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CARBONIFEROUS SPORES FROM THE CHEŁM I BORING (EASTERN POLAND)

Contents

Abstract. — A description is given of 34 species of 10 genera of megaspores, of this number 8 new species and one new variety, from Carboniferous of the Chełm I boring. A hundred and sixty eight species of microspores of 59 genera are identified. A new genus and 6 new species of microspores are described. Quantitative (specific and generic) microspore analyses have been carried out whose results are shown in Tables 2 and 3, as well as a megaspore qualitative analysis presented in Table 1. A stratigraphic correlation is made with the Upper Silesian Coalfield (Western Poland), with the U.S.S.R.'s coalfield and with Carboniferous of Spitsbergen. It is used as a basis for distinguishing in the Carboniferous series of the Chełm I boring, of the following stratigraphic units: Upper and Lower(?) Viséan, Namurian A, B and C, and Westphalian A (+B?).

INTRODUCTION

In June, 1957, I received the material for the present work, from the Lowland Department of the Geological Institute in Warsaw. It comes from the Carboniferous deposits of the Chełm I boring, situated on the Uherka River, 1 km from Chełm. In this boring, Carboniferous formations occur at depth, ranging from 1,207.70 to 580.20 m. The lithological profile of these formations has been worked out by Korejwo (1960*a*). I used it for taking samples, necessary for microfloristic studies.

The aim of the present work is to establish, on the basis of microflora, an accurate age of particular Carboniferous layers of the Chełm I boring section and to study the spores found in it. The laboratory work has been carried out at the Laboratory of Palaeobotany of Warsaw University. I took about 500 samples (approximately, at 1 m intervals), of which 200 were macerated for mega- and 200 for microspores.

As a result of the mega- and microspore analyses, I succeeded in drawing boundaries between Namurian and Westphalian, Viséan and Namurian, as well as in distinguishing Lower(?) and Upper Viséan, Namurian A, B and C and Westphalian A (+B?).

A very rich megaspore material and a lack of more extensive and up-to-date studies on megaspores, which occur in Poland, have induced me to a detailed study of this material. I described 34 species, of this number 8 new ones, as well as one new variety. On account of the existence of a relatively recent work by Dybová and Jachowicz (1957*a*) who deal with microspores of the Upper Silesian productive Carboniferous (Namurian A — Westphalian D), I confined myself to the assignment of the microspores found (168 species). In this material, 1 genus and 6 species turned out to be new ones. For stratigraphic purposes a quantitative spore analysis was carried out.

The collection of the spores described is kept at the Laboratory of Palaeobotany of Warsaw University, designated with the symbols *Z.Pb.A* to *O*.

The present work has been carried out under the guidance of Prof. M. Kostyniuk ,Director of the Laboratory of Palaeobotany of Warsaw University, to whom I would like to express my warmest thanks for numerous indications and advice. Likewise, I thank Prof. W. Pożaryski, Director of the Laboratory of Micropalaeontology of Warsaw University, and Prof. S. Z. Stopa, from the Mining and Metallurgy School in Cracow, for their valuable remarks. My gratitude is also due to the employees of the Upper Silesian Field Station of the Geological Institute at Sosnowiec, Doc. Dr. S. Dybová-Jachowicz, Doc. Dr. A. Jachowicz and Miss Z. Żołdani, for numerous discussions and putting within my reach comparative materials from the borings they worked out. I am also indebted to Miss L. Łuszczewska for taking microphotographs.

WORKING METHODS

In order to obtain the spores, I macerated about 400 samples, mostly applying Schulze's method, modified by T. Bocheński, as well as S. Dybová and A. Jachowicz. This method is based on the oxidizing action of the fuming nitric acid (with a specific gravity amounting to 1.5) applied to coals and coal shales. To obtain megaspores, I macerated a rock, crushed into grains about 2.5 mm in thickness and, to obtain microspores, into grains, lesser than 2.5 mm in thickness. The maceration time did not exceed 8 hours. Afterwards, samples were washed in water and cleaned by means of a 5-per cent sodium hydroxide. Shales and sandstones were macerated in a 40-per cent hydrofluoric acid.

In the case of microspores, satisfactory results were obtained in 33 and — of megaspores — in 18 samples. The richest in spores turned out to be coals and coal shales whose samples were the most suitable for the quantitative spore analysis. Other types of rocks as clayey shales and sandstones are marked by the lack or a very low content of spores.

During the observation of thin-membraneous megaspores, it turned out that positive results were obtained by cleaning particular specimens by means of the sodium hydroxide which dissolved substances filling the spores. After washing these spores and putting them in glycerine, they may be observed in a transmitted light which makes the ornamentation very well visible. This cleaning operation should be performed very carefully, cautiously and relatively quickly lest the spore exines become destroyed. Such spores should be kept in glycerine which prevents them from drying up. Since they are fine, when dried up, they contract and become destroyed.

STRATIGRAPHY

The microfloristic material from the Carboniferous part of the Chełm I boring is very abundantly represented by both mega- and microspores. After the qualitative mega- (Table 1) and microspore, as well as the quantitative microspore (Tables 2 and 3) analyses, it turned out that this material is suitable for making a stratigraphic correlation with other coalfields. Microflora of the upper part of the column (from a depth of 1,073.70 m) displays a considerable similarity to the Upper Silesian Carboniferous. The assemblage of spores occurring below 1,073.70 m may be only compared with analogous assemblages of spores from the U.S.S.R.'s (Ishchenko, 1952, 1956, 1958 and 1962) and Spitsbergen's (Playford, 1962, 1963*a*) coalfields.

Spore assemblages from Carboniferous of the Chełm I boring

1) The assemblage of microspores, occurring in the series of deposits,

situated at depths ranging between 1,205.60 and 1,099.25 m, very rich and differentiated, is represented by 39 genera and 90 species. Of this number, 10 genera and 54 species do not pass to overlying layers. There occur many (about 50 per cent) species common with the Donetz Coalfield and the eastern part of the Bug Coalfield (Ishchenko, 1952, 1956 and 1958) such as, *Murospora astricta, M. dupla, Potoniespores latus, Cincturasporites mediasulcatus, C. sulcatus, Reticulatisporites cancellatus, Densosporites substrictus, D. duriusculus, Convolutispora clavata, Knoxisporites hederatus and Stenozonotriletes castus.* These species occur in the Soviet Union's Carboniferous only in Viséan, whereas at Chełm they are limited to the formations at the depth under study. The remaining species, common for Chełm and Soviet coalfields, make up the Viséan-Namurian assemblage (about 14 species) which, among other ones, include *Knoxisporites literatus, Cingulizonates bialatus, Tripartites articulosus* nad others.

The assemblage of microspores from the beds discussed is also similar to that of the Lower Carboniferous from Spitsbergen. There are about 50 common species with a similar stratigraphic range. Playford (1963*a*) settles certain index species for Tournaisian, Viséan and common ones for both these stages. He also assumes that the formations, he studied, also include Namurian A. Of index species, settled by Playford, 22 are common for Spitsbergen and Carboniferous of the Chełm I boring. Three of them, *Punctatisporites labiatus, Lophozonotriletes rarituberculatus* and *Knoxisporites hederatus* occur in Spitsbergen only in Tournaisian. Others as *Cyclogranisporites flexuosus, Reticulatisporites cancellatus, Radialetes costatus, Convolutispora tuberculata, Tripartites incisotrilobus, Endosporites micromanifestus* and *Knoxisporites literatus* occur all over the Spitsbergen section from Tournaisian to Namurian A(?). The most numerous group of common species (12) is formed by index microspores for Viséan and Namurian A of Spitsbergen, i.e. *Reticulatisporites variolatus, R. peltatus, Foveosporites insculptus, Densosporites aculeatus, D. rarituberculatus, Lophozonotriletes appendices, Diatomozonotriletes saetosus, D. hughessi, Tripartites complanatus, Murospora aurita, Cingulizonates bialatus* and *Lycospora uber.*

On the basis of the comparison of the Carboniferous microspore assemblage from the Chełm I section from depths, ranging between 1,205.60 and 1,099.25 m, with microspores from the Donetz Coalfield and from Spitsbergen, it was possible to determine the age of the formations from Chełm as Viséan. This is testified to by a considerable microfloristic differentiation and the occurrence of a large number of species, known from Viséan of the U.S.S.R. and Spitsbergen.

The assemblage of spores, occurring in the borings at depths, ranging between 1,205.60 and 1,195.10 m, differs from the material, coming from

Table 1

DISTRIBUTION OF MEGASPORE SPECIES IN THE CARBONIFEROUS SECTION OF THE CHEŁM I BORING

Age		Sample No.	Depth (in metres)	*Calamospora sinuosa*	*C. laevigata*	*C. magna*	*C. ovata*	*Laevigatisporites glabratus*	*L. fulgens*	*Apiculatisporites brevispiculus*	*A. breviapiculatus*	*A. subspinus*	*A. parviapiculatus*	*Lagenicula horrida*	*L. horrida* var. *hippocastaniformis*	*L. subpilosa*	*L. crassiaculeata*	*L. baculata*	*L. clavata*	*L. brevispinosa*	*L. maeandrica*	*Lagenoisporites simplex* var. *levis*	*L. rugosus*	*L. vastus*	*L.* cf. *nudus*	*Lagenoisporites* sp. *1*	*Lagenoisporites* sp. *2*	*Lagenoisporites?* sp. *4*	*Lagenoisporites?* sp. *3*	*Setosisporites praetextus*	*S. hirsutus*	*S. hirsutus* var. *brevispinosa* f. *I*	*S. hirsutus* var. *brevispinosa* f. *II*	*S. reticulatus*	*S. dybovae*	cf. *Setosisporites* sp. *2*	*Setosisporites?* sp. *1*	*Valvisisporites auritus*	*Zonalesporites brasserti*	*Z. brasserti* f. *solida*	*Z. radiatus*	*Z. superbus*	*Triangulatisporites triangulatus*	*Cystosporites giganteus*	*C. varius*	*C. verrucosus*	*C. strictus*	*Cystosporites* sp.	*Triletes* sp. *1*	*Triletes?* sp. *2*	*Megaspore?*
WESTPHALIAN	A (B?)	38	611.90— 612.50	+	+		+	+		+	+	+		+	+	+		+	+	+			+						+	+	+							+	+			+	+	+	+	+			+	+	
		39	612.50— 613.55	+		+					+			+	+	+		+	+	+			+							+								+	+					+	+						+
		40	613.55— 614.30	+	+			+			+			+	+	+		+	+	+			+								+							+	+			+			+					+	
	A	56	629.80— 630.10					+			+			+	+	+							+							+	+											+		+	+						
		148	727.50— 728.20								+			+	+	+																																			
		154	732.60— 738.70					+						+	+	+				+						+		+			+													+	+			+			
NAMURIAN	C	192	776.00— 778.00											+		+																																			
		230	815.80— 817.40																											+									+												
		239	824.50— 829.30																											+	+								+					+	+						
	B	263	852.00— 855.50							+				+																	+													+							
		266	855.50— 857.50											+																																					
	A	399	1002.50—1002.60			+									+	+														+					+		+		+					+							
		425	1026.80—1026.95							+				+																									+												
		472	1073.50—1073.70											+																											+										
VISÉAN	Upper	527	1134.95—1135.10						+																					+					+				+		+										
		571b	1193.00—1193.50														+									+								+										+			+				
		573	1195.10—1195.20		+				+				+								+	+		+	+		+					+	+						+	+	+			+							
	?Lower	575	1198.00—1198.20						+				+								+	+														+			+	+	+										

depths, varying within limits of 1,195.10 and 1,099.25m, in the predominance of the *Pseudoannulatisporites polonicus* n.sp., spores which do not occur in overlaying layers, and in the presence of spores which, in the U.S.S.R. and Spitsbergen, were found only in Tournaisian and Lower Viséan. The lastnamed species occur at Chełm only occasionally and probably constitute the relics of Tournaisian. Twenty seven species do not pass to beds situated higher than at a depth of 1,195.10. Instead, there occur 9 other species (Table 3). These differences might show that the complex of deposits, situated at this depth could be assigned to Lower Viséan, whereas the complex of deposits, situated at a depth of 1.195.10 to 1,099.25 m, to Upper Viséan.

2) The complex of deposits, coming from depths between 1,073.70 and 1,002.50 m, is marked by a very rich assemblage of microspores, which is similar in character to those, occurring in Carboniferous of the U.S.S.R., Spitsbergen and Upper Silesia. With regard to the specific composition, the assemblage of microspore from this depth displays a similarity to that, formed in the three areas, referred to above. At this depth, there occur many species known from Namurian A of Upper Silesia (*Schulzospora primigenia, Cingulizonates tuberosus, Lycospora parva, Tripartites cristatus*, etc.), as well as a certain number of species, known from Carboniferous of the U.S.S.R. (such as, abundantly represented, *Granisporites paululus* and *Densosporites diatretus*, and, in a small number but constantly occurring, *Rotaspora fracta*) and of Spitsbergen such as, abundantly represented, *Lycospora uber* which is an index species for Viséan and Namurian A. The assemblage of microspores from the complex of deposits under study displays a considerable similarity to that, found in Namurian A of Upper Silesia (Dybová & Jachowicz 1957 *a, b;* Jachowicz, 1958). The occurrence of about 50 per cent of microspores of the genus *Lycospora*, about 30 per cent of spores of the genus *Densosporites* and still less of the representatives of the genera *Tripartites, Schulzospora* and *Sporonites* are their common features. On the basis of these facts, I consider the complex of deposits, occurring at depths between 1,073.70 and 1,002.50 m to be Namurian A.

3) Deposits, situated at depths from 950.70 to 852.00 m, are marked by a relatively slightly differentiated, poor assemblage of microspores (17 genera and 26 species), similar to an assemblage of spores, which occurs within the range of "anticlinal beds" (Namurian B) of the Upper Silesian productive Carboniferous (Dybová & Jachowicz, 1957*b*; Jachowicz, 1958). A quantitative supremacy of microspores of the genus *Densosporites* (+*Anulatisporites*) and a smaller number of spores of the genera *Lycospora* and *Tripartites* are common characters of these two assemblages. In contrast to Upper Silesia, in this place, there still do not occur the spores, assigned to the species *Cirratriradites saturni* and *Dictyotri-*

Table 2

DISTRIBUTION OF MICROSPORE SPECIES IN THE CARBONIFEROUS SECTION OF THE CHELM I BORING

o — 5% | — 5 — 10% + 10 — 20% ✳ 20 — 50% • 50 — 100%

Sample No.	581	580	575	573	571b	527	497	472	432	426	425	413	399	351	266	263	239	230	207	198	197	192	165	154	148	118	56	46	40	39	38	30	5
Age	VISEAN ? Lower			Upper				NAMURIAN A						B			C							WESTPHALIAN A					A(?B)				
Depth (in metres)	1,203.60 — 1,205.60	1,198.70 — 1,203.60	1,198.00 — 1,198.20	1,195.10 — 1,195.20	1,193.00 — 1,193.50	1,134.95 — 1,135.10	1,099.25 — 1,099.35	1,073.50 — 1,073.70	1,038.50 — 1,040.40	1,027.20 — 1,027.25	1,026.80 — 1,026.95	1,014.80 — 1,015.80	1,002.50 — 1,002.60	947.00 — 950.70	855.50 — 857.50	852.00 — 855.50	824.50 — 829.30	815.80 — 817.40	790.10 — 791.50	781.50 — 782.50	780.60 — 781.50	776.00 — 778.00	743.50 — 745.60	732.60 — 738.70	727.50 — 728.20	696.30 — 697.30	629.80 — 630.10	617.00 — 620.10	613.55 — 614.30	612.50 — 613.55	611.90 — 612.50	598.50 — 611.90	580.20 — 584.20

Species
Lycospora uber (Hoffmeister, Staplin & Malloy) Staplin, 1960
Radialetes costatus Playford, 1963
Cyclogranisporites flexuosus Playford, 1962
Densosporites minutus (Ishchenko) nov. comb.
Pseudoannulatisporites polonicus n. sp.
Punctatisporites glaber (Naumova) Playford, 1962
Cyclogranisporites lasius (Waltz) Playford, 1962
Knoxisporites hederatus (Ishchenko) Playford, 1963
Leiotriletes ornatus Ishchenko, 1956
Densosporites rarispinosus Playford, 1963
Densosporites annulatus (Loose) S., W. & B., 1944
Murospora strigata (Waltz) Playford, 1962
Calamospora microrugosa (Ibrahim) S., W. & B., 1944
Punctatisporites labiatus Playford, 1962
Acanthotriletes maturus Ishchenko, 1952
Acanthotriletes novicus Ishchenko, 1952
Convolutispora usitata Playford, 1962
Hymenozonotriletes substrictus Ishchenko, 1956
Lophozonotriletes appendices (Hacquebard & Barss) Playford, 1963
Lophozonotriletes rarituberculatus (Luber) Kedo, 1957
Convolutispora labiata Playford, 1962
Murospora astricta (Ishchenko) nov. comb.
Potoniespores (al. *Hymenozonotriletes*) *latus* (Ishchenko) nov. comb.
Knoxisporites solutus (Ishchenko) nov. comb.
Cincturasporites sulcatus (Waltz) Hacquebard & Barss, 1957
Leiotriletes subinortus (Waltz) Ishchenko, 1952 var. *rotundatus* Waltz, 1941
Acanthotriletes circumactus Ishchenko, 1952
Reticulatisporites variolatus Playford, 1962
Foveosporites insculptus Playford, 1962
Densosporites aculeatus Playford, 1963
Reticulatisporites cancellatus (Waltz) Playford, 1962
Murospora dupla (Ishchenko) Playford, 1962
Diatomozonotriletes saetosus (Hacquebard & Barss) Hughes & Playford, 1961
Diatomozonotriletes hughessii Playford, 1963
Endosporites micromanifestus Hacquebard, 1957
Knoxisporites cinctus (Waltz) Butterworth & Williams, 1958
Microreticulatisporites lunatus Knox, 1950
Murospora aurita (Waltz) Playford, 1962
Convolutispora tuberculata (Waltz) Hoffmeister, Staplin & Malloy, 1955
Anapiculatisporites concinnus Playford, 1962
Anapiculatisporites serratus Playford, 1962
Tripartites incisotrilobus (Naumova) Potonié & Kremp, 1956
Tripartites complanatus Staplin, 1960
Granulatisporites commodus (Ishchenko) nov. comb.
Leiotriletes inermis (Waltz) Ishchenko, 1952
Reticulatisporites peltatus Playford, 1962
Knoxisporites literatus (Waltz) Playford, 1963
Stenozonotriletes facilis var. *praecrassus* Ishchenko, 1956
Murospora intorta (Waltz) Playford, 1962
Chaetosphaerites pollenisimilis (Horst) Butterworth & Williams, 1958
Leiotriletes microgranulatus Playford, 1962
Cincturasporites mediasulcatus (Waltz) nov. comb.
Acanthotriletes pennatus Ishchenko, 1952
Densosporites salebrosus (Ishchenko) nov. comb.
Cingulizonates bialatus (Waltz) nov. comb.
Lycospora punctata Kosanke, 1950
Schulzospora primigenia Dybová & Jachowicz, 1957
Acanthotriletes obesus Ishchenko, 1952
Reticulatisporites planus Hughes & Playford, 1961
Granisporites contortus (Ishchenko) nov. comb.
Granisporites punctulatus (Ishchenko) nov. comb.
Convolutispora clavata (Ishchenko) Hughes & Playford, 1961
Schulzospora primigenia f. *elongata* Dybová & Jachowicz, 1957
Punctatisporites platirugosus (Waltz) Sullivan, 1964
Densosporites duriusculus (Ishchenko) nov. comb.
Granisporites paululus (Ishchenko) nov. comb.
Acanthotriletes cystostegius Ishchenko, 1956
Granulatisporites microgranifer Ibrahim, 1933
Pustulatisporites irregularis n. sp.
Ibrahimispores brevispinosus Neves, 1961
Densosporites diatretus Playford, 1963
Tripartites rugosus (Horst) Dybová & Jachowicz, 1957
Cingulizonates tuberosus Dybová & Jachowicz, 1957
Verrucosisporites horridus (Ishchenko) nov. comb.
Granulatisporites minutus (Ishchenko) nov. comb.
Stenozonotriletes castus Ishchenko, 1958
Dictyotriletes mediareticulatus (Ibrahim) Potonié & Kremp, 1955
Diatomozonotriletes ubertus Ishchenko, 1956
Brachytrilistrium spinosum Ishchenko, 1952
Punctatisporites platirugosus var. *minutus* (Waltz) nov. comb.
Savitrisporites nux (Butterworth & Williams) Sullivan, 1964
Triquitrites cf. *articulosus* (Ishchenko) Sullivan & Neves, 1964
Rotaspora fracta Schemel, 1950
Granulatisporites piroformis Loose, 1934
Apiculatisporites macrurus (Luber) Potonié & Kremp, 1955
Densosporites bacatus (Dybová & Jachowicz) Agrali, 1964
Densosporites coronarius (Dybová & Jachowicz) nov. comb.
Densosporites glandulosus Kosanke, 1950
Densosporites granulosus Kosanke 1950
Lycospora parva Kosanke, 1950
Reinschospora triangularis Kosanke, 1950
Canaliculatisporites spongiatus Dybová & Jachowicz, 1957
Densosporites spinosus Dybová & Jachowicz, 1957
Granulatisporites granulatus Ibrahim, 1933
Sporonites unionus (Horst) Dybová & Jachowicz, 1957
Calamospora liquida Kosanke, 1950
Tripartites cristatus Dybová & Jachowicz, 1957
Diatomozonotriletes rarus Playford, 1963
Granisporites ferus (Ishchenko) nov. comb.
Apiculatisporites apiculatus f. *minor* Dybová & Jachowicz, 1957
Triquitrites clavatus (Ishchenko) Sullivan & Neves, 1964
Acanthotriletes microspinosus (Ibrahim) Potonié & Kremp, 1954
Laevigatisporites laevigatus Dybová & Jachowicz, 1957
Lycospora granulata Kosanke, 1950
Lycospora intermedia n. sp.
Leiotriletes sphaerotriangulus (Loose) Potonié & Kremp, 1954
Triquitrites pandus (Ishchenko) Sullivan & Neves, 1964
Lophotriletes primitivus Ishchenko, 1956
Microsporites radiatus (Ibrahim) Dijkstra, 1946
Cingulizonates radiatus Dybová & Jachowicz, 1957
Brachytrilistrium minutus Ishchenko, 1956
Dictyotriletes castanaeformis (Horst) Sullivan, 1964
Canaliculatisporites bastionatus Dybová & Jachowicz, 1957
Reinschospora magnifica Kosanke, 1950
Raistrickia pallida Dybová & Jachowicz, 1957
Anapiculatisporites spinosus (Kosanke) Potonié & Kremp, 1955
Cristatisporites solaris (Balme) Butterworth & Smith, 1964
Apiculatisporites apiculatus f. *maior* Dybová & Jachowicz, 1957
Cirratriradites saturni (Ibrahim) S., W. & B., 1944
Granisporites minor Dybová & Jachowicz, 1957
Granisporites medius Dybová & Jachowicz, 1957
Florinites antiquus Schopf, 1944
Dictyotriletes bireticulatus (Ibrahim) Potonié & Kremp, 1955
Apiculatisporites apiculatus f. *media* Dybová & Jachowicz, 1957
Laevigatosporites vulgaris Ibrahim f. *maior* Loose, 1934
Ahrensisporites angulatus (Kosanke) Dybová & Jachowicz, 1957
Raistrickia superba (Ibrahim) S., W. & B., 1944
Tuberculatisporites regularis Dybová & Jachowicz, 1957
Raistrickia aculeata Kosanke, 1950
Radiizonates rotatus (Kosanke) Staplin & Jansonius, 1964
Raistrickia irregularis Kosanke, 1950
Densosporites pseudoconfragosus n. sp.
Cyclogranisporites orbiculus Potonié & Kremp, 1955
Knoxisporites sp.
Savitrisporites minor n. sp.
Triquitrites pulvinatus Kosanke, 1950
Lophotriletes insignitus (Ibrahim) Potonié & Kremp, 1955
Lophotriletes pseudoaculeatus Potonié & Kremp, 1955
Florinites volans (Loose) Potonié & Kremp, 1956
Converrucosisporites armatus (Dybová & Jachowicz) nov. comb.
Tuberculatisporites micronodatus Dybová & Jachowicz, 1957
Pustulatisporites pustulatus Potonié & Kremp, 1954
Densosporites lemniscus Dybová & Jachowicz, 1957
Microreticulatisporites sifati (Ibrahim) Potonié & Kremp, 1955
Latosporites latus (Kosanke) Potonié & Kremp, 1954
Cirratriradites punctatus Dybová & Jachowicz, 1957
Calamospora pedata Kosanke, 1950
Vestispora cancellatus (Dybová & Jachowicz) Dybová & Jachowicz, 1966
Calamospora breviradiata Kosanke, 1950
Converrucosisporites verrucosus (Dybová & Jachowicz) nov. comb.
Calamospora mutabilis (Loose) S., W. & B., 1944
Wilsonia punctata Dybová & Jachowicz, 1957
Florinites pumicosus (Ibrahim) S., W. & B., 1944
Laevigatisporites minimalis f. *obesa* Dybová & Jachowicz, 1957
Laevigatisporites giganteus Dybová & Jachowicz, 1957
Laevigatosporites ovalis Kosanke, 1950
Densosporites reticulatus Dybová & Jachowicz, 1957
Verrucosisporites adenotatus Dybová & Jachowicz, 1957
Eellispores bellus Artüz, 1957
Punctatisporites punctatus Ibrahim, 1932
Microreticulatisporites fistulosus (Ibrahim) Knox, 1950
Cristatisporites indignabundus (Loose) Potonié & Kremp emend. Staplin & Jansonius, 1964
Lycospora brevis Bhardwaj, 1957
Gravisporites triangularis n. sp.
Sahnisporites cf. *saarensis* Bhardwaj, 1954
Vestispora cf. *lucida* (Butterworth & Williams) Potonié & Kremp, 1960
Lophotriletes cf. *primitivus* Ishchenko, 1956
Calamospora sp.

letes bireticulatus. Such species as *Lycospora uber* or *Densosporites rarispinosus,* characteristic of Namurian A, do not pass to these beds.

On the basis of these findings, I consider the complex of deposits, laying at depths from 950.70 to 852.000 m to be Namurian B.

4) The complex of deposits, situated at depths from 829.30 to 743.50 m contains an assemblage of microflora, typical of the lower part of the Ruda Beds (Namurian C) in Upper Silesia (Dybová & Jachowicz, 1957*b*); Jachowicz, 1958). A repeated considerable differentiation of the microspore assemblage, a final disappearance of the Namurian species and an appearance of the Westphalian genera (*Florinites* and *Cirratriradites*) and species are the characteristic features of this complex in which the part of spores of the genus *Densosporites* is decreased, and that of *Lycospora* — increased. In contradistinction to Upper Silesia, the lack is here recorded of spores of the genus *Tripartites* which do not pass to this series of deposits. This is the reason why I assign the complex of deposits laying at depths between 829.30 and 743.50 m to Namurian C.

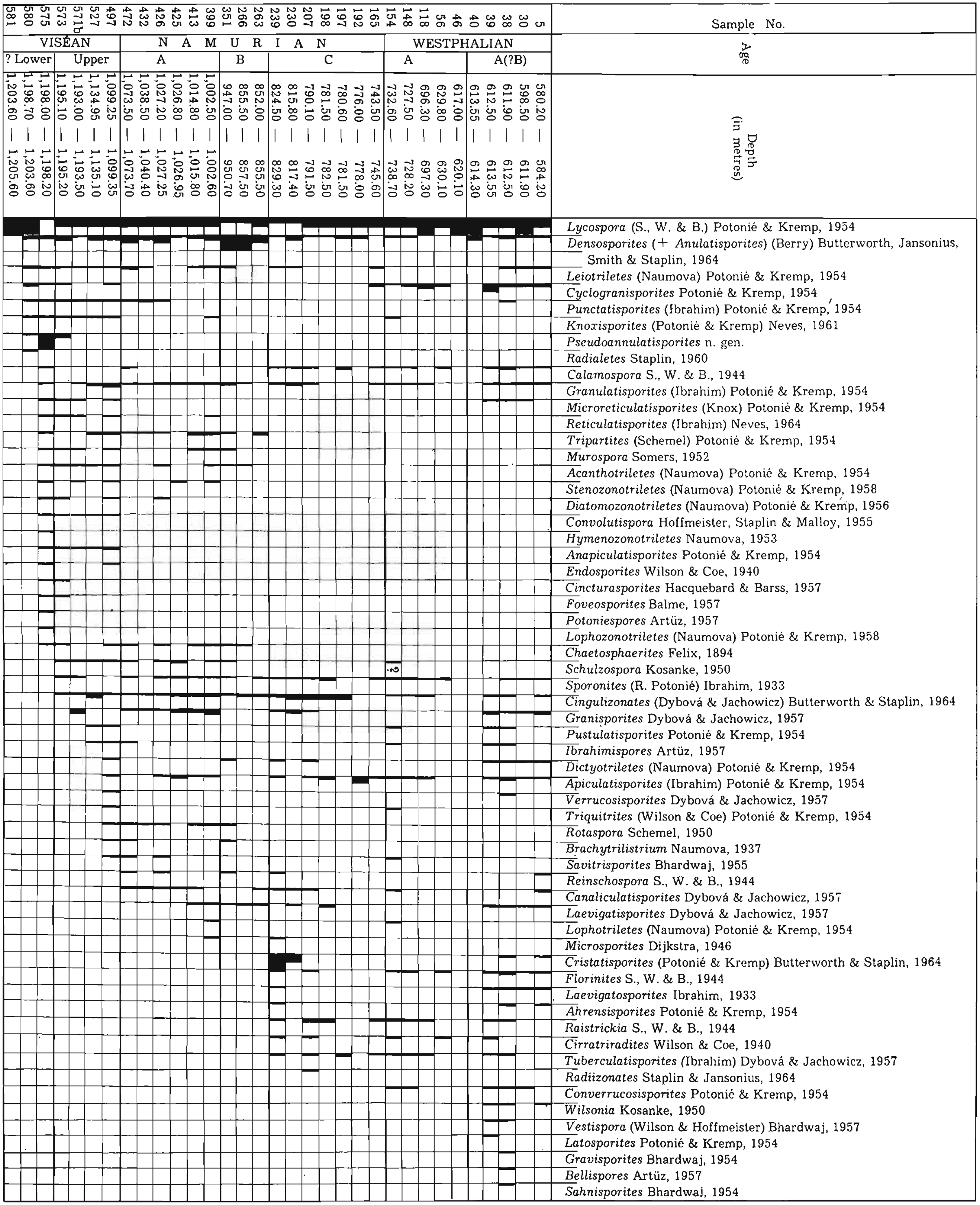
5) The complex of deposits at depths, ranging from 732.60 to 580.20 m, contains an assemblage of microspores typical of the upper part of the Ruda Beds (Westphalian A) of Upper Silesia. A predominant role of the genus *Lycospora,* a smaller number of the representatives of the genus *Densosporites,* a more abundant occurrence of spores of the genus *Florinites* and an appearance of a dozen or so new species, known only from Westphalian such as *Cyclogranisporites orbiculus, Cristatisporites indignabundus, Latosporites latus,* etc., make up characteristic features of this assemblage.

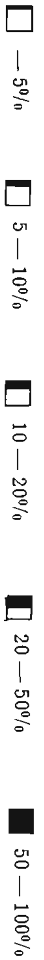
In the upper part of this zone (above 614.30 m), species begin to appear occasionally which are characteristic of later stages (Westphalian B). These are, for instance, *Wilsonia punctata, Vestispora cancellatus, Densosporites reticulatus, Calamospora breviradiata* and *Lycospora brevis.* A complete lack is here recorded of Namurian species. On the other hand, a repeated (after Viséan) optimum is marked of the occurrence of spores (53 species, 32 genera). On the basis of these facts, I assign the complex of deposits, laying at depths from 732.60 to 580.20 m, to Westphalian A with the reservation that deposits, laying from 614.30 to 580.20 m, probably make up the lowermost zone of Westphalian B.

The results, obtained on the basis of the microspore analysis are confirmed by the megaspore analysis. Megaspores of *Setosisporites hirsutus,* occurring at a depth of 855.50 m, constitute an additional index of age of these deposits (Namurian C). The species *Cystosporites varius,* for a long time considered to be typically Westphalian (Brzozowska & Żołdani 1958) and found by Dybová (1958) on the Ostrava-Karvina area (Czechoslovakia) in Namurian C, at Chełm occurs at a depth of 829.30 m. On the basis of the microspore analysis, the age of this deposits has also been

Table 3

DISTRIBUTION OF MICROSPORE GENERA IN THE CHEŁM I BORING





determined as Namurian C. This fact confirms the view of Dybová who believes that the *C. varius* spores appear in Namurian C.

The Namurian-Westphalian boundary which, on the basis of the microspore analysis, has been set at a depth of 732.60 m, is confirmed by the appearance of megaspores of the species *Laevigatisporites glabratus* and *Apiculatisporites breviapiculatus* which are characteristic of Westphalian. The Westphalian age of deposits, situated higher than 738.70 m, is also testified to by the occurrence of such species as, for instance, *Valvisisporites auritus, Lagenosisporites rugosus, Zonalesporites superbus* and *Cystosporites verrucosus*. A few new species as *Lagenicula brevispinosa* n. sp., *L. clavata* n. sp., *L. baculata n.* sp., *Calamospora ovata* n. sp. and *C. magna* n. sp., also appear in this beds.

Like in the microspore material, in this complex of deposits, there is also recorded a repeated optimum of the occurrence of megaspores and a considerable specific differentiation.

In the Carboniferous section of the Chełm I boring, the boundaries between particular stratigraphic units have been set on the basis of macrofaunistic (Korejwo, 1960b), microfaunistic (Liszka, 1960) and microfloristic (Jachowicz, 1960) studies. Results, obtained in the present work, do not coincide in certain respects with those, reached by Jachowicz and Liszka. This is shown in the Table 4.

The results of my work are in conformity with those, obtained by Korejwo (1960*b*) on the basis of macrofauna. On the other hand, differences occur when the data, obtained on the basis of microflora, are compared with the results of microfaunistic studies. According to Liszka (1960), the boundary between Viséan and Namurian occurs at a depth of 966 m, which is not confirmed either by microspore assemblages, I found at depths between 966 and 1,073.7 m which are typically Namurian in character, or by the composition of macrofauna, described by Korejwo.

According to Jachowicz (1960, p. 75): "An exact determination of boundaries between Namurian A and B, Namurian B and C, and Namurian C and Westphalian is difficult because of an irregular sampling of the cores under study". This author states that the complex of deposits at a depth, ranging between 577.80 and 642.40 m, corresponds to the Ruda Beds in Upper Silesia, that between 655,60 and 1,075.90 m is Namurian, and the sample, coming from a depth between 1,192.20 and 1,197.70, is Viséan. Comparing these results with those, I obtained, one may state that the boundary between Viséan and Namurian lies, in both cases, in the same place. Certain differences occur in determining the Namurian-Westphalian boundary which could not be exactly settled by Jachowicz, since he had not at his disposal appropriate microfloristic materials.

Table 4

Division of Carboniferous of the Chełm I boring, on the basis of microflora, macrofauna and microfauna

Microflora				Macrofauna		Microfauna	
Jachowicz, 1960		Karczewska, 1967		Korejwo, 1960		Liszka, 1960	
Depth (in m)	Age	Depth (in m)	Age	Depth (in m)	Age	Depth (in m)	Age
577.80— 642.40	Lower Westphalian						
655.60— 701.00	Upper Namurian	580.20— 732.60	Westphalian A(+B?)	580.20— 733.50	Lower Westphalian	580.00— 733.00	Westphalian
728.00— 782.50	Lower Namurian	743.50— 829.30	Namurian C				
818.50— 855.50	upper part of Lower Namurian	852.00— 950.70	Namurian B	733.50—1,099.25	Namurian	733.00— 966.00	Namurian
855.50—1,075.90	lower part of Lower Namurian	1,002.50—1,073.70	Namurian A			966.00—1,093.00	Viséan
—	—	1,099.25—1,195.10	Upper Viséan	1.099.25—1,207.70	Upper Viséan	—	—
		1,195.10—1,205.60	Lower (?) Viséan				

DESCRIPTIONS

MEGASPORES

Anteturma **Sporites** H. Potonié, 1893
Turma **Triletes** (Reinsch, 1881) Potonié & Kremp, 1954
Subturma **Azonotriletes** Luber, 1935
Infraturma **Laevigati** (Bennie & Kidston, 1886) Potonié & Kremp, 1954
Genus *Calamospora* Schopf, Wilson & Bentall, 1944
Type species: *Calamospora hartungiana* Schopf, 1944

Description of the genus. — Spores round or oval in outline. According to the authors of the genus, dimensions of these spores "vary considerably, i. e. from about 40 μ (or, in underdeveloped specimens, even less) to several hundreds μ". In *Calamospora magna*, described in the present work, the upper limit is shifted even to 2,000 μ. Triradiate figure with arms shorter than a half of the spore radius. Lips may be present. Contact area may display certain differences in sculpture or thickness of exospore. Arcuate ridges mostly lacking or, if present, very slightly outlined. Spore exine strongly folded. Folds may run parallel to the spore margin and take a semilunar or almost round shape. This very complex folding of spore exine constitutes one of the most important diagnostic characters of species. Thickness of exospore amounts to from 2 to 17 μ. Depending on the thickness, spores are yellow to red-brown in transmitted light and tan-brown in reflected light.

Remarks. — Some authors, as Zerndt (1934, 1937*a*) or Dijkstra (1946), described such megaspores as those belonging to Calamariaceae. Zerndt (1937) describes them as *Type 2,* determines features characteristic of the entire group and does not separate particular species, although he emphasizes (1937*a*, p. 5) that "it is almost certain that spores of *Type 2* do not belong to one but to several species". Without checking Zerndt's materials, it is impossible to classify megaspores of *Type 2* (of Zerndt) to any definite species. They may be only assigned to the genus *Calamospora* and considered as most similar to the species *C. laevigata* (Ibrahim) and *C. sinuosa* (Horst).

Calamospora laevigata (Ibrahim, 1933) Schopf, Wilson & Bentall, 1944

(Pl. I, Figs. 2 and 3)

1933. *Laevigati-sporites laevigatus* Ibrahim; A. C. Ibrahim, Sporenformen..., p. 17, Pl. 6, Fig. 46.
1934. *L. laevigatus* Ibrahim; F. Loose, Sporenformen..., p. 146, Pl. 7, Fig. 36.
1944. *Calamospora laevigatus* (Ibrahim); J. M. Schopf, L. R. Wilson & R. Bentall, Annotated synopsis..., p. 52.

1955. *C. laevigata* (Ibrahim) S. W. & B.; R. Potonié & G. Kremp, Die Sporae..., p. 48, Pl. 12, Fig. 136 a, b.
1959. *C.* cf. *C. laevigata;* M. R. Winslow, Upper Mississippian..., p. 60, Pl. 13, Fig. 11.
1962. *C.laevigata* (Ibrahim) S. W. & B.; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 57, Pl. 1, Fig. 1.

Material. — Twenty four well-preserved specimens.
Dimensions (in μ):

	Z. Pb. B32	Z. Pb. G39	Z. Pb. E32
Diameter of spore	342.5	510	620
Thickness of exospore	7	5	7

Description. — Megaspores round or oval in outline. Triradiate figure not always visible. Length of arms of triradiate figure does not exceed 1/3 of the length of spore radius. Surface of spores smooth, lustrous and folded. Folds are often semilunar in shape. In the reflected light, spores are brown or black and in the transmitted light — yellow, tan-brown or dark--red.

Remarks. — Megaspores of *C. laevigata* from Chełm differ from those, described by Potonié and Kremp, in only slightly larger dimensions.

Occurrence. — Poland: the Chełm I boring (samples 38, 40 and 573) — Viséan and Westphalian A. Upper Silesia — Namurian A. Czechoslovakia: Moravska Ostrava — Namurian A. Germany — Westphalian B. U.S.S.R.: the Novomoskovsk and Petropavlovsk regions — Viséan. U.S.A.: the Illinois Coalfield — Upper Namurian and Westphalian.

Calamospora sinuosa (Horst, 1943) Potonié & Kremp, 1955

(Pl. I, Fig. 1)

1943. *Triletes (laevigati) sinuosus*; U. Horst, Mikrostratigraphischer Beitrag..., Fig. 3.
1955. *Calamospora (Triletes) sinuosa* (Horst); R. Potonié & G. Kremp, Die Sporae..., p. 48.
1955. *C. sinuosa* (Horst); U. Horst, Die Sporae..., p. 155, Pl. 17, Fig. 3.
1959. *C.* cf. *C. sinuosa*; M. R. Winslow, Upper Mississippian..., p. 60, Pl. 13, Fig. 10.

Material. — Seven well-preserved specimens.
Dimensions (in μ):

	Z. Pb. B2	Z. Pb. I22	Z. Pb. B37
Diameter of spore	750	902.5	1,000
Length of Y rays	150	175	175
Thickness of exospore	7	7	6

Description. — Megaspores round or oval in shape. Triradiate figure not always visible. Arms of triradiate figure often slightly elevated. Sometimes, there are visible slightly marked traces of contact fields. Surface of spore exine smooth, strongly folded. Folds run parallel to the spore margin. Particular folds often intersect each other at a right angle. In transmitted light, spores are red-brown, in reflected light — tan-brown to black.

Remarks. — Megaspores of *C. sinuosa* from Chełm differ from those, described by Horst (1943), only in the fact that they occur in younger beds since their range more or less corresponds to the stratigraphic position of *C.* cf. *Calamospora sinuosa*, described by Winslow (1959).

Occurrence. — Poland: Chełm I (samples 38 and 40) — Westphalian A; Upper Silesia — Namurian A. Czechoslovakia (Moravska Ostrava) — Namurian A. U.S.A. (the Illinois Coalfield) — Westphalian A.

Calamospora magna n. sp.

(Pl. I, Fig. 5; Pl. IX, Fig. 18)

Holotypus: Specimen No. Z. Pb. K2, Pl. IX, Fig. 18.
Stratum typicum: Namurian A, Westphalian A.
Locus typicus: Chełm I, sample 399.
Derivatio nominis: Lat. *magna* = large, on account of its very large dimensions.

Diagnosis. — Calamospore very large with a relatively thin and densely folded exospore. Folds run in different directions.

Material. — Eleven well-preserved specimens.

Dimensions (in μ):

	Z. Pb. G7	Z. Pb. D9	Z. Pb. K2
Diameter of spore	900	1,500	2,000
Thickness of exospore	5	3.0	2.5

Description. — Megaspores round or oval in outline. Triradiate figure very poorly visible or, sometimes — on account of a strong folding of spore exine — invisible at all. Length of arms of triradiate figure does not exceed $^1/_3$ of spore radius. Spore exine very densely folded with folds running in different directions. Surface of spore exine smooth, mat. As compared with the size of megaspores, exospore is very thin. In reflected light, spores are tan-brown, in transmitted light — yellow-brown.

Remarks. — *C. magna* n. sp. differs from the species, previously described, in very large dimensions and incommensurably thin exospore. The latter feature is for a certainty a cause of a very strong folding of exospore. *C. magna* n. sp. takes, among megaspores, a position similar to that of *C. perrugosa* (Loose) among small spores. *C. perrugosa* is marked, among microspores, by largest dimensions and a relatively thin and strongly folded exospore. A general outline of these forms is almost identical. At present, it is difficult to find whether or not any closer relationship takes place between these two forms. However, a great morphological similarity may be emphasized.

Occurrence. — Poland: the Chełm I boring (samples 399 and 39) — Namurian A and Westphalian A.

Calamospora ovata n. sp.

(Pl. I, Fig. 4)

Holotypus: Specimen No. Z. Pb. G. 18; Pl. I, Fig. 4.
Stratum typicum: Westphalian A.
Locus typicus: Chełm I, sample 38.
Derivatio nominis: Lat. *ovata* = ovate; on account of a predominant number of ovate forms.

Diagnosis. — Megaspores ovate in outline. Spore exine very slightly folded, developing only one or two longitudinal folds. Spore surface slightly punctate.

Material. — Seven well-preserved specimens.

Dimensions (in μ):

	Z. Pb. A14	Z. Pb. G18	Z. Pb. A14
Length of spore	837	1,050.0	1,200
Width of spore	662	750	775.0
Thickness of exospore	7.5	12.5	15

Description. — Megaspores ovate, rarely round in outline. Triradiate figure visible in almost all specimens. Length of arms of the Y figure does not exceed $^1/_2$ of spore radius. Scar of triradiate figure is often split. Spore exine slightly folded. Most often, there occur one or two folds which run longitudinally. Spore surface slightly punctate. In reflected light, spores are tan-brown, in transmitted light — yellow-brown.

Remarks. — Megaspores of *C. ovata* n. sp. are, to the greatest extent, similar to *C. sinuosa* (Horst) from which they differ, however, in a less complex folding of exospore. In *C. sinuosa,* exospore is very strongly folded, with folds running parallel to the spore margin. In contrast to *C. sinuosa*, *C. ovata* n. sp. has not a so distinctly marked contact area.

Occurrence. — Poland: the Chełm I boring — Westphalian A.

Calamospora sp.

(Pl. I, Fig. 6)

Material. — Four not very well-preserved specimens.

Dimensions (in μ):

	Z. Pb. A11	Z. Pb. I17	Z. Pb. A11
Diameter of spore	575	625	750
Thickness of exospore	7.5	10	10

Description. — Megaspores round in outline. Triradiate figure invisible or very slightly outlined. In reflected light, spores are tan-brown, in transmitted light — yellow-brown.

Remarks. — Megaspores of *Calamospora* sp. are, to the greatest extent, similar to the spores of *C. laevigata* (Ibrahim) from which they, however, differ in slightly larger dimensions and thicker and fine-punctate exospore.

Occurrence. — Poland: the Chełm I boring (sample 38) — Westphalian A.

Genus *Laevigatisporites* (Ibrahim) Potonié & Kremp, 1954

Type species: *Laevigatisporites primus* (Wicher, 1934)'

Laevigatisporites glabratus (Zerndt, 1930) Potonié & Kremp, 1955 (*sensu* Dijkstra)

(Pl. I, Figs. 7, 8)

1946. *Triletes glabratus* Zerndt, Typ 10 Zerndt, Typ 9 Zerndt = Typ 10 Zerndt; S. J. Dijkstra, Eine monographische..., p. 26, Pl. 1, Figs. 1—3, 5—8; Pl. 1, Fig. 4?; Pl. 4, Fig. 35 (*here earlier synonymy included*).
1947. *T. glabratus* Zerndt; A. T. Cross, Spore floras..., p. 298, Pl. 2, Fig. 58.
1947. *T. reinschi* (Ibrahim) Schopf; A. T. Cross, *Ibid.*, p. 296, Pl. 2, Figs. 28—40.
1951. *T. glabratus* Zerndt, 1930 (*sensu* Dijkstra); M. Kalibová, Megaspory..., p. 38, Pl. 2, Figs. 7—10.
1955. *T. glabratus* Zerndt; S. Dijkstra, Megaspores..., p. 328, Pl. 35, Fig. 1.
1955. *Laevigatisporites glabratus* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp. Die Sporae..., p. 53, Pl. 1, Figs. 4, 5, 7, 8.
1955. *L. primus* (Wicher) Potonié & Kremp; R. Potonié & G. Kremp, *Ibid.*, p. 55, Pl. 1, Figs. 2, 3, 6.
1955. *L. reinschi* Ibrahim; R. Potonié & G. Kremp, *Ibid.*, p. 55, Pl. 2, Figs. 9, 10.
1956. *Triletes glabratus*; M. C. Bonet & S. J. Dijkstra, Megaspores..., p. 256, Pl. 48, Fig. 1, Pl. 49, Fig. 9.
1958. *Laevigatisporites glabratus* (J. Zerndt) R. Potonié & G. Kremp, *sensu* Dijkstra; P. Piérart, Palynologie..., p. 34, Pl. 1, Figs. 1—2.
1959. *Triletes glabratus* Zerndt, 1930 (*sensu* Dijkstra); M. Winslow, Upper Mississippian..., p. 28, Pl. 6, Figs. 7—10.
1961. *T. glabratus* Zerndt; M. V. Oshurkova, Megaspory, p. 110, Pl. 9, Figs. 1, 2.
1962. *Megalaevigati glabratus* (Zerndt) Ishchenko; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 63, Pl. 4, Fig. 2.
1963. *Laevigatisporites glabratus* (Zerndt) Potonié & Kremp *sensu* Dijkstra; P. Piérart, Mégaspores..., p. 232, Pl. 1, Fig. 1.
1965. *L. glabratus* (Zerndt) Potonié & Kremp *sensu* Dijkstra; E. Spinner, Westphalian D megaspores..., p. 87, Pl. 14, Figs. 1, 2.

Material. — Three well-preserved specimens and a few fragments.

Dimensions (in μ):

	Z. Pb. G33	Z. Pb. H. 20	Z. Pb. B39
Diameter of spore	437	1,300	1,780
Thickness of exospore	62	25	40

Description. — Megaspores trilete; specimens are flattened, in proximal-distal direction round, oval or triangular in outline. Immature, small megaspores have the arms of the Y figure ridgelike with a small prominence at the top and distinctly marked arcuate ridges. Contact area occupies about 2/3 of the proximal surface of the spore. Large, mature megaspores have an open germination cleft. Arcuate lines less distinct or almost invisible. Contact area occupies about 1/3 to 1/2 of the proximal surface of the spore. Spores smooth, lustrous, brown to black.

Remarks. — Like Dijkstra and Piérart, I have assigned the spores, described by Zerndt as *Types 9* and *10*, to the species *Laevigatisporites glabratus.* At first, Zerndt considered them to represent two separate species. But when the megaspores from the *Sigillaria* cones have been described by Bocheński (1936), it turned out that the same cone contained spores 440 to 2,700 μ in diameter, and underdeveloped spores which were triangular, thicker than the normal ones and with strongly marked lines of triradiate figure. Referring to Bocheński's work, Zerndt (1938) stated that finding of megaspores of *Types 9* and *10* in the same cone is of a considerable importance to the species *Triletes glabratus* and, since then, only *Type 10* has been mentioned by him in stratigraphic tables.

In my opinion, there are no reliable grounds to distinguish such species as *Laevigatisporites primus* (Wicher) and *Laevigatisporites reinschi* Ibrahim, as it has been done by Potonié and Kremp (1955). Erecting the species *Sporites primus,* Wicher assigned only the specific name to the spores, described by Kidston and Zerndt as *Triletes Type I* Kidston. He found the species *Sporonites reinschi*, previously erected by Ibrahim (1932) to be identical with *Sporites primus*, he erected himself and — contrary to the law of priority — included *Sporonites reinschi* Ibrahim, 1932 in the synonymy of *Sp. primus* Wicher, 1934. After the publication of Bocheński's work, it became clear that the spores of *Triletes Type I* Kidston (= *Sporonites reinschi* = *Sporites primus*) and *Triletes glabratus* Zerndt belong to the same species. *Triletes glabratus* Zerndt, 1930 is the oldest specific name and, therefore, it is entitled to the priority.

Affinity. — *Sigillariostrobus czarnockii* Bocheński, 1936.

Occurrence. — Poland: Upper Silesia-Westphalian A-D; Chełm I boring (samples 38, 40 and 154) — Westphalian A. Czechoslovakia — Westphalian B-Stephanian B. France — Westphalian B and D. Germany — Westphalian A — C. The Netherlands — Westphalian A — C. Spain — Westphalian A. Belgium — Westphalian C. Turkey — Westphalian C-D. U.S.A. — Westphalian. U.S.S.R., the Karaganda Coalfield — Middle Carbonifereous, the Donetz Coalfield and its western extension — Westphalian A-C.

Laevigatisporites fulgens (Zerndt, 1937) Potonié & Kremp, 1955

(Pl. I, Fig. 11)

1931. *Typ 8*, Zerndt; J. Zerndt, Megasporen..., p. 171, Pl. 3, Figs. 9, 10.

1937. *Triletes fulgens* Zerndt, Type 8; J. Zerndt, Les mégaspores..., p. 3, 5, Fig. 2, Pl. 1, Figs. 1—9.
1938. *Typ 8*, Zerndt; J. Zerndt, Die Eignung..., p. 1715, 1720, Pl. 1, 2.
1947. *Triletes fulgens* (?); A. T. Cross, Spore floras..., p. 297, Pl. 2, Figs. 50, 56—57.
1950. *Triletes fulgens* Zerndt; C. A. Arnold, Megaspores..., p. 79, Pl. 12.
1955. *Laevigatisporites (Triletes) fulgens* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 53.

Material. — About 500 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. E33	Z. Pb. H9	Z. Pb. D29	Z. Pb. E15
Diameter of spore	425	475	750	332
Length of radii of triradiate figure .	140	162	250	100
Thickness of radii of triradiate figure	32	25	50	60
Width of arcuate ridges	27	25	38	38
Thickness of exospore	15	20	35	40

Description. — Trilete megaspores, round in outline. Radii of triradiate figure, ridgelike in shape, run straight or slightly undulate. Arcuate ridges mostly distinctly marked. Contact area smooth, sometimes with certain irregularities, probably caused by an internal folding of the spore. The remaining part of the spore surface smooth, lustrous. Spores are dark-brown or black.

A specimen with four radial ridges has been found among the forms, described above. The diameter of this spore is smaller than that of normal ones. This form is identical with that, figured by Zerndt (1937, Pl. 1, Fig. 4).

Remarks. — Megaspores of *L. fulgens* from Chełm differ from those, described by Zerndt (1931, 1937*a*), only in slightly smaller mean dimensions. Most forms, found by Zerndt, had their diameters varying from 550 to 575 μ. These magnitudes are, however, within limits of the specific variation and all proportions in the spore structure are identical.

Occurrence. — Poland: Upper Silesia — Namurian A, Chełm I boring (samples 527, 573 and 575) — Viséan. U.S.A. (Michigan Coalfield) — Lower Pennsylvanian (Namurian); States of Virginia and Kentucky — Pennsylvanian.

Infraturma **Apiculati** (Bennie & Kidston, 1886) Potonié & Kremp, 1956

Subinfraturma **Nodati** Dybová & Jachowicz, 1957

Genus *Apiculatisporites* Ibrahim, 1933 (non Bennie & Kidston)

Type species: *Apiculatisporites aculeatus* Ibrahim, 1933

Apiculatisporites breviapiculatus Danzé, Levet-Carette & Loboziak, 1964

(Pl. I, Fig. 9)

1964. *Apiculatisporites breviapiculatus* Danzé, Levet-Carette & Loboziak; J. Danzé, J. Levet-Carette & S. Loboziak, Révision des Spores..., p. 21, Pl. 3, Figs. 1 a—b, 2 a—b.

Material. — Nine complete specimens and a few fragments.

Dimensions (in μ):

	Z. Pb. A32	Z. Pb. A32	Z. Pb. H2	Z. Pb. A32
Spore diameter	1,325	1,600	1,750	2,000
Height of cones	40—47.5	55—75	37—60	52—63
Width of cones	37—47	40—47	30—40	37—49
Diameter of granules on contact area	5— 7.5	5—8	5—20	—
Number of cones on spore equator	52	56	40	56

Description. — Trilete megaspores; specimens, flattened along equator, round or oval. Arms of Y-figure narrow, their mean length amounting to about 2/3 of spore radius. Most specimens with open germination cleft. Contact area covered with fine granules, the rest of the spore surface covered with conic appendages with wide bases, tapering distally, very often elongated, threadlike and bent, densely arranged. Spores brown, cones brown-cherry.

Remarks. — Some specimens of *A. breviapiculatus* from Chełm have cones somewhat larger than those, described by Danzé *et al.* (1964), most of them, however, fall within limits of specific variability.

Occurrence. — Poland, Chełm I boring (samples 38, 39, 40, 56 and 148) — Westphalian A. France — Westphalian B-C.

Apiculatisporites brevispiculus (Schopf, 1938) Danzé, Levet-Carette & Loboziak, 1964

(Pl. IX, Fig. 10)

1964. *Apiculatisporites brevispiculus* (Schopf) Danzé, Levet-Carette & Loboziak; J. Danzé, J. Levet-Carette & S. Loboziak, Révision des Spores..., p. 17, Pl. 1, Figs. 6 a—b (*here earlier synonymy included*).

Material. — One well-preserved specimen and a few fragments.

Dimensions (in μ):

	Z. Pb. L31
Spore diameter	1,500
Height of cones	15
Width of cones at the base	20—30
Number of cones on equator	about 50

Description. — Trilete megaspores, rounded or oval in outline. Y-figure small. Arcuate ridges slightly marked. Contact area covered with fine granules, very widely scattered. The rest of the spore surface covered with irregularly scattered cones. Spore tan-brown.

Occurrence. — Poland, Chełm I boring (samples 38, 236 and 425) — Namurian A and B Westphalian A. France — Westphalian B-C. U.S.A. (Illinois Coalfield) — Westphalian D.

Apiculatisporites subspinus Danzé, Levet-Carette & Loboziak, 1964
(Pl. IX, Fig. 15)

1934. *Type 14* Zerndt; J. Zerndt, Les mégaspores..., Pl. 14, Fig. 2, Pl. 17, Fig. 2.
1964. *Apiculatisporites subspinus* Danzé, Levet-Carette & Loboziak; J. Danzé, J. Levet-Carette & S. Loboziak, Révision des Spores..., p. 22, Pl. 3, Fig. 3a, b.

Material. — Two well-preserved specimens and 2 fragments.
Dimensions (in μ):

	Z. Pb. L32	Z. Pb. L32
Spore diameter	1,625	1,750
Height of cones	70—100	50—100
Width of cones	30—80	37—47
Diameter of granules on contact area	5—20	5—15
Number of cones on equator	45	40

Description. — Trilete megaspores, oval or subround in outline. Arms of Y-figure short (about 1/3 of the spore radius). Contact area covered with fine granules, the rest of the spore surface — with cones whose size decreases near contact area. Cones have a rounded base with a distally tapering spine. Spores tan-brown.

Remarks. — Megaspores of *A. subspinus* from Chełm differ from those described from France (Danzé *et al.*, 1964) in a slightly smaller number of cones in equator.

Occurrence. — Poland, Upper Silesia — Namurian C, Chełm I boring (sample 38) — Westphalian A. France — Westphalian C.

Apiculatisporites parviapiculatus (Zerndt) nov. comb.
(Pl. I, Fig. 10)

1937. *Triletes parviapiculatus* Zerndt; J. Zerndt, Les mégaspores..., p. 17, Pl. 24, Figs. 1—4.

Material. — Thirteen well-preserved specimens and a few fragments.
Dimensions (in μ):

	Z. Pb. E34	Z. Pb. I10	Z. Pb. E34
Spore diameter	425	500	637
Length of spines	8	7.5	7
Width of cones at the base	4	3	3
Thickness of exospore	26	25	13

Description. — Trilete megaspores; specimens flattened in proximal distal direction, subtriangular in outline. Arms of Y-figure straight, narrow, length equal to spore radius. Arcuate ridges running along spore margin, mostly invisible, hidden by sculpture. Distal surface of spores, and sometimes contact area, are covered with small spiny processes, disposed near each other. Spores are dark tan-brown to black.

Remarks. — Megaspores of *A. parviapiculatus* from Chełm differ from those, described by Zerndt (1937*a*) in slightly larger dimensions. Zerndt had at his disposal only two specimens and, therefore, he determined the variability within narrow bounds.

Occurrence. — Poland, Upper Silesia — Lower Namurian; Chełm I boring (samples 572 and, rather questionably, 575) — Viséan.

Subturma **Lagenotriletes** Potonié & Kremp, 1954 emend. Bhardwaj, 1957

Infraturma **Gulati** Bhardwaj, 1957

Genus *Lagenicula* (Bennie & Kidston 1886) Potonié & Kremp, 1954

Type species: *Lagenicula horrida* Zerndt, 1934

Lagenicula crassiaculeata Zerndt, 1937

(Pl. II, Figs. 1—3)

1931. *Typ 26*, Zerndt; J. Zerndt, Megasporen..., p. 175, Pl. 9, Fig. 28.
1936. *Typ 26*, Zerndt; J. Nowak & J. Zerndt, Zur Tektonik..., p. 63, Pl. 1, Fig. 1.
1937. *Lagenicula crassiaculeata* Zerndt; J. Zerndt, Les mégaspores, p. 2, 13, Fig. 9.
1947. *Triletes crassiaculeatus* (Zerndt); A. T. Cross, Spore floras..., p. 304, Pl. 4, Figs. 107—110.
1953. *T. crassiaculeatus* (Zerndt); W. G. Chaloner, On the megaspores..., p. 274, Pl. 8—12.
1955. *Lagenicula crassiaculeata* Zerndt; R. Potonié & G. Kremp, Die Sporae..., p. 119, Text-fig. 35.

Material. — Three not very well-preserved specimens.

Dimensions (in μ):

	Z. Pb. G21	Z. Pb. G6	Z. Pb. D39
Diameter of spore	1,250	—	—
Length of spore	1,250	1,250	1,500
Length of spines	125—220	130—200	145—220
Width of spines at the base	25—45	25—40	25—50
Length of additional spines	12—13	12—15	12—15
Thickness of exospore	37.5	50	37.5

Description. — Trilete pear-shaped megaspores. On the proximal side, there is a large, strongly extended apical prominence. Lips mostly open. Contact area occupies about 1/2 of the proximal part of spore. Both lips and contact area smooth. The remaining part of spore covered with spines of two types. Large ones, extended at the base and pointed at the end, are slightly smaller and more densely arranged near contact area. Smaller, additional spines are distributed between them. Arcuate ridges are distinct. In the transmitted light spores are red-brown, in the reflected light — tan-brown in colour. Spines are — in the transmitted light — yellow-red.

Remarks. — Megaspores of *L. crassiaculeata* from Chełm differ from those, described by Zerndt (1937*a*), in slightly smaller dimensions, but they fall within limits of the specific variability.

Occurrence. — Poland, Upper Silesia — Lower Namurian; Chełm I boring (sample 571b) — Viséan. Turkey — Namurian A and B; Scotland — Lower Carboniferous. U.S.A., States of Kentucky and Indiana — Lower Carboniferous.

Lagenicula subpilosa (Ibrahim, 1933) Potonié & Kremp, 1955

(Pl. II, Figs. 4—6)

1933. *Setosisporites subpilosus* Ibrahim; A. C. Ibrahim, Sporenformen..., p. 27, Pl. 5, Fig. 40.
1934. *Lagenicula kidstoni* Zerndt; J. Zerndt, Les mégaspores..., p. 26, Fig. 12, Pl. 28, Figs. 6—11; Pl. 29 (non *Lagenicula kidstoni* Zerndt 1937).
1946. *Triletes subpilosus* (Ibrahim) Dijkstra; S. J. Dijkstra, Eine monographische..., p. 46, Pl. 11, Figs. 116—128.
1952. *T. subpilosus* (Ibrahim) f. *major* Dijkstra; S. J. Dijkstra, Megaspores..., p. 13.
1954. *T. subpilosus* forma *major* Dijkstra; W. G. Chaloner, Mississippian megaspores..., p. 27, Pl. 1, Figs. 4—8.
1955. *Lagenicula subpilosa* (Ibrahim) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 119, Pl. 4, Fig. 21.
1955. *L. subpilosa* (Ibrahim) Potonié & Kremp; U. Horst, Die Sporae..., p. 170, Pl, 20, Figs. 24—27.
1956. *Triletes subpilosus* (Ibrahim) Dijkstra; M. C. Bonet & S. J. Dijkstra, Megaspores..., p. 258, Pl. 55, Fig. 40.
1956. cf. *Triletes subpillosus* (Ibrahim) Schopf, Wilson & Bentall f. *major*; S. J. Dijkstra, Lower Carboniferous..., p. 14, Pl. 9, Figs. 95—96; Pl. 10, Figs. 97—103.
1957, *Triletes subpilosus* (Wicher) Schopf, Wilson & Bentall forma *major* Dijkstra; S. J. Dijkstra, *Ibid.*, p. 12, Pl. 11, Figs. 126, 127.
1958. *Lagenicula subpilosa* (Ibrahim) Potonié & Kremp; P. Piérart, Palynologie..., p. 12, Pl. 10, Fig. 16.
1959. *Triletes subpilosus* (Ibrahim) Schopf, Wilson & Bentall (*sensu* Dijkstra); M. R. Winslow, Upper Mississippian..., p. 17, Pl. 2, Figs. 1—5.
1959. *T. subpilosus* forma *major* Dijkstra, ex Chaloner, 1954; M. R. Winslow, *Ibid.* p. 18, Pl. 1, Figs. 1—9.
1962. *Lagenicula subpilosa* (Ibrahim) Potonié & Kremp; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 71, Pl. 8, Fig. 1.

Material. — About 100 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. D3	Z. Pb. G40	Z. Pb. G11	Z. Pb. D15
Length of spore	650	750	1250	1500
Width of spore	450	625	1000	1125
Length of trilete rays	270	125	350	290
Height of apical prominence	350	250	425	390
Length of spines	25—50	40—83	75—115	37—63
Width of spines at the base	8—15	12—25	25—35	17—25
Distance between spines	15—50	ca, 25	25—38	30—75
Thickness of exospore	20	20	25	12,5

Description. — Trilete megaspores; specimens, flattened laterally, are pear-shaped or oval; those, flattened in proximal-distal direction, take a round outline. Mostly, they are flattened laterally. A pyramidal protuberance (or what is known as "gula") has a rounded apex. Both lips and contact area are covered with small knobs, particularly so near the base of lips. Arcuate ridges distinct. Distal surface of spores is covered with hair-like spines which are straight, bent, bluntly terminating or rounded, and less frequently, pointed at the ends. In some specimens, spines, adhering to arcuate lines, are shorter and more crowded. In the reflected light, spores are tan-brown, in the transmitted light — orange-brown.

Remarks. — Megaspores of *L. subpilosa* from Chełm differ from those, described by Ibrahim (1933), in longer spines, which is probably caused by a better preservation state. This form may be easily distinguished from other species of the genus *Lagenicula*. It is most similar to *L. horrida* Zerndt, from which it differs in smaller dimensions, thinner and shorter spines, thinner exospore and fine knobs, situated on contact area. Since the spines of *L. subpilosa* are relatively thin, they are often inclined at their base and adhering to the spore surface which makes them poorly visible against the background of the spore outline, particularly so in photographs. These spines are best visible when viewed in the transmitted light because of the contrast between a dark spore and yellow-red spines showing through.

Like Dijkstra (1946), I included the megaspores, described by Zerndt (1934) as *L. kidstoni* (not *L. kidstoni* Zerndt, 1937*a*) in the species *L. subpilosa* (Ibrahim) Potonié & Kremp. Erecting *L. kidstoni* has not been justified since two different groups of spores of the species *L. subpilosa* and *L. horrida* were assigned to it by Zerndt. Since *L. subpilosa* (Ibrahim 1933), Potonié & Kremp was described before *L. kidstoni* Zerndt, 1934, the former species is entitled to the priority.

The distinction of the forma *major* from the species *L. subpilosa* seems to be unjustified. According to Dijkstra (1952), the length of spores in *L. subpilosa* forma *major* varies within limits of 900 and 1,300 μ. The dimensions of spores, assigned to *L. subpilosa,* which mostly fluctuate between about 650 and 1,120 μ, easily fall within the limits, mentioned above. In the collections of some authors, there are specimens as small as 300 μ. Winslow (1959) quotes the dimensions of spores of *L. subpilosa* as ranging from 550 to 1.270 μ, and of *L. subpilosa* f. *major* — from 465 to 1,790 μ. Consequently, the dimensions of the former are contained within limits of the dimensions of the latter. In addition, Winslow states that the specimens of *Triletes subpilosus* from her collections have variants of all diameters and sizes of spines which, on the whole, decrease from the geologically older to younger beds. Except for the characters, referred to above, there are no differences which would allow one to distinguish separate forms within *L. subpilosa*. On the basis of this fact, I included megaspores of *L. subpilosa* f. *major* in the synonymy of the species *L. subpilosa*.

Occurrence. — Poland, Upper Silesia — Namurian A to Westphalian A; Chełm I boring (samples 38, 39, 40, 46, 148, 154, 192 and 399) — Namurian A to Westphalian A. Germany — Westphalian B and C. The Netherlands — Westphalian A to C. Turkey — Dinantian to Namurian C. Czechoslovakia — Namurian A. Belgium — Westphalian C. Scotland and Ireland — Namurian. U.S.S.R. (Moscow Coalfield and Donetz Coalfield with its western extension) — Viséan to Westphalian A. U.S.A. (Illinois Coalfield) — Namurian to Westphalian A and (States of Indiana and Michigan) — Dinantian.

Lagenicula horrida Zerndt, 1934

(Pl. II, Figs. 1—4)

1934. *Lagenicula horrida* Zerndt; J. Zerndt, Les mégaspores..., p. 25, Pl. 28, Figs. 1—5
1946. *Triletes horridus* (Zerndt) Dijkstra; S. J. Dijkstra, Eine monographische..., p. 45, Pl. 12, Figs. 129—136 (*here earlier synonymy included*).
1950. *Lagenicula horrida* Zerndt; A. C. Arnold, Megaspores..., p. 81, Pl. 10.
1953. *Triletes horridus* from *Lepidostrobus dubius; W. G.* Chaloner, On the megaspores..., p. 268, Figs. 3—7.
1955. *Lagenicula horrida* Zerndt; U. Horst, Die Sporae..., p. 172, Pl. 20, Figs. 28—29.
1955. *Lagenicula horrida* Zerndt; R. Potonié & G. Kremp, Die Sporae..., p. 119, Pl. 4, Fig, 20.
1956. *Triletes horridus* (Zerndt) Schopf, Wilson & Bentall; S. J. Dijkstra, Lower Carboniferous..., p. 10, Pl. 3, Fig, 35.
1956. *Triletes horridus*; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 258, Pl. 52, Fig. 24; Pl. 55, Figs. 35—39.
1956. *Lagenicula horrida* Zerndt; R. Potonié, Synopsis..., p. 50.
1958. *Lagenicula horrida* Zerndt; P. Piérart, Palynologie..., p. 41, Pl. 11, Figs. 3—4.
1959. *Triletes horridus* (Zerndt) Schopf, Wilson & Bentall (sensu Dijkstra); M. R. Winslow, Upper Mississippian..., p. 20, Pl. 2, Figs. 6—12; Pl. 3, Fig. 1.
1962. *Lagenicula horrida* Zerndt; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 69, Pl. 7, Figs. 1 a—d.

Material. — More than 200 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. A1	Z. Pb. G4	Z. Pb. G3	Z. Pb. L33
Length of spores	600	1,070	1,200	1,325
Width of spores	525	1,000	875	1,250
Length of Y-rays	175	300	250	362
Height of apical prominence	145	425	500	325
Length of spines	50—60	150—175	175—200	100—150
Width of spines at the base	12—14	17—30.5	37—50	37—40
Distance between spines	30	37—100	37—62	37—45
Diameter of globule at the spine apex	20	—	12—20	—
Thickness of exospore	19	25	37	38

Description. — Trilete megaspores; specimens, flattened in proximal--distal direction, are round or oval, those, flattened laterally, are pear--shaped or also oval. Lips mostly open. Contact area occupies about 1/2 of the proximal part of spore and is mostly smooth or, sometimes, covered with irregularly scattered fine spines. Arcuate ridges distinct. The remaining part of the spore surface is covered with spines, extended at the base, mostly pointed, sometimes rounded, usually bent in a hooklike manner. Small, globular bodies are very often observed on the ends of spines. Additional spines occur seldom. In the transmitted light, spores are yellow-orange or red and, in the reflected light, tan-brown or black.

Remarks. — Megaspores of *L. horrida* from Chełm differ from those, described by Zerndt (1934), in a slightly broader extent of sizes. The length of spores described by Zerndt was 830 — 1,130 μ whereas megaspores from Chełm are 600 to 1,350 μ long. Likewise, the length of spines in Zerndt's work, varies from 113 to 130 μ, and in megaspores, described in the present paper — from 50 to 175 μ. This is probably caused by the fact that the material from Chełm was marked by a greater abundance of spores of this species, and, consequently, by a greater extent of variability. This has been confirmed by data known from recent literature. In the structure of spines in *L. horrida*, there may be observed a certain detail which has not been noted by Zerndt, i.e. small globular bodies occurring on the ends of spines, to which attention was attracted by Arnold (1950). In observing the spines in the transmitted light, one may notice that these spines, towards their ends, become thinner and thinner but at the very tip, there occurs a strong swelling, resulting in the formation of a globular body which may be easily broken off.

Occurrence. — Poland, Upper Silesia — Dinantian to Westphalian A; Chełm I boring (samples 38, 39, 40, 56, 148, 154, 192, 263, 266, 425 and 472) — Namurian A to Westphalian A. Czechoslovakia — Namurian A and B. Germany — Westphalian B. Scottland — Dinantian to Namurian. Spain — Westphalian A. Belgium — Westphalian C. Turkey — Namurian A. U.S.A. (Illinois and Michigan Coalfields) — Namurian to Westphalian. U.S.S.R. (Donetz Coalfield and its western extension) — Viséan to Westphalian A.

Lagenicula horrida Zerndt *hippocastaniformis* n. var.

(Pl. III, Figs. 5, 6)

Holotypus: Specimen No. Z. Pb. G2; Pl. III, Fig. 6.
Stratum typicum: Namurian A — Westphalian A.
Locus typicus: Chełm I, sample 154.
Derivatio nominis: Lat. *hippocastanicum* = spore shaped like a chestnut.

Diagnosis. — Megaspores with a distinct apical prominence. Surface covered with densely arranged, rigid and slightly flattened spines.

Material. — Fifty well-preserved specimens and many fragments.

Dimensions (in μ):

	Z. Pb. G8	Z. Pb. G2
Length of spore	1125	1325
Width of spore	750	975
Length of Y-rays	250	325
Height of apical prominence	325	350
Length of spines	187	200
Width of spines at the base	32	50
Distance between spines	35	75
Thickness of exospore	19	25

Description. — Trilete megaspores; specimens mostly flattened in lateral direction, are pearlike or elliptical in shape, those flattened in proximal-distal direction, are round or subround. Apical prominence distinct. Lips mostly open, arcuate ridges distinct. Contact area unornamented. The remaining part of the spore surface is covered with densely arranged, long spines, tapering towards the ends. Spines seem to be partly flattened, particularly so in their proximal parts and probably fairly rigid since they are very seldom bent and, often, broken off. In the transmitted light, spores are dark red-brown and, in the reflected light, dark brown or, sometimes, even black, which makes up a contrast with red-brown spines.

Remarks. — Megaspores, assigned to *L. horrida* v. *hippocastaniformis* are, in their general structure and dimensions, similar to *L. horrida.* The difference consists in the fact that the megaspores of *L. horrida* var. *hippocastaniformis* are more often flattened laterally. In addition, despite the fact that their dimensions fall within limits of the specific variability of *L. horrida* whose length fluctuates from 600 to 1.350 μ, they are represented only by large specimens about 1,125 to 1,325 μ long (mean 1.120 μ, as measured on 12 specimens). The most important difference is recorded in the manner of the development of spines which, in *L. horrida,* are considerably extended at the base, strongly pointed at the ends and mostly bent in a hooklike manner, whereas, in *L. horrida* var. *hippocastaniformis,* a mean length of spines is much larger (almost 100 μ), they are not so very sharp in the distal part, are very seldom bent, often broken off and mostly flattened. With regard to the structure of spines, this form is more similar to *L. crassiaculeata,* the difference consisting in smaller dimensions, flattening of spines and a different stratigraphic position.

Occurrence. — Poland, Chełm I boring (samples 38, 39, 40, 154 and 399) — Namurian A to Westphalian A.

Lagenicula brevispinosa n. sp.

(Pl. IV, Figs. 1, 3 and 4; Pl. X, Fig. 9)

Holotypus: Specimen No. Z. Pb. H 24; Pl. IV, Fig. 3.
Stratum typicum: Westphalian A.
Locus typicus: Chełm I, sample 154.
Derivatio nominis: Lat. *brevis* = short, *spina* = spine; after short spines covering the distal surface of spores.

Diagnosis. — Megaspores with contact area covered with fine knobs, and the rest of the spore surface — with short spines, wide at the base.

Material. — Eighteen well-preserved specimens.

Dimensions (in μ):

	Z. Pb. B13	Z. Pb. H24	Z. Pb. C37
Length of spores	687	875	1200
Width of spores	500	850	950
Length of Y-rays	132	250	250
Width of Y-rays	25	62.5	62
Height of apical prominence	156	325	300
Diameter of knobs on contact area	8	10—13	8—18
Length of spines	30—50	25—52	40—56
Width of spines at the base	20—28	25—30	28—37
Thickness of exospore	25	25	38

Description. — Trilete megaspores, those, flattened in proximal-distal direction, are round or oval in outline, those, flattened laterally, are pear--shaped with a distinct, pyramidal apical prominence. Triradiate ridges straight. There are many specimens with an open germination cleft. Arcuate ridges mostly invisible. Contact area, in contrast to the rest of the spore surface, covered with fine, densely distributed knobs, which are most closely crowded at the apex of pyramid. The remaining part of the spore surface is covered with irregularly scattered, relatively short spines, wide at the base. Spores tan-brown or black.

Remarks. — Megaspores of this species are most similar to those of *Triletes acuminatus* Dijkstra, 1957, from which they differ, however, in smaller dimensions and shorter spines which, in *T. acuminatus,* are 50 to 180 μ long. Megaspores of *L. brevispinosa* n. sp. have, on their contact area, characteristic knobs, never observed in other, related forms. *Triletes acuminatus* is marked by a very thick exospore (40—100 μ). In addition, both these forms differ from each other in their stratigraphic positions.

Occurrence. — Poland, Chełm I boring (samples 38, 39, 40? and 154) — Westphalian A.

Lagenicula baculata n. sp.

(Pl. II, Figs. 7—11)

Holotypus: Specimen No. Z. Pb. G22; Pl. II, Fig. 9.

Stratum typicum: Westphalian A.

Locus typicus: Chelm I, sample 38.

Derivatio nominis: Lat. *baculum* = rod, after baculiform appendages covering the spore surface.

1950. *Triletes rugosus* (Loose) Schopf, Wilson & Bentall (sensu Dijkstra); M. R. Winslow, Upper Mississippian..., Pl. 3, Fig. 7 only.

Diagnosis. — Megaspores with a distinct apical prominence. Arcuate ridges visible. Exospore longitudinally and obliquely folded. Spore surface covered with fine, baculiform appendages.

Material. — More than 70 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. G22	Z. Pb. G23	Z. Pb. G12
Length of spore	750	850	1000
Width of spore	625	700	875
Length of Y-rays	150	200	225
Height of apical prominence	225	300	350
Length of rods	14—17.5	2—15	7—22
Width of rods	5—7.5	2—7	5—12
Distance between rods	30	25	24
Thickness of exospore	27	12.5	12

Description. — Trilete megaspores, pear-shaped round or oval, with a distinct apical prominence. Shape depending, to a considerable extent, of the state of preservation. Arcuate ridges, on well-preserved specimens, distinct. Lips very often open. Spore surface covered with minute knobs, baculae or spines. These sculptural elements are, in all specimens, rounded at the ends and there are no forms with strongly sharpened spines, baculiform appendages being the predominant elements. Exospore folded longitudinally or obliquely. In the transmitted light, spores are yellow-orange or red-brown.

Remarks. — Spores of this species are most similar to those of *Lagenoisporites rugosus* (Loose), from which they differ only in the sculpture of exospore. Arnold (1950) was the first to notice — among the forms assigned to *L. rugosus* — specimens with fine baculae, 5 μ wide at the base, and 9—10 μ long, with rounded ends, scattered over the surface. On account of only occasional occurrence of such spores, Arnold considered the erection of a new species to be groundless. He mentioned, however, that the taxonomic characters of *L. rugosus* was not well-defined and that these were probably spores of more than one species.

Winslow (1959) presents the species *Lagenoisporites rugosus* within very broad limits and includes in it ornamented forms, estimating the length of the elements of sculpture at 5 to 20 and even 31 μ. In figures published in this author's work (1959), there are clearly visible, completely smooth forms, together with so distinctly ornamented one as that shown in his Pl. 3, Fig. 7. I assigned the last-named form to *Lagenicula baculata* n. sp. Since the specimens of both the species *Lagenoisporites rugosus* and *Lagenicula baculata* n. sp. are more or less equal in size and since many specimens with an open germination cleft are met with among the representatives of these two species, these forms do not seem to be immature specimens. In the material from Chełm they occur in abundance. The separation of completely smooth and lustrous forms from those with a distinct sculpture seems to be fully justified. A considerable variability may be observed among ornamented forms. Thus, there are forms with fine appendages whose height fluctuates within limits of 2 and 5 μ, as well as those with baculiform appendages mostly about 22 μ long. Perhaps, this is not a completely uniform systematic group of spores.

Occurrence. — Poland, Chełm I boring (samples 38, 39 and 40) —Westphalian A. U.S.A. (Illinois Coalfield) — Westphalian.

Lagenicula clavata n. sp.

(Pl. III, Figs. 8, 9; Pl. X, Fig. 5)

Holotypus: Specimen No. Z. Pb, I 12; Pl. III, Fig. 8.
Stratum typicum: Westphalian A.
Locus typicus: Chełm I, sample 39.
Derivatio nominis: Lat. *clava* = club, after clavate appendages, covering the spore surface.

Diagnosis. — Megaspores oval. Arcuate ridges indistinct, apical prominence shaped like a pyramid. Spore surface, except for apical prominence, covered with clavate appendages.

Material. — More than 80 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. G31	Z. Pb. I12	Z. Pb. B32
Length of spore	812	812	1100
Width of spore	750	700	825
Length of Y-rays	250	165	300
Height of apical prominence	300	250	400
Length of clavate appendages	16—20	16—25	16—40
Width of clavate appendages at the base	6—7	7—8	6—9
Width of clavate appendages near the apex	9—12	9—14	9—16
Diameter of small knobs	ca 4	ca 4	4—5
Thickness of exospore	15	20	20

Description. — Trilete megaspores; specimens, flattened in proximal-distal direction, are sacklike or oval, and those, flattened in lateral direction, subtriangular. Arcuate ridges mostly invisible, sometimes only slightly outlined, best visible in the transmitted light. Apical prominence very often strongly compressed, so that it is difficult to examine its shape. Well--preserved, not flattened specimens display an apical prominence with a very characteristic, pyramidal shape. Clavate appendages are irregularly scattered all over the spore surface, except for apical prominence. These appendages are most closely concentrated near arcuate ridges and most widely scattered on the distal side of spores. Sometimes, in addition to clavate appendages, there also occur small, round knobs. The fact that exospore is, almost in all specimens, folded longitudinally and that mostly it forms one or two folds, running along the entire spore, constitutes a characteristic feature of this species. Sometimes, finer transverse or oblique foldings are also present. In the reflected light, spores are tan--brown and in the transmitted light — yellow-orange to red-cherry.

Remarks. — Megaspores of *L. clavata* n. sp. are most similar to those of *L. baculata* n. sp. from which they differ primarily in the shape of appendages, covering the spore surface. In *L. clavata* n. sp. they are longer and, at the apex, strongly swollen and forming clavae, whereas baculae and blunt spines are characteristic of the *L. baculata* spores. In addition, a mean thickness of the *L. clavata* exospore is slightly smaller.

Occurrence. — Poland, Chełm I boring (samples 38—40) — Westphalian A.

Lagenicula maeandrica n. sp.

(Pl. IV, Figs. 2 and 5)

Holotypus: Specimen No. Z. Pb. H 19; Pl. IV, Fig. 2.
Stratum typicum: Viséan.
Locus typicus: Chełm I, sample 573.
Derivatio nominis: Lat. *maeander* = after intricate pattern of ornamentation of its spores.

Diagnosis. — Megaspores with trilete rays, in the form of thick rolls, strongly elevated at the apex. Arcuate ridges, consisting of several knobs, strongly crowded or even fused together. Contact area radially folded. The remaining part of the spore surface very strongly wrinkled in the form of thick roll-like elevations. The appearance of the whole strongly resembles the folds of the cerebral cortex.

Material. — Twenty five well-preserved specimens.

Dimensions (in μ):

	Z. Pb. H8	Z. P. H19
Length of spore	450	1075
Width of spore	400	962
Length of Y-rays	212.5	250
Width of Y-rays	37.5	112
Height of Y-rays	62.5	125

Height of apical prominence	237.5	375
Length of arcuate ridges	200	425
Length of ridges on the distal surface of spore	37—100	75—200
Width of ridges on the distal surface of spore	37—40	50—87
Diameter of knobs near arcuate ridges	12.5—16	25—75
Number of folds on contact area . .	1—2	3—5
Thickness of exospore	50	75

Description. — Trilete megaspores; specimens, flattened in proximal--distal direction, are round, those, flattened in lateral direction — pear-like. Trilete rays developed in the form of thick ridges, slightly elevated at the apex. Contact area covered with radial folds and bounded with distinct arcuate ridges, consisting of several knobs, which very strongly crowded and very often fused together, to form a sort of an irregularly shaped roll. The rest of the spore surface is very strongly folded like the cerebral cortex. These are roll-like elevations, separated by depressions. Exospore very massive. Spores are dark tan-brown or black and with a lustrous surface.

Remarks. — Megaspores of *Lagenicula maeandrica* n. sp. are most similar to the spores of *L. agnina* Zerndt, 1937, from which they primarily differ in the lack of knobs, typical of the *L. agnina.* In addition, trilete rays in *L. agnina* are longer, much wider and thicker.

Megaspores of *L. maeandrica* n. sp. are somewhat similar to those of *L. pseudoagnina,* whose surface is covered with larger knobs than *L. agnina,* but they are distant from each other and very seldom fuse together. *L. pseudoagnina* is more similar to *L. agnina* than to *L. maeandrica.*

Occurrence. — Poland, Chełm I boring (samples 573, 575) — Viséan.

Genus *Lagenoisporites* Potonié & Kremp, 1954

Type species: *Lagenoisporites rugosus* (Loose) Potonié & Kremp, 1954

Lagenoisporites simplex var. *levis* (Zerndt, 1937) Potonié & Kremp, 1954

(Pl. V, Figs. 1—9; Pl. VI, Figs. 1—9)

1937. *Lagenicula simplex* var. *levis* Zerndt; J. Zerndt, Les mégaspores..., pp. 3, 15, Pl. 23, Figs. 1—5.
1938. Typ 36; J. Zerndt, Die Eignung..., p. 1713.
1955. *Lagenoisporites (Lagenicula) simplex* var. *levis* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 121.
1957. *Lagenicula simplex* var. *levis* Zerndt; S. J. Dijkstra & P. Piérart, Lower Carboniferous..., p. 16, Pl. 16, Figs. 198—203; Pl. 19, Figs. 240—241.
1957. *Triletes subsimplex* Dijkstra; S. J. Dijkstra P. Piérart, *Ibid.*, p. 10, Pl. 5, Figs. 79—87; Pl. 16, Figs. 198—203.
1962. *Lagenicula simplex* var. *levis* Zerndt; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 75, Pl. 10, Figs. 1a—b.

Material. — More than 300 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. J1	Z. Pb. J2	Z. Pb. J3	Z. Pb. J4	Z. Pb. J5
Length of spores	275	400	900	1050	1125
Width of spores	250	380	750	1000	850
Length of Y-rays	87	125	325	325	175
Width of Y-rays	50	75	187	150	112
Height of Y-rays (in apical part)	45	50	180	225	75
Width of arcuate ridges	12	25	50	75	62
Height of arcuate ridges	12	12.5	25	50	62
Diameter of knobs in the contact place of Y-rays and arcuate ridges	37	—	150	112	125
Height of these knobs	25	—	62	75	75
Number of folds on contact area	—	1—2	2—3	—	—
Thickness of exospore	37	62	50	50	62

Description. — Trilete megaspores; specimens, flattened in lateral direction, are pear-shaped, and those, flattened in proximal-distal direction, are round or triangular. Specimens, flattened obliquely, irregular in shape, are also often met with. Triradiate ridges are strongly elevated and extended, shaped like rolls. Arcuate ridges are very distinctly roll-like. In the place, where triradiate ridges contact arcuate ridges, there occur characteristic knobs. In some forms, contact area is smooth and, in some others, covered with 3—7 folds, converging at the apex. The remaining part of the spore surface is smooth, except for the largest specimens, in which fine globules occur sometimes. In the reflected light, spores are dark-brown or black.

Remarks. — Megaspores of *L. simplex* var. *levis* from Chełm differ from those, described by Zerndt (1937*a*) in a more extensive range of dimensions, the length of the smallest specimens amounting to 275 μ (according to Zerndt's findings, 750 μ). Zerndt presumed that *L. simplex* and *L. simplex* var. *levis* virtually make up the same species of megaspores. However, no forms have been found with a size intermediary between these two forms. The samples from Chełm did not contain megaspores of this species larger than 1.125 μ. Thus, it has been difficult to state what was the relationship of the *L. simplex* spores to the *L. simplex* var. *levis* megaspores. Presumably, however, the abundant occurrence of megaspores of *L. simplex* var. *levis* in these samples, with a simultaneous complete lack of spores, known as *L. simplex*, testifies to the fact that spores of *L. simplex* var. *levis* are not an abortive form of *L. simplex*, as it has been suggested by Dijkstra (1952), the more so as this variety includes many mature spores with an open germination cleft. Likewise, there are no sufficient reasons why the species *T. subsimplex* should be distinguished in such a form as that suggested by Dijkstra (1957). Two groups, which differ from each other only in the manner of the development of the contact-field surfaces, may be distinguished in *L. simplex* var. *levis*. A series of forms may be arranged with completely smooth contact fields, and another, analogous series, in which distinct folds are visible on contact fields. In all descriptions of this variety, presented so far, the contact fields were determined as smooth and no folds were mentioned, despite the fact that they might be observed even in such early illustrations as those, figured by Zerndt (1937). Such folds are also visible in Dijkstra & Piérart (1957, Pl. 16, Figs. 199, 201, 202; Pl, 19, Fig. 240). Dijkstra (1957) was the first to mention the existence of such folds on contact fields in his description of the species *T. subsimplex*. If the existence of such folds might be considered a specific difference, *T. subsimplex* Dijkstra, 1957 could be considered an independent species, to which only the forms with folds on contact fields would be assigned.

Occurrence. — Poland, Upper Silesia — Namurian; Chełm I boring (samples 573 and 575) — Viséan. Turkey — Namurian B. U.S.S.R. (Moscow Coal Field) — Namurian, and (Donetz Coal Field and its western extension) — Viséan.

Lagenoisporites rugosus (Loose, 1932) Potonié & Kremp, 1954

(Pl. III, Figs. 7 and 10)

1946. *Triletes rugosus* (Loose) Dijkstra; S. J. Dijkstra, Eine monographische..., p. 47, Pl. 9, Figs. 83—99; Pl. 10, Figs. 100—103, 109, 110, 113?, 114?; Pl. 11, Fig. 115 (*here earlier synonymy included.*
1950. *Lagenicula rugosa* (Loose) Arnold; C. A. Arnold, Megaspores..., p. 82, Pl. 11, Pl. 12, Figs. 1—4.
1951. *Triletes rugosus* (Loose) Dijkstra; M. Kalibova, Megaspores..., p. 49. Pl. 2, Figs. 19, 22.
1954. *Lagenoisporites rugosus* (Loose) Potonié & Kremp; R. Potonié & G. Kremp. Die Gattungen..., p. 151.
1955. *L. rugosus* (Loose) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 122, Pl. 4, Fig. 22.
1956. *Triletes rugosus* (Loose) Schopf, Wilson & Bentall var. *major* Dijkstra; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 259, Pl. 53, Figs. 19—21; Pl. 54, Figs. 25—28.
1956. *T. rugosus* (Loose) Dijkstra; M. C. Bonet & S. J. Dijkstra, *Ibid.*, p. 259, Pl. 53, Fig. 22; Pl. 54, Figs. 29—31.
1958. *Lagenoisporites rugosus* (Loose) Potonié & Kremp; P. Piérart, Palynologie..., p. 42, Pl. 3, Figs. 11 a, b; Pl. 10, Figs. 1—11.
1959. *Triletes rugosus* (Loose) Schopf, 1938 (*sensu* Dijkstra); M. R. Winslow, Upper Mississippian..., p. 22, Pl. 3, Figs. 4, 6, 8, 9?.
1965. *Lagenoisporites rugosus* (Loose) Potonié & Kremp; E. Spinner, Westphalian D megaspores..., p. 91, Pl. 14, Fig. 7.

Material. — More than 70 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. A7	Z. Pb. G14	Z. Pb. B25
Length of spore	500	850	1,050
Width of spore	400	750	887
Length of Y-rays	150	225	287
Height of apical prominence	175	250	300
Thickness of exospore	10	27	16

Description. — Trilete megaspores; specimens, flattened laterally, are more or less oval, and those, flattened in proximal-distal direction, round or oval. Apical prominence distinct. Arcuate ridges, in well-preserved specimens, distinctly marked. Contact area occupies more or less $^1/_2$ of the spore radius. Spore surface smooth or slightly punctate, lustrous. Spores thin and very strongly folded or secondarily compressed in different directions and hence their considerably varying general outline. In the transmitted light, spores are yellow or red-brown.

Remarks. — Spores, described as *Triletes rugosus,* make up a considerably differentiated group. Thus far, completely smooth forms were grouped together with distinctly ornamented ones, which does not seem to be correct. In the present paper, only forms with a smooth, lustrous or only slightly punctate surface of exospores are assigned to *Lagenoisporites rugosus* (Loose) and ornamented spores — to new species of the genus *Lagenicula.* As results from Loose's illustrations (1932, Pl. 20, Fig. 57), the form he described as a holotype of the species *Sporonites rugosus* is not ornamented. Likewise, according to Wicher (1934), these spores do not display any sculpture at all. All spores of this type (*Type 25*) are described by Zerndt (1931, 1937*a*) as forms with a thin, smooth, lustrous exospore and devoid of appendages. This is precisely the reason why I assigned to this type the spores, identified by Schopf (1938) as *T. translucens* whose surface is devoid of sculpture. In the same work, Schopf described another form which, according to him, differs only in a slightly thicker and less translucent exospore and whose surface is rough. However, no distinct elements of sculpture are mentioned by this author. In this connection, the assignment of this group of spores to a separate species does not seem necessary. In addition to smooth spores, certain forms with fine sculptural elements have been observed by some later authors (Arnold, 1950; Winslow, 1959) who, because of an occasional occurrence of these forms, did not erect new species.

Occurrence. — Poland, Upper Silesia — Namurian and Westphalian A and B; Chełm I boring (samples 38—40 and 56) — Westphalian A. Czechoslovakia — Westphalian B to D. The Netherlands-Westphalian A to C. Germany-Westphalian B and C. France-Westphalian C. and D. Spain — Westphalian A. Belgium — Westphalian C. U.S.A. (Illinois Coal Field) — Westphalian.

Lagenoisporites vastus (Dijkstra, 1957) nov. comb.

(Pl. III, Figs. 11 and 12)

1957. *Triletes vastus* Dijkstra; S. J. Dijkstra & P. Piérart, Lower Carboniferous..., p. 13, Pl. 11, Figs. 133—138.

Material. — Two well-preserved specimens.

Dimensions (in μ):

	Z. Pb. J22	Z. Pb. J21
Length of spore	450	750
Width of spore	425	662
Length of Y-rays	100	187
Width of Y-rays	50	70
Height of Y-rays	60	80
Width of arcuate ridges	—	37
Height of arcuate ridges	—	25
Diameter of knobs near arcuate ridges	—	150
Height of knobs near arcuate ridges	—	100
Thickness of exospore	38	43

Description. — Trilete megaspores; specimens, flattened in proximal--distal direction, are triangular in outline. Trilete rays roll-like, in particular on smaller specimens. Contact are bounded by a large swelling of exospore. A ligulate swelling is situated in the place in which arcuate ridges contact Y-rays. Spore surface smooth. Spores are tan-brown or black.

Remarks. — Megaspores of *Lagenoisporites vastus* (Dijkstra) n. comb. differ from those described by Dijkstra (1957) only in slightly thicker Y-ridges. They are most similar to the spores of *L. simplex* var. *levis* but for the fact that Dijkstra happened to find them even in tetrads, where all spores were equal in size, they could not be considered an abortive form of this species.

Occurrence. — Poland, Chełm I boring (sample 573) — Viséan. U.S.S.R. (Moscow Coal Field) — Lower Carboniferous.

Lagenoisporites cf. *nudus* (Nowak & Zerndt, 1936) Potonié & Kremp, 1955

(Pl. IV, Fig. 6)

1936. *Type 43, Lagenicula nuda* Nowak & Zerndt; J. Nowak & J. Zerndt, Zur Tektonik..., p. 60, Pl. 1, Fig. 6.

1955. *Lagenoisporites nudus* (Nowak & Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 121.

Material. — Two well-preserved specimens.

Dimensions (in μ):

	Z. Pb. II	Z. Pb. E26
Length of spore	500	850
Width of spore	425	750
Length of Y-rays	180	188
Height of Y-rays	60	62
Height of apical prominence	200	250
Width of arcuate ridges	37	37,5
Thickness of exospore	37,5	40

Description. — Trilete megaspores; specimens, laterally flattened, are pear-shaped. Large apical prominence surrounded by strongly outlined and thickened arcuate ridges. Trilete rays straight. Spore surface smooth or fine granular. Spores dark tan-brown.

Remarks. — Megaspores of *L.* cf. *nudus* from Chełm differ from those, described by Nowak & Zerndt (1936), only in somewhat smaller dimensions. Due to a small number of specimens, there was not a possibility to trace accurately the variability within this group of spores.

Occurrence. — Poland, Upper Silesia — Lower Namurian; Chełm I boring (sample 573) — Viséan.

Lagenoisporites sp. *1*

(Pl. IV, Fig. 10)

Material. — Two well-preserved specimens.

Dimensions (in μ):

	Z. Pb. C38	Z. Pb. I 9
Length of spore	1000	1075
Width of spore	700	650
Length of Y-rays	150	175
Height of apical prominence	250	300
Thickness of exospore	50	50

Description. — Trilete megaspores; specimens, laterally flattened, are elliptical in outline. Y-rays strongly elevated and forming apical prominence pyramidal in shape. Arcuate ridges relatively wide (50 μ). Near arcuate ridges, exospore radially folded. A double fold runs along the entire spore. Spore surface smooth. Spores tan-brown.

Remarks. — These spores are most similar to megaspores of *L. simplex* var. *levis* in which, however, trilete rays are roll-like, whereas in the forms, described above, they are flat and apical prominence occupies the entire contact area.

Occurrence. — Poland, Chełm I boring (samples 154 and 571b) — Viséan and Westphalian A.

Lagenoisporites sp. 2
(Pl. IV, Fig. 7)

Material. — One specimen.

Dimensions (in μ):

	Z. Pb. G47
Length of spore	700
Width of spore	575
Length of Y-rays	125
Thickness of exospore	12

Description. — Trilete megaspore; specimen, longitudinally flattened, sack-like in shape. Apical prominence with height almost equal to length of Y-ray. Spore surface with one longitudinal and one transverse fold, without sculpture, with fine knobs, occurring here and there as if a remnant of broken off spines. Spore dark tan-brown.

Occurrence. — Poland, Chełm I boring (sample 573) — Viséan.

Lagenoisporites? sp. 3
(Pl. IV, Fig. 11)

Material. — Four poorly preserved specimens.

Dimensions (in μ):

	Z. Pb. A33	Z. Pb. H17
Length of spore	950	1225
Width of spore	412	550
Length of Y-rays	200	225
Height of apical prominence	250	250
Thickness of exospore	5	7,5

Description. — Trilete megaspores; specimens longitudinally flattened, oval in outline. Trilete ridges, strongly elevated, forming trilete apical prominence. Arcuate ridges invisible. Exospore strongly folded and longitudinally rolled up which makes difficult the determination of a real shape of spores. Spore surface smooth, lustrous, dark-brown or black.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A.

Lagenoisporites? sp. 4
(Pl. IV, Fig. 9)

Material. — One specimen.

Dimensions (in μ):

	Z. Pb. G26
Length of spore	1150
Width of spore	650
Length of Y-rays	100
Height of apical prominence	200
Thickness of exospore	60

Description. — Trilete megaspore; specimen longitudinally flattened, oval in outline. Trilete apical prominence shaped like a truncate pyramid. Arcuate ridges marked in the form of a depression surrounding apical prominence. Exospore smooth, longitudinally folded. The entire spore was probably covered with a membraneous areola, whose remains occur on the surface of exospore and along the entire spore margin, apical prominence included, there is visible a membraneous stripe. Spore black.

Remarks. — This spore, despite its general structure of the *Lagenoisporites* type, may be just an abortive form of some species of the genus *Cystosporites*.

Occurrence. — Poland, Chełm I boring (sample 154) — Westphalian A.

Genus *Setosisporites* (Ibrahim 1933) Potonié & Kremp, 1954

Type species: *Setosisporites hirsutus* (Loose) Ibrahim 1933

Setosisporites praetextus (Zerndt, 1934) Potonié & Kremp, 1955

(Pl. VII, Figs. 1 and 2)

1946. *Triletes praetextus* Zerndt; S. J. Dijkstra, Eine monographische..., p. 43, Pl. 7, Figs. 66, 67; Pl. 8, Figs. 68, 69 (*here earlier synonymy included*).
1947. *T. praetextus* Zerndt; A. T. Cross, Spore floras..., p. 301, Fig. 20.
1947. *T. praetextus* var. *I* Cross; A. T. Cross, *Ibid.*, p. 302, Figs. 91—94.
1955. *Setosisporites praetextus* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die sporae..., p. 124, Pl. 5, Figs. 30—32.
1955. *S. praetextus* (Zerndt) Potonié & Kremp; U. Horst, Die Sporae..., p. 174, Pl. 19, Figs. 19, 20.
1955. *Triletes praetextus* Zerndt; S. J. Dijkstra, Megasporas..., p. 334, Pl. 41, Fig. 28.
1956. *T. praetextus* Zerndt, forma *minor* Dijkstra; S. J. Dijkstra, Lower Carboniferous..., p. 14, Pl. 7, Fig. 77.
1956. *T. praetextus* Zerndt; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 257, Pl. 52, Figs. 13, 14.
1957. *Setosisporites praetextus* (Zerndt) Potonié & Kremp; D. C. Bhardwaj, The palynological..., p. 93, Pl. 25, Figs. 11, 12.
1958. *S. praetextus* (Zerndt) Potonié & Kremp; P. Piérart, Palynologie..., p. 44, Pl. 3, Figs. 1—4.
1959. *Triletes praetextus* Zerndt; M. R. Winslow, Upper Mississippian..., p. 46, Pl. 5, Figs. 9, 10.
1962. *Megaligulati praetextus* (Zerndt) Ishchenko & Semenova; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 64, Pl. 4, Fig. 4.

Material. — Twenty well-preserved specimens.

Dimensions (in μ):

	Z. Pb. C18	Z. Pb. H39	Z. Pb. L35
Diameter of spore	550	1275	1425
Length of Y-rays	250	450	600
Width of apical prominence	100	250	300
Height of apical prominence	75	225	250
Length of equatorial appendages . .	75	250	—
Thickness of equatorial appendages	20	37	—
Thickness of exospore	35	50	—

Description. — Trilete megaspores; specimens, flattened in proximal-distal direction, are round, those, flattened in lateral direction, subtriangular in shape. Y-rays roll-like with their width gradually increasing towards the apex of spore, where a small apical prominence is formed. Contact area smooth, devoid of sculpture. A few rows of spinal appendages, which are simple or 2—3 times branched, are disposed on the outside of arcuate ridges. Distal surface of spores smooth. Spores are tan-brown. Elements of sculpture strongly lustrous, under reflected light red-brown and under transmitted light red-orange.

Remarks. — No diameters of the *S. praetextus* (Zerndt) spores have been given by Zerndt. According to recent descriptions of megaspores of this species, their diameters vary between 800 and 1,800 μ. In the material from Chełm they are slightly smaller (500 to 1.425 μ), mostly about 1,200 μ in diameter which is in conformity with data, presented by other authors. Spores of this species, 700 to 1,000 μ in diameter, have been described by Dijkstra (1952*a*) as *S. praetextus* f. *minor* which does not seem correct. At Chełm, one may also find forms 550 μ in diameter, but they are not numerous. All of them are identical in structure, whose particular elements increase their size in proportion to the increase in the size of spores. Spores of all dimensions have been found in a single sample and, therefore, their division into small and large ones is ill-grounded, the more so as these forms are very characteristic and easy to distinguish between them.

Occurrence. — Poland, Upper Silesia — Namurian A to Westphalian B; Chełm I boring (samples 38, 39, 56, 230, 239, 399 and 527) — Viséan to Westphalian A. Czechoslovakia — Namurian A to Westphalian B and C. Germany — Westphalian C. France — Westphalian A to C. The Netherlands — Westphalian B and C. Scotland and Ireland — Lower Carboniferous. Spain — Westphalian A. Turkey — Namurian A to Westphalian B. U.S.A. (Illinois Coal Field, as well as the States of Virginia and Kentucky) — Namurian to Westphalian. U.S.S.R. (Donetz Coal Field and its western extension) — Westphalian A.

Setosisporites hirsutus (Loose, 1932) Ibrahim, 1933

(Pl. V, Figs. 11, 12)

1946. *Triletes hirsutus* (Loose), *Type 13* Zerndt; S. J. Dijkstra, Eine monographische..., p. 37, Pl. 7, Figs. 62—65; Pl. 8, Figs. 79—82 (*here earlier synonymy included*).
1947. *T. tenuispinosus* Zerndt; A. T. Cross, Spore floras..., p. 299.
1952. *Type 13* = *Triletes hirsutus* (Loose); S. J. Dijkstra, The stratigraphical..., p. 163.
1954. *Setosisporites hirsutus* (Loose) Ibrahim; R. Potonié & G. Kremp, Die Gattungen..., p. 152, Pl. 10, Fig. 43; Pl. 20, Fig. 14.
1955. *S. hirsutus* (Loose) Ibrahim; R. Potonié & G. Kremp, Die Sporae..., p. 123, Fig. 37; Pl. 4, Figs. 23—29.
1955. *Triletes hirsutus* (Loose) Schopf, Wilson & Bentall; S. J. Dijkstra, Megasporas..., p. 300, Pl. 36, Figs. 11, 12.
1956. *T. hirsutus* (Loose) Schopf, Wilson & Bentall; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 256, Pl. 52, Figs. 17, 18.
1958. *Setosisporites hirsutus* (Loose) Ibrahim; P. Piérart, Palynologie..., p. 43, Pl. 3, Figs. 10, a—c.
1958. *S. hirsutus* (Loose) Ibrahim; W. G. Chaloner, A. Carboniferous..., Pl. 44, Fig. 11.
1959. *Triletes* cf. *Triletes hirsutus* (Loose) Schopf, Wilson & Bentall; M. R. Winslow, Upper Mississippian..., p. 45, Pl. 5, Fig. 7.
1963. *Setosisporites hirsutus* (Loose) Ibrahim; P. Piérart, Synopsis..., p. 236, Pl. 3, Fig. 14.

Material. — Ten well-preserved specimens.

Dimensions (in μ):

	Z. Pb. B38	Z. Pb.H36	Z. Pb. H30
Diameter of spore	500	600	650
Height of Y-rays	25	25	30
Height of apical prominence	75	125	125
Length of appendages covering spore surface	60—63	62—90	62—100
Width of appendages at the base	12	12,5	12,5
Thickness of exospore	28	37	37,5

Description. — Trilete megaspores, round in proximal-distal outline and oval in lateral outline. Trilete rays ridgelike, near the apex strongly elevated and forming apical prominence pyramidal in shape. Contact area devoid of sculpture, sometimes slightly folded. The remaining part of the spore surface covered with numerous, densely distributed appendages which are either simple or bifurcated at apex. Spores are gray-brown, appendages brown-red. Elements of sculpture highly lustrous.

Affinities. — *Selaginellites canonbiensis* Chaloner, 1958 has megaspores very similar to those of *Setosisporites hirsutus.*

Occurrence. — Poland, Upper Silesia — Namurian C to Westphalian C; Chełm I boring (samples 38, 40, 56, 154, 239 and 263) — Namurian B to Westphalian A. Germany — Westphalian B and C. France — Westphalian A to C. The Netherlands — Westphalian A to D. Turkey — Westphalian A to C. Belgium — Westphalian C. Spain — Westphalian A. U.S.A. (Illinois Coal Field and the States of Virginia and Kentucky) — Westphalian A.

Setosisporites hirsutus var. *brevispinosa* f. *1* (Zerndt, 1937) Potonié & Kremp, 1955

(Pl. IX, Fig. 7)

1937. *Type 13A, Triletes tenuispinosus* var. *brevispinosa* Zerndt; J. Zerndt, Les mégaspores..., p. 6, Text-fig. 4; Pl. 3, Figs. 1, 2, 5—7.
1946. *Triletes hirsutus* var. *brevispinosa* Zerndt; S. J. Dijkstra, Eine monographische..., p. 38, Pl. 7, Figs. 61 a—b; Pl. 15, Figs. 167—168.
1952. *T. hirsutus* var. *brevispinosa* Zerndt forma *1*; S. J. Dijkstra, The stratigraphical..., p. 163, Pl. 7, Fig. 7.
1955. *Setosisporites (Triletes) hirsutus* var. *brevispinosa* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 123.
1955. *S. hirsutus* var. *brevispinosa* (Zerndt) Potonié & Kremp; U. Horst, Die Sporae..., p. 174, Pl. 19, Figs. 17, 18.
1956. *Triletes hirsutus* (Loose) Schopf, Wilson & Bentall var. *brevispinosa* forma *1*; S. J. Dijkstra, Lower Carboniferous..., p. 13, Pl. 7, Figs. 67—71.
1957. *T. hirsutus* (Loose) Schopf, Wilson & Bentall var. *brevispinosa* forma *1* Zerndt; S. J. Dijkstra & P. Piérart. Lower Carboniferous..., p. 8, Pls. 31—33; Pl. 19. Figs. 228—233.

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. I21
Diameter of spore	500
Height of Y-rays	25
Height of apical prominence	50
Length of spines	6
Thickness of exospore	12

Description. — Trilete megaspore, round in outline. Trilete rays ridgelike, their length reaching 2/3 of the spore radius. Contact area radially folded. The remaining part of the spore surface covered with fine spines. Spore tan-brown.

Remarks. — Megaspores of *S. hirsutus* var. *brevispinosa* (Zerndt) from Chełm differs from the holotype in a slightly smaller apical prominence.

Occurrence. — Poland, Upper Silesia — Namurian A and B; Chełm I boring (sample 573) — Viséan. Czechosłovakia — Namurian A. The Netherlands — Namurian B. Scotland and Ireland — Namurian. U.S.S.R. (Moscow Coal Field) — Lower Carboniferous. Turkey — Namurian A and B.

Setosisporites hirsutus var. *brevispinosa* f. *II* (Zerndt) Potonié & Kremp, 1955

(Pl. IX, Fig. 11)

1937. *Type 13A, Triletes tenuispinosus* var. *brevispinosa II*; J. Zerndt, Les mégaspores..., p. 6, Text-fig. 5; Pl. 3, Figs. 3—4.

1952. *Triletes hirsutus* var. *brevispinosa* Zerndt forma *II*; S. J. Dijkstra, The stratigraphical..., p. 163, Pl. 7, Fig. 8.

1955. *Setosisporites hirsutus* var. *brevispinosa* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 123.

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. I24
Diameter of spore	500
Length of Y-rays	175
Height of Y-rays	25
Height of apical prominence	100
Length of appendages	37
Thickness of exospore	20

Description. — Trilete megaspore, round in outline. Y-rays ridgelike, near apex strongly elevated. Contact area slightly folded, the remaining part of spore surface covered with spined appendages closely adhering to each other. Spore are dark tan-brown.

Occurrence. — Poland, Upper Silesia — Lower Carboniferous; Chełm I boring (sample 573) — Viséan. Turkey — Namurian C.

Setosisporites dybovae n. sp.

(Pl. VII, Figs. 4, 5)

Holotypus: Specimen No. Z. Pb. H38; Pl. VII, Fig. 5.

Stratum typicum: Viséan, Namurian A.

Locus typicus: Chełm I, sample 399.

Derivatio nominis: dybovae — in honour of Doc. Dr. S. Dybová-Jachowicz. investigator of the Carboniferous microflora.

Diagnosis. — Trilete megaspores with ridgelike trilete rays, which are uniform in width and height over the entire length. Apical prominence occupies about 1/4 of the trilete ray. Contact area and distal surface smooth. A row of either simple, or several times branched appendages is situated on the outside of arcuate ridges.

Material. — Thirty five well-preserved specimens.

Dimensions (in μ):

	Z. Pb. D17	Z. Pb. H38	Z. Pb. H33	Z. Pb. D18
Diameter of spore	500	775	875	937
Length of Y-rays	210	325	350	375
Width of Y-rays	12	25	30	50
Height of apical prominence	40	50	100	100
Length of equatorial appendages	60	75	100	100
Width of equatorial appendages	12	20	25	30
Thickness of exospore	25	38	25	30

Description. — Trilete megaspores; specimens, compressed in proximal-distal direction, are round or subtriangular in outline. Trilete rays ridgelike, slightly and regularly undulated. At the spore apex, trilete ridges form a small, conical prominence. Contact area smooth, mostly delimited by very distinct arcuate ridges. Simple or — more often — several times branched appendages are situated along arcuate ridges on their outer side. Sometimes, adjacent appendages are fairly closely connected with each other. They are easily destroyed and, after breaking off, leave traces in the form of fine knobs. Distal surface of spores smooth. Spores tan-brown or black.

Remarks. — Megaspores of this species are most similar to spores of *S. praetextus* (Zerndt), but they have much shorter equatorial appendages, smaller apical prominence and differently developed Y-rays. *S. praetextus* has trilete rays which are distinctly roll-like and more and more contracting as the distance increases from apex, whereas in *S. dybovae* n. sp. trilete rays are ridgelike, slightly undulated and almost uniform in width and height over the entire length. The width of apical prominence in *S. praetextus* equals about 1/2 of the length of the trilete ray and, in *S. dybovae* n. sp., this width makes up 1/4 of Y-ray radius. The length of equatorial appendages in *S. dybovae* n. sp. — in contradistinction to *S. praetextus* — does not exceed 100 μ.

Occurrence. — Poland, Chełm I boring (samples 399 and 527) — Viséan to Namurian A.

Setosisporites reticulatus n. sp.

(Pl. V, Fig. 10; Pl. X, Fig. 8)

Holotypus: Specimen No. Z. Pb. H7; Pl. V, Fig. 10.
Stratum typicum: Viséan.
Locus typicus: Chełm I, sample 571b.
Derivatio nominis: Lat. *reticulum* = network, after a characteristically reticulate distal surface of spore.

Diagnosis. — Megaspores with contact area radially folded. The rest of the spore surface is covered with a flat reticulum with round and ovate lumina. The entire surface of reticulum is covered with fine knobs.

In the place, where reticulum contacts arcuate ridges, a flange is formed with spined appendages occurring on its margin.

Material. — Ten well-preserved specimens.

Dimensions (in μ):

	Z. Pb. D38	Z. Pb. H7	Z. Pb. L37
Diameter of spore	350	400	587
Length of Y-rays	100	150	200
Height of apical prominence	50	75	100
Width of equatorial flange	—	37,5	75
Length of spines on the margin of flange	—	7—16	10—16.5
Thickness of exospore	25	25	32

	Z. Pb. K12
Thickness of reticulum covering spore	3—4
Diameter of lumina of reticulum	7—41
Height of knobs on the surface of reticulum	3.3—7.7

Description. — Trilete megaspores; specimens, compressed in proximal-distal direction, are round in shape. Length of trilete rays equalling about 3/4 of the length of spore radius. Trilete rays roll-like, at the apex forming a typical apical prominence. Contact area smooth or covered with fine knobs, slightly folded. The remaining part of the spore surface covered with a flat reticulum closely adhering to exospore. Lumina of reticulum round or oval, considerably varying in size. The entire reticulum covered with fine, slightly contracting, knobs. A flat flange with spined appendages on its margin is formed in the place, where reticulum contacts arcuate ridges. In well-preserved specimens, reticulum closely adheres to exospore and is poorely visible but, in slightly damaged specimen, it is detached from the rest of spore. It may be gently torn off and examined under transmitted light. Spores are tan-brown-black and reticulum brown-cherry, under transmitted light yellow-orange.

Remarks. — *Setosisporites reticulatus* n. sp. is most similar to S. *globosus* (Arnold) var. *B* Winslow (1959). The difference consists in slightly smaller middle dimensions of spores, and, primarily in a different sculpture of the distal surface. True enough, Winslow mentions a certain irregularity of the reticulum, but she also states that this reticulum consists of beadlike appendages whose length amounts to 15—57 μ. Whereas the reticulum of *S. reticulatus* is uniform and knobs represent only an additional body on its surface. Moreover, knobs are relatively fine, their height does not exceed 7.8 μ and, therefore, they do not reach even a lower limit of size of the *S. globosus* var. *B* spines. The similarity consists in the presence — in both forms — of a flange which occurs in the place, where arcuate ridges contact the remaining parts of spore.

In their general appearance, megaspores of *S. reticulatus* resemble spores, described by Zerndt (1937) as *T. tenuispinosus* var. *brevispinosa* f. *II*. In both cases, contact area is folded and densely distributed spined appendages occur on the spore circumference. The difference consists in the fact that appendages in Zerndt's spores are much longer and there is no reticulum on the distal surface.

Occurrence. — Poland, Chełm I boring (sample 571b) — Viséan.

Setosisporites? sp. *1*

(Pl. VII, Fig. 6)

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. H32
Length of spore	625
Width of spore	500
Length of Y-rays	250
Height of Y-rays	30
Height of apical prominence	62
Width of apical prominence at the base	87
Thickness of exospore	37

Description. — Trilete megaspore, oval in outline. Trilete rays ridge-like. Arcuate ridges distinct. Spore smooth, tan-brown.

Remarks. — Megaspore of *Setosisporites?* sp. resembles, in its general shape and dimensions, spores of the genus *Setosisporites*. In the representatives of this genus, the elements of sculpture are often very loosely connected with exospore and, after their destruction, sometimes, no traces are left on the spore surface. In all probability, therefore, *Setosisporites?* sp. is a spore of the genus *Setosisporites* whose sculpture was completely destroyed. With regard to its dimensions, this specimen is most similar to the species *S. dybovae* n. sp., except for the fact that, in this species, the broken off spines usually leave traces in the form of small knobs.

Occurrence. — Poland, Chełm I boring (sample 399) — Namurian A.

cf. *Setosisporites* sp. *2*

(Pl. VII, Fig. 7)

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. G34
Diameter of spore	338
Length of Y-rays	125
Height of apical prominence	67.5
Width of apical prominence at the base	125
Height of knobs	2.5—12
Width of knobs	2.0—10
Thickness of exospore	20

Description. — Trilete magaspore, subtriangular in equatorial outline. Trilete rays ridge-like, half-way their length extended, elevated and forming a trilete apical prominence. Contact area smooth, lustrous. Arcuate ridges distinct. The remaining part of spore surface covered with fine knobs. Spore almost black.

Remarks. — The megaspore described above, is of an intermediary character between the genera *Setosisporites* and *Lagenicula,* which differ from each other in the development of apical prominence (what is known as "gula"), which is most strongly developed in *Lagenicula* in which Y-rays are strongly elevated over their entire length, whereas, in *Setosisporites,* only a small part of Y-rays forms a small elevation at the very apex. In the megaspore of cf. *Setosisporites* sp. 2, this elevation of trilete ridges does not occur over the entire length, but it occupies a considerable part of it and is trilete as in the genus *Lagenicula.* Since in the Chełm I boring, only one specimen has been found, it was impossible to determine its systematic position.

Occurrence. — Poland, Chełm I boring (sample 575) — Viséan.

Turma **Zonales** (Bennie & Kidston, 1886) Potonié & Kremp, 1956
Subturma **Auritotriletes** Potonié & Kremp, 1954
Infraturma **Auriculati** (Schopf, 1938) Potonié & Kremp, 1954
Genus *Valvisisporites* (Ibrahim, 1933) Potonié & Kremp, 1954
Type species: *Valvisisporites trilobus* Ibrahim, 1933

Valvisisporites auritus (Zerndt, 1930) Potonié & Kremp, 1956

(Pl. IV, Fig. 8)

1946. *Triletes auritus* Zerndt; S. J. Dijkstra, Eine monographische..., p. 51, Pl. 3, Figs. 16, 17 a—b; Pl. 4, Fig. 25; Pl. 16, Fig. 178 (*here earlier synonymy included*).
1947. *T. auritus* Zerndt; A. T. Cross, Spore floras..., p. 383, Pl. 1, Figs. 7—9, 13, 14, 15?; Pl. 4, Figs. 151—152.
1950. *T. auritus* Zerndt; C. Arnold, Megaspores..., p. 76, Pl. 6, Figs. 3—6.
1951. *T. auritus* Zerndt; M. Kalibova, Megaspores..., p. 21, Pl. 3, Figs. 4—13, 17—27.
1955. *Valvisisporites auritus* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., Pl. 6, Figs. 38, 40, 41, 43

1956. *Triletes auritus* Zerndt; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 256, Pl. 49, Figs. 47, 50.
1957. *Valvisisporites auritus* (Zerndt) Bhardwaj; D. C. Bhardwaj, The palynological..., p. 98, Pl. 26, Figs. 12, 13.
1957. *V. westphalensis* Bhardwaj; D. C. Bhardwaj, The spore flora..., p. 124, Pl. 25, Figs. 71, 72.
1958. *V. westphalensis* Bhardwej; P. Piérart, Palynologie..., p. 46, Pl. 2, Fig. 15; Pl 14, Fig. 4.
1958. V. cf. *flavus* (Stach & Zerndt) Potonié & Kremp; P. Piérart, *Ibid.*, p. 52, Pl. 2, Figs. 12—14.
1958. *V. augustae* (Loose) Potonié & Kremp; P. Piérart, *Ibid.*, p. 51, Pl. 2, Figs. 5—11.
1959. *Triletes auritus* Zerndt (*sensu* Potonié & Kremp); M. R. Winslow, Upper Mississippian..., p. 30, Pl. 7, Figs. 7—11.
1962. *Megastenozonales auritus* (Zerndt) Ishchenko & Semenova; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 76, Pl. 11, Fig. 1.
1962. *M. notabilis* Ishchenko & Semenova; A. M. Ishchenko & E. V. Semenova, *Ibid.*, p. 78, Pl. 11, Fig. 2.
1965. *Valvisisporites auritus* (Zerndt) Potonié & Kremp; (*sensu* Bhardwaj, 1957); E. Spinner, Westphalian D megaspores..., p. 96, Pl. 17, Figs. 6, 7.

Material. — Fifteen well-preserved specimens.

Dimensions (in μ):

	Z. Pb. H37	Z. Pb. L37
Diameter of spore	750	1,150
Length of Y-rays	350	527
Thickness of Y-rays	37.5	58
Width of auriculae at the base	212	280
Thickness of exospore	25	30

Description. — Trilete megaspores; in equatorial plane, specimens are round to subtriangular in outline. Y-rays slightly elevated, the highest ones at the spore apex. Arcuate ridges running almost on the spore margin, forming a narrow ring on the equator. In the corners of triangle, arcuate ridge joins rays of the triradiate figure and, in this place, the ring is slightly wider and forms auriculae. The width of auriculae is smaller than the distance between them. The length of auriculae, measured centrifugally along the spore radius, does not exceed 1/2 of radius. Spore surface smooth or slightly rough. Spore colour bright-brown.

Remarks. — There are many divergent views concerning the megaspores of the group Auriculati. This fact is due to a certain inconsistency of Zerndt who — under the name of *T. auritus* — introduces a few groups of spores and divides them into *Triletes auritus I, II, III,* etc., separates *Types 11, 11a* and *11b* as well as *Type 12* and, in addition to them all, *T. auritus* var. *grandis* and "auriculate spores 0.7 mm in diameter". In the diagnosis of the species *T. auritus I,* Zerndt emphasizes that, despite certain similar characters, the auriculate spores 0.7 mm in diameter seem to represent another species. Zerndt (1931) explains that by *Type 11* he means "spores 0.7 mm in diameter", described from the Izabella bed and that *Triletes aurites* from Libiąż he considers to be *Type 12.* In 1933, describing coal balls from the Carpathian Mountains, he designates *Triletes auritus* as *Type 11.* In his 1937b work, within the group Auriculati, Zerndt distinguished the following types: *Triletes auritus I, T. auritus II* and *T. appendiculatus* Maślankiewiczowa. The last-named type was previously described by him as *Type 12* and, maybe also, 5. In that work, within *T. auritus Type 11,* Zerndt also distinguished *Type 11a,* i. e. *T. auritus* var. *grandis.* Since in stratigraphic tables, both these forms occur together as a single *Type 11,* Zerndt added an explanatory note in the text, according to which *T. auritus* var. *grandis, Type 11a,* is characteristic of Westphalian D and Stephanian of Bohemia. The remaining spores of this group are called by him *Type 11b* and, furthermore, he explains that the range of their occurrence usually does not exceed Westphalian B and C. Spores of *Types 11* and *12,* found by him in North-French Basin (1938*a*), have been combined by Zerndt into one and presented in stratigraphic tables as *Type 11.* Describing spores from Saar Basin, Zerndt (1940) continues to distinguish two groups of spores within *Type 11. Triletes auritus* var. *grandis* is assigned by him to *Type 11a* and the remaining spores — to *Type 11* and, like in Carboniferous of Bohemia, *Type 11a* is, according to him, stratigraphically younger than the remaining spores of *Type 11.* This seems to be a sufficient basis for keeping in force the specific name of *T. auritus* for the forms, described in 1930 under this name and being in conformity with the diagnosis of this species. *Type 12* may virtually be considered as *Triletes appendiculatus* Maślankiewiczowa, especially as in his work on megaspores from Bohemia, a mutual relationship of these two groups of megaspores is precisely interpreted in this way by Zerndt (1932) himself. In the works by Zerndt in which *Type 11,* shown in tables, represents both the forms, previously designated as *Type 11* and those, known as *Type 12* as, for instance, in his work, published in 1938*a*, it is impossible to distinguish the species *T. auritus.* As far as the spores of *T. auritus* var. *grandis* are concerned, described from both Bohemia and Saar Basin, Zerndt presents the description of these forms and precisely states the stratigraphic range of *T. auritus* and *T. auritus* var. *grandis.*

"Spores 0.7 mm in diameter with auriculate exospore", described by Zerndt (1929), do not display differences which would allow one to consider them a different species and they completely fall within limits of specific variability of the species *Valvisisporites auritus* (Zerndt).

The species *V. westphalensis*, erected by Bhardwaj (1957*b*), to which such forms have been assigned by Zerndt as *V. auritus* (Zerndt), does not seem to be sufficiently justified. The occurrence of a characteristic elevation of ridges of the triradiate figure at the spore apex has been mentioned by previous authors as, for instance, Potonié & Kremp (1956, p. 94).

Affinities. — The cones of fossil lycopods, known as *Polysporia mirabilis* Newberry, have been described by Chaloner (1958). These cones contained megaspores similar to those of the species *Valvisisporites auritus*. The size of megaspores, found in these fructifications, vary from 520 to 1,360 μ. Chaloner emphasizes that a more correct seems to be the view of Dijkstra whose *Triletes auritus* is more broadly understood than that of Potonié & Kremp. The last-named authors distinguish — within the limits of the genus *Valvisisporites* — a certain number of species, some of which only slightly differ from each other. According to Chaloner, megaspores from the cones of *Polysporia mirabilis* correspond, in their shape and dimensions, to the species *T. auritus* Dijkstra (1946), *V. auritus, V. flavus* and *V. augustae* Potonié & Kremp (1956). In addition, he claims that *Triletes auritus* var. *grandis* differs from *T. auritus* only in its size.

Occurrence. — Poland, Upper Silesia — Westphalian B to D; Chełm I boring (samples 38—40) — Westphalian A. Czechoslovakia — Westphalian B and C. France — Westphalian A to D. The Netherlands — Westphalian A to C. Spain — Westphalian A. Germany — Westphalian B and C. Belgium — Westphalian C. U.S.A. (Illinois and Michigan Coal Fields and the States of Virginia and Kentucky) — Westphalian A to D. U.S.S.R. (Donetz Coal Field) — Westphalian C.

Subturma **Zonotriletes** Waltz, 1935

Infraturma **Zonati** Potonié & Kremp, 1954

Genus *Zonalesporites* (Ibrahim, 1933) Potonié & Kremp, emend. Spinner 1965

Type species: *Zonalesporites brasserti* (Stach & Zerndt, 1931) Potonié & Kremp, 1956

Zonalesporites brasserti (Stach & Zerndt, 1931) Potonié & Kremp, 1956

(Pl. VIII, Figs. 1—5)

1946. *Triletes brasserti* Stach & Zerndt; S. J. Dijkstra, Eine monographische..., p. 39, Pl. 5, Fig. 47—55; Pl. 15, Fig. 172 (*here earlier synonymy included*).
1947. *T. brasserti* Stach & Zerndt; A. T. Cross, Spore floras..., p. 300, Pl. 1, Fig. 22; Pl. 3, Figs. 66—67.
1950. *T. brasserti* Stach & Zerndt; C. Arnold, Megaspores..., p. 70, Pl. 1, Figs. 1, 2; Pl. 2, Fig. 1; Pl. 3, Fig. 1.
1954. *Zonalesporites brasserti* (Stach & Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Gattungen..., p. 161, Pl. 13, Fig. 59.
1955. *Z. brasserti* (Stach & Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 185, Pl. 7, Figs. 52—56.
1955. *Z. brasserti* (Stach & Zerndt) Potonié & Kremp; U. Horst, Die Sporae..., p. 185, Pl. 17, Figs. 6, 7; Pl. 18, Figs. 8, 9.

1955. *Triletes brasserti* Stach & Zerndt, forma *minor*; S. J. Dijkstra, Megasporas..., p. 302, Pl. 37, Fig. 14; Pl. 38, Fig. 16; Pl. 39, Fig. 22; Pl. 40, Figs. 24—26.
1955. *T. brasserti* Stach & Zerndt, forma A; S. J. Dijkstra, *Ibid.*, p. 303, Pl. 38, Fig. 15; Pl. 39, Fig. 23; Pl. 41, Fig. 27.
1956. *T. brasserti* Stach & Zerndt; S. J. Dijkstra, Lower Carboniferous, p. 13, Pl. 7, Figs. 73—76.
1956. *T. brasserti* Stach & Zerndt; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 257, Pl. 51, Figs. 8, 9, 117.
1956. *T. brasserti* Stach & Zerndt forma *minor* Dijkstra; M. C. Bonet & S. J. Dijkstra, *Ibid.*, p. 257, Pl. 51, Fig. 12.
1957. *T. brasserti* Stach & Zerndt; S. J. Dijkstra & P. Piérart, Lower Carboniferous..., p. 9, Pl. 4, Figs. 61—78; Pl. 14, Figs. 185, 186; Pl. 19, Figs. 237—238.
1957. *Zonalesporites brasserti* (Stach & Zerndt) Potonié & Kremp; D. C. Bhardwaj, The palynological..., p. 108, Pl. 28, Figs. 25, 26; Pl. 29, Figs. 1, 2.
1958. *Z.brasserti* (Stach & Zerndt) Potonié & Kremp; P. Piérart, Palynologie..., p. 57, Pl. 10, Fig. 17; Pl. 11, Figs. 1, 2.
1959. *Triletes brasserti* Stach & Zerndt; M. R. Winslow, Upper Mississippian..., p. 35—37, Pl. 9, Figs. 3—10.
1962. *Megahymenozonales brasserti* (Stach & Zerndt) Ishchenko & Semenova; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 79, Pl. 12, Fig. 1.
1965. *Zonalesporites brasserti* (Stach & Zerndt) Potonié & Kremp; E. Spinner, Westphalian D megaspores..., p. 100, Pl. 16, Figs. 1—3.

Material. — More than 1,000 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. H27	Z. Pb. H28	Z. Pb. A23
Diameter of spore	700	925	1,750
Diameter of central part	425	600	1,000
Width of equatorial zone	150	250	375
Length of Y-rays	250	300	850
Height of Y-rays	50	50	200
Thickness of exospore	50	75	75

Description. — Trilete megaspores with equatorial outline round to subtriangular. Spore consisting of a central part and equatorial zone. Width of equatorial zone equals about 1/2 of the length of the spore radius. Equatorial zone consists of a few rows of strongly elongated appendages, closely adhering to each other. Triradiate ridge strongly elevated, their height decreasing with the distance from the spore apex, reaching almost to the outer margin of spore. It is precisely in the extension of these ridges that equatorial zone is the widest. Ridges of triradiate figure is undulate. Their upper margin is built of a substance which — under reflected light — is highly lustrous and which is similar to that forming the elements of equatorial zone. Spore surface smooth or covered with fine knobs — more or less semilunar in shape and irregularly scattered. Under reflected light, spores are tan-brown or black and cingulum red brown. Under transmitted light cingulum is orange-red.

Remarks. — Following the fact that, after more extensive studies, Zerndt (1938 b) found it necessary to combine the forms, previously described as Types 18 and 20, in a single species, *Triletes brasserti*, and to designate it as No. 20, the diagnosis of this species was subject to modification. *Type 18c*, to which the spores with apertures, distributed all over the circumference of cingulum, are assigned by Zernd (1934), is the only type which should be excluded since this character assigns these forms rather to the species *Superbisporites superbi* (Bartlett) than to *Triletes brasserti*. Megaspores of *Z. brasserti* are marked by a considerable variability in size, whereas the ratio of the width of their cingulum and the height of Y-ridges to the diameter of the spore make up a constant magnitude. This regularity, occurring in the structure of the elements, referred to above, and the character of equatorial cingulum have primarily been taken into account in the assignment of spores of this species from Chełm.

In his works, Dijkstra distinguishes — within the species Z. *brasserti* — the *minor, media* and *maior* forms. This does not seem to be correct. As long as there is no certainty of these forms representing different species, dividing them only on the basis of size is not necessary in practice.

Occurrence. — Poland, Upper Silesia — Dinantian to Westphalian B; Chełm I boring (samples 38—40, 230, 239, 399, 425, 527, 573 and 575) — Viséan to Westphalian A. Czechoslovakia — Namurian A. Germany — Westphalian B and C. France — Westphalian A to D. Belgium — Westphalian C. The Netherlands — Westphalian A to C. Scotland — Dinantian to Lower Namurian. Spain — Westphalian A. Egypt — Lower Carboniferous. U.S.A. (Michigan and Illinois Coal Fields; the States of Virginia and Kentucky) — Namurian to Westphalian A. U.S.S.R. (Moscow and Donetz Coal Fields) — Lower Carboniferous.

Zonalesporites brasserti (Stach & Zerndt) f. *solida* (Dijkstra, 1957) nov. comb.

(Pl. VII, Figs. 10—12)

1957. *Triletes brasserti* Stach & Zerndt forma *solida* Dijkstra; S. J. Dijkstra & P. Piérart, Lower Carboniferous..., p. 9, Pl. 3, Figs. 39—58.

Material. — Twenty well-preserved specimens.

Dimensions (in μ):

	Z. Pb. G36	Z. Pb. G25	Z. Pb. H23	Z. Pb. G27
Diameter of spore	525	575	575	600
Length of Y-rays	162	250	250	225
Width of equatorial zone	37	50	87	38
Width of equatorial appendages at the base	7—10	10—16	11—16	10—16
Diameter of knobs	6—7	9—10	6—10	10—18
Thickness of exospore	25	45	50	50

Description. — Trilete megaspores; specimens, compressed in proximal-distal direction, are round in outline, most often, however, they take a subtriangular shape. Y-rays almost straight, roll-like, their width increasing with the distance from the spore apex. A slight elevation is formed in the place where Y-rays converge. Equatorial zone is built of appendages, closely adhering to each other, except for their ends which are loosely disposed, forming a sort of a dentation. Sometimes, on the distal surface or even on contact area, there occur small baculae or knobs. Spores are tan-brown or black.

Occurrence. — Poland, Chełm I boring (samples 573 and 575) — Viséan. U.S.S.R. (Moscow Coal Field) — Lower Carboniferous.

Zonalesporites radiatus (Zerndt, 1937) Spinner, 1965

(Pl. VI, Figs. 10—12)

1946. *Triletes radiatus* Zerndt; S. J. Dijkstra, Eine monographische..., p. 43 (*here earlier synonymy included*).
1954. *Radiatisporites radiatus* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Gattungen..., p. 163, Pl. 14, Fig. 63.
1955. *R. radiatus* (Zerndt) Potonié & Kremp, U. Horst, Die Sporae..., p. 188, Pl. 19, Figs, 21—23.
1956. *R. radiatus* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Sporae..., p. 133, Text-fig. 58.
1962. *Megacapillarizonales radiatus* (Zerndt) Ishchenko & Semenova; A. M. Ishchenko & E. V. Semenova, Megaspory..., p. 86, Pl. 17, Fig. 1.

Material. — More than 100 well-preserved specimens.

Dimensions (in μ):

	Z. Pb. E40	Z. Pb. H29	Z. Pb. H18
Diameter of spore	525	750	900
Length of Y-rays	260	387	400
Width of Y-rays	35	50	37
Height of Y-rays	60	87	62.5
Length of equatorial appendages	75	162	112
Width of equatorial appendages	15—16	15—25	17.5—30
Distance between appendages	17—19	17—25	25—30
Diameter of knobs on contact area	16—20	17—25	20—25
Thickness of exospore	32	25	25

Description. — Trilete megaspores, subround in outline. Triradiate ridge undulate. They reach as far as the spore equator, their height being uniform over the entire length. In the equatorial part, there is a rim, consisting of cylindrically shaped appendages. They are simple, often clavate or 2—3 times bifurcated, sometimes pointed at the ends. These appendages are disposed more or less loosely, do not contact each other or, if at all, only with their bases, while the ends remain free. Hemispherical knobs, irregularly scattered, occur on contact area and, occasionally, also on the distal surface. Spores brown or black.

Remarks. — Two groups of spores are distinguished by Zerndt (1937*a*) within this species. In the structure of their equatorial appendages, spores from Chełm are more similar to Zerndt's group II.

Occurrence. — Poland, Upper Silesia — Dinantian to Namurian B; Chełm I boring (samples 472, 527, 573 and 575) — Viséan to Namurian A. Czechoslovakia — Namurian A. U.S.S.R. (Donetz Coal Field and its western extension) — Viséan.

Zonalesporites superbus (Bartlett, 1928) Spinner, 1965

(Pl. IX, Fig. 14)

1946. *Triletes superbus* Bartlett; S. J. Dijkstra, Eine monographische..., p. 40, Pl. 6, Figs. 56—59; Pl. 7, Fig. 60 (*here earlier synonymy included*).
1947. *T. superbus* Bartlett; A. T. Cross, Spore floras..., p. 300, Pl. 1, Fig. 1; Pl. 3, Figs. 62—65.
1954. *Superbisporites superbus* (Bartlett) Potonié & Kremp; R. Potonié & G. Kremp, Die Gattungen..., p. 164.
1958. *S. superbus* (Bartlett) Potonié & Kremp; P. Piérart, Palynologie..., p. 59, Pl. 12, Figs. 1 a—b, 2 a—b.
1959. *Triletes superbus* Bartlett:, M. R. Winslow, Upper Mississippian..., p. 34, Pl. 8, Figs. 7—8; Pl. 9, Figs. 1—2.
1962. *Superbisporites superbus* (Bartlett) Potonié & Kremp; W. G. Chaloner, A Sporangiostrobus..., p. 78, Pl. 11, Figs. 1—2.
1965. *Zonalesporites superbus* (Bartlett); E. Spinner, Westphalian D..., p. 99.

Material. — Five incomplete specimens.

Dimensions (in μ):

	Z. Pb. I23
Size of spore ($\frac{1}{2}$) without rim	1250
Width of rim	550
Diameter of knobs	45—50
Length of hairlike appendages	ca. 150
Thickness of exospore	50

Description. — Despite the fact that only a half of distal part with the rim have been preserved, characteristic details of structure allowed us to identify this material. Megaspores large. Rim built of flat appendages, connected with each other in many places. Irregular apertures occur in the outermost part of rim. Distal surface covered with blunt knobs with hairlike appendages. Spores tan-brown, rim brown-cherry and lustrous.

Affinities. — Megaspores of *Z. superbus* are very similar to those, found in the cones of *Sporangiostrobus ohioensis* Chaloner, 1962. According to Chaloner (1962), the latter megaspores display a close similarity to

Z. superbus in their dimensions, character of trilete apical prominence, distal appendages and a general appearance of the equatorial zone, and differ in a more open-work rim. The last-named character makes them more similar to *Triletes ramosus* Arnold (1950). With regard to equatorial zone, Chaloner places megaspores of *Sporangiostrobus ohioensis* between *Zonalesporites superbus* and *Triletes ramosus*. *S. ohioensis* has been found in the State of Ohio, U.S.A., in the group of the New River, in the series of Pottsville, which is considered by Chaloner as an equivalent of the lower part of Westphalian A in Europe.

Occurrence. — Poland, Upper Silesia — Westphalian B and C.; Chełm I boring (samples 38, 40 and 56) — Westphalian A. Czechoslovakia — Westphalian B and C. Germany — Westphalian C. France — Westphalian A to C. The Netherlands — Westphalian B and C. Belgium — Westphalian C. Turkey — Westphalian C. U.S.A. (Michigan and Illinois Coal Field) — Westphalian A.

Genus *Triangulatisporites* Potonié & Kremp, 1954

Type species: *Triangulatisporites triangulatus* (Zerndt, 1930) Potonié & Kremp, 1954

Triangulatisporites triangulatus (Zerndt) Potonié & Kremp, 1954

(Pl. VII, Figs. 8 and 9)

1946. *Triletes triangulatus* Zerndt; S. J. Dijkstra, Eine monographische..., p. 52, Pl. 4, Figs. 24—25, 27—34 (*here earlier synonymy included*).
1947. *T. triangulatus* Zerndt; A. T. Cross, Spore floras..., p. 302, Pl. 1, Fig. 5; Pl. 4, Figs. 112—114.
1950. *T. triangulatus* Zerndt; Ch. Arnold, Megaspores..., p. 75, Pl. 6, Figs. 1—2, 4.
1951. *T. triangulatus* Zerndt; M. Kalibová, Megaspory..., p. 32, Pl. 3, Figs. 14—15.
1954. *Triangulatisporites triangulatus* (Zerndt) Potonié & Kremp; R. Potonié & G. Kremp, Die Gattungen..., p. 163, Pl. 14, Fig. 62; Pl. 20, Fig. 108.
1955. *Triletes triangulatus* Zerndt; S. J. Dijkstra, Megasporas..., p. 338, Pl. 37, Fig. 21; Pl. 38, Figs. 19—20.
1956. *Triangulatisporites triangulatus* (Zerndt) Potonié & Kremp, R. Potonié & G. Kremp, Die Sporae..., p. 128, Pl. 9, Figs. 68—72.
1956. *Triletes triangulatus* Zerndt; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 260, Pl. 7, Figs. 32—34.
1958. *Triangulatisporites triangulatus* (Zerndt) Potonié & Kremp; P. Piérart, Palynologie..., p. 58, Pl. 3, Fig. 6.
1959. *Triletes triangulatus* Zerndt (*sensu* Dijkstra); M. R. Winslow, Upper Mississippian..., p. 38, Pl. 10, Figs. 1—10.
1961. *Triletes triangulatus* Zerndt; M. V. Oshurkova, Megaspory..., p. 113, Pl. 9, Fig. 7.
1962. *Megastenozonales triangulatus* (Zerndt) Ishchenko & Semenova; A. M. Ischenko & E. V. Semenova, Megaspory..., p. 75, Pl. 10, Figs. 2 a—b.

Material. — Three well-preserved specimens and one fragment.

Dimensions (in μ):

	Z. Pb. A22	Z. Pb. H21	Z. Pb. H25
Diameter of spore without equatorial zone	400	500	500
Width of equatorial zone	62.5	100	100
Length of Y-rays	225	250	275
Diameter of lumina of reticulum	57.5—87.5	37.5—62.5	62.5—75
Thickness of equatorial zone	7.5	9	10
Thickness of exospore	20	25	30

Description. — Trilete megaspores, round or triangular in outline. Triradiate ridges distinct, extending from the center to margin of spore and even pass onto equatorial zone, slightly elevated and somewhat undulate. Their height increases towards the center of spore. Arcuate ridges run along the spore circumference and form an almost closed circle. All elements of sculpture, situated on the spore surface, are formed by perispore after whose destruction spores are smooth. Perispore is marked by a reticulate structure, which is best-developed on the distal side. Lumina of reticulum polygonal or round, on the proximal surface of reticulum they are indistinct and with a smaller diameter. Proximal part of perispore radially folded. In the equatorial part, there is situated a membraneous, translucent zone, often having a slightly undulate margin and a reticulate structure. In the case when ridges of triradiate figure pass onto the zone, its width in this place increases and spores take a triangular shape. Under reflected light, spore is dark-brown; under transmitted light, the body of spore is dark and opaque and equatorial zone transparent and yellow-red.

Remarks. — A small number of specimens did not allow one to carry out detailed studies which might facilitate an accurate distinction between closely related species. At present, the most correct seem to be the view of Potonié and Kremp (1956*a*) who accept the existence of a few, closely related species of the genus *Triangulatisporites*. Dijkstra (1946) combines them to form a single species of *Triangulatisporites triangulatus*. The correctness of Potonié's and Kremp's standpoint is testified to by the fact that megaspores of different species of the genus *Selaginellites*, which was considered to be a parent genus of megaspores of the genus under study, are morphologically only very slightly differentiated. There are a few species of *Selaginellites* from Carboniferous whose megaspores are marked by a characteristic equatorial zone and reticulate perispore and which differ only in the size of spores and of the lumina of reticulum, such as, for instance, *S. crassicinctus* Hoskins & Abbot or *S. suissei* Zeiller, which developed megaspores with morphological characters in conformity with the descriptions of forms, assigned by Dijkstra to *T. triangulatus*.

Affinity. — Lycopsida (Selaginellales).

Occurrence. — Poland, Upper Silesia — Namurian A to Westphalian D; Chełm I boring (sample 38) — Westphalian A. Czechoslovakia — Westphalian B to Stephanian B. Germany — Westphalian C. The Netherlands — Westphalian A to C. France — Westphalian A to Stephanian D. Spain — Westphalian A. Belgium — Westphalian C. Turkey — Namurian A to Westphalian D. U.S.A. (Illinois and Michigan Coal Fields) — Namurian to Westphalian. U.S.S.R. (Donetz Coal Field and its western extension) — Westphalian C.

Turma **Cystites** Potonié & Kremp, 1954
Genus *Cystosporites* Schopf, 1938
Type species: *Cystosporites breretonensis* Schopf, 1938
Cystosporites giganteus (Zerndt, 1930) Schopf, 1938
(Pl. VIII, Figs. 6—10)

1946. *Cystosporites giganteus* (Zerndt); S. J. Dijkstra, Eine monographische..., p. 56, Pl. 12, Figs. 137—138; Pl. 13, Figs. 142—145; Pl. 15, Figs. 157—160 (*here earlier synonymy included*).
1950. C. *giganteus* (Zerndt) Schopf; Ch. Arnold, Megaspores..., p. 87, Pl. 18, Fig. 1.
1951. C. *giganteus* (Zerndt) Schopf; M. Kalibová, Megaspores..., p. 37, Pl. 4, Figs. 4—5.
1954. C. *giganteus* (Zerndt) Schopf; W. G. Chaloner, Mississippian megaspores..., p. 30, Pl. 2, Figs. 7—8.
1955. C. *giganteus* (Zerndt) Schopf; S. J. Dijkstra, Megasporas..., p. 339, Pl. 44, Figs. 48—50.
1956. C. *giganteus* (Zerndt) Schopf; R. Potonié & G. Kremp, Die Sporae..., p. 150, Pl. 10, Figs. 76, 79.
1956. C. *giganteus* (Zerndt) Schopf; S. J. Dijkstra, Lower Carboniferous..., p. 15, Pl. 10, Figs. 104—110.
1956. cf. *Cystosporites giganteus* (Zerndt) Schopf; S. J. Dijkstra, *Ibid.*, p. 12, Pl. 6, Figs. 59—63.
1956. C. *giganteus* (Zerndt) Schopf; M. C. Bonet & S. J. Dijkstra, Megasporas..., p. 260, Pl. 16, Figs. 41—44.
1957. C. *giganteus* (Zernd) Schopf; D. C. Bhardwaj, The palynological..., 113, Pl. 30, Fig. 6.
1958. C. *giganteus* (Zerndt) Schopf; P. Piérart, Palynologie..., p. 62, Pl. 3, Fig. 7; Pl. 10, Figs. 14—15.
1959. C. *giganteus* (Zerndt) Schopf; M. R. Winslow, Upper Mississippian..., p. 52, Pl. 11, Figs. 9, 10; Pl. 12, Figs. 1—4.
1963. C. *giganteus* (Zerndt) Schopf; P. Piérart, Synopsis..., p. 243, Pl. 4, Figs. 19—20.
1965. C. *giganteus* (Zerndt) Schopf; E. Spinner, Westphalian D megaspores..., p. 100, Pl. 16, Figs. 5, 6.

Material. — Thirty fertile specimens and more than 100 abortive forms. Abortive forms are usually better-preserved than fertile specimens, which are more fragile, with a relatively thin exospore, very often strongly folded and compressed. On account of the middle part of their exospore being very thin, frequently it is subject to destruction and the remaining two parts are separated from each other. The proximal part is the most often met with part of the spore.

Dimensions (in μ):

a) *Fertile form*

	Z. Pb. H3 (a fragment)	Z. Pb. H1 (a fragment)	Z. Pb. D33 (apex lacking)
Length of spore	3,000	3,750	5,500
Width of spore	2,000	1,500	2,000
Length of Y-rays	250	—	250
Distance of arcuate ridges from the spore apex	112	—	400
Thickness of exospore at the apex	25	—	40
Thickness of exospore in the middle	12.5	5	10
Thickness of exospore in the distal part	—	20	30
Diameter of luminae in the reticulum of exospore	3—6	—	4—9

b) *Abortive form*

	Z. Pb. L36	Z. Pb. H11	Z. Pb. L20
Length of spore	400	587	925
Width of spore	400	362	650
Length of Y-rays	150	200	340
Thickness of exospore	30	57	30

Description. — a) *Fertile form.* Trilete megaspores sacklike, with polar axis strongly elongated. Spores longitudinally or transversely folded. Contact area situated at or near the apex of spore; as compared with the size of spore, it is relatively small. Width of rays of triradiate figure is almost uniform over the entire length or slightly larger at the apex. Arcuate ridges distinct, sometimes varying in length, two of them often being identical in size, and the third — somewhat smaller. Height and width of arcuate ridges are more or less equalling each other. A distinct, oblong, fairly wide appendage, which seems to be a sort of an extension of exospore, occurs on the distal pole of some specimens. According to Bocheński (1936), this appendage served the spore to attach itself to the sporangium. Exospore surface smooth or slightly rough. In a single specimen, thickness of exospore is not uniform. It is the thickness at the apex, thinner near contact area on distal pole and the thinnest in the middle part. In these forms, exospore is formed by a coil of threads, representing a sort of an irregular reticulum; in the places where exospore is thick, it takes a spongy appearance and — in its thinner parts — is transparent. In the last-named case, coils of threads are looser and free spaces are formed (similar to lumina of the reticulum). Depending on its thickness, exospore is — under transmitted light — yellow-brown to black.

b) *Abortive form.* Trilete megaspores, round or oval. Contact area occupies an almost entire proximal part of spore. Rays of trilete figure distinct. Arcuate ridges strongly developed. On laterally compressed specimens, contact area takes the form of a pyramid. Spores smooth. Thickness of exospore, as compared with the size of spore, fairly large. Spores are tan-brown to black.

Remarks. — The dimensions of spores of *C. giganteus* (Zerndt), from Chełm are somewhat smaller than those of the spores, described by Zerndt (1930*a*) but they fall within limits of the specific variability. Both fertile and abortive forms are abundantly represented. Some dozen complete fertile megaspores have been found which, on account of their thin exospore, were strongly folded and compressed. All elements of structure may be traced on them, but they are not fit to be photographed. The abortive megaspores very seldom occur in combination with the fertile form, whereas it is often observed that three abortive spores remain connected together. In abortive forms, contact area displays a considerable variability. In some laterally flattened spores it has the appearance of a pyramid. Likewise, the height of arcuate ridges is a variable character.

Affinities. — Spores of *C. giganteus* have been found by Bocheński (1936) in the cones of *Lepidocarpon (Lepidostrobus) major* (Brogn.) Potonié & Kremp, 1956. According to this author (p. 238), sporangia of *Lepidocarpon major* "contains only one tetrad of megaspores, one of which is disposed along the axis of sporangium and developed to giant dimensions of 11.5 mm in length and 5.1 mm in width, while the remaining three are abortive, round and only 0.4 to 0.6 mm in diameter. Large megaspores have, in their distal (adaxial) part, an appendage of the exospore membrane with a knot. This appendage served the large megaspore to attach itself to the adaxial wall of sporangium". Continuing this description, Bocheński identifies the spores, referred to above, with those of *Triletes giganteus* Zerndt and states that the large megaspore germinated inside the sporangium, probably still on sporophyte, which would testify to the fact that this was a transition stage from archegoniates with megaspores loosely resting in sporangium — to the forms in which megaspores are morphologically connected with sporangium. He considers them to be „a transition link from lepidodendrons to Lepidospermae".

Occurrence. — Poland, Upper Silesia — Dinantian to Westphalian D; Chełm I boring (samples 38, 39, 56, 154, 239, 263, 399, 571b and 573) — Viséan to Westphalian A. Czechoslovakia — Namurian A to Stephanian B. Germany — Namurian to Westphalian C. France — Westphalian A to Stephanian A. Spain — Westphalian A to Stephanian. Belgium — Westphalian C. The Netherlands — Namurian B to Westphalian D. Scotland and Ireland — Namurian. Turkey — Namurian A to Westphalian D. Egypt — Upper Devonian to Namurian. U.S.A. (Illinois and Michigan Coal Fields and the State of Indiana) — Namurian to Westphalian.

Cystosporites varius (Wicher, 1934) Dijkstra, 1946
(Pl. IX, Figs. 1, 6, 8)

1946. *Cystosporites varius* (Wicher) Dijkstra; S. J. Dijkstra, Eine monographische..., p. 58, Pl. 14, Figs. 146—156 (*here earlier synonymy included*).
1950. *C. varius* (Wicher) Dijkstra; Ch. Arnold, Megaspores..., p. 88, Pl. 16—17.
1952. *C. varius* (Wicher) Dijkstra; S. J. Dijkstra, The stratigraphical..., p. 166, Pl. 6, Fig. 2.
1955. *C. varius* (Wicher) Dijkstra; U. Horst, Die Sporae..., p. 192, Pl. 17, Fig. 2.
1956. *C. varius* (Wicher) Dijkstra; R. Potonié & G. Kremp. Die Sporae..., p. 152, Pl. 10, Figs. 80—85.
1958. *C. varius* (Wicher) Dijkstra; P. Piérart, Palynologie..., p. 61, Pl. 3, Fig. 8.
1959. *C. varius* (Wicher) Dijkstra; M. R. Winslow, Upper Mississippian..., p. 51, Pl. 12, Figs. 5—8.
1961. *C. varius* (Wicher) Dijkstra; P. Piérart, Les mégaspores..., p. 41, Pl. 3, Figs. 3—5; Pl. 5, Fig. 6.
1965. *C. varius* (Wicher) Dijkstra; E. Spinner, Westphalian D megaspores..., p. 102, Pl. 16, Figs. 7—9.

Material. — Thirty well-preserved specimens of abortive form and 4 partly destroyed specimens of fertile form.

Dimensions (in μ):

a) *Fertile form*

	Z. Pb. L19	Z. Pb. L18
Length of spore	2,000	2,500
Width of spore	750	1,250
Thickness of exospore	12	12.5

b) *Abortive form*

	Z. Pb. A30	Z. Pb. H13	Z. Pb. C19
Diameter of spore	500	750	1075
Height of spongy cushion	125	275	325
Thickness of exospore	37	37.5	50

Description. — a) *Fertile form.* Megaspores, compressed in lateral direction, are oval in outline, slightly elongated; those, compressed in proximal-distal direction, are probably oval, which cannot be stated with any degree of certainty because of the flattening and strong folding of specimens. A spongy trilobate cushion occurs on the proximal pole. Exospore is built like an irregular reticulum with its lumina smaller than those in *C. giganteus.* Under transmitted light, spores are orange--brown.

b) *Abortive forms.* Megaspores, compressed in proximal-distal direction, are round or triangular and often irregular in outline, depending on the manner of compression. Those, compressed in lateral direction, are pearlike or triangular. A trilobate or triangular spongy cushion occurs on proximal pole. Small folds which give laterally compressed spores the shape, of a tied up sack radially diverge from this cushion. Spore surface smooth and mat, tan-brown to black.

Remarks. — Megaspores of *C. varius* (Wicher) are most similar to spores of *C. giganteus* (Zerndt) from which they differ, however, in larger dimensions of abortive forms and smaller lumina in the coils of exospore of fertile forms. The occurrence of trilobate or triangular spongy apical cushion, covering concrescence scars and contact area, makes up a fundamental feature characteristic of *C. varius*.

Spores of *C. varius* occur in almost all coal fields the world over. Since in the material, coming from geographically different territories, no considerable differences have been discovered in the structure and dimensions of these spores, this species seems to be fairly conservative. Moreover, it is a species with a considerable stratigraphic significance, allowing one to settle a boundary between Namurian and Westphalian. It is marked by an extensive geographical range; spores of this species have been found even in China (Piérart, 1961). This finding facilitates a correlation of deposits from different coal fields.

The solution of the problem of a relationship of *C. varius* to *C. breretonensis* Schopf is very important. The most correct seems to be the standpoint of Winslow (1959) who assigns *C. breretonensis* forma *abortivus* Schopf (1938, p. 40, Pl. 1, Fig. 10 and Pl. 8, Fig. 4) to the species *C. varius* (Wicher) Dijkstra. On the other hand, *C. breretonensis* forma *reticulatus* Schopf is considered by this author as an independent species. This view seems to be the more correct as Winslow, the same as Schopf, used the material from the Illinois Coal Field and, in addition, she had at her disposal much more numerous material than that, used by predecessor.

Affinities. — The botanic position of the spores of *C. varius* could be settled owing to Bocheński (1936) who — in the cone of *Lepidocarpon (Lepidostrobus) bohdanowiczi* (Bocheński, 1936) Potonié & Kremp, 1956 — found the spores which he identified with those of *C. varius* (Wicher) and those of Zerndt's Type 30. The combination of fertile and abortive forms is possible only when complete fertile specimens — or at least their proximal part — are found since, in such a case, the occurrence of spongy apical cushion of the spore constitutes a diagnostic character.

Occurrence. — Poland, Upper Silesia — Westphalian A?, B and C; Chełm I boring (samples 38, 39, 40, 56, 154 and 239) — Namurian C to Westphalian A. Czechoslovakia — Namurian C to Stephanian A. Germany — Westphalian A to C. France — Westphalian C. Belgium — Westphalian C. The Netherlands — Westphalian A to C. Spain — Westphalian A. U.S.A. (Michigan and Illinois Coal Fields) — Namurian C to Westphalian. China — Stephanian to Permian.

Cystosporites verrucosus Dijkstra, 1946

(Pl. IX, Figs. 2, 3, 9, 13, 16, 17)

1946. *Cystosporites? verrucosus* forma *abortivus* Dijkstra; S. J. Dijkstra, Eine monographische..., p. 60, Pl. 15, Figs. 163—166.
1946. *Cystosporites?* Dijkstra; *Ibid.*, p. 61, Pl. 15, Figs. 161, 162.
1955. *C. verrucosus* Dijkstra; S. J. Dijkstra, La correlation..., p. 114, Pl. A, Figs. 1—7.
1956. *C. verrucosus* Dijkstra; M. C. Bonet & S. J. Dijkstra, p. 260, Pl. 57, Figs. 47—51.
1959. *C. verrucosus* Dijkstra; M. R. Winslow, Upper Mississippian..., p. 53, Pl. 11, Figs. 4—8.
1963. *C. verrucosus* Dijkstra; P. Piérart, Synopsis..., p. 242, Pl. 4, Figs. 18, 21—23.

Material. — Three almost complete specimens and a few fragments of fertile form, as well as six specimens of abortive form.

Dimensions (in μ):

a) *Fertile form*

	Z. Pb. L16	Z. Pb. L17	Z. Pb. I25
Length of spore	1,750	2,200	3,250
Width of spore	1,000	1,600	1,875
Length of spines	75—88	40—52	40—65
Width of spines at the base	25	38	37
Length of winglike processes	—	500	—
Width of base of winglike processes	—	750	—
Width of ends of winglike processes	—	125	—
Thickness of exospore	15	25	18

b) *Abortive form*

	Z. Pb. I19	Z. Pb. I18	Z. Pb. I4
Length of spore	575	850	1,325
Width of spore	450	650	1,300
Height of apical prominence	250	400	380
Width of apical prominence	62	125	100
Length of spines	25—50	12.5—20	17—45
Width of spines at the base	15	16	20
Thickness of exospore	12	30	20

Description. — a) *Fertile form.* Trilete megaspores, shaped like an oblong sack. Rays of triradiate figure are seldom visible, mostly there occurs a germination cleft or, in some cases, the apical part is lacking. Contact area is surrounded by longitudinal folds of exospore, running as far as more or less 1/3 or 1/2 of the spore length. The width of contact area is almost equal to the height. Exospore is covered with fine spines, which are irregularly scattered primarily on the proximal surface of spore. These spines gradually disappear towards the distal surface. On the distal end of spore, there are winglike processes (1—2) triangular in outline. Spores are tan-brown on their distal end and dark-brown to black on the proximal end.

b) *Abortive form*. Trilete megaspores, round or oval in outline, with a large apical prominence. Y-rays sometimes are slightly marked. Arcuate ridges fairly distinct. Near arcuate ridges, exospore covered with longitudinally running folds, which form irregular elevations on the distal surface. The entire exospore is covered with irregularly hairlike spines, which occur most abundantly on the proximal side of spore. Spores brown to black.

Remarks. — Fertile spores of *C. verrucosus* are completely preserved in few cases only but — due to a very characteristic sculpture of surface which is identical with that in abortive forms — they are easily distinguishable.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A. Belgium and the Netherlands — Westphalian A and B. Spain — Westphalian A. U.S.A. (Illinois Coal Field) — Westphalian?

Cystosporites strictus Dijkstra, 1957
(Pl. VII, Fig. 3)

1957. *Cystosporites strictus* Dijkstra; S. J. Dijkstra & P. Piérart, Lower Carboniferous..., p. 14, Pl. 13, Figs. 165—176; Pl. 14, Figs. 177—178.

Material. — One specimen of fertile form.

Dimensions (in μ):

	Z. Pb. H15
Length of spore	1450
Width of spore	925
Length of Y-rays	160
Distance of arcuate ridges from the spore apex	200
Width of equatorial fold	37
Depth of equatorial fold	50
Thickness of exospore in proximal part	25
Thickness of exospore in distal part	4

Description. — *Fertile form*. Megaspore laterally compressed, suboval in outline. In the equatorial part of spore, there occurs a characteristic fold, which divides the spore into two parts approximately equal in length. Rays of Y-figure slightly elevated. Arcuate ridges poorly visible. Spore surface smooth, mat, gray or tan-brown.

Remarks. — Megaspore of *C. strictus* from Chełm is most similar to the specimen, figured by Dijkstra (1957, Pl. 14, Fig. 177).

Occurrence. — Poland, Chełm I boring (sample 571b) — Viséan. U.S.S.R. — Lower Carboniferous.

Cystosporites sp.
(Pl. IX, Fig. 4)

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. G23
Length of spore	575
Width of spore	500
Length of Y-rays	100
Height of apical prominence	375
Width of apical prominence	138
Thickness of exospore	50

Description. — Trilete megaspore, pearlike in shape, with a strongly extended necklike apical prominence. Y-rays on the apex of apical prominence. Scar of Y-figure cleaved. Spore surface smooth, mat, dark brown.

Remarks. — Megaspore of *Cystosporites* sp. is most similar to abortive spores of *C. giganteus,* from which it differs only in a more characteristic necklike apical prominence. Such a regularly built apical prominence, occurring in the form of a tube, extended at the bottom and with a distinct triradiate germination cleft at the apex, has never been recorded in the spores of *C. giganteus.*

Occurrence. — Poland, Chełm I boring (sample 154) — Westphalian A.

Forms incertae sedis

Triletes sp. *1*
(Pl. IX, Fig. 19)

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. I 8
Diameter of spore	800
Length of Y-rays	500
Height of Y-rays	250
Thickness of exospore	60

Description. — Trilete megaspore; compressed in proximal-distal direction, is triangular in outline. Ridges of Y-figure flat and straight, except for the apex where they are undulate. Arcuate ridges invisible. Surface of exospore smooth. Spore tan-brown.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A.

Triletes? sp. 2

(Pl. IX, Fig. 12)

Material. — Two specimens.

Dimensions (in μ):

	Z. Pb. B29	Z. Pb. G17
Length	1,250	1,630
Width	1,250	1,362
Thickness	12	12

Description. — Specimens strongly compressed, round or oval, vesicular in structure. They are strongly folded in various directions. In some place, there seems to outline the triradiate figure which is not, however, certain since these may as well be the shadows thrown by the folding of membrane. Surface fine-granular. Under reflected light, these specimens are tan-brown, and under transmitted light, yellow-orange.

Remarks. — In their appearance, these specimens, resemble the megaspores of *Cryptoletes aplicatus* from Scotland, described by Dijkstra (1956), but they are much smaller and occur in lower parts of Carboniferous.

Occurrence. — Poland, Chełm I boring (samples 38 and 40) — Westphalian A.

Megaspore?

(Pl. IX, Fig. 5)

Material. — Six specimens.

Dimensions (in μ):

	Z. Pb. B19	Z. Pb. I13
Diameter	450	500
Thickness	50	60

Description. — Round, disclike specimens, with a rough, fine-granular surface, on which there occasionally occur small longitudinal swellings, resembling foldings. These are relatively thick forms.

Occurrence. — Poland, Chełm I boring (sample 39) — Westphalian A.

MICROSPORES

Anteturma **Sporites** H. Potonié, 1893
Turma **Triletes** (Reinsch, 1881) Potonié & Kremp, 1954
Subturma **Azonotriletes** Luber, 1935

Infraturma **Laevigati** (Bennie & Kidston, 1886) Potonié & Kremp, 1954
Genus *Calamospora* Schopf, Wilson & Bentall, 1944
Type species: *Calamospora hartungiana* Schopf, 1944
Calamospora sp.
(Pl. XII, Fig. 5)

Material. — One well-preserved specimen.
Dimensions (in μ):

	Z. Pb. N11
Diameter of spore . . .	242

Description. — Spore subround in outline, with a triradiate figure visible close to its margin. Y-rays straight, thin, unequal in length; one of them being much longer than the remaining two, equals about 1/2 of the length of the spore radius. Spore surface fine-granular, covered with numerous, wide folds intersecting each other at different angles in the center. Spore is yellow, in folded places, tan-brown.

Remarks. — *Calamospora* sp. has been found, among microspores, in a microscopic preparation. On account of its dimensions, it should be classified as a transitory form between micro- and megaspores. Being of a considerable size, it has, however, a thin exospore. In its diameter, it is most similar to the megaspores of the species *C. laevigata* (Ibrahim), from which it differs in a thinner and differently folded exospore. In its general appearance and manner of folding, it resembles microspores of the species *C. microrugosa* (Ibrahim), whose diameter does not, however, exceed 100 μ. The upper limit of size, assumed for microspores by Zerndt, amounts to 200 μ, except for e.g. microspores of the genus *Microsporites*, whose diameter exceeds 400 μ. Since only one specimen of *Calamospora* sp. has been found which — in its structure — did not resemble any forms, either those known from literature, or found in the profile of the Chełm I boring, it has been assigned to the genus, without giving it any specific name. This form may constitute a certain stage in the development of one of the known species, but there are no intermediate forms.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A.

Infraturma **Apiculati** (Bennie & Kidston, 1886) R. Potonié, 1956
Subinfraturma **Nodati** Dybová & Jachowicz, 1957
Genus *Lophotriletes* (Naumova, 1937) Potonié & Kremp, 1954
Type species: *Lophotriletes gibbosus* (Ibrahim, 1933)
Potonié & Kremp, 1954
Lophotriletes cf. *primitivus* Ishchenko, 1956
(Pl. X, Fig. 3)

1956. *Lophotriletes primitivus* Ishchenko; A. M. Ishchenko, Spory..., p. 37, Pl. 5, Figs. 66—67.

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. N23
Diameter of spore	46
Diameter of knobs	2.5—10

Description. — Trilete microspore, triangular in outline. Length of Y-rays equalling about 2/3 of the spore radius. Spore surface covered with irregular knobs, sometimes narrowing at the apex, irregularly scattered all over the surface. Exospore medium in thickness and dark-yellow. Knobs yellow or tan-brown.

Remarks. — Spore of *L.* cf. *primitivus* from Chełm does not display any important differences as compared with holotype. It differs only in the stratigraphic position.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A. U.S.S.R. (Donetz Coal Field) — Viséan to Namurian.

Genus *Pustulatisporites* Potonié & Kremp, 1954

Type species: *Pustulatisporites pustulatus* Potonié & Kremp, 1954

Pustulatisporites irregularis n. sp.

(Pl. X, Fig. 6)

Holotypus: Specimen No. Z. Pb. M86; Pl. X, Fig. 6.
Stratum typicum: Viséan.
Locus typicus: Chełm I, sample 497.
Derivatio nominis: Lat. *irregularis* = irregular; after irregularly scattered spines covering the spore surface.

Diagnosis. — Microspore relatively small. Y-rays ridgelike, reaching the spore margin. Spore surface covered with short, blunt spines, irregularly scattered and widely spaced.

Material. — Six well-preserved specimens.

Dimensions (in μ):

	Z. Pb. M86	Z. Pb. M87
Diameter of spore	30.8	44
Length of spines	to 1.5	to 1.5

Description. — Microspores triangular with rounded corners. Trilete rays strongly thickened, slightly undulate, reaching the spore margin. Spore surface covered with short, bluntly ended spines, irregularly scattered all over the surface, very widely spaced. Their bases sometimes contact each other. Four to five spines occur on the equatorial outline. Spores thin, bright-yellow, except for trilete rays which are tan-brown.

Remarks. — *Pustulatisporites irregularis* n. sp. differs from most species of this genus mainly in thicker Y-rays and relatively small dimensions.

Occurrence. — Poland, Chełm I boring (samples 497 and 527) — Viséan.

Subturma **Perinotriletes** Erdtman, 1947

Genus *Vestispora* (Wilson & Hoffmeister, 1956) Bhardwaj, 1957

Type species: *Vestispora profunda* Wilson & Hoffmeister, 1956

Vestispora cf. *lucida* (Butterworth & Williams, 1958) Potonié & Kremp, 1960

(Pl. XII, Fig. 6)

1958. *Glomospora lucida* Butterworth & Williams; A. M. Butterworth & R. W. Williams, The small spore..., p. 385, Pl. 4, Figs. 4—6.

1960. *Vestispora* (al. *Glomospora*) *lucida* (Butterworth & Williams) Potonié; R. Potonié, Synopsis..., p. 52.

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. N23
Diameter of spore	88
Diameter of central body	66

Description. — Trilete microspore, round in outline. Central body is completely surrounded by a round bladder which forms a wide zone on the equator. Y-rays straight, their length is almost equal to the spore radius. Surface of central body and bladder smooth. Bladder strongly folded. Folds run spirally and irregularly, obscuring the trilete rays.

Remarks. — Microspore of *Vestispora* cf. *lucida* from Chełm differs from those, described by Butterworth and Williams, only in the stratigraphic position.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A. Scotland — Namurian.

Turma **Zonales** (Bennie & Kidston, 1886) R. Potonié, 1956

Subturma **Auritotriletes** Potonié & Kremp, 1954

Infraturma **Auriculati** (Schopf, 1938) Potonié & Kremp, 1954

Genus *Triquitrites* (Wilson & Coe, 1940) Potonié & Kremp, 1954

Type species: *Triquitrites arculatus* Wilson & Coe, 1940

Triquitrites cf. *articulosus* (Ishchenko, 1956) Sullivan & Neves, 1964

(Pl. XII, Figs. 1 and 2)

1956. *Trilobozonotriletes articulosus* Ishchenko; A. M. Ishchenko, Spory..., p. 98, Pl. 19, Fig, 237.

1964. *Triquitrites articulosus* (Ishchenko) Sullivan & Neves; H. J. Sullivan & R. Neves, Triquitrites..., p. 1087.

Material. — Four well-preserved specimens.

Dimensions (in μ):

	Z. Pb. M44	Z. Pb. M42
Length of spore	68.2	68.2
Length of auriculae	16.5	17.6
Width of auriculae	27.5	33

Description. — Trilete microspore, trilobate in outline. Length of Y-rays amount to 1/2 — 2/3 of the spore radius. Three thick auriculae, two of which are mostly larger and the third of them almost by half smaller, occur in corners. Spores thick-walled, dark-brown.

Remarks. — Microspores of *T.* cf. *articulosus* (Ishchenko) differ from those, described by Ishchenko (1956) in slightly larger dimensions. The size of auriculae, which in spores from Chełm are twice as large as those of microspores from the Donetz Coal Field, constitutes the most important difference.

Occurrence. — Poland, Chełm I boring (samples 399 and 497) — Viséan to Namurian A. U.S.S.R. (Donetz Coal Field) — Viséan and Namurian?

Subturma **Zonotriletes** Waltz, 1935

Infraturma **Cingulati** Potonié & Klaus, 1954

Genus *Lycospora* (Schopf, Wilson & Bentall, 1944) Potonié & Kremp, 1954

Type species: *Lycospora micropapillata* (Wilson & Coe, 1940) Schopf, Wilson & Bentall, 1944

Lycospora intermedia n. sp.

(Pl. X, Fig. 7)

Holotypus: Specimen No. Z. Pb. N18; Pl. X, Fig. 7.

Stratum typicum: Namurian A and Westphalian A.

Locus typicus: Chełm I, sample 38.

Derivatio nominis: Lat. *intermedius* = intermediate; on account of its structure, being intermediate between *Lycospora brevijuga* Kosanke and *L. pseudoannulata* Kosanke.

Diagnosis. — Microspores with a very distinct triradiate figure. Width of cingulum equalling 1/4 — 1/2 of the length of spore radius.

Material. — Fourteen well-preserved specimens.

Dimensions (in μ):

	Z. Pb. N18	Z. Pb. M36
Diameter of spore	37.4	40
Thickness of Y-rays	2.2	2

Description. — Trilete microspores, triangular or round in shape. Triradiate figure very distinct. Y-rays thick, roll-like, reaching the spore margin. Cingulum wide, on the average equalling 1/3 of the length of spore radius. Spore surface covered with fine granules. Equatorial outline almost smooth. Spore relatively thin, bright-yellow.

Remarks. — *Lycospora intermedia* n. sp. takes an intermediate position between *L. brevijuga* Kosanke, 1950 and *L. pseudoannulata* Kosanke, 1950. In its general appearance, dimensions and structure of Y-rays, it resembles the spores of *L. brevijuga* from which it differs in a considerably wider cingulum. From *L. pseudoannulata* it differs in a somewhat smaller diameter, thicker Y-rays and more distinct sculpture. Both the species *L. intermedia* and *L. pseudoannulata* have a wide cingulum.

Occurrence. — Poland, Chełm I boring (samples 38, 39, 154, 207, 239, 399 and 413) — Namurian to Westphalian A.

Genus *Densosporites* (Berry, 1937) Butterworth, Jansonius, Smith & Staplin, 1964

Type species: *Densosporites covensis* Berry, 1937

Densosporites pseudoconfragosus n. sp.

(Pl. XII, Fig. 4)

Holotypus: Specimen No. Z. Pb. N10; Pl. XII, Fig. 4.
Stratum typicum: Westphalian A.
Locus typicus: Chełm I, sample 38.
Derivatio nominis: Lat. *pseudo* = sham, falseness; on account of a certain similarity to the spores of *Densosporites confragosus* Leschik, 1959.

Diagnosis. — Microspore large. Y-figure not always visible. Central body and cingulum covered with fine knobs.

Material. — Twenty four well-preserved specimens.

Dimensions (in μ):

	Z. Pb. N13	Z. Pb. N10	Z. Pb. N19
Complete diameter of spore	60	68.2	72
Diameter of central body	34	37.5	45
Diameter of knobs	1—2	1—3	1—3

Description. — Trilete microspores, triangular in outline with rounded corners or suboval. They consist of central body and cingulum, the largest thickness of the latter occurring in the place where it contacts the central body of spore. Trilete rays, which is not always visible, reach the inner margin of cingulum. Both central body and cingulum are densely covered with knobs. Central body is dark-yellow and cingulum brown.

Remarks. — Microspores of *Densosporites pseudoconfragosus* n. sp. are most similar to *D. confragosus* Leschik, 1959, from which they differ in larger diameter, which in the last-named species amounts to 44 μ. In addition, there are considerable geographical and stratigraphic differences in the occurrence of these species. *D. pseudoconfragosus* occurs at Chełm from Namurian C to Westphalian A, whereas *D. confragosus* was described from Lower Permian of South-west Africa.

Occurrence. — Poland, Chełm I boring (samples 30, 38, 39, 154 and 207) — Namurian C to Westphalian A.

Genus *Savitrisporites* Bhardwaj, 1955

Type species: *Savitrisporites triangulus* Bhardwaj, 1955

Savitrisporites minor n. sp.

(Pl. X, Fig. 1)

Holotypus: Specimen No. Z. Pb. N 71; Pl. X, Fig, 1.
Stratum typicum: Westphalian A.
Locus typicus: Chełm I, sample 154.
Derivatio nominis: Lat. *minor* = small; on account of its relatively small dimensions.

Diagnosis. — Microspore small, trilete figure distinct. Y-rays thin, reaching cingulum.

Material. — One very well-preserved specimen.

Dimensions (in μ):

	Z. Pb. N71
Diameter of spore	44

Description. — Microspore triangular in outline, with rounded corners. Y-rays distinct, straight, without rolls and lips, reaching cingulum. Cingulum displaying the greatest thickness on the corners of spore. Exospore not uniform in thickness. Proximal surface more or less smooth, distal covered with irregular swellings. Cingulum densely covered with short spines. Spore thick-welled, dark tan-brown.

Remarks. — Microspore of *S. minor* n. sp. is most similar to those of *S. triangulus* Bhardwaj, 1955, from which it mostly differs in a smaller diameter which in *S. triangulus* amounts to 53—65 μ and in *S. minor* — only to 44 μ. In addition, spores of *S. triangulus* are known only from Stephanian.

Occurrence. — Poland, Chełm I boring (sample 154) — Westphalian A.

Genus *Gravisporites* Bhardwaj, 1954

Type species: *Gravisporites sphaerus* (Butterworth & Williams, 1954) Bhardwaj, 1954

Gravisporites triangulatus n. sp.

(Pl. X, Fig. 4)

Holotypus: Specimen No. Z. Pb. N13; Pl. X, Fig. 4.
Stratum typicum: Westphalian A.
Locus typicus: Chełm I, sample 38.
Derivatio nominis: Lat. *triangulum* = triangle; on account of a triangular outline of spore.

Diagnosis. — Microspore small, with a narrow cingulum.

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. N13
Diameter of spore	50
Width of Y-rays	11
Width of cingulum	5

Description. — Microspore triangular in outline, with a narrow massive cingulum (crassitudo) on the equator. Trilete rays very thick, slightly undulate, reach the inner margin of cingulum. Spore surface is covered with closely adhering granules. Spore dark-orange, cingulum and Y-rays brown.

Remarks. — *Gravisporites triangulatus* n. sp. is very similar to *G. sphaerus* (Butterworth & Williams, 1954) from which it differs however, in a much smaller diameter.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A.

Genus *Knoxisporites* (Potonié & Kremp, 1954) Neves, 1961

Type species: *Knoxisporites hageni* Potonié & Kremp, 1954

Knoxisporites sp.

(Pl. X, Fig. 2)

Material. — One well-preserved specimen.

Dimensions (in μ):

	Z. Pb. N76
Diameter of spore	42

Description. — Trilete microspore, subtriangular in outline. Y-rays straight, thin, their length equals approximately 2/3 of the spore radius.

Sculpture in the form of rolls. One of the rolls rims along the entire equator, forming a sort of a cingulum. A triradiate roll with very wide arms, which are disposed obliquely to Y-rays, is situated on the proximal side. Between the arms of rolls and cingulum there are empty spaces, semicircular in shape. Radially diverging rolls, occurring on the distal surface of spore, are visible against the background of these spaces. Spore relatively thick, tan-brown.

Remarks. — Since only specimen of *Knoxisporites* sp. has been found in the Chełm I boring and since this spore is marked by a very complex structure, it was impossible to trace accurately all elements of sculpture. In this connection, it has been given no specific name.

Occurrence. — Poland, Chełm I boring (sample 154) — Westphalian A.

Genus *Pseudoannulatisporites* n. gen.
Type species: *Pseudoannulatisporites polonicus* n. sp.

Diagnosis. — Microspores consist of the central body and cingulum. The entire spores, together with cingulum, but except for the contact area, are closed within a bowllike coat which is relatively thick. Very often, spores are met with, which seem to be in the stage of flowing out of this coat. Sometimes, specimens are found completely devoid of such coat and, on the other hand, there are also empty coats, occurring separately.

Pseudoannulatisporites polonicus n. sp.
(Pl. XI, Figs. 1—11)

Holotypus: Specimen No. Z. Pb. 035; Pl. XI, Fig. 8.
Stratum typicum: Viséan.
Locus typicus: Chełm I, sample 575.
Derivatio nominis: *polonicus* — spores of this species were first found in Poland.

Diagnosis. — Microspores with a very variable equatorial outline, mostly triangular, oval or round, provided with a thick, smooth coat (perispore?). Cingulum covered with fine apertures.

Material. — A few thousand very well-preserved specimens.

Dimensions (in μ):

	Z. Pb. 035						
Diameter of spore	25.3	—	41.8	52.8	52.8	—	72.6
Diameter of central body of spore	11.0	19.8	26.4	22.0	20.0	26.4	22.0
Width of coat	16.5	—	19.8	25.3	14—22	20.0	24.2
Diameter of spore without coat	—	33.0	—	32.0	—	33.0	—
Width of equatorial cingulum	4,0	8.0	—	7.7	—	7.0	—

Description. — Microspores triangular, oval, round and, sometimes, very irregular in outline, trilete. Y-rays straight, reaching the inner margin of equatorial cingulum, mostly invisible because central body of spore is very thin and easily destructible. Spores consist of the central body, equatorial cingulum and coat which covers the entire spore, except for contact area. Thickness of coat is not uniform. Very often, spores seem to flow out of the coat. There are all transitory stages, i.e from spores completely closed within the coat, through those which gradually slip out of it, up to the stage in which spore is completely free of coat. Spores without coats and, separately, coats alone are also met with sometimes. Now and then, the coat is torn open and its trace is visible on two sides of the spore. Spore surface, which has a spongy appearance, is covered with multitude of fine apertures. Such apertures are also observed on cingulum, on which they occur near the inner margin, where they are arranged in one or two rows, or even irregularly scattered all over the surface of cingulum. In spores, closed within the coat, these apertures are disposed only near the central body where they occur, arranged in the form of a one- or two-row wreath. Sometimes, equatorial cingulum is not uniform, but contracted in one or two places. Spores, devoid of coat, are — almost in all cases — triangular in outline with rounded corners. The central body of spore is yellow, cingulum — dark-yellow or tan-brown, and coat — dark-brown to black.

Remarks. — Microspores *Pseudoannulatisporites polonicus* n. sp. have characters resembling those of a few species of spores. Spores, completely closed within the coat, are similar to *Densosporites variabilis* (Waltz) Potonié & Kremp, 1956, in which a row of apertures, surrounding the middle part of spore, occurs on cingulum. The difference consists in the fact that in spores of *P. polonicus* there occurs a coat, which mostly may be observed in the stage of slipping off from the spore surface. Specimens, completely closed within the coat, are relatively few, but such coat has never been recorded in spores of *D. variabilis*. Similar apertures, situated near the inner margin of cingulum, are known in *Anulatisporites bacatus* Dybová & Jachowicz, 1957, which have a smooth contact area and a cingulum uniform in thickness. Such species as *A. coronarius, A. sacculus* and *A. coronatus,* all of them described by Dybová and Jachowicz (1957*a*) have large apertures or a greater number of apertures on cingulum, but they do not have the coat. The stage in which the coat is slipped off half--way or in which coats are already empty, resembles the genus *Torispora* Balme. Finding single specimens, representing this stage, may cause an erroneous assignment of these specimens to the genus *Torispora.*

Occurrence. — Poland, Chełm I boring (samples 573, 575 and 580) — Viséan.

Anteturma **Pollenites** R. Potonié, 1931
Turma **Saccites** Erdtman, 1947 (= **Saccata** Naumova· 1937)
Subturma **Disaccites** Cookson, 1947
Genus *Sahnisporites* Bhardwaj, 1954
Type species: *Sahnisporites saarensis* Bhardwaj, 1954

Sahnisporites cf. *saarensis* Bhardwaj, 1954

(Pl. XII, Fig. 3)

1954. *Sahnisporites saarensis* Bhardwaj; D. C. Bhardwaj, Einige neue Sporengattungen..., p. 522, Fig. 12.
1956. *Sahnisporites saarensis* Bhardwaj; R. Potonié & G. Kremp, Die Sporae..., p. 176.

Material. — One well-preserved specimen.
Dimensions (in μ):

	Z. Pb. N11
Length of spore	88
Length of central body	44
Diameter of air-bladders	38.5

Description. — Microspore with two air-bladders, without triradiate figure. In the equatorial situation, it has a more or less elliptical central body with a fairly deep cleft, running through its center. Air-bladders, with a infrareticulate structure, are situated near each other, so that they nearly contact each other. Central body is brown, air-bladders — yellow.

Remarks. — Spore of *S.* cf. *saarensis* differs from those, described by Bhardwaj, in the occurrence in time. *S. saarensis* is known from Stephanian C, whereas the spore from Chełm comes from Westphalian A.

Occurrence. — Poland, Chełm I boring (sample 38) — Westphalian A.

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JADWIGA KARCZEWSKA

SPORY KARBOŃSKIE WIERCENIA CHEŁM I

Streszczenie

W pracy niniejszej opisano mikro- i megaspory z karbonu wiercenia Chełm I. Wiercenie to wykonane zostało w odległości 1 km od Chełma, nad rzeką Uherką. Miąższość utworów karbońskich wynosi ponad 600 m. Pobrano około 500 prób, z czego 200 przemacerowano na mikrospory i 200 — na megaspory. Stosowano metodę Schulzego, zmodyfikowaną przez Bocheńskiego oraz Dybovą i Jachowicza (1957). Łupki i piaskowce macerowano 40% kwasem fluorowodorowym. Pozytywny wynik maceracji w przypadku mikrospor uzyskano w 33 próbach, megaspor — w 18 próbach. Najbogatsze w spory były węgle i łupki węglowe. Przy obserwacji megaspor cienkobłonnych dobre wyniki dało oczyszczanie poszczególnych okazów przy pomocy ługu sodowego, który rozpuszcza substancje wypełniające spory. Po przemyciu tych spor i przeniesieniu do gliceryny, można je oglądać w świetle przechodzącym.

Opisano 34 gatunki należące do 10 rodzajów megaspor, z czego 8 nowych, a mianowicie: *Calamospora magna* n. sp., *C. ovata* n. sp., *Lagenicula baculata* n. sp., *L. brevispinosa* n. sp., *L. clavata* n. sp., *L. maeandrica* n. sp., *Setosisporites dybovae* n. sp., *S. reticulatus* n. sp., oraz 1 nową odmianę *Lagenicula horrida hippocastaniformis* n. var.

Oznaczono 168 gatunków mikrospor należących do 59 rodzajów. Opisano nowy rodzaj *Pseudoannulatisporites* n. gen. i 6 nowych gatunków mikrospor: *Pustulatisporites irregularis* n. sp., *Lycospora intermedia* n. sp., *Densosporites pseudoconfragosus* n. sp., *Savitrisporites minor* n. sp., *Gravisporites triangulatus* n. sp. i *Pseudoannulatisporites polonicus* n. sp.

Wykonano analizy mikrosporowe ilościowe (gatunkowe i rodzajowe), których wyniki przedstawiono graficznie (Tab. 2 i 3), oraz analizę megasporową jakościową (Tab. 1). Przeprowadzono korelację stratygraficzną z Zagłębiem Górnośląskim, za-

głębiami radzieckimi i karbonem Spitsbergenu. Na tej podstawie wydzielono w karbonie wiercenia Chełm I następujące jednostki stratygraficzne: wizen dolny (?) i górny, namur A, B i C oraz westfal A (+B?).

Opisana kolekcja znajduje się w Zakładzie Paleobotaniki Uniwersytetu Warszawskiego, oznaczona symbolami Z. Pb. A — O.

ЯДВИГА КАРЧЕВСКА

КАМЕННОУГОЛЬНЫЕ СПОРЫ ИЗ БУРОВОЙ СКВАЖИНЫ ХЕЛМ I (ВОСТОЧНАЯ ПОЛЬША)

Резюме

В настоящей работе описано микро- и мегаспоры каменноугольных отложений из скважины Хелм I. Бурение проведено на расстоянии 1 км от г. Хелм, над рекой Угерка (восточная Польша). Мощность каменноугольных отложений более 600 м. Отобрано около 500 проб, из чего 200 было подвержено мацерации на микроспоры и 200 — на мегаспоры. Применялся метод Шульце (Schulze), измененный Бохеньским (Bocheński), а также Дыбовой и Яховичем (Dybová & Jachowicz, 1957). Сланцы и песчаники были мацерированы в 40% фтористоводородной кислоте. Положительный результат мацерации получено для микроспор в 33 пробах, для мегаспор — в 18 пробах. Наиболее богатые спорами были угольные пласты и углистые сланцы. При наблюдении мегаспор с тонкой экзиной, хорошие результаты дала очистка отдельных спор при помощи натрового щёлка, который растворяет субстанции выполняющие споры. После промывки этих спор и переноса в глицерин, можно наблюдать их в проходящем свете.

Описано 34 видов принадлежащих к 10 родам мегаспор, из чего 8 новых, а именно: *Calamospora magna* n. sp., *C. ovata* n. sp., *Lagenicula baculata* n. sp., *L. brevispinosa* n. sp., *L. clavata* n. sp., *L. maeandrica* n. sp., *Setosisporites dybovae* n. sp., *S. reticulatus* n. sp. и 1 новый вариетет: *Lagenicula horrida hippocastaniformis* n. var.

Определено 168 видов микроспор принадлежащих к 59 родам. Описано новый род *Pseudoannulatisporites* n. gen. и 6 новых видов микроспор: *Pustulatisporites irregularis* n. sp., *Lycospora intermedia* n. sp., *Densosporites pseudoconfragosus* n. sp., *Savitrisporites minor* n. sp., *Gravisporites triangulatus* n. sp., и *Pseudoannulatisporites polonicus* n. sp.

Сделано количественные микроспоровые анализы (видовые и родовые), а результаты представлено графически (Таб 2 и 3), а также качественный мегаспо-

ровый анализ (Таб. 1). Проведено стратиграфическую корреляцию с верхнесилезским бассейном (западная Польша), советскими бассейнами и каменноугольными отложениями Шпицбергена. На этом основании выделено в карбоне буровой скважины Хелм I следующие стратиграфические единицы: нижний (?) и верхний визе, намюр A, B, C и вестфаль A (+B?).

Описанная коллекция, обозначенная символами Z. Pb. A-O. находится в Лаборатории Палеоботаники Варшавского Университета.

PLATES

Plate I

Fig. 1. *Calamospora sinuosa* (Horst). Westphalian A (Z. Pb. B37); ×26.
Fig. 2. *C. laevigata* (Ibrahim). Viséan, Westphalian A (Z. Pb. G39); ×40.
Fig. 3. *C. laevigata* (Ibrahim). Viséan, Westphalian A (Z. Pb. I5); ×30.
Fig. 4. *C. ovata* n. sp. Westphalian A (Z. Pb. G18); ×30.
Fig. 5. *C. magna* n. sp. Namurian A — Westphalian A (Z. Pb. G7); ×30.
Fig. 6. *Calamospora* sp. Westphalian A (Z. Pb. I 17); ×40.
Fig. 7. *Laevigatisporites glabratus* (Zerndt). Westphalian A (Z. Pb. H2O); ×30.
Fig. 8. *L. glabratus* (Zerndt). Westphalian A (Z. Pb. G33); ×40.
Fig. 9. *Apiculatisporites breviapiculatus* Danzé, Levet-Carette & Loboziak. Westphalian A (Z. Pb. H2); ×20.
Fig. 10. *A. parviapiculatus* (Zerndt). Viséan (Z. Pb. I10); ×40.
Fig. 11. *Laevigatisporites fulgens* (Zerndt), Viséan (Z. Pb. H9); ×40.


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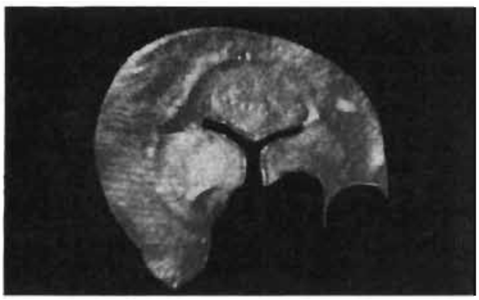
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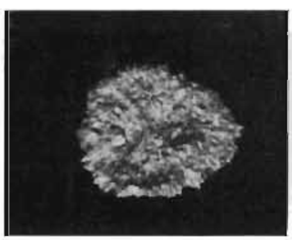
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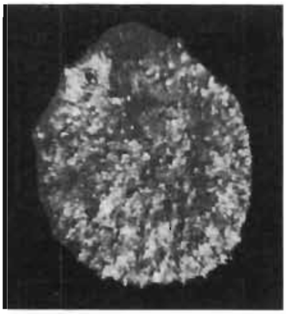

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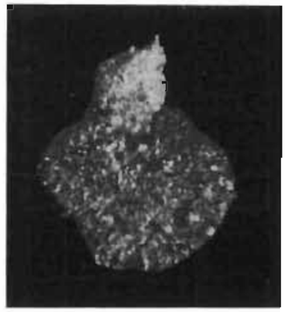

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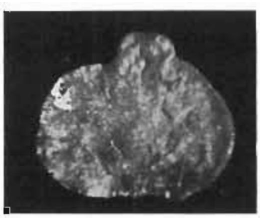

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Plate II

Lagenicula crassiaculeata Zerndt
(Viséan)

Fig. 1. Z. Pb. G21.
Fig. 2. Z. Pb. G6.
Fig. 3. Z. Pb. D39.

Lagenicula subpilosa (Ibrahim)
(Namurian A — Westphalian A)

Fig. 4. Z. Pb. G11.
Fig. 5. Z. Pb. G10.
Fig. 6. Z. Pb. G29.

Lagenicula baculata n. sp.
(Westphalian A)

Fig. 7. Z. Pb. G12.
Fig. 8. Z. Pb. G28.
Fig. 9. Z. Pb. G22.
Fig. 10. Z. Pb. G13.
Fig. 11. Z. Pb. G15.

All specimens × 30

Plate III

Lagenicula horrida Zerndt
(Namurian A — Westphalian A)

Fig. 1. Z. Pb. G9; × 30.
Fig. 2. Z. Pb. G3; × 30.
Fig. 3. Z. Pb. G4; × 30.
Fig. 4. Z. Pb. G1; × 30.

Lagenicula horrida hippocastaniformis n. var.
(Namurian A — Westphalian A)

Fig. 5. Z. Pb. G8; × 30.
Fig. 6. Z. Pb. G2 × 30.

Lagenoisporites rugosus (Loose)
(Westphalian A)

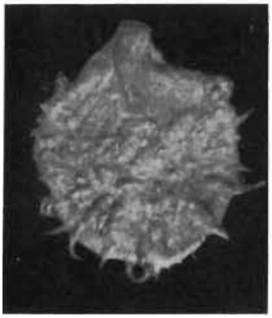
Fig. 7. Z. Pb. G32; × 40.
Fig. 10. Z. Pb. G14; × 30.

Lagenicula clavata n. sp.
(Westphalian A)

Fig. 8. Z. Pb. I12; × 30.
Fig. 9. Z. Pb. G31; × 30.

Lagenoisporites vastus (Dijkstra)
(Viséan)

Fig. 11. Z. Pb. J21; × 30.
Fig. 12. Z. Pb. J22; × 40.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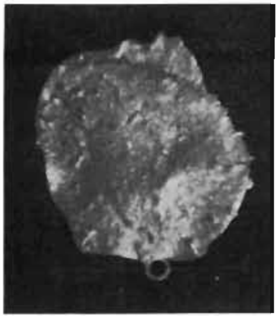
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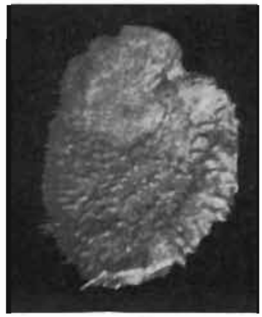
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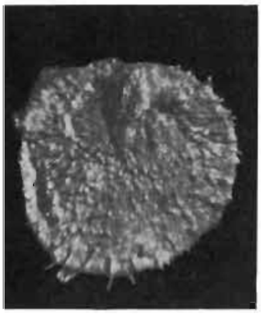
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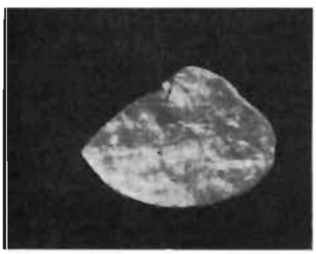
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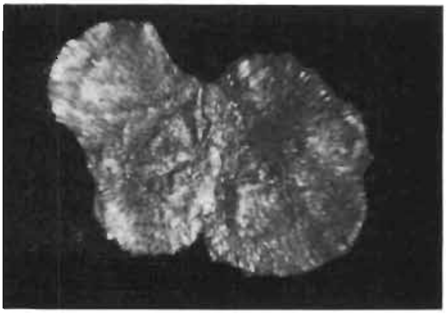

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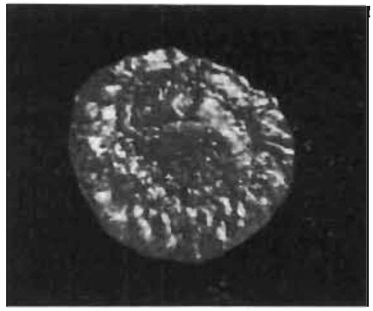

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Plate IV

Fig. 1. *Lagenicula brevispinosa* n. sp. Westphalian A (Z. Pb. I20); × 20.
Fig. 2. *L. maeandrica* n. sp. Viséan (Z. Pb. H19); × 30.
Fig. 3. *L. brevispinosa* n. sp. Westphalian A (Z. Pb. H24); × 30.
Fig. 4. *L. brevispinosa* n. sp. Westphalian A (Z. Pb. H5); × 30.
Fig. 5. *L. maeandrica* n. sp. Viséan (Z. Pb. H8); × 40.
Fig. 6. *Lagenoisporites* cf. *nudus* (Nowak & Zerndt). Viséan (Z. Pb. I1); × 30.
Fig. 7. *Lagenoisporites* sp. *2*. Viséan (Z. Pb. G37); × 30.
Fig. 8. *Valvisisporites auritus* (Zerndt). Westphalian A (Z. Pb. H37) × 30.
Fig. 9. *Lagenoisporites?* sp. *4*. Westphalian A (Z. Pb. G26); × 30.
Fig. 10. *Lagenoisporites* sp. *1*. Viséan, Westphalian A (Z. Pb. I9); × 30.
Fig. 11. *Lagenoisporites?* sp. *3*. Westphalian A (Z. Pb. H17); × 30.

Plate V

Lagenoisporites simplex var. *levis* (Zerndt)
(Viséan)

Fig. 1. Z. Pb. J19; × 40.
Fig. 2. Z. Pb. J14; × 40.
Fig. 3. Z. Pb. J15; × 30.
Fig. 4. Z. Pb. J9; × 30.
Fig. 5. Z. Pb. J5; × 30.
Fig. 6. Z. Pb. J16; × 40.
Fig. 7. Z. Pb. J3; × 30.
Fig. 8. Z. Pb. J17; × 30.
Fig. 9. Z. Pb. J18; × 40.

Setosisporites reticulatus n. sp.
(Viséan)

Fig. 10. Z. Pb. H7; × 40.

Setosisporites hirsutus (Loose)
(Namurian B — Westphalian A)

Fig. 11. Z. Pb. H30; × 30.
Fig. 12. Z. Pb. H36; × 30.

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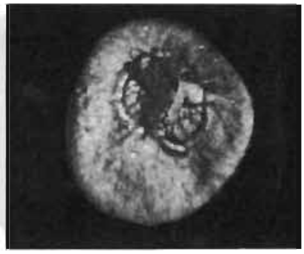

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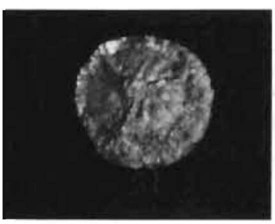

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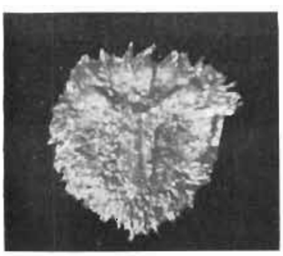
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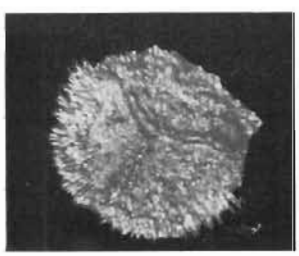
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Plate VI

Lagenoisporites simplex var. *levis* (Zerndt)
(Viséan)

Fig. 1. Z. Pb. J1; × 40.
Fig. 2. Z. Pb. J2; × 40.
Fig. 3. Z. Pb. J11; × 30.
Fig. 4. Z. Pb. J8; × 30.
Fig. 5. Z. Pb. J13; × 40.
Fig. 6. Z. Pb. J6; × 30.
Fig. 7. Z. Pb. J4; × 30.
Fig. 8. Z. Pb. J7; × 30.
Fig. 9. Z. Pb. J12; × 40.

Zonalesporites radiatus (Zerndt)
(Viséan — Namurian A)

Fig. 10. Z. Pb. G16; × 30.
Fig. 11. Z. Pb H18; × 30.
Fig. 12. Z. Pb. H31; × 50.

Plate VII

Fig. 1. *Setosisporites praetextus* (Zerndt). Viséan — Westphalian A (Z. Pb. H34); × 30.
Fig. 2. *S. praetextus* (Zerndt). Viséan — Westphalian A (Z. Pb. H39); × 30.
Fig. 3. *Cystosporites strictus* Dijkstra. Viséan (Z. Pb. H15); × 30.
Fig. 4. *Setosisporites dybovae* n. sp. Viséan-Namurian A (Z. Pb. H33) ×60.
Fig. 5. *S. dybovae* n. sp. Viséan — Namurian A (Z. Pb. H38); ×30.
Fig. 6. *Setosisporites?* sp. *1*. Namurian A (Z. Pb. H32); × 30.
Fig. 7. cf. *Setosisporites* sp. *2*. Viséan (Z. Pb. G34); × 40.
Fig. 8. *Triangulatisporites triangulatus* (Zerndt). Westphalian A (Z. Pb. H25); × 30.
Fig. 9. *T. triangulatus* (Zerndt). Westphalian A (Z. Pb. H21); × 30.
Fig. 10. *Zonalesporites brasserti* f. *solida* Dijkstra. Viséan (Z. Pb. G27); × 30.
Fig. 11. Z. *brasserti* f. *solida* Dijkstra. Viséan (Z. Pb. G25); ×30.
Fig. 12. Z. *brasserti* f. *solida* Dijkstra. Viséan (Z. Pb. H23); × 30.


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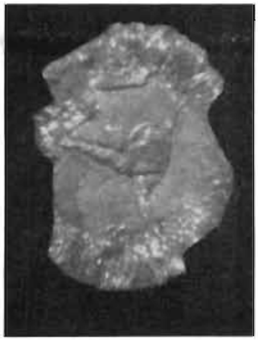
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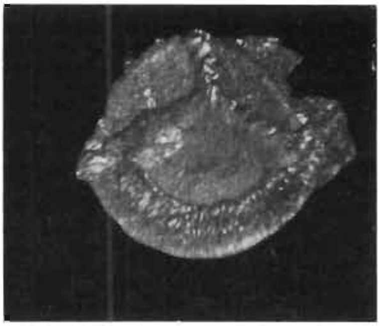

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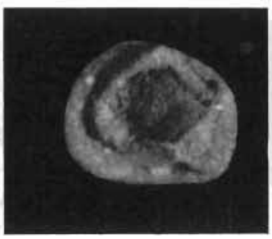

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Plate VIII

Zonalesporites brasserti (Stach & Zerndt)
(Viséan — Westphalian A)

Fig. 1. Z. Pb. H26; × 30.
Fig. 2. Z. Pb. H35; × 30.
Fig. 3. Z. Pb. H27; × 30.
Fig. 4. Z. Pb. G35; × 40.
Fig. 5. Z. Pb. H16; × 30.

Cystosporites giganteus (Zerndt)
(Viséan — Westphalian A)

Fig. 6. Z. Pb. H11; × 40.
Fig. 7. Z. Pb. H10; × 40.
Fig. 8. Z. Pb. H3; × 10.
Fig. 9. Z. Pb. H12; × 40.
Fig. 10. Z. Pb. H1; × 10.

Plate IX

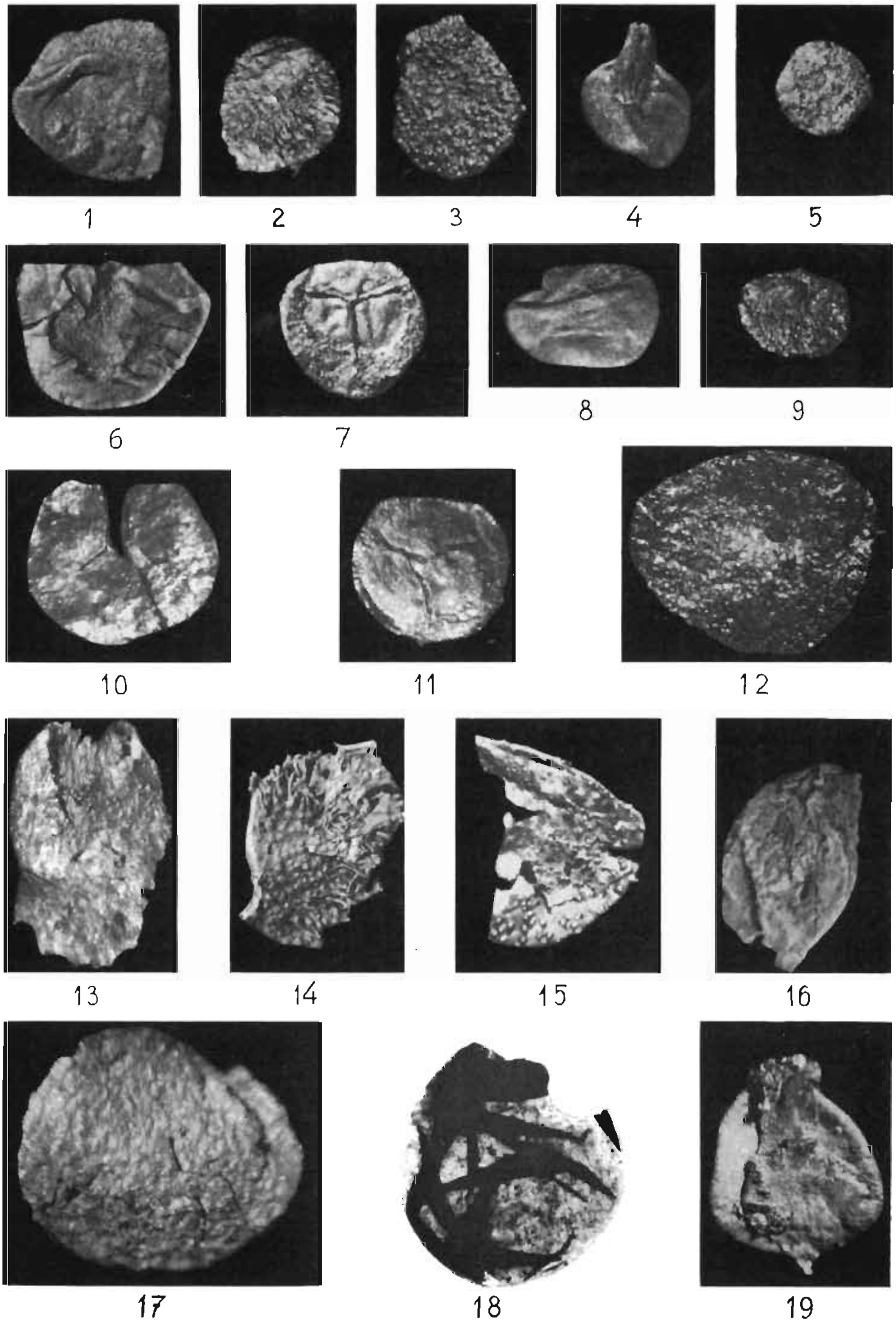
Cystosporites varius (Wicher)
(Namurian C — Westphalian A)

Fig. 1. Z. Pb. H14; × 30.
Fig. 6. Z. Pb. H40; × 30.
Fig. 8. Z. Pb. H13; × 30.

Cystosporites verrucosus Dijkstra
(Westphalian A)

Fig. 2. Z. Pb. I6; × 30.
Fig. 3. Z. Pb. I18; × 30.
Fig. 9. Z. Pb. I19; × 30.
Fig. 13. Z. Pb. I25; × 10.
Fig. 16. Z. Pb. L16; × 17.
Fig. 17. Z. Pb. I4; × 30.

Fig. 4. *Cystosporites* sp. Westphalian A (Z. Pb. G23); × 30.
Fig. 5. Me*gaspora?* Westphalian A (Z. Pb. I13); × 30.
Fig. 7. *Setosisporites hirsutus* var. *brevispinosa* f. *I* (Zerndt). Viséan (Z. Pb. I21); × 40.
Fig. 10. *Apiculatisporites brevispiculus* (Schopf). Namurian A, C, Westphalian A (Z. Pb. L31); × 20.
Fig. 11. *Setosisporites hirsutus* var. *brevispinosa* f. *II* (Zerndt). Viséan (Z. Pb. I24); × 40.
Fig. 12. *Triletes?* sp. *2*. Westphalian A (Z. Pb. G17); × 20.
Fig. 14. *Zonalesporites superbus* (Bartlett). Westphalian A (Z. Pb. I23); × 20.
Fig. 15. *Apiculatisporites subspinus* Danzé, Levet-Carette & Loboziak. Westphalian A (Z. Pb. L32); × 20.
Fig. 18. *Calamospora magna* n. sp. Namurian A, Westphalian A (Z. Pb. K2); × 17.
Fig. 19. *Triletes* sp. *1*. Westphalian A (Z. Pb. I8); × 30.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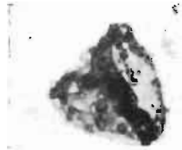

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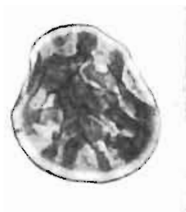

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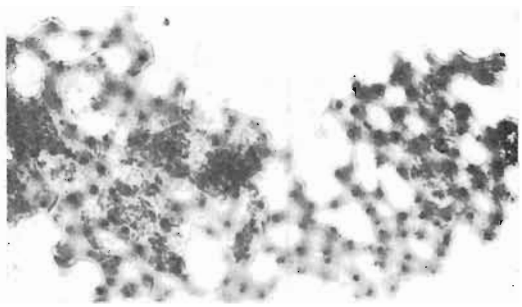

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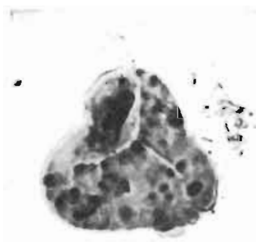

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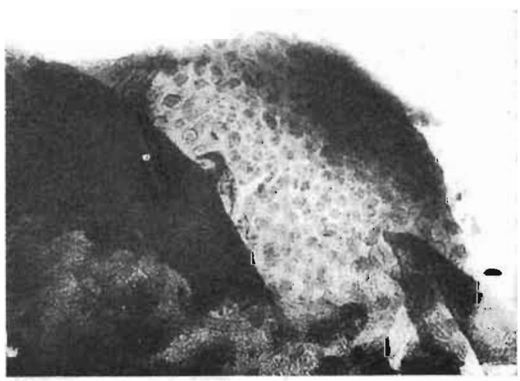

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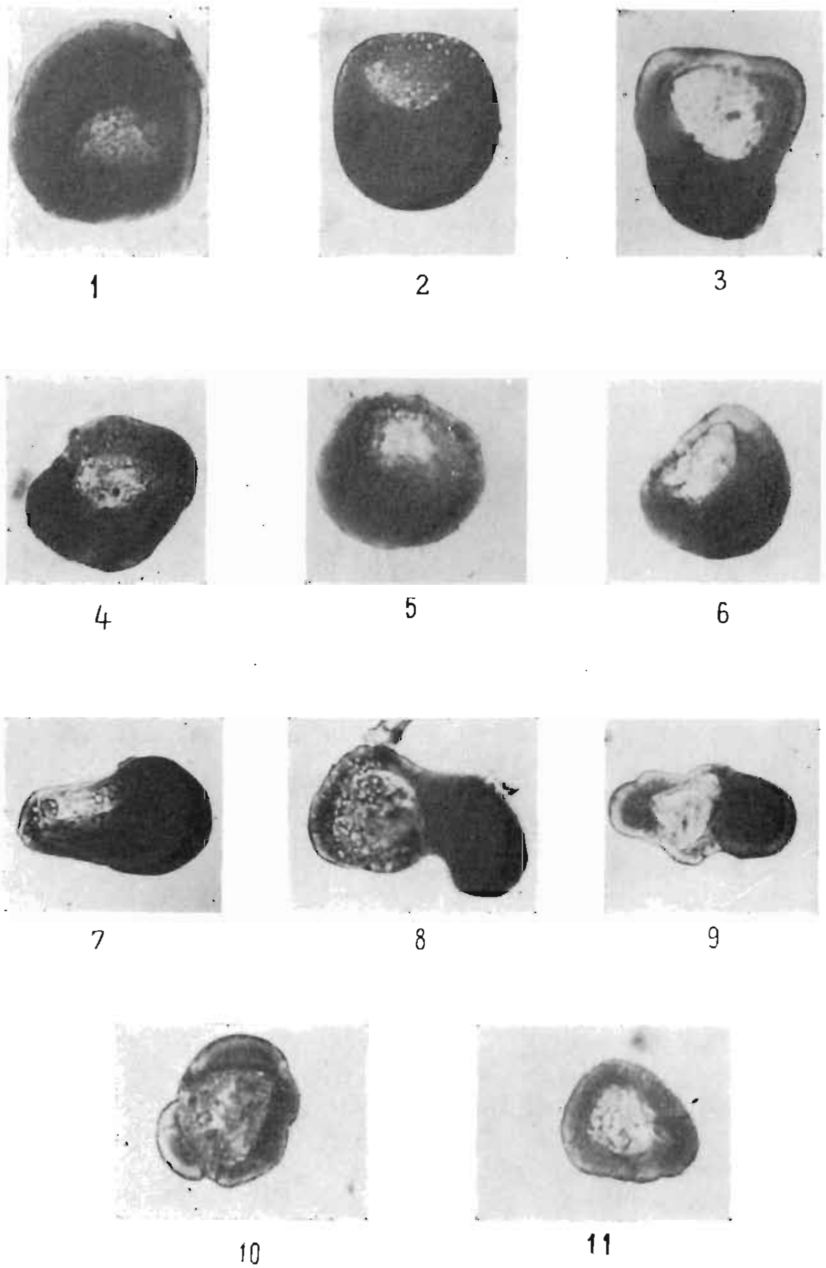
Plate X

Fig. 1. *Savitrisporites minor* n. sp. Westphalian A (Z. Pb. N71); × 450.
Fig. 2. *Knoxisporites* sp. Westphalian A (Z. Pb. N76); × 470.
Fig. 3. *Lophotriletes* cf. *primitivus* Ishchenko. Westphalian A (Z. Pb. N23); × 450.
Fig. 4. *Gravisporites triangulus* n. sp. Westphalian A (Z. Pb. N13); × 500.
Fig. 5. *Lagenicula clavata* n. sp. Westphalian A (Z. Pb. K3); × 40.
Fig. 6. *Pustulatisporites irregularis* n. sp. Viséan (Z. Pb. M86); × 500.
Fig. 7. *Lycospora intermedia* n. sp. (Namurian A — Westphalian A), (Z. Pb. N18); × 540.
Fig. 8. *Setosisporites reticulatus* n. sp. (Reticulum from distal surface of the spore), Viséan (Z. Pb. K12); × 200.
Fig. 9. *Lagenicula brevispinosa* n. sp. (Contact field with the knobs), Westphalian A (Z. Pb. K5); × 100.

Plate XI

Pseudoannulatisporites polonicus n. sp.
(Viséan)

Fig. 1. Z. Pb. 035; × 530.
Fig. 2. Z. Pb. 034; × 520.
Fig. 3. Z. Pb. 035; × 470.
Fig. 4. Z. Pb. 034; × 470.
Fig. 5. Z. Pb. 035; × 470.
Fig. 6. Z. Pb. 035; × 470.
Fig. 7. Z. Pb. 034; × 500.
Fig. 8. Z. Pb. 035; × 500.
Fig. 9. Z. Pb. 035; × 500.
Fig. 10. Z. Pb. 035; × 500.
Fig. 11. Z. Pb. 035; × 500.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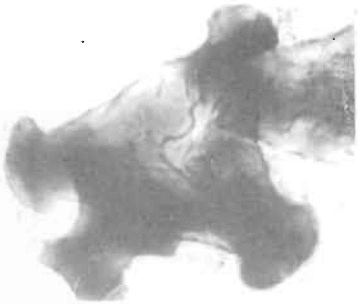

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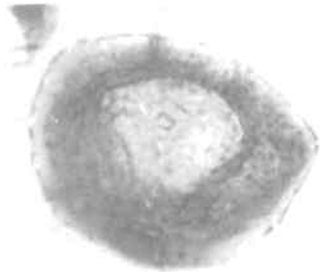

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Plate XII

Fig. 1. *Triquitrites* cf. *articulosus* (Ishchenko). Viséan — Namurian A (Z. Pb. M42);×500.
Fig. 2. *T.* cf. *articulosus* (Ishchenko). Viséan — Namurian A (Z. Pb. M44); ×420.
Fig. 3.*Sahnisporites* cf. *saarensis* Bhardwaj. Westphalian A (Z. Pb. N11); ×500.
Fig. 4. *Densosporites pseudoconfragosus* n. sp. Namurian C- Westphalian A (Z. Pb. N10); × 550.
Fig. 5. *Calamospora* sp. Westphalian A (Z. Pb. N11); × 225.
Fig. 6. *Vestispora* cf. *lucida* (Butterworth & Williams). Westphalian A (Z. Pb. N23); × 570.