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ORDOVICIAN AND SILURIAN ACRITARCHS OF THE NIESTACHÓW SANDSTONE FORMATION (GÓRY ŚWIĘTOKRZYSKIE MOUNTAINS)

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Abstract: Acritarchs of the Niestachów Sandstone Formation from Niestachów in the southern part of the Góry Świętokrzyskie Mountains (the Kielce region) indicate a Silurian age of the formation, which confirms opinions expressed previously. The assemblages of acritarchs typical of Silurian include also an admixture of Ordovician species, which indicates redeposition. Twenty-two previously published species are recognised. Of these twenty-one are described together with three taxa which are not specifically assigned.

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INTRODUCTION

The studies on Palaeozoic acritarchs started in Europe in the thirties (Eisenack, 1931). In Poland, first publications on these from the Góry Świętokrzyskie Mountains appeared thirty years later. Jagielska (1962a,b) recorded several acritarch species from lower Palaeozoic deposits from Brzeziny, Zbrza and Uszkowice, while Górka (1967, 1969) described and illustrated those from Ordovician rocks from Wysoczki, Zbilutka, Chojnowy Dół, Zalesie, Pułaczów and Zbrza (Fig. 1).

The Palaeozoic rocks exposed in Niestachów have been the matter of interest for geologists for a long time. Czarnocki (1919) divided them into two complexes. The lower one consisting of graywackes was considered by this author to be of Ludlovian age. The upper one containing graywackes, sandstones and conglomerates was considered transitory between Silurian and Devonian (Downtonian). The age of the graywacke complex was later determined by Tomczykowa & Tomczyk (1981), on graptolites, as Siedlce (upperLudlovian). Przybyłowicz & Stupnicka (1989), on the basis of petro-

logical study, retained the two-fold division of this succession. They named the upper unit the Niestachów Sandstone Formation which they considered to be older than Emsian. The present study gives the first biostratigraphic evidence of the Silurian age of this formation.

Fig. 1. Location index-map against the outline of Palaeozoic deposits in the Góry Świętokrzyskie Mountains

GEOLOGICAL SETTING

In the southern part of the Góry Świętokrzyskie Mountains (the Kielce region), the Silurian succession is represented by graptolite shales (Llandoverian — lower Ludlovian) overlain by graywackes named the Niewachlów Graywackes (Siedlce — upper Ludlovian) (Tomczykowa & Tomczyk, 1981). In this region, the outcrops of Upper Silurian rocks are scanty and poor, excepting the area of Niestachów. At the slopes of the Otrocz Hill, in the northern ravine and south of it, there crop out some Ordovician rocks and the Silurian graptolite shales and graywackes (Tomczyk, 1956; Filonowicz, 1971).

The deposits concerned in this paper are exposed in a quarry in Niestachów (Fig. 2), at the eastern slope of the Otrocz Hill. These are pale-gray, fine quartz sandstones of bed thicknesses from 10 cm to 1 m intercalating with clayey mudstones and shales up to 40 m thick. The petrological study of these rocks called the Niestachów Sandstone Formation is presented by Przybyłowicz & Stupnicka (1989). The formation is overlain unconformably by sandstones with placoderms, belonging to Lower Devonian. The stratigraphical position of the Niestachów Sandstone Formation is shown in Fig. 3.

MATERIAL

The palynological samples have been collected in the quarry in Niestachów near Kielce (Fig. 1), situated at the eastern slope of the Otrocz Hill. They represent clayey mudstones and shales in the Niestachów Sandstone Formation. Five samples were processed, using standard methods. Four of these yielded palynomorphs. Eighteen slides were examined. The material is stored in the Institute of Geological Sciences, Polish Academy of Sciences in Warszawa.

Fig. 2. Photo of the outcrop studied, showing location of sampled deposits (*arrow*)

STRATIGRAPHIC PALYNOLOGY

The assemblages of acritarchs from all studied samples from Niestachów are similar in composition. They are rich in specimens but poor in taxa. The taxa identified are listed in the chapter „Palaeontological descriptions".

Considering the known stratigraphical ranges of the taxa recorded from Niestachów, one can include them in three groups. They are (1) taxa typical of Ordovician, others (2) appearing for the first time in Silurian, and (3) long-ranging ones common to Ordovician and Silurian, some also to Devonian.

The assemblage typical of Ordovician includes: *Acanthodiacrodium* cf.

ubui, Arbusculidium filamentosum, Baltisphaeridium annelieae, Dasydiacrodium sp., *Leiovalia scaberula, L. tenuissima, Ordovicidium nudum* and *Vulcanisphaera* cf. *imparilis.* The species *A. ubui* and *V. imparilis* appear for the first time in the Tremadocian and the genus *Vulcanisphaera* is a short ranging one and has only infrequently been recorded from the Arenigian. This could suggest an early Ordovician age of the redeposited assemblage, but, on the other hand, it also contains species which have not, so far, been recorded from rocks older than Llandeilian or Caradocian. These are: *Baltisphaeridium plicatispinae* and *Ordovicidium nudum.*

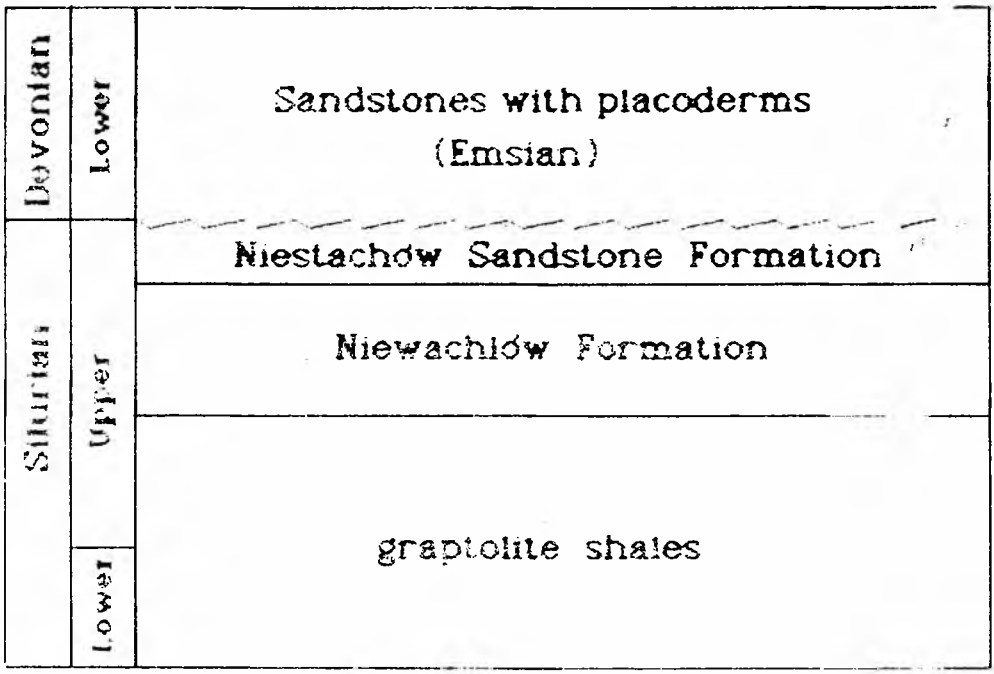

Fig. 3. Schematic diagram showing the stratigraphic position of the Niestachów Sandstone Formation

One could suppose that the Ordovician acritarchs from Niestachów represent two assemblages of different ages, but the evidence of this is rather weak. *A. ubui* considered in Great Britain to be indicative of the Tremadocian (Lister, 1970a) persists in Belgium up to the Ashgilian (Martin, 1968), and the identify of *V.* cf. *imparilis* from Niestachów can be doubted as present specimens are much larger than those of *V. imparilis* described from the tremadocian of England (Rasul, 1976).

The second group of taxa includes *Baltisphaeridium dubitum, Cymatiosphaera heloderma, Multiplicisphaeridium forquillum, M. denticulatum, Micrhystridium acerbum* and *Tylotopalla tappanae.* These species appear

for the first time in the Silurian, and, so far, have not been recorded from deposits younger than that.

Thus, it may be concluded that the investigated rocks from Niestachów belong to Silurian. This is consistent with the previously expressed opinions based on geological or petrological data (Czarnocki, 1919; Tomczyk, 1956; Filonowicz, 1971; Tomczykowa & Tomczyk, 1981; Przybyłowicz & Stupnicka, 1989). It is not possible to determine on the present material the exact age of these strata. The presence of taxa known to be restricted to Ordovician indicates reworking from older sediments.

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PALAEONTOLOGICAL DESCRIPTIONS

List of species. The following is an inventory of taxa recognized in the Niestachów samples. Twenty four of these are described below.

Acanthodiacrodium cf. *ubui* Martin, 1968
Acanthodiacrodium sp.
Arbusculidium filamentosum Vavrdová, 1972
Baltisphaeridium cf. *annelicae* (Kjellström) Bockelie & Kjellström, 1979
B. dubitum Lister, 1970
B. plicatispinae Górka, 1969
Cymatiosphaera heloderma Cramer & Diez, 1972
Dasydiacrodium sp.
Dictyotidium sp.
Leiovalia scaberula Loeblich & Tappan, 1978
L. tenuissima Eisenack, 1958
Lophosphaeridium citrinum Downie, 1963
Micrhystridium acerbum Martin, 1968
Micrhystridium sp.
Multiplicisphaeridium denticulatum Cramer, 1970
M. forquillum Cramer & Diez, 1972
M. ramusculosum (Deflandre) Lister, 1970
M. rusticum Martin, 1973
Navifusa sp.
Ordovicidium nudum Tappan & Loeblich, 1971
Polygonium spinosum Jadriné, Combaz, Magloire, Peniguel & Vachey, 1974
Tylotopalla tappanae, Kiryanov, 1978
Veryhachium europaeum Stockmans & Willière, 1960
V. lairdi (Deflandre) Deunff, 1958
V. reductum Deunff, 1958
V. trispinosum (Eisenack) Deunff, 1954
V. sp.
Vulcanisphaera cf. *imparilis* Rasul, 1976

DESCRIPTIONS

Genus *Acanthodiacrodium* (Timofeev) Deflandre & Deflandre-Rigaud, 1961

Acanthodiacrodium cf. *ubui* Martin, 1968
Pl. I: 3

Description: Vesicle bipolar, poles widely rounded, covered with conical processes 2 — 3 μm wide at base, 2 — 3 μm long, up to 30 in number at each pole. Close to equatorial area, there are a few longer (4 — 5 μm), curved processes. Equatorial area smooth or wrinkled.

Dimensions: Length 28 — 30 μm, width 24 — 26 μm (7 specimens).

Remarks: In the described species, the appendages appear smooth while those in *A. ubui* Martin (1968) from the type material are spinose. The poor preservation of the Niestachów material may be responsible for the apparent lack of this ornament.

Previous records: Belgium, Ordovician (Martin, 1968); England, Tremadocian (Lister, 1970a; Richardson & Rasul, 1978).

Genus *Arbusculidium* Deunff, 1968

Arbusculidium filamentosum Vavrdové, 1972
Pl. I: 4

Description: Vesicle bipolar, angular. One pole flat, the other rounded. The flat pole bears a few large, discrete processes 10 — 18 μm long, and the rounded one is covered by 30 — 40 fine processes up to 8 μm long, fused at base and forking. Equatorial area smooth.

Dimensions: Length 44 μm, width 38 — 39 μm (3 specimens).

Previous records: Central Bohemia, Ordovician (Vavrdova, 1972); Belgium, Arenigian (Martin, 1968).

Genus *Baltisphaeridium* (Eisenack) Downie & Sarjeant, 1963

Baltisphaeridium cf.*annelieae* (Kjellström) Bockelie & Kjellström, 1979
Pl. I: 10

Description: Vesicle subcircular, having numerous processes (about 30 processes cross the equator). Process interiors do not communicate with the vesicle cavity. Some processes are thread like, longer than vesicle diameter, other ones are less slender, and shorter than vesicle diameter.

Dimensions: Diameter 37 — 40 μm (4 specimens).

Previous records: Sweden, Ordovician (Kjellström, 1976; Górka, 1987); Canada, Caradocian (Martin, 1983).

Baltisphaeridium dubitum Lister, 1970b
Pl. I: 12

Description: Vesicle oval, wall thick, granulate. Processes also granulate, homomorphic, thin-walled in relation to vesicle wall, acute, slightly shorter than vesicle diameter (up to 40 μm), 4 — 6 μm wide at base.

Dimensions: Diameter 48 — 55 μm (6 specimens).

Previous records: Spain, transition Silur — Devon (Cramer & Diez, 1976); England, Wenlockian — lower Ludlovian (Lister, 1970b).

Baltisphaeridium plicatispinae Górka, 1969
Pl. I: 16

Description: Vesicle circular, wall psilate or pitted, with secondary folds or thickenings. Processes 8 — 10 in number, homomorphic, tapering to a sharp tip, 3 — 4 μm wide at base, about 50 μm long. Process interiors do not communicate with the vesicle cavity. Process surface uneven and wavy.

Dimensions: Diameter 50 — 62 μm (4 specimens).

Previous records: North-east Poland, Llandeilan, Ashgilian (Górka, 1969); Baltic region, Silurian (Eisenack, 1931, 1938).

Genus *Cymatiosphaera* O. Wetzel ex Deflandre, 1954

Cymatiosphaera heloderma Cramer & Diez, 1972
Pl. I: 8 — 9

Description: Vesicle sphaerical. Vesicle surface divided into 4 — 6 polygonal areas by high, membranous muri. Height of muri close to vesicle diameter.

Dimensions: Diameter 35 — 50 μm (5 specimens).

Previous records: USSR, Podolia, Llandoverian (Kiryanov, 1978); USA, Ohio, Alger Shale, Silurian (Cramer & Diez, 1972).

Genus *Dasydiacrodium* (Timofeev), Deflandre & Deflandre-Rigaud, 1961

Dasydiacrodium sp.
Pl. I: 5, 6, 7

Description: Vesicle bipolar, poles broadly rounded, covered by appendages, equatorial area smooth. In each specimen, the number and size of appendages on the two poles differs. One pole bears 5 — 6 discrete, rapidly tapering spines, while the other is covered by about 30 fine spines fused at base.

Dimensions: Length 36 — 60 μm, width 30 — 36 μm (3 specimens).

Genus *Leiovalia* (Eisenack) Combaz, Lange & Pansart, 1967

Leiovalia scaberula Loeblich & Tappan, 1978
Pl. I: 17

Description: Vesicle oval or circular. Wall thick, psilate, broadly folded. Folds 2 — 3 μm wide, usually parallel to vesicle equator, some fold terminations fused.

Dimensions: Diameter 80 — 115 μm (8 specimens).

Previous records: Sweden, mid Ordovician (Górka, 1987); USA, Oklahoma, Ordovician (Loeblich & Tappan, 1978).

Genus *Lophosphaeridium* Timofeev, 1959

Lophosphaeridium citrinum Downie, 1963
Pl. I: 11

Description: Vesicle circular. Wall covered with verrucae which are discrete, irregularly rounded in profile, about 1 μm wide at base.

Dimensions: Diameter 38 — 42 μm (4 specimens).

Previous records: Poland, Góry Świętokrzyskie Mts, Ordovician (Górka, 1969); England, Shales of Wenlock, Wenlockian (Downie, 1963); Belgium, Ordovician, Silurian (Martin, 1968); Sweden, mid Ordovician (Górka, 1987).

Genus *Micrhystridium* Deflandre, 1937

Micrhystridium acerbum Martin, 1968
Pl. II: 7

Description: vesicle sphaerical, wall psilate, covered by homomorphic processes. These are 2 — 3 μm wide at base, 4 — 5 μm long, longitudinally striate, conical or bulbous and surmounted by a single, short cone. Eight to nine processes cross the equator.

Dimensions: Diameter 15 — 20 μm (5 specimens).

Previous records: Belgium, Silurian (Martin, 1968); USSR, Podolia and Volynia, Silurian (Kiryanov, 1978).

Micrhystridium sp.
Pl. II: 10

Description: Vesicle circular or polygonal, wall psilate, bearing a few heteromorphic processes. The length of processes equals vesicle diameter. They are about 2 μm wide at base, and they taper gradually to a simple and acute or bifurcate tip. Process interiors distinctly communicate with vesicle interior. Five processes are situated at equator.

Dimensions: Diameter 48 — 50 μm (3 specimens).

Remarks: *Micrhystridium sp.* is similar to *M. stellatum* Deflandre, 1945, but is larger both from the type specimens and from those described by Kiryanov (1978) from the Silurian of the USSR.

Genus *Multiplicisphaeridium* Staplin, 1961

Multiplicisphaeridium denticulatum Cramer, 1970
Pl. II:12

Description: Vesicle circular. Wall covered with grana or small spines. The same ornamentation occurs on processes. These are thick walled, heteromorphic, simple or forked several times at tip. They are 4 — 5 μm wide at base, and their length more or less equals vesicle diameter. Process interiors communicate freely with vesicle cavity.

Dimensions: Diameter 32 — 50 μm (4 specimens).

Previous recods: Belgium, Silurian (Stockmanns & Willière, 196[illegible]); Sahara, Ludlovian, Gedinnian (Jardiné *et al.*, 1974); USA, mid Silurian (Loeblich, 196[illegible]).

Multiplicisphaeridium forquillum Cramer & Diez, 1972
Pl. II:9

Description: Vesicle rectangular, wall finely granulate. Each angle is provided by a process of granulate surface, forking at tip. Processes are about 3 μm at base, 20 μm long, there are 4 — 6 processes on each specimen.

Dimensions: Diameter 28 — 30 μm (3 specimens).

Previous records: USSR, Podolia, Silurian (Kiryanov, 1978).

Multiplicisphaeridium ramusculosum (Deflandre) Lister 1970b
Pl. II: 14

Description: Vesicle circular, wall psilate. Processes heteromorphic, cylindrical, branching up to third order or simple, with smooth surface, 1 — 2 μm wide at base. Branching usually commences at 0.5 of distance from proximal to distal extremity of process. Length of processes equals or exceeds diameter of vesicle.

Dimensions: Diameter 22 — 26 μm (6 specimens).

Previous records: Western Europe, common in Ordovician to Devonian (Cramer & Diez, 1973, 1979); Sahara, Ludlovian, Gedinnian (Jardiné *et al.*, 1974).

Genus *Navifusa* Combaz, Lange & Pansart, 1967

Navifusa sp.
Pl. II: 11

Description: Vesicle ellipsoidal, elongate, without processes. Wall thin, psilate, in vicinity of poles punctate.

Dimensions: Length 102 μm, width 50 — 60 μm (2 specimens).

Remarks: *Navifusa* sp. is similar to *N. concepsipuncta* Loeblich, 1969 in being punctate at poles, but it is less elongate.

Genus *Ordovicidium* Tappan & Loeblich, 1971

Ordovicidium nudum (Eisenack) Loeblich & Tappan, 1978
Pl. II: 6

Description: Vesicle circular, wall psilate or rough. Processes, 15 — 20 in number, homomorphic, cylindrical, branching up to second order. Length of processes 13 — 22 μm (one halve of vesicle diameter), basis width 2 μm, width of process corona 3 — 8 μm.

Dimensions: Diameter 25 — 45 μm (6 specimens).

Previous recods: North-east Poland, Llandeilan, Caradocian (Górka, 1969); Estonian SSR, Llandeilan, Ashgilian (Eisenack, 1958); Sweden, Gotland, Ordovician (Kjellström, 1971; Górka, 1987); Libya, Lower Ordovician (Molyneux & Paris, 1985).

Genus *Polygonium* Vavrdova, 1966

Polygonium spinosumm Jardiné, Combaz, Magloire, Peniguel & Vachey, 1974
Pl. II: 13

Description: Vesicle rectangular, slightly elongated, sides straight or convex. Four processes arise from vesicle corners. They are simple, tapering gradually and acuminate,

slightly curved, longer than one halve of vesicle diameter. Process interiors communicate with vesicle cavity. Additional, broad-based processes, 5 in number, are situated close to the main ones. Wall of vesicle and processes psilate.

Dimensions: Diameter 40 — 52 μm (4 specimens).

Previous recods: Algeria, Arenigian/Llanvirnian, Ludlovian, Lower Gedinnian (Jardiné *et al.*, 1974).

Genus *Tylotopalla* Loeblich, 1970

Tylotopalla tappanae Kiryanov, 1978
Pl. II: 3

Description: Vesicle circular, wall psilate. Processes, 8 — 10 in number, homomorphic, parallell-sided and tapering abruptly at tip, covered with verrucae usually 1 μm wide at base. Process interiors contact freely the vesicle cavity. Length of processes about 2/3 of vesicle diameter, width at base 4 — 5 μm.

Dimensions: Diameter 40 — 45 μm (4 specimens).

Remarks: In the described specimens, verrucae on processes are smaller than those in the type material.

Previous records: USSR, Podolia, Silurian (Kiryanov, 1978).

Genus *Veryhachium* (Deunff) Downie & Sarjeant, 1963

Veryhachium europaeum Stockmans & Willière, 1960
Pl. II: 1

Description: Vesicle triangular, sides straight, wall psilate. Three acuminate processes arise from vesicle corners. Process interiors communicate freely with vesicle cavity. Additional, slightly smaller, broad-based processes, 1 — 2 in number, occur in central part of vesicle. Length of processes 10 — 15 μm.

Dimensions: Diameter 38 — 45 μm (3 specimens).

Previous records: England, Wenlockian (Downie, 1963); Spain, Silurian — Devonian (Cramer & Diez, 1976); Belgium, Caradocian — Silurian (Martin, 1973), and Devonian (Stockmans & Willière, 1960); West Germany, Devonian (Riegel, 1974).

Veryhachium lairdi (Deflandre), Deunff, 1954

Description: Vesicle rectangular, sides straight or slightly concave, wall psilate. Vesicle corners extended to form 10 — 18 μm long, acuminate processes of psilate surface.

Dimensions: Diameter 44 — 46 μm (3 specimens).

Previous recods: Western Europe, Ordovician — Devonian (Cramer & Diez, 1979); Canada, Silurian (Brito, 1968).

Veryhachium reductum Deunff, 1958
Pl. II: 2

Description: Vesicle triangular, sides straight or slightly convex, wall psilate. Vesicle corners extended to form conical, broad-based processes terminated by a narrow spine.

Dimensions: Diameter 30 — 33 μm (4 specimens).

Previous records: France, Devonian (Deunff, 1958).

Veryhachium trispinosum (Eisenack) Deunff, 1954

Description: Vesicle triangular, sides straight or slightly convex, wall psilate. Vesicle corners extended to form conical, acuminate processes 12 — 15 μm long. Process interiors contact freely with vesicle cavity.

Dimensions: Diameter 15 — 20 μm (5 specimens).

Previous records: This species has been commonly recorded from Ordovician to Devonian rocks of the Northern Hemisphaere.

Genus *Vulcanisphaera* Deunff, 1961

Vulcanisphaera cf. *imparilis* Rasul, 1976
Pl. II: 4

Description: Vesicle circular or polygonal, wall psilate. Processes simple, 15 — 20 in number, 4 μm long, narrow, arise from volcano-shaped base. Process interiors communicate with vesicle cavity.

Dimensions: Diameter 40 — 42 μm (2 specimens).

Remarks: The described specimens are larger by 5 — 10 μm from those of the type material.

Previous records: England, Shropshire, Tremadocian (Rasul, 1976).

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Streszczenie

ORDOWICKIE I SYLURSKIE AKRITARCHY Z FORMACJI PIASKOWCÓW Z NIESTACHOWA (GÓRY ŚWIĘTOKRZYSKIE)

Marzena Stempień

Materiał poddany badaniom pochodzi z południowej części Gór Świętokrzyskich (region kielecki), z kamieniołomu w Niestachowie (Fig. 1), z ilasto-mułowcowych przewarstwień pomiędzy ławicami piaskowców (Fig. 2). Piaskowce te określane są jako poziom przejściowy między górnym sylurem a dewonem (Czarnocki, 1919), starszy niż piaskowce plakodermowe emsu (Przybyłowicz & Stupnicka, 1989) (por. Fig. 3).

Wśród akritarchów z Niestachowa, zilustrowanych na Planszach I — II, oprócz gatunków długowiecznych, stwierdzono występowanie dwóch zespołów. Pierwszy z nich, najprawdopodobniej redeponowany, charakterystyczny dla ordowiku, drugi dla syluru. W skład zespołu pierwszego wchodzą następujące taksony: *Acanthodiacrodium* cf. *ubui*, *Arbusculidium filamentosum*, *Baltisphaeridium* cf. *annelieae*, *Leiovalia scaberula*, *Ordovicidium nudum*, *Vulcanisphaera* cf. *imparilis* i *Dasydiacrodium* sp.

Drugi z wyróżnionych w Nieństachowie zespołów reprezentuje gatunki sylurskie: *Baltisphaeridium dubitum*, *Multiplicisphaeridium denticulatum*, *Cymatiosphaera heloderma*, *Micrhystridium acerbum*, *Multiplicisphaeridium forquillum* oraz *Tylotopalla tappanae*.

Nie stwierdzono występowania wskaźnikowych form dewońskich. Wiek formacji piaskowców z Niestachowa określono jako sylurski.

EXPLANATIONS OF PLATES

Plate I

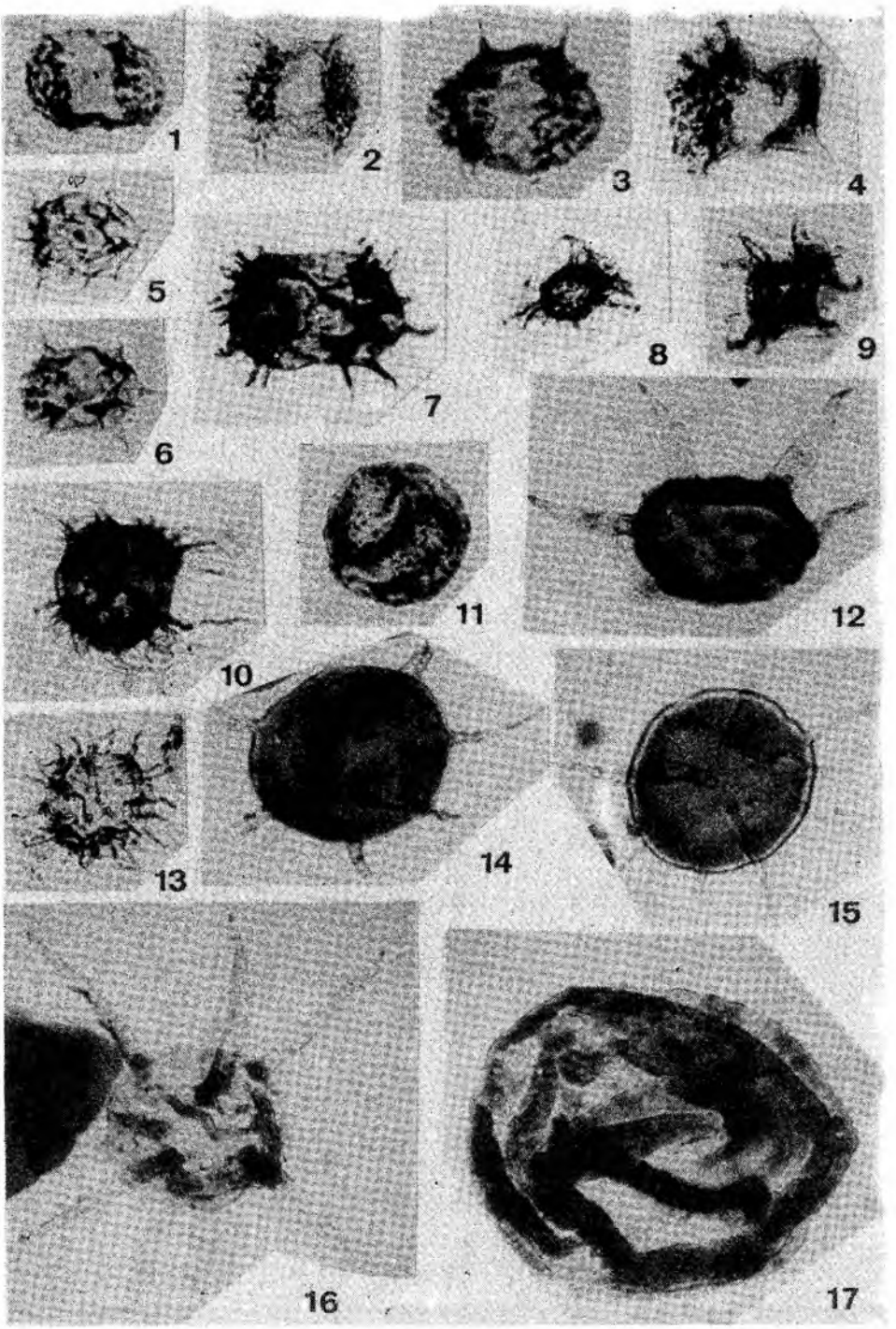
Acritarchs from Niestachów Sandstone Formation; all photographs ×500

1 — 1, 2 — *Acanthodiacrodium* sp., slide 13
3 — *Acanthodiacrodium* cf. *ubui* Martin, 1968, slide 4
4 — *Arbusculidium filamentosum* Vavrdová, 1972, slide 4
5, 6, 7 — *Dasydiacrodium* sp. slides 3 and 4
8, 9 — *Cymatiosphaera heloderma* Cramer & Diez, 1972, slide 9
10 — *Baltisphaeridium* cf. *annelieae* (Kjellström) Bockelie & Kjellström, 1979, slide 4
11 — *Lophosphaeridium citrinum* Downie, 1963, slide 3
12 — *Baltisphaeridium dubitum* Lister, 1970, slide 13
13,14,15 — *Baltisphaeridium* sp., slides 4 and 13
16 — *Baltisphaeridium plicatispinae* Górka, 1969, slide 4
17 — *Leiovalia scaberula* Loeblich & Tappan, 1978, slide 3

Plate II

Acritarchs from Niestachów Sandstone Formation; all photographs ×500, except when indicated

1 — *Veryhachium europaeum* Stockmans & Willière, 1960, slide 6
2 — *Veryhachium reductum* Deunff, 1958, slide 4
3 — *Tylotopalla tappanae* Kiryanov, 1978, slide 7
4 — *Vulcanisphaera* cf. *imparilis* Rasul, 1976, slide 7
5 — *Veryhachium* sp., slide 9
6 — *Ordovicidium nudum* Tappan & Leoblich, 1971, slide 4
7 — *Micrhystridium acerbum* Martin, 1968, slide 5
8 — *Dictyotidium* sp., slide 10
9 — *Multiplicisphaeridium forquillum* Cramer & Diez, 1972, slide 8
10 — *Micrhystridium* sp., slide 4
11 — *Navifusa* sp., slide 4
12 — *Multiplicisphaeridium denticulatum* Cramer, 1970, slide 6
13 — *Polygonium spinosum* Jardiné *et al.*, 1974, slide 7
14 — *Multiplicisphaeridium ramusculosum* (Deflandre) Lister, 1970, slide 4, ×1000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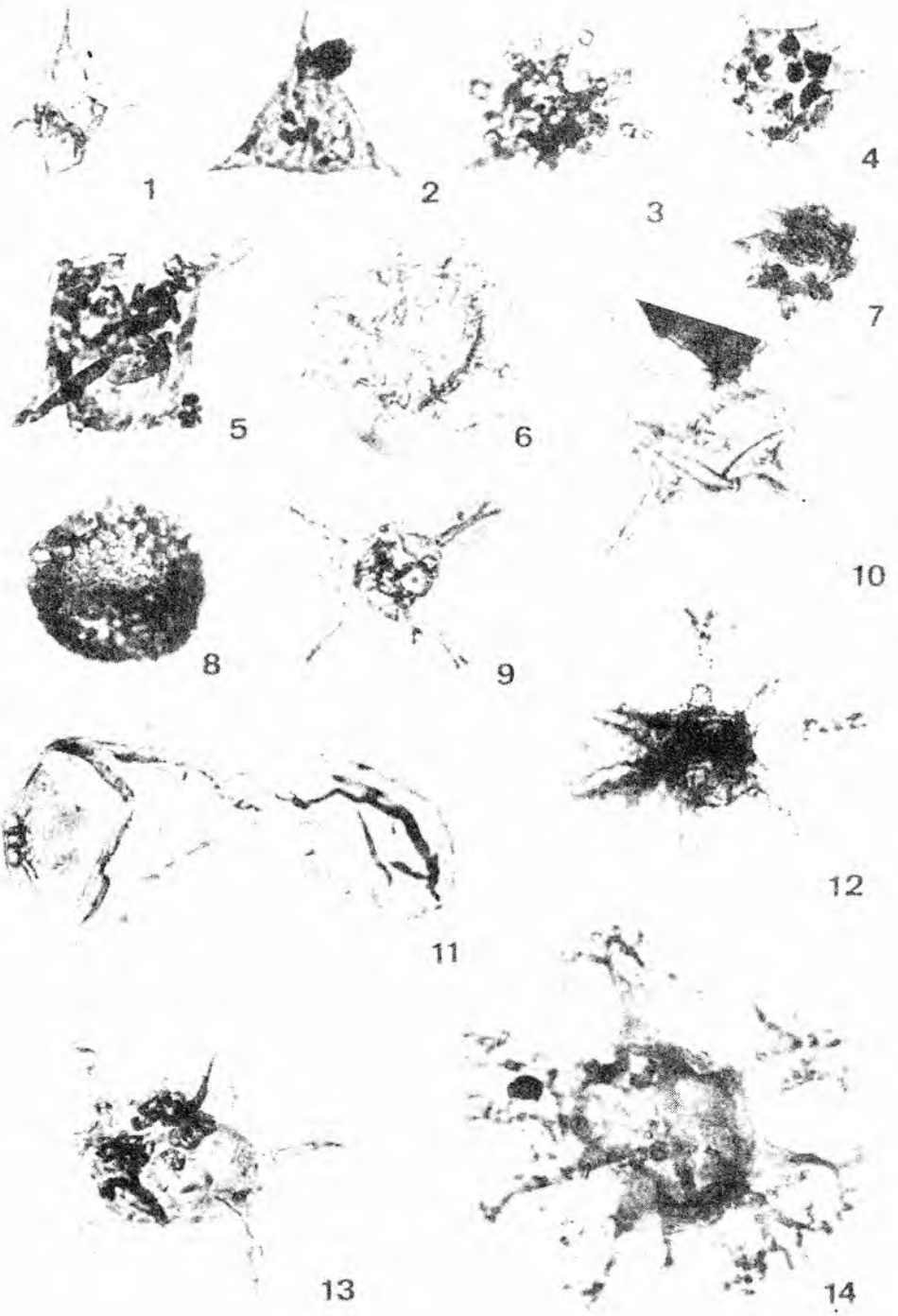
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