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Upper Triassic *Charophyta* Zones from the Eastern Margin of the Upper Silesian Coal Basin

by

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Summary. Two *Charophyta* zones were distinguished in the Upper Triassic sediments from the eastern margin of the Upper Silesian Coal Basin: *Stellatochara thuringica* partial range zone and *Auerbachichara rhaetica* range zone. *Stellatochara thuringica* zone defined in the epicontinental Upper Triassic in Poland corresponds to Keuper. Along the eastern margin of the Upper Silesian Coal Basin *Charophyta* were not found in the lower part of the Keuper sequence – the Chrzanów Formation. The lower range of index species of *Stellatochara thuringica* zone is located in the bottom part of the Błędów Claystone Member. Range of this zone corresponds to the range of the Bolesław Formation. *Auerbachichara rhaetica* range zone includes the Grabowa Formation and the bottom part of later Rhaetic sediments. Correlation of the distinguished *Charophyta* zones with the ostracods ones as well as with the spore-and-pollen and megaspore assemblages of the Upper Triassic is presented.

1. Introduction. Stratigraphic importance of Charophyta has been demonstrated by Horn af Rantzien [12]. Saidakovsky [20–22] distinguished seven *Charophyta* zones in the Triassic of the southern part of East-European Platform. Kisielevsky [13] established stratigraphy of the Triassic in northwestern part of the Caspian Depression basing on *Charophyta*. Kozur [17, 18] found *Charophyta* assemblages from the Lower Triassic of East Germany to be comparable with those from the Triassic in the European part of Soviet Union and distinguished five *Charophyta* zones in the Middle Triassic. Finally, in the modern subdivision of the Triassic of East-European Platform [23] four *Charophyta* zones were defined.

The Triassic epicontinental facies in Poland includes sediments deposited partly in fresh-water and in brackish environments and containing abundant

Charophyta. Bilan [1, 2, 7] described species from the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin and found variability of the ranges of individual species in the studied sequences. Basing on *Charophyta* [7] and referring to the earlier subdivisions [13, 17, 18, 20–23], the same author presented the *Charophyta* subdivision of epicontinental Triassic in Poland.

Bilan [7] found that the wide distribution of *Charophyta*, diversity of their assemblages in time and defined ranges of index species in stratigraphic profiles enable their application for both the local and the regional correlations of Triassic continental facies. The same author determined the limiting factors for the growth of Triassic *Charophyta*: depth of the basin, salinity, concentrations of iron compounds and calcium carbonate and redox potential. He also distinguished *Charophyta* assemblages dominated by representatives of specific genera, pointed out to the relationships between the assemblages and environment conditions and demonstrated their distribution in the Triassic epicontinental sediments in Poland [7].

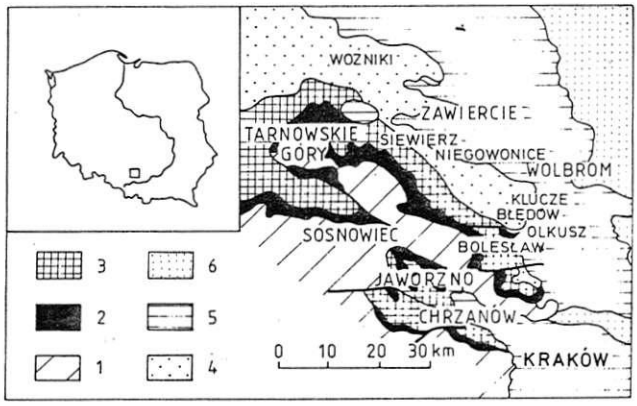

Fig. 1. The occurrence of Upper Triassic sediments at the eastern margin of the Upper Silesian Coal Basin
1 – Palaeozoic, 2 – Lower Triassic, 3 – Middle Triassic, 4 – Upper Triassic, 5 – Jurassic, 6 – Cretaceous

The Upper Triassic of the eastern margin of the Upper Silesian Coal Basin (Fig. 1) comprises two from the distinguished zones [7]: *Stellatochara thuringica* partial range zone and *Auerbachichara rhaetica* range zone (Fig. 2).

2. *Stellatochara thuringica* partial range zone. The index species for this zone was found in few samples originated from the Lower Keuper and the Lower Gypsum Keuper as well as from numerous samples of Reed Sandstone and Upper Gypsum Keuper of the Polish Lowlands [7]. In the eastern margin of the Upper Silesian Coal Basin the lower range of the index species falls into the bottom part of the Bolesław Formation. Besides *Stellatochara thuringica* Kozur et Reinhardt, also *Stellatochara kozuri* Bilan and *Auerbachichara arguta* (Saidakovsky) were observed along with numerous species known from the zones defined in both the Lower and the Middle Triassic (Fig. 2).

Referring to the subdivisions of Upper Triassic of the Polish Lowlands [8–10, 14, 15, 28] including the Silesia-Cracov area [11, 16], four units were distin-

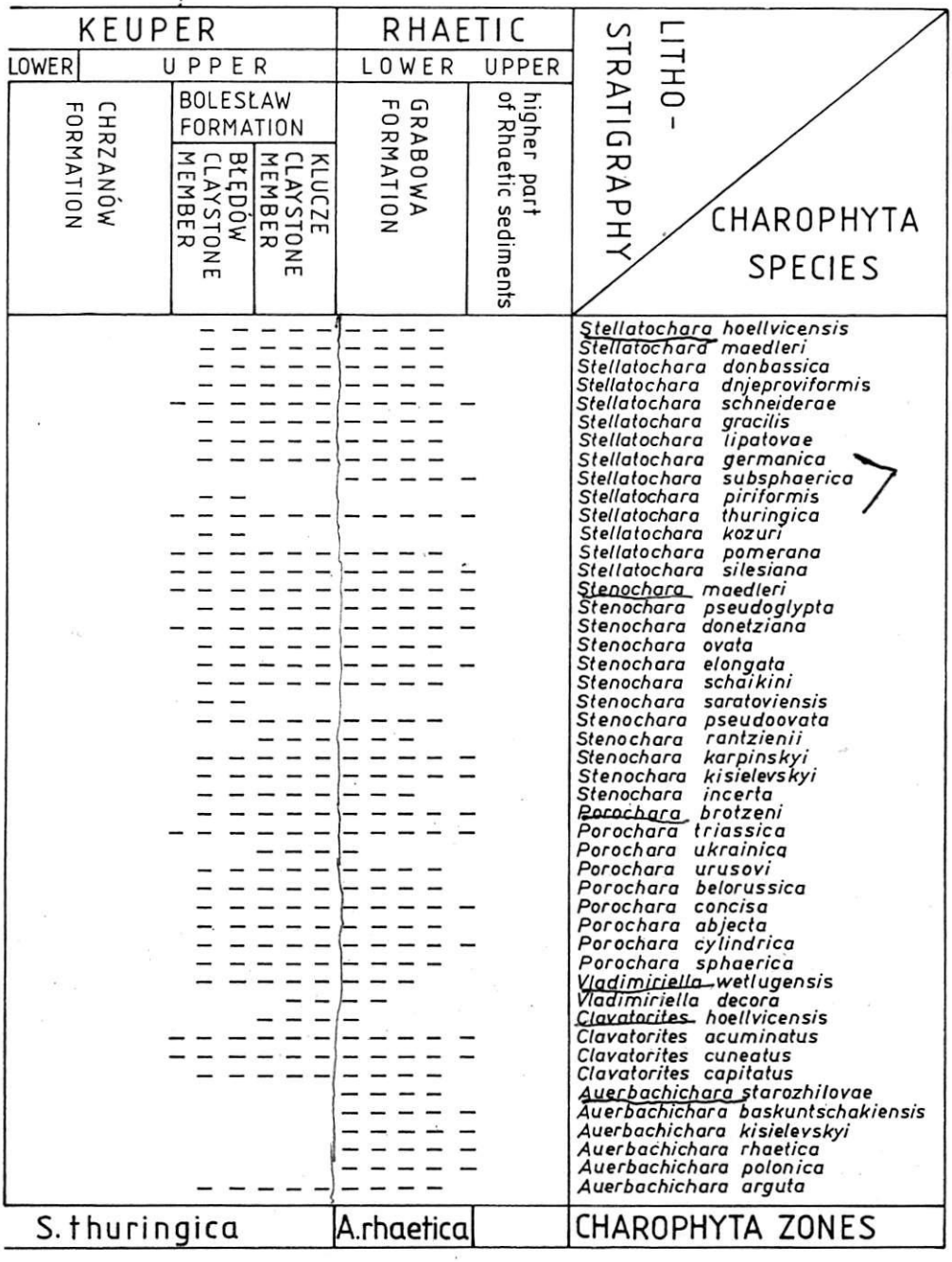

Fig. 2. Stratigraphic range of the species of *Charophyta* in the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin

guished in the Upper Triassic [3–5]. Two of them (Chrzanów and Bolesław formations) were ascribed to the Upper Keuper and two others to the Rhaetic. Correlation of the subdivisions of epicontinental Middle and Upper Triassic in Poland was presented in [24, 25].

The Chrzanów Formation comprises claystones, mudstones, dolomitic marls and dolomites. Locally, dolomite conglomerates, gypsum and sandstone interbeds appear. The sediments show grey colouration with sporadic mottled intercalations. The thickness varies from 80 metres in the southern part (Chrzanów vicinity) to 30 metres in the area of Bolesław and 10 metres in the neighbourhood of Niegowonice. In many profiles from the central and northern parts of the eastern margin of the Upper Silesian Coal Basin the Chrzanów Formation has not been observed [3]. In the Chrzanów Formation sediments compared with the Lower Gypsum Keuper and with the Boundary Dolomite [3] *Charophyta* were not found.

Basing on the quantitative dominance of the specific genera in the Polish epicontinental Triassic, Bilan [7] distinguished five *Charophyta* assemblages. In the Keuper sediments remarkable variability is observed in both the species and the genera compositions of the assemblages as well as in the number of specimens. In the Lower Gypsum Keuper sequences with *Porochara-Stenochara* and *Stenochara-Stellatochara* assemblages alternate. In numerous samples gyrogonites are absent. Assemblages from these sediments are relatively poor and representatives of *Stenochara* genus prevail. Assemblages are dominated with eurytopic forms. Such features suggest unfavourable environment conditions and the sequence of assemblages point out to the oscillating changes in salinity. Vertical variability of the *Charophyta* assemblages seem to reflect the sequence of conditions: ±limnic to mesohaline-brackish. The absence of gyrogonites may be caused (despite other possible environment changes) by the temporary increasing salinity [7]. The lack of *Charophyta* in the Chrzanów Formation is presumably the effect of unfavourable conditions, mostly salinity and depth.

The Bolesław Formation reveals variable lithology. In the lower part (Błędów Claystone Member) multicolour claystones, mudstones, sandstones, limestones and marls occur with rare dolomites. In the bottom part conglomerates and gravels are commonly observed. The thickness of this member varies usually from 15 to 25 metres and may not exceed 10 metres in some sequences. The upper part (Klucze Claystone Member) is dominated by mottled claystones with mudstones, limestones and marls interbeds. The thickness of this sediments varies from several to more than ten metres and reaches 30 metres in few localities [3, 5]. The Bolesław Formation is correlated with the Reed Sandstone (Schilfsandstein) and its uppermost part (upper part of the Klucze Claystone Member) can be a reduced equivalent of the Upper Gypsum Keuper [3].

The Bolesław Formation contains numerous *Charophyta*. Besides the *Stenochara-Stellatochara* and *Porochara-Stenochara* assemblages, the *Stel-*

latochara one appears [7]. The latter occurs usually in the lower part of the Bolesław Formation and indicates the reducing conditions. Significant variability of both the *Stenochara-Stellatochara* and *Porochara-Stenochara* assemblages points out not only the changes in salinity in the range of limnic to mesohaline-brackish conditions but also to the variable bathymetry, content of specific chemical components and types of bedrocks [7].

3. *Auerbachichara rhaetica* range zone. The range of this zone corresponds to that of the *Auerbachichara rhaetica* Bilan. Apart from the index fossil, the representatives of *Auerbachichara* genus occur: *A. starozhilovae* Kisielevsky, *A. baskuntschakiensis* Kisielevsky, *A. kisielevskyi* Saidakovsky and *A. polonica* Bilan as well as numerous other species known from the zones defined in the Bunter, Muschelkalk and Keuper [7].

The *Auerbachichara rhaetica* range zone comprises early Rhaetic sediments including the Grabowa Formation correlated with the R I cyclothem and bottom part of the later part of Rhaetic sediments correlated with the R II cyclothem [3, 4, 7]. The Grabowa Formation consists of mottled, claystone-mudstone sediments with numerous intercalations of conglomerates and breccias composed of carbonate fragments cemented with calcareous-argillaceous matter, sandstones, limestones and marls, rarely dolomites. The thickness varies from more than ten metres in the vicinity of Olkusz to about 100 metres in the areas of Siewierz and Zawiercie. In the later part of the Rhaetic carbonate conglomerates with calcareous-argillaceous cement, sandstones, grey (rarely mottled) mudstones and claystones occur. Minor components are limestone and marl interbeds. The thickness varies from more than ten to 25 metres in the northern part to several metres in the central part of the studied area.

In both the Grabowa Formation and the later part of Rhaetic sediments *Stenochara-Stellatochara* and *Porochara-Stenochara* assemblages occur along with *Auerbachichara* one. Alternation of these assemblages point out to the changes in salinity whereas the variability of the number of species and specimens indicates the changing bathymetry and, probably, also varying bedrocks types and chemical composition of the environment. The occurrence of specific fossil remains allows the reconstruction of salinity changes in the sedimentary basin in the range limnic to pliohaline-brackish conditions [7]. However, the presence of redeposited fossils diminishes the clarity of environmental changes.

4. Correlation of *Charophyta* zones with other biostratigraphic subdivisions. Abundant microfossils are known to occur in the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin. Important for stratigraphy and correlation are, first of all, ostracods, microspores, megaspores and charophytes. Palynologic studies of the Upper Triassic deposits from the northeastern margin

of the Upper Silesian Coal Basin revealed the presence of abundant and well-preserved microflora. Its diversity allows to distinguish three stratigraphically important palynologic assemblages [11]. The first spore-and-pollen assemblage contains numerous representatives of *Ovalipollis* Krutzsch and *Triadispora* Klaus with the dominating *Triadispora undulata* Orłowska-Zwolińska and *T. keuperiana* Orłowska-Zwolińska accompanied by *Conbaculatisporites longdonensis* Clarke, *Taeniaesporites noviaulensis* Leschik, *T. sulcatus* (Pautsch), *Lueckisporites virkkiae* Potonie et Klaus, *Camerosporites secatus* Leschik, *Duplicisporites granulatus* Leschik, *D. verrucosus* Leschik and *Praecirculina granifer* (Leschik). This assemblage is connected with the Lower Gypsum Keuper and the Boundary Dolomite sediments [11] which are correlated with the Chrzanów Formation [3].

In the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin two ostracod zones were distinguished by Bilan [6]: *Karnocythere germanica* = *Lutkevichinella germanica* (Wienholz et Kozur) range zone after Styk [26, 27] and *Clinocypris? silesia* = *Pulviella silesia* (Styk) range zone after Styk [26, 27] with and interzone contained between them (Fig. 2). The *Lutkevichinella germanica* zone includes the Błędów Claystone Member whereas the *Lutkevichinella germanica*, *Pulviella silesia* interzone comprises the Klucze Claystone Member. In [27] the biostratigraphic subdivision of the epicontinental Triassic sediments in Poland basing on the ostracod ranges was proposed. In the Upper Keuper three zones were distinguished, embracing the following succeeding units: Lower Gypsum Beds, Reed Sandstone and Upper Gypsum Beds. In the zones corresponding to the Lower and the Upper Gypsum Beds, there were found [27] only rare *Darwinula liassica* (Brodie) specimens. The Reed Sandstone was described as *Lutkevichinella brotzenorum alpina* zone [27] which corresponds to the *Lutkevichinella germanica* zone [7].

The second spore-and-pollen assemblage [11] is characterized by the dominance of *Ovalipollis* Krutzsch, *Aulisporites astigmosus* (Leschik) and *Leschikisporites aduncus* (Leschik) as well as by abundant *Aratrisporites paraspinosus* Klaus and *A. coryliseminis* Klaus. *Camarozonosporites* (*Camarozonosporites*) *laevigatus* Schulz and *C. rudis* (Leschik) occur in less amount. This is the Reed Sandstone assemblage [11] which appears to correlate with the Bolesław Formation without its uppermost part [3]. Its range corresponds to the range of megaspore *Narkisporites harrisi* zone [19], to the ostracod *Lutkevichinella germanica* zone and to the upper part of the *Stellatochara thuringica* zone.

The ostracod *Pulviella silesia* zone which includes the Grabowa Formation [6] corresponds to the *Rhombocythere nodosa* zone [27]. The range of both zones is, in turn, identical with that of the *Auerbachichara rhaetica* zone excluding its uppermost part which correlates with the later Rhaetic sediments.

The third microflora assemblage [11] contains numerous *Ovalipollis*

Krutzsch, *Granuloperculatipollis rudis* Venkatachala et Goczan, *Corollina meyeriana* (Klaus), *Classopollis classoides* (Pflug), *Enzonalasporites manifestus* Leschik, *E. vigens* Leschik, *E. marginalis* (Leschik), *Brachysaccus* cf. *B. neomundanus* (Leschik) and *Cedripites microreticulatus* Orłowska-Zwolińska. This assemblage occurs in the sediments classified by Grodzicka-Szymanko [10] as R II cyclothem, and, in minor part, as the upper portion of R I cyclothem [11]. Therefore, it presumably includes only the upper part of the Grabowa Formation (which corresponds to the R I cyclothem) and the later part of Rhaetic sediments correlated with the R II cyclothem [3]. Comparison of Rhaetic microflora from the northeastern margin of the Upper Silesian Coal Basin with that from western and central Poland shows remarkable similarity of the third spore-and-pollen assemblage to the microflora from the Jarkowo and the Zbąszynek Beds [11]. Thus, the range of the third spore-and-pollen assemblage only partly corresponds to the upper part of *Auerbachichara rhaetica* zone.

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REFERENCES

[1] W. Bilan, *Characeae from Keuper sediments of the Kolbark district*, Ann. Soc. Geol. Pol., **39** (1969) 433–454.

[2] W. Bilan, *Three new species of Charophyta from the Upper Triassic in the Cracow-Silesian area*, Ann. Soc. Geol. Pol., **44** (1974) 483–489.

[3] W. Bilan, *Stratygrafia Górnego triasu wschodniego obrzeżenia Górnośląskiego Zagłębia Węglowego*, Zesz. nauk. AGH, Geologia, **3** (1976) 1–73.

[4] W. Bilan, *Występowanie osadów górnego triasu we wschodnim obrzeżeniu Górnośląskiego Zagłębia Węglowego*, Zesz. nauk. AGH, Geologia, **4** (1976) 65–78.

[5] W. Bilan, *The evolution of the Upper Triassic Basin in the eastern margin of the Upper Silesian Coal Basin*, Bull. Ac. Pol. Sci., Ser. Sci Terre, **24** (1977) 235–242.

[6] W. Bilan, *Ostracod zones in the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin*, Bull. Ac. Pol. Sci., ser. Sci. Terre, **27** (1980) 185–192.

[7] W. Bilan, *The epicontinental Triassic Charophytes of Poland*, Acta Palaeobot., **28** (1988) 63–161.

[8] R. Dadlez, J. Kopik, *Problem retyku w zachodniej Polsce na tle profilu w Książu Wielkopolskim*, Kwart. Geol., **7** (1963) 131–158.

[9] Z. Deczkowski, *Budowa geologiczna pokrywy permsko-mezozoicznej i jej podłoża we wschodniej części monokliny przedsudeckiej (obszar kalisko-częstochowski)*, Pr. Inst. Geol., **82** (1977) 1–63.

[10] W. Grodzicka-Szymanko, *Cyclic sedimentary subdivision of the Rheatian in the Polish lowlands*, Bull. Ac. Pol. Sci., ser. Sci. Terre, **19** (1971) 137–147.

[11] W. Grodzicka-Szymanko, T. Orłowska-Zwolińska, *Stratygrafia górnego triasu NE części obrzeżenia Górnośląskiego Zagłębia Węglowego*, Kwart. Geol., **16** (1972) 216–232.

[12] H. Horn af Rantzien, *Middle Triassic Charophyta of South Sweden*, Opera Bot., 1 (1954) 1–83.

[13] F. Kisielevsky, *Znachenie iskopaemykh kharovykh vodoroslei dlia raschlenenia*

triasovykh otlozheni severo-zapadnoi chasti Prikaspiskoi vpadiny, Vopr. Geol. Iu. Urala i Povolzhia, **5** (1969) 3–25.

[14] J. Kopik, *The boundary between the epicontinental Triassic and Jurassic deposits in Poland*, Biul. Inst. Geol., **203** (1967) 11–24.

[15] J. Kopik, *Retyk*, in: *Budowa geologiczna Polski, 1. Stratygrafia, 2. Mezozoik*, eds: S. Sokołowski, S. Cieśliński, J. Czermiński, Wyd. Geol., Warszawa 1973.

[16] S. Kotlicki, *Stratigraphic position of the Triassic sediments in the Upper Silesian region*, Bull. Ac. Pol. Sci., ser. Sci Terre, **22** (1974) 161–166.

[17] H. Kozur, *Biostratigraphic der germanischen Mitteltrias*, Freiberger Forsch. -H., C **280**, (1974), 1–70.

[18] H. Kozur, *Probleme der Triasgliederung und Parallelisierung der germanischen und tethyalen Trias. Teil 2. Anschluss der germanischen Trias an die internationale Triasgliederung*, Freiberger Forsch.-H., C **304** (1975) 51–77.

[19] T. Marcinkiewicz, *Megaspory*, in: *Budowa geologiczna Polski, 3. Atlas skamieniałości przewodnich i charakterystycznych, 2a. Mezozoik, Trias*, ed: L. Malinowska, Wyd. Geol., Warszawa 1979.

[20] L. J. Saidakovsky, *Kharofity iz triasovykh pestrotsvetov Bolshogo Donbassa*, Dokl. AN SSSR, **145** (1962) 1141–1144.

[21] L. J. Saidakovsky, *Biostratigrafia triasovykh otlozheni iuga Russkoi platformy*, Tr. Geol. Inst. An SSSR, **143** (1966) 93–144.

[22] L. J. Saidakovsky, *Kharovye vodorosli*, in: *Stratigrafia SSSR, Triasovaia sistema*, ed: D. V. Nalivkin, Moskva 1973.

[23] L. J. Saidakovsky, F. J. Kisielevsky, *Znachenie kharovykh vodoroslei dlia stratigrafi triasa Vostochno-Evropeiskoi platformy*, in: *Triasovye otlozhenia Vostochno-Evropeiskoi platformy*, ed: A. V. Vostriakov, Saratov 1985.

[24] H. Senkowiczowa, *Możliwości sformalizowania podziału litostrotygraficznego środkowego i górnego triasu epikontynentalnego w Polsce*, Kwart. Geol., **23** (1979) 583–600.

[25] H. Senkowiczowa, *Możliwości sformalizowania podziału litostratygraficznego środkowego i górnego triasu Wyżyny Śląsko-Krakowskiej*, Kwart. Geol., **24** (1980) 787–804.

[26] O. Styk, *Gromada Ostracoda latreille, 1806*, in: *Budowa geologiczna Polski, 3. Atlas skamieniałości przewodnich i charakterystycznych, 2a. Mezozoik, Trias*, ed: L. Malinowska, Wyd. Geol., Warszawa 1979.

[27] O. Styk, *Biostratygrafia osadów epikontynentalnych triasu Polski na podstawie małżoraczków*, Biul. Inst. Geol., **329** (1982) 5–62.

[28] A. Szyperko-Śliwczyńska, *O stratygrafii i rozwoju kajpru w Polsce*, Kwart. Geol., **4** (1960) 701–712.