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PRELIMINARY STUDY OF MICROFLORA FROM LOWER DEVONIAN DEPOSITS IN THE AREA OF BIELSKO-WADOWICE

(PL. XXV—XXVI AND 2 FIGS.)

Dotychczasowe wyniki badań mikroflorystycznych dewonu dolnego w obszarze Bielsko-Wadowice

(Tabl. XXV—XXVI i 2 fig.)

The Lower Devonian deposits of sandstones and siltstones discovered in deep boreholes drilled in the area of Bielsko-Mogilany (K. Konior, 1965, 1966, 1968, 1969), which yielded some traces of hydrocarbonates, have opened up new possibilities of oil exploration in the Palaeozoic sediments WSW from Kraków (K. Konior, 1970, 1972).

In this connection the comprehensive investigation of these deposits and the determination of their age and conditions of sedimentation is of a great importance. Designation of the age and character of these sediments is difficult since they lack remains or traces of organisms, except for some Psilophyton flora and traces of mud eaters (the bioturbated sandstones). K. Konior (1965, 1966, 1969) described these sediments as being of a mixed terrestrial-marine character and he assumed their age as Emsian on the grounds of their similarity to the Lower Devonian deposits of the Holy Cross Mountains (J. Czarnocki, 1937, 1957).

In 1966 K. Konior divided these Lower Devonian sediments occuring in four boreholes in the Bielsko-Andrychów area into three units: upper, middle and lower. The upper unit included unequigranular sandstones, conglomerates and siltstones, locally with Psilophyton flora. The middle unit was characterised by presence of fine- or medium-grained, "saccharoid" sandstones. Its upper part with intercalations of dark gray siltstones and with traces of mud eaters was then described as scolithus sandstones. The lower unit contained fine- and coarse-grained sandstones and conglomerates.

[1] Ul. Kasprowicza 15 m. 5, 31-523 Kraków.
[2] Ul. Senacka 3. 31-002 Kraków. Pracownia Geologii Złóż PAN.

This division can now be supplemented owing to additional materials from new boreholes drilled in the area of the southern border of the Silesian Coal Basin between Bielsko and Mogilany. It appears that in some boreholes the "saccharoid" sandstones of the middle unit are partially (the borehole Bielsko 5) or completely (the boreholes Kęty 9, Piotrowice 1

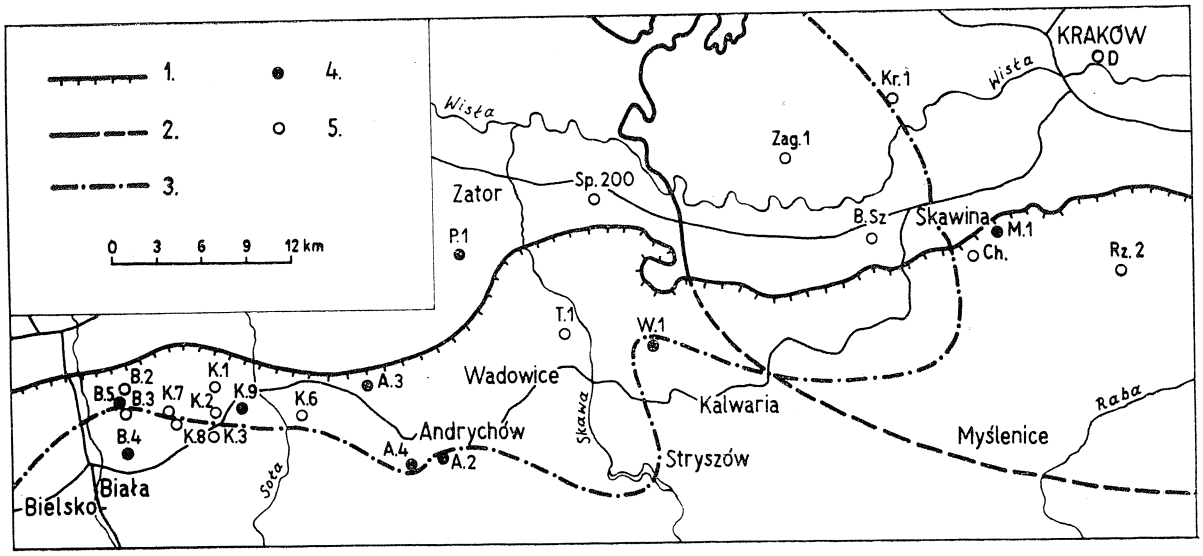

Fig. 1. Location of boreholes in the area of Bielsko-Kraków. Explanation: 1 — northern margin of the Carpathians; 2 — established and hipothetical western range of the Jurassic deposits; 3 — hipothetical southern border of the Silesian Coal Basin; 4 — boreholes dealt with in this paper; B — Bielsko; K — Kęty; A — Andrychów; W — Wysoka; P — Piotrowice; 5 — other important boreholes

Fig. 1. Szkic sytuacyjny wierceń obszaru Bielsko-Kraków. Objaśnienie: 1 — północny brzeg Karpat fliszowych; 2 — stwierdzona i przypuszczalna zachodnia granica zasięgu utworów jurajskich; 3 — przypuszczalna granica południowa Górnośląskiego Zagłębia Węglowego; 4 — wiercenia omawiane w tekście: B — Bielsko; K — Kęty; A — Andrychów; W — Wysoka; P — Piotrowice; 5 — ważniejsze inne wiercenia

and Wysoka 1) replaced by red sandstones of the Old Red type. In the most eastern borehole Mogilany 1 the sediments of red colour replace all three units of the Lower Devonian sediments occuring in the other boreholes.

The most recent observations have also cleared up the question of scolithus sandstones. Already in 1968 K. Konior noticed among the "saccharoid" sandstones of the middle unit in the borehole Andrychów 4 some almost vertical structures resembling scolithus. He described these sandstones conditionally as pseudoscolithus sandstones. After few years, when the drill cores had dryed out, the typical scolithus could be observed among the "saccharoid" sandstones or the red rocks of the Old Red type which replace them (K. Konior, A. Ślączka 1972). The scolithus occur, as a rule, below the sandstones with traces of mud eaters described earlier by K. Konior as scolithus sandstones (1966) or sandstones of

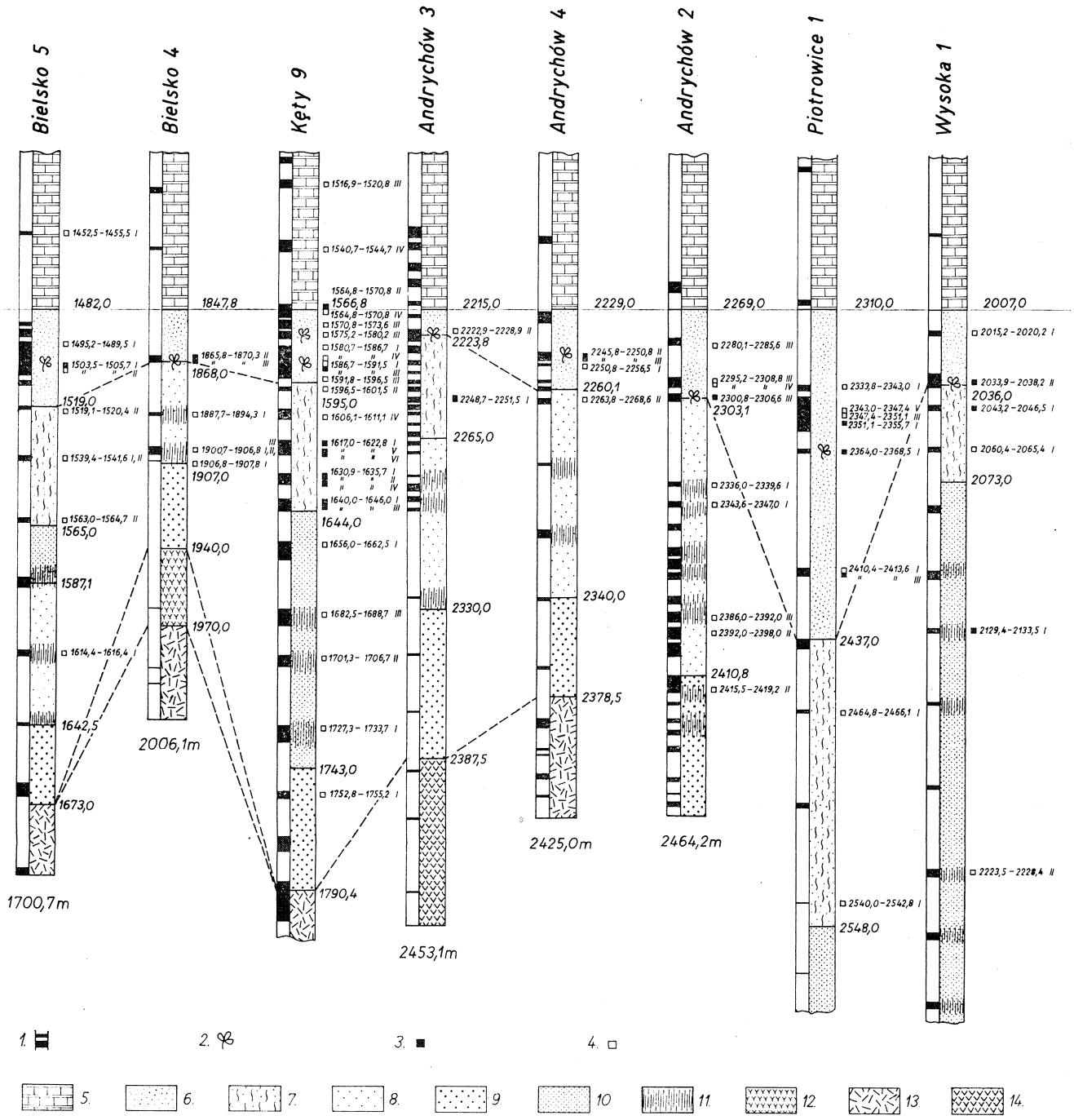

Fig. 2. Sections of boreholes with correlation of the Lower Devonian deposits and position of samples studied: 1 — drill cores takem; 2 — macroflora; 3 — samples containing sporomorphs; 4 — sterile samples; 5 — Eifelian dolomites with interpolations of shales, siltstones and sandstones at the base; 6 — II Lower Devonian; 6 — unequigranular sandstones, conglomerates and siltstones, occasionally with Psilophyton flora; 7 — bioturbated sandstones; 8 — fine grained, "saccharoid" sandstones; 9 — fine and coarse-grained sandstones and conglomerates (6 — upper unit; 7,8 — middle unit; 9 — lower unit); 10 — sandstones, mostly fine grained, and siltstones of Old Red — type facies; 11 — horizons with scolithus, partly according to A. Ślączka; 12 — teschenite; 13 — metamorphic rocks, 14 — gabbro

Fig. 2. Korelacyjne zestawienie dewonu dolnego i pozycja próbek zbadanych mikroflorystycznie z wierceń obszaru Bielsko-Wadowice. 1 — pobrane rdzenie; 2 — makroflora; 3 — próbki zawierające sporomorfy; 4 — próbki jałowe, 5 — dolomity eiflu, w spągowej części z wkładkami iłołupków, mułowców, a nawet piaskowców; 6 — 11 dewon dolny: 6 — piaskowce nierównoziarniste i zlepieńce oraz mułowce lokalnie z psylofitami; 7 — piaskowce bioturbacyjne; 8 — piaskowce drobnoziarniste, „cukrowate"; 9 — piaskowce drobno- gruboziarniste i zlepieńce; (6 — poziom górny; 7,8 — poziom środkowy; 9 — poziom dolny); 10 — piaskowce przeważnie drobnoziarniste i mułowce old-redu; 11 — poziomy ze skolitusami częściowo według A. Ślączki; 12 — cieszynit; 13 — utwory metamorficzne; 14 — gabro

scolithus type (1969), and now called bioturbated sandstones [1] (K. Konior, A. Ślączka, 1972).

The present lithological division of the Lower Devonian deposits in the area of Bielsko-Wadowice is shown in text-fig. 2.

In 1971 and 1972 palynological investigations of these rocks, suggested by K. Konior, were undertaken by E. Turnau. Samples were taken from the boreholes Bielsko 5, 4, Andrychów 2, 3, 4, Kęty 9, Wysoka 1, Piotrowice 1 and Mogilany 1, mostly from the upper unit of the Lower Devonian succession, as divided By K. Konior (1965, 1966, 1968, 1969), in which exclusively a rich and well preserved Psilophyton flora had been found (K. Konior 1965, 1966). The boreholes Kęty 9 and Andrychów 2 were sampled in all distinguished units (text-fig.2) the possibility of achieving a detailed stratigraphy, based on spores, being considered. For the same purpose one sample from the base of the Middle Devonian carbonate series of the Kęty 9 borehole was taken within which an intercalation of sandstone of a typical Lower Devonian appearance had been found.

Similar intercalations occured also in other boreholes. In Bielsko 5, within dark gray dolomites intercalating with dark gray shales a layer of gray unequigranular sandstone was found at a depth between 1452,5——1455,5 m. Layers of dark gray siltstones and shales among dolomites were found also in the Andrychów 2 borehole at a depth between 2258,5——2263,9 m. I—IV *, in the Andrychów 3 borehole at depths between 2203,2—2207,5 m. I and 2215,5—2217,1 m. I, II — (cf. K. Konior 1965, 1966, 1969) and in the borehole Andrychów 4 at depths between 2201,0——2205,2 m. I—III and 2230,0—2234,9 m. I—V. The facts mentioned above make it clear that the transition between the Lower and Middle Devonian rocks in this region is gradual, this having been suggested earlier by K. Konior (1965). Therefore it is difficult to locate the Lower/Middle Devonian boundary with certainty; the accepted upper limit of the Lower Devonian deposits is the arbitrary one placed at the base of the first layer of carbonate rocks typical for the Middle Devonian deposits.

Of the seventy-five samples prepared for microscopic investigation only twenty-three yielded sporomorphs; the assemblages recovered from three of these samples were very poor in spore specimens. The state of

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[1] This part of the sandstone-siltstone series have been recently assigned by K. Kotas (1973) to the Cambrian, on the basis of trilobites. According to the latter author the deposits of the Goczałkowice IG-1 borehole, in which trilobites have been found, are closely comparable with the lower part of the Bielsko-Mogilany terrigenous deposits in question. Until this suggestion is thoroughly investigated the problem must be left open.

* A drill core is stored in one meter long sections; sections of a given range are labelled by Roman numerals (downwards).

preservation of the microflora was bad, especially in samples from the Piotrowice 1 and Wysoka 1 boreholes. The spores were highly coalified, dark an often opaque. An additional two hour treatment with Schulze solution did not improve the appearance of the spores but caused disintegration of spore exines.

The levels in which the samples with microflora were found are marked in text-fig. 2 and listed in table 1.

Two distinctly different assemblages are distinguishable in the studied Devonian succession of the Bielsko-Wadowice region. The first (upper) containes ca 90% to 100% of land plant spores, the second (lower) is composed exclusively of some water plant remains.

The first assemblage was present in all fertile samples of the boreholes Bielsko 4, 5, Andrychów 4, 2, in two samples of the Kęty 9 borehole (at depths between 1564,8—1570,8 m. II and 1586,7—1591,9 m. III), in two samples of the Piotrowice 1 borehole (at depths between 2351,1——2355,7 m I and 2364,0—2368,5 m. I) and in two samples of Wysoka 1 borehole (at depths 2033,9—2038,2 II and 2129,4—2133,5 m. I). All these samples came exclusively from the upper unit (cf. „6" in text-fig. 2) except for one sample from the Wysoka 1 borehole from a depth between 2129,4—2133,5 m. I. It must be however taken into consideration that this sample might had been misplaced before it was collected for microscopic investigation.

This assemblage is characterised by the presence of large forms of *Dibolisporites,* cavate/zonate spores, and also spores with grapnel-shaped appendages (Pl. XXV, Figs. 1—12, Pl. XXVI, Figs. 1—4).

Middle Devonian miospore assemblages described from various parts of Western Europe and Spitsbergen (K. C. Allen 1965, F. H. Cramer 1969, A. Eisenack 1944, R. Raucher, J. Doubinger 1969, J. B. Richardson 1960, 1965, W. Riegel 1968, M. Streel 1964) are closely comparable in composition and contain numerous species in common with the first assemblage of Bielsko-Wadowice area. There are also some species in common with the Middle Devonian assemblages of the Russian Platform (A. D. Arkhangelskaja 1963, G. I. Kedo 1955, S. N. Naumowa 1953).

But most closely comparable to our first assemblage are those recorded from the Upper Emsian and possibly Lower Eifelian deposits of North Canada (D. C. McGregor, B. Owens 1966), from Uppermost Emsian rocks of the Arctic Archipelago (D. C. McGregor, T. T. Uyeno 1972) and of the Eifel region (E. P. Lanninger 1968) dated on marine fossils. According to D. C. McGregor et al. (1970) the spores of the genus *Procoronaspora* are most significant; they occur broadly in the Emsian deposits of Canada and they are also recorded from sediments of Emsian age of Europa and Africa (S. Jardiné, L. Yapaudjian, 1968, G. Schulz, 1968, M. Streel, 1967). Spores of *Procoro-*

Microfloral assemblage \ Samples	Bielsko 5 1503,5–1505,7 I	Bielsko 4 1865,8–1870,3 II	Bielsko 4 1865,8–1870,3 III	Kęty 9 1564,8–1570,8 II	Kęty 9 1586,7–1591,5 III	Kęty 9 1617,0–1622,8 I,V,VI	Kęty 9 1630,9–1635,7 I,II,IV	Kęty 9 1640,0–1646,0 I,III	Andrychów 3 2248,7–2251,5 I	Andrychów 4 2245,8–2250,8 II,III	Andrychów 2 2300,8–2306,6 III	Piotrowice 1 2351,1–2355,7 I	Piotrowice 1 2364,0–2368,5 I	Piotrowice 1 2410,4–2413,6 III	Wysoka 1 2033,9–2038,2 III	Wysoka 1 2043,2–2046,5 I	Wysoka 1 2129,4–2133,5 I
Leiotriletes sp.		3	1,5		5,5					X			1,5		X		
Calamospora sp.	X	22	11,5		6					X			>1				
Retusotriletes sp.	X	10	5	X	7					X		X	5,5				X
Procoronaspora type					>1						X		2				
Dibolisporites echinaceus	X	5	6	X	>1					X	X	ca 60	2,5		X		X
Dibolisporites cf. gibberosus var. major	X	8	12,5	X	21					X	X	X	12				
Dibolisporites sp. cf. Retusotriletes antiquus	X	0,5	2	X	1,5						X	X	>1				
Hystricosporites corystus		>1	1,5														
Hystricosporites sp.				X	>1					X	X						
Emphanisporites annulatus		0,5															
Emphanisporites rotatus					>1					X	X						
Perotrilites aff. mutabilis		5															
Perotrilites–Cyclogranisporites type	X	5,5	10,5		0,5						X		7				X
Aneurospora cf. semizonalis													10				
Hymenozonotriletes argutus	X	2	5,5		3												
Hymenozonotriletes praetervisus													10				
Samarisporites sp.			10,5												ca 76		
Calyptosporites velatus	X				>1												
Spinozonotriletes cf. naumovii			>1	X	1						X		1		X		
Grandispora sp.					>1						X						
Ancyrospora ancyrea var. ancyrea		1,5			>1												
Ancyrospora sp.	X	2	1	X	3						X						
Protoleiosphaeridae and Leiosphaeridaceae		4,5	1	X	11	100	100	100	100	X			4	X	X	X	X

Table 1. Spore distribution in samples from Bielsko-Wadowice region. The constituent genera and species are recorded as percentages based on a count of 200 specimens and those indicated as ca. on count of 100 specimens. X indicates that a genus or species is present in a sample, but not in the actual count

Tabela 1. Rozprzestrzenienie spor w próbkach wierceń z rejonu Bielsko-Wadowice. Występowanie spor z poszczególnych rodzajów i gatunków zostało zanotowane w procentach na podstawie przeliczenia 200 egzemplarzy w każdej próbce. Procentowa zawartość zaznaczona jako ca. oparta jest na policzeniu 100 egzemplarzy. X oznacza występowanie gatunku (rodzaju) niezależnie od stanu ilościowego

naspora type occur also in the Devonian rocks of the Bielsko — Wadowice region (cf. Table 1). Moreover, the discussed assemblage contains species or spore types recorded exclusively or most commonly from rocks of Upper Emsian age of Canada and the Eifel region, namely spores *Perotrilites-Cyclogranisporites* type (cf. D. C. McGregor, B. Owens, 1966, Pl. II. Figs. 7, 17, 18, 19, and D. C. McGregor, T. T. Uyeno, 1972, Pl. I, Fig. 3.), some spores belonging to *Dibolisporites* assigned by E. P. Lanninger (1968) to *Retusotriletes antiquus* Kedo, spores belonging to *Samarisporites* determined by the same author as *Hymenozonotriletes argutus* Naumowa and *Hymenozonotriletes praetervisus* Naumowa, and also *Ancyrospora* sp. a form with a wide flange, comparable with *Ancyrospora* sp. in McGregor and Owens (1966), Pl. VIII, Figs. 1, 5.

Therefore it seems that the beds containing the upper assemblage are of uppermost Emsian age. On the other hand there are very few data on Lower Eifelian spore assemblages, the majority of papers hitherto deal with those of Givetian or Middle to Upper Eifelian, which makes precise establishing of the age of the upper assemblage difficult.

The second assemblage was recovered from eight samples from the Kęty 9 borehole (from depths between 1617,0—1622,8 m. I, V, VI, 1630,9—1635,7 m. I, II, IV and 1640,0—1646,0 m. I, III). It contains 100% of sphaeromorphic bodies resembling acritarchs of Protoleiosphaeridae Timofeev and Leiosphaeridaceae Eisenack (Pl. XXVI, Figs. 6, 7). These sphaeromorphs are vary abundant in samples from the Kęty 9 borehole and they occur together with organic filaments probably of algal origin (Pl. XXVI, Fig. 5). Similar assemblages, but much poorer in specimens, were found also in the boreholes Andrychów 3 at a depth between 2248,7—2251,5 m. I, Piotrowice 1 at a depth between 2410,4—2413,6 m. III and Wysoka 1 at a depth between 2043,2—2046,5 m. I.

Assemblages dominated by smooth sphaeromorphs are not rare in Lower Devonian deposits. Chibrikova (1970) records assemblages containing 42% to 85% of sphaeromorphs (*Psophosphaera*) from the Lower Devonian deposits of West Bashkir and Ural. Timofeev (1963) mentions the occurrence of abundant simple sphaeromorphs in sediments of the same age of Podole and the Holy Cross Mountains. Some Lower Devonian assemblages described by Franke (1965) are dominated by smooth acritarchs.

Interesting assemblages of the same type are described by Combaz (1967) from Silurian deposits from the Sahara. They sometimes contain more than 90% of Leiosphaeridaceae and Protoleiosphaeridae. This author observed the sphaeromorphs in sacs (spermatocysts?) and sometimes in connection with algal remains and therefore suggested they were spores of some bentonic algae. The horizons with sphaeromorphs extended, according to Combaz 1967 over a distance of hundreds kilometres. In the same horizons a low content of boron was recorded. Combaz suggests

that the hipothetical algae grew in littoral regions along Palaeozoic continents in water freshened by melting glaciers. It seems likely that the horizons with sphaeromorphs of the Bielsko — Wadowice region also originated in a littoral zone. It shall be pointed out that sphaeromorphs of similar type, though much less abundant, occur in the upper assemblage as well. It can be taken as evidence that sedimentation conditions of the deposits in which the two assemblages occur were the same. It is remarkable that in connection neither with the upper nor with the lower assemblages have any typically open sea microfossils such as chitinozoa, hystrichosphaeridia or acritarcha with long appendages, been found, which supports the suggestion of littoral facies present.

It is striking that in the horizons with the lower assemblage no land plant spores occur. If we assume that this assemblage is not much older than the upper one, the lack of land plant remains seems most surprising. Unfortunately this assemblage gives no suggestion regarding its age; simple sphaerical bodies of this kind are recorded from rocks of early Palaeozoic to recent age.

The hitherto obtained results of palynological investigations of the Lower Devonian deposits from the Bielsko — Wadowice region give evidence of Uppermost Emsian age of the upper part of the complex and explain to a certain degree the conditions of their sedimentation. In the lower part of this complex no sporomorphs have as yet been discovered.

translated by E. Turnau

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STRESZCZENIE

Mikroflora znaleziona w terygenicznych osadach dewonu z wierceń rejonu Bielsko-Wadowice (fig. 1, 2) reprezentuje dwa różne zespoły sporomorf (tab. 1, tabl. XXV i XXVI). Zespół wyższy, dominowany przez spory roślin lądowych, zbliżony jest najbardziej do zespołów opisywanych z utworów najwyższego emsu. Zespół niższy, zawierający wyłącznie mikroszczątki roślin wodnych, reprezentuje prawdopodobnie roślinność bentonicznych glonów strefy litoralnej. Przeprowadzone dotychczas badania mikroflorystyczne utworów dolnego dewonu z wierceń obszaru Bielsko-Wadowice wskazują na górnoemski wiek górnej części tych utworów, a ponadto wyjaśniają do pewnego stopnia warunki ich powstawania. W niższej części omawianych utworów nie odkryto do tej pory sporomorf.

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EXPLANATION OF PLATES

OBJAŚNIENIE TABLIC

Plate — Tablica XXV

All figures × 500 except when indicated.

Wszystkie powiększenia 500 × z wyjątkiem tych figur, które objaśniono w inny sposób.

Fig. 1. *Leiotriletes* sp. Kęty 9, depth (głębokość) 1596,7—1591,8 m. III. slide (preparat) BA/20

Fig. 2. *Retusotriletes* sp. Kęty 9, depth (głębokość) 1586,7—1591,8 m. III. slide (preparat) BA/15

Fig. 3,4. *Perotrilites-Cyclogranisporites* type. Kęty 9, 1586,7—1591,8 m. III. slide (preparat) BA/15

Fig. 5. *Emphanisporites annulatus* McGregor. Bielsko 4, depth (głębokość) 1865,8—1870,3 m. II, slide (preparat) BA/65

Fig. 6,7. *Emphanisporites rotatus* McGregor. Kęty 9, depth (głębokość) 1586,7—1591,8 m. III. slide (preparat) BA/16. BA/17

Fig. 8. *Anapiculatisporites-Proccronaspora* type. Piotrowice 1, depth (głębokość) 2364,0—2368,5 m. I, slide (preparat) BA/78, × 1000

Fig. 9. *Dibolisporites echinaceus* (Eisenack) Richardson. Kęty 9, depth (głębokość) 1586,8—1591,8 m. III, slide (preparat) BA/19

Fig. 10. *Dibolisporites* cf. *gibberosus* f. *major* (Kedo) Richardson, Kęty 9, depth (głębokość) 1596,7—1591,8 m. III, slide (preparat) BA/21

Fig. 11. *Hystricosporites corystus* Richardson. Bielsko 4, depth (głębokość) 1865,8—1870,3 m. III, slide (preparat) BA/67, × 350

Fig. 12. *Ancyrospora* sp. Bielsko 4, depth (głębokość) 1865,8—1870,3 m. II. slide (preparat) BA/61

Plate — Tablica XXVI

All figures × 500 except when indicated.

Wszystkie powiększenia 500 × z wyjątkiem tych figur, które objaśniono w inny sposób.

Fig. 1. *Calyptosporites velatus* (Eisenack) Richardson. Bielsko 5, depth (głębokość) 1503,5—1505,7 m. I, slide (preparat) BA/70

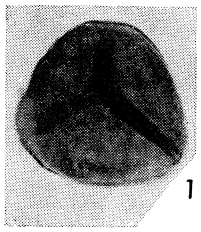
Fig. 2. *Grandispora* sp. Andrychów 2, depth (głębokość) 2300,8—2306,6 m. III, slide (preparat) BA/53

Fig. 3. *Hymenozonotriletes argutus* Naumova. Kęty 9, depth (głębokość) 1586,7—1591,8 m. III. slide (preparat) BA/17, × 350

Fig. 4. *Ancyrospora ancyrea* (Eisenack) Richardson. Kęty 9, depth (głębokość) 1586,7—1591,8 m. III. slide (preparat) BA/19

Fig. 5. An assemblage of sphaeromorphs with algal (?) filaments (Zespół sferomorf z nitkami alg?). Kęty 9, depth (głębokość) 1630,9—1635,7 m. I. slide (preparat) BA/38

Fig. 6,7. *Protoleiosphaeridium* sp. Kęty 9, depth (głębokość) 1630,9—1635,7 m. I. slide (preparat) BA/38, × 1000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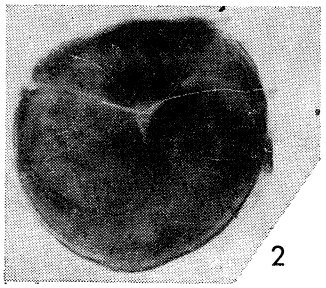
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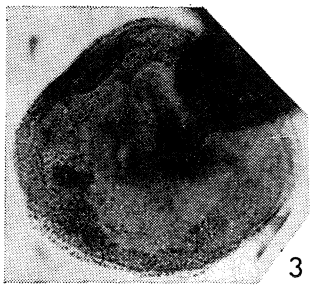
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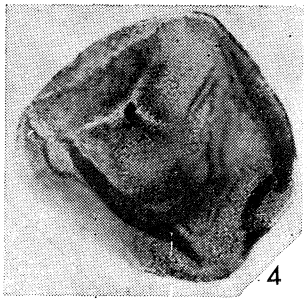
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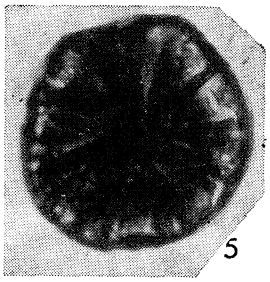
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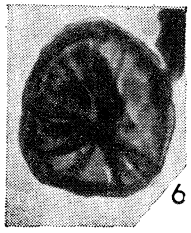
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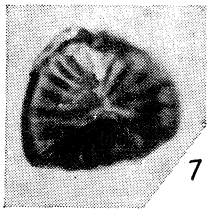
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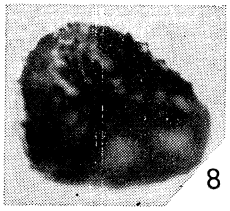
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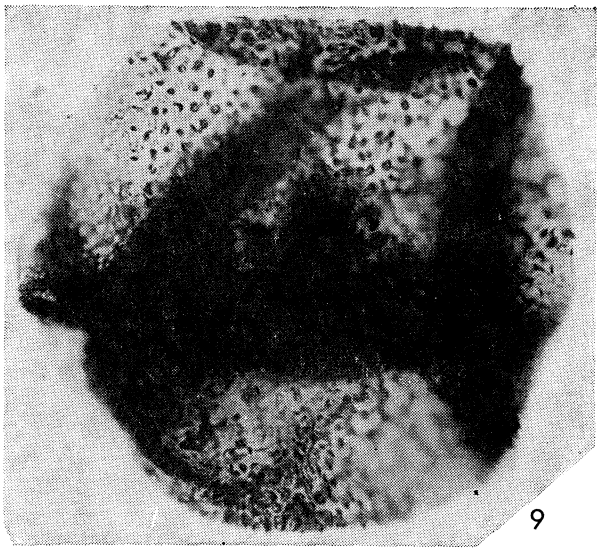
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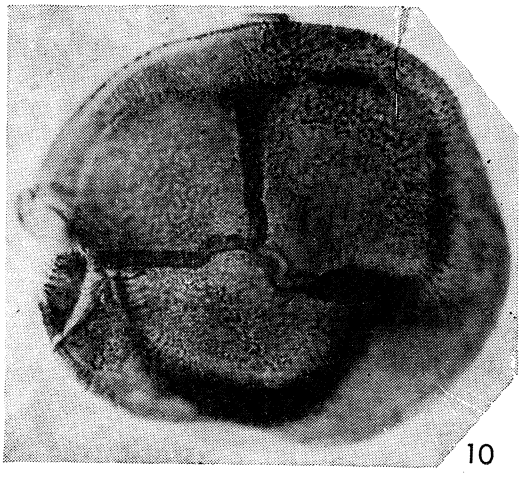
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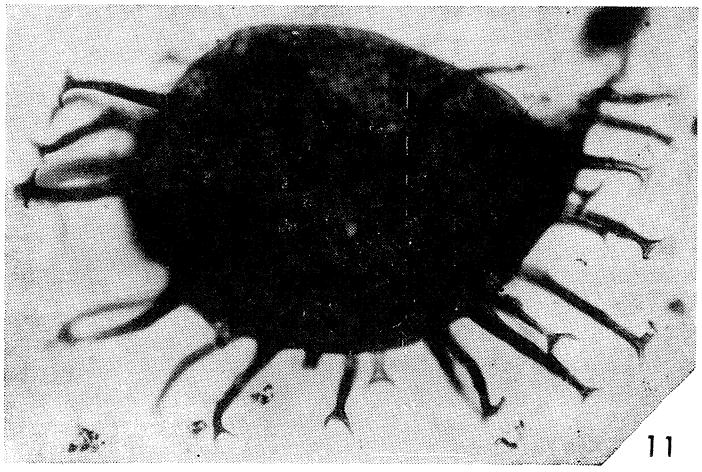
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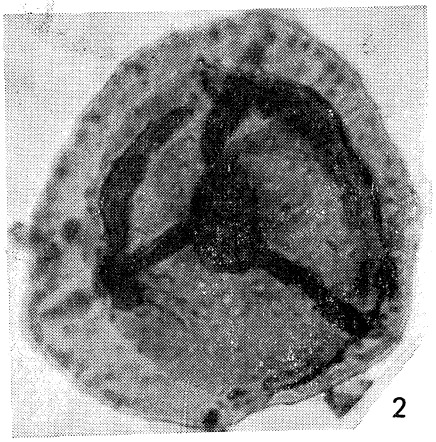

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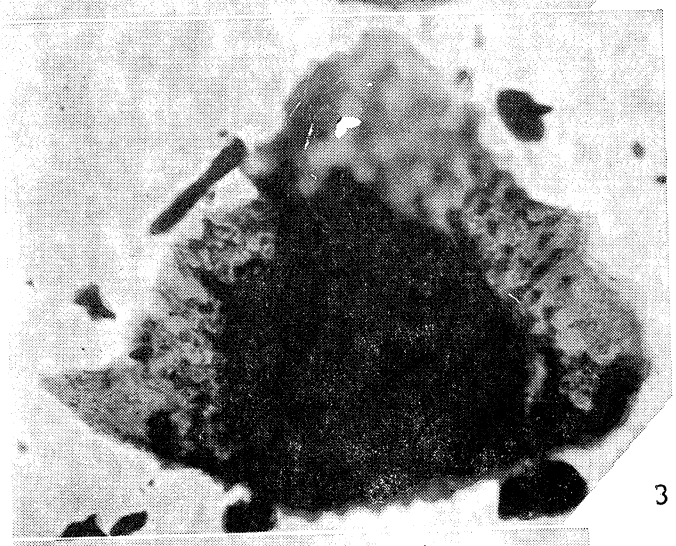

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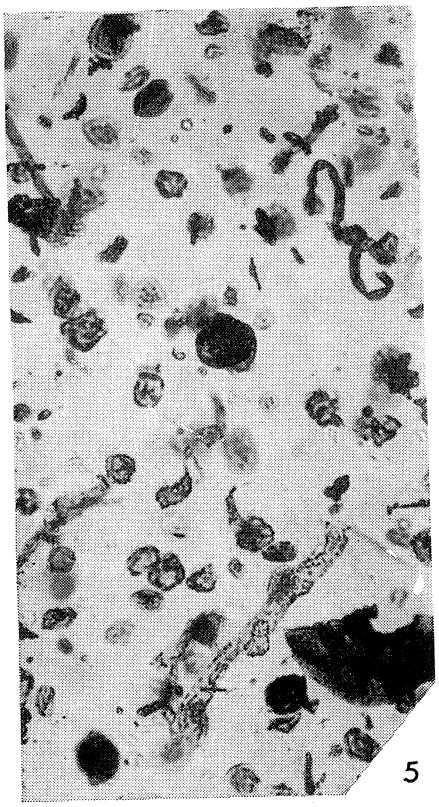

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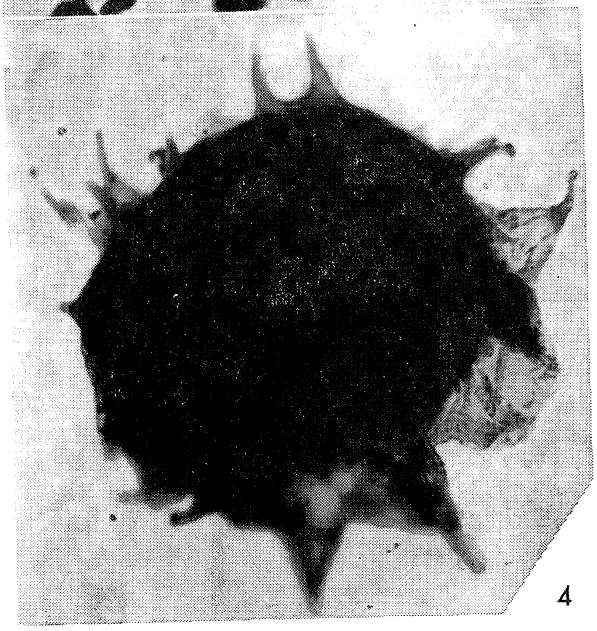

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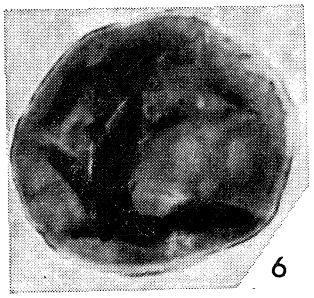

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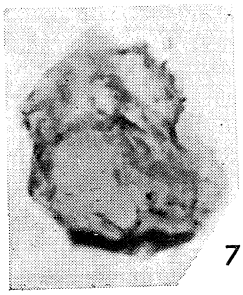

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