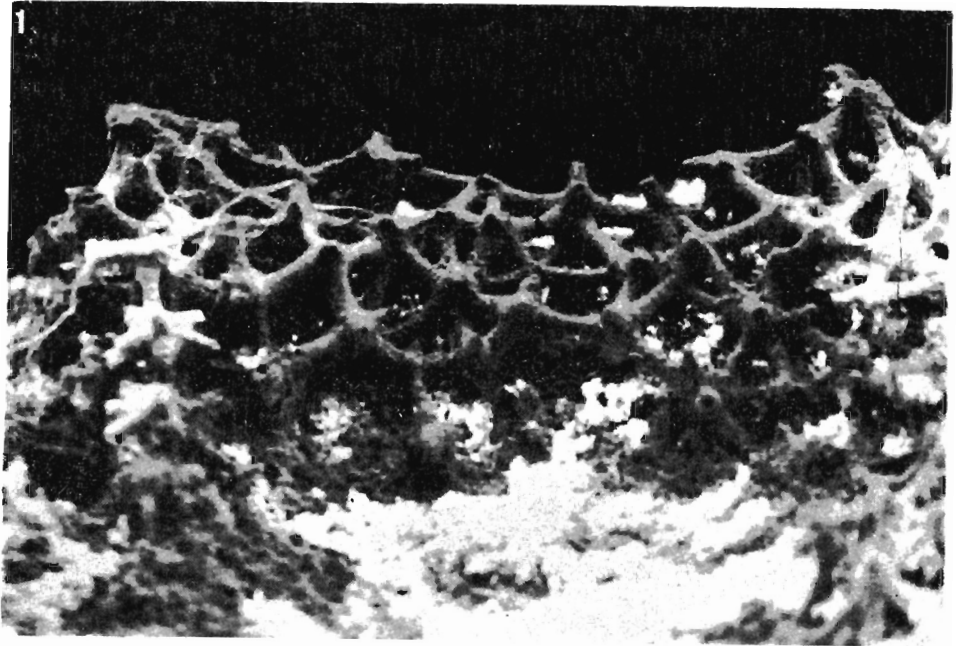


Upper Devonian sponges from the Jazwica Quarry

1-4 — Side views of characteristic forms showing different size, shape and surface sculpture; details of canal patterns are visible in Fig. 2 (magnified in Pl. 3) and in Fig. 4 (magnified in Pl. 4); all natural size



Details of canal patterns of the sponge illustrated in Pl. 2, Fig. 2 (upper arrow Fig. 1, lower arrow — Fig. 2); magn. $\times 5$



Dictyid skeletal net, to show fused, hexactine-based spicules in the sponge illustrated in Pl. 2, Fig. 4; SEM, magn. $\times 40$ (Fig. 1) and $\times 75$ (Fig. 2)