ROCZNIK POLSKIEGO TOWARZYSTWA GEOLOGICZNEGO
ANNALES DE LA SOCIÉTÉ GÉOLOGIQUE DE POLOGNE

Tom (Volume) XXXIX — 1969 Zeszyt (Fascicule) 1—3 Kraków 1969

STEFAN WITOLD ALEXANDROWICZ *

THURAMMINOIDES SPHAEROIDALIS PLUMMER (FORAMINIFERA) FROM CAMBRIAN BEDS OF THE VICINITY OF SANDOMIERZ

(3 Figs.)

Thuramminoides sphaeroidalis Plummer (Foraminifera) z kambru okolic Sandomierza

(3 fig.)

Abstract: Numerous specimens of Foraminifera determined as *Thuramminoides sphaeroidalis* Plummer were found in clayey shales of Middle Cambrian age, lying immediately under Tortonian clays of Sandomierz. This species was noted hitherto from Ordovician, Carboniferous and Permian beds.

INTRODUCTION

The Cambrian microfauna is poorly known and every new occurrence of Foraminifera in sediments of this age deserves special attention. Numerous and relatively well preserved specimens, representing only one species, were found in shales, in samples obtained from a shallow bore-hole drilled in the southern suburb of Sandomierz (Fig. 1). The geological position of these shales and their lithologic character indicate, that they belong to the Middle Cambrian. Undeterminable specimens of Foraminifera (representing possibly the family Ammodiscidae) were also found in shales representing the upper zone of the Middle Cambrian, exposed in the Góry Pieprzowe hills, c. 3 km east of Sandomierz.

The profile of the bore-hole from top to bottom was following: Quaternary sands and loams (17 m), Lower Tortonian marly clays with fragmented fauna underlain by detrital limestones and Lithotamnium limestones (12 m), clayey shales with intercalations of siltstones, assigned to the Cambrian, in which 54 m were drilled without reaching the base. The microfauna was found in the lower 20 metres of the profile of the clayey shales. The Cambrian sediments are lithologically monotonous. They consist of grey and light-grey claystones and clayey shales, slightly sandy, non-calcareous, relatively tough with tabular fissility, and earthy fracture surfaces. Some bedding planes are covered by minute muscovite

* Address: Doc. dr S. W. Alexandrowicz, Katedra Geologii Ogólnej AGH, Kraków, al. Mickiewicza 30. Poland.

flakes. The shales are alternating with grey siltstones, which have irregular fracture surfaces and tabular fissility. The siltstones consist of alternating light and dark parallel laminae. Microscopic examination of thin sections revealed that the siltstones contain a large amount of fine angular quartz grains ranging from 0,01 to 0,10 mm in diameter, irregularly dispersed or arranged in bands. The parallel structure of the rock is due to the arrangement of numerous muscovite flakes and thin layers composed mainly of quartz grains. The grains are cemented by clayey material. Accessory components consist of small strongly chloritised biotites, single feldspars, pyrite crystals and not determined dark minerals. The described rocks correspond lithologically to shales of the upper zone of the Middle Cambrian defined by J. Samsonowicz (1920) as alum shales, and described in detail by S. Orłowski (1964).

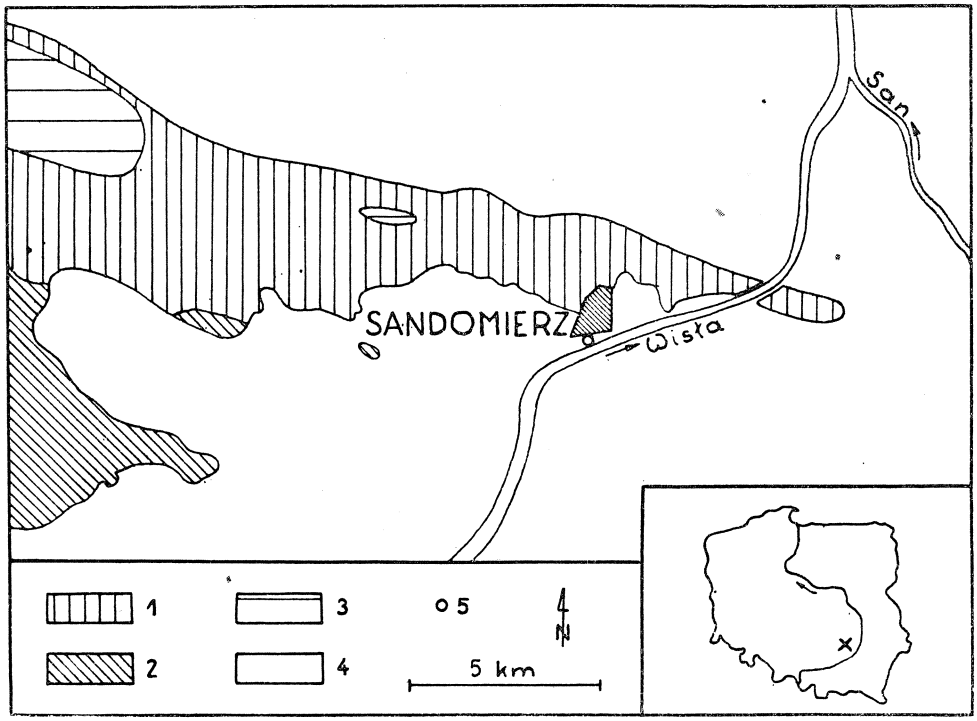

Fig. 1. Geologic situation of the sample with Cambrian microfauna. 1 — Middle Cambrian; 2 — Lower Cambrian; 3 — Ordovician and Silurian; 4 — Miocene; 5 — sampling station (bore-hole)

Sandy material with an admixture of muscovite remain after washing of the samples of clayey shales and mudstones. Numerous fairly well preserved specimens of Foraminifera were found in some samples. These included complete tests belonging to the genus Thuramminoides, fragmented tests and a small undeterminable fragment of a tubular test.

DESCRIPTION OF SPECIES

Thuramminoides sphaeroidalis Plummer 1945, emend. Conkin, 1961

Fig. 2, 1—6

1945 *Thuramminoides sphaeroidalis* n. sp. Plummer, p. 218, pl. 15, Fig. 4—10 (in: B. Ellis, R. Messina).

1958 *Thuramminoides sphaeroidalis* Plummer; Crespin: p. 40, pl. 3, fig. 9—11, pl. 31, fig. 1, 2.

1959 *Thuramminoides sphaeroidalis* Plummer; Alexandrowicz: p. 874, tab. I, fig. 3—6.

1961 *Thuramminoides sphaeroidalis* Plummer; Conkin: p. 243, pl. 17, fig. 1—10, pl. 18, fig. 1—4, pl. 16, fig. 1—3 (in B. Ellis, R. Messina).

1965 *Thuramminoides sphaeroidalis* Plummer; J. Conkin et B. Conkin: p. 211, pl. I, fig. 1—17.

1968 *Thuramminoides sphaeroidalis* Plummer; J. Conkin, B. Conkin et W. Canis: p. 168, pl. 1, fig. 16, 17.

Material: more than 100 complete well preserved specimens.

Dimensions: (mm)

		specimen					
		1	2	3	4	5	6
diameter		0.50	0.56	0.41	0.42	0.49	0.42
thickness		0.12	0.13	0.08	0.12	0.10	0.16
flattening	$\frac{\text{thickness}}{\text{diameter}}$	0.24	0.23	0.19	0.29	0.20	0.38

Description: Test with round or oval outline, disc-shaped, flat. Margin gently rounded, side walls flat, smooth or provided with small irregular depressions and protuberances. Surface of test rough; small poorly visible tubercles are present on some specimens. In transmitted light a large central chamber is distinctly visible. In especially well preserved specimens polished and dyed with methyl blue traces of labyrinthic structure can be observed (Fig. 2—4 c_1). In a number of specimens the side wall of the test is slightly depressed, and a regular inflated ring is present on the periphery (flat disc form), while in others the centre of the test is slightly convex and the surface of walls is distinctly uneven (convex disc form). The flattening of the tests and the depression of their walls are secondary features, caused by deformation of originally spherical or nearly spherical tests.

The wall of the test is arenaceous, built of very fine quartz grains, 5—15 microns in diameter, embedded in an abundant siliceous cement. It is either white, feebly translucent, or yellowish-grey, distinctly translucent. The aperture is usually fairly well visible, especially in transmitted light in specimens dyed with methyl blue. It is most often situated near the periphery of the test, more rarely near its centre. The surface of the test is flat around the aperture, and only in a few specimens it is inflated, so that the aperture may be situated at the apex of a small tubercle. In a few cases specimens with two or three apertures were observed; numerous forms in which the aperture was not visible were also noted.

Remarks: The individual variation of the described foraminifers consists in differences in dimensions of the test, and in colour and translucence of the tests which may be related to some degree with the thickness of walls. Although the thickness and the degree of flattening expressed as the thickness: diameter ratio are subject to variation. Statistical data calculated on the basis of measurements carried out on 100 specimens are presented in Table 1.

The above data permit to determine the range of variation of the

Table 1

Results of measurements of tests of *Thuramminoides sphaeroidalis* Plummer

	mean $\bar{x}$	standard deviation s_d
diameter of test	0.380 mm	0.103 mm
thickness of test	0.078 mm	0.029 mm
flattening of test	0.22	0.05

Table 2

DIFFERENTIATION OF SIZE AND STATISTICAL INDICES OF TESTS OF THURAMMINOIDES SPHAEROIDALIS PLUMMER

	Specimens with white tests	Specimens with yellowish-grey tests
DIAMETER OF TEST		
mean - $\bar{x}$	0.430 mm	0.327 mm
maximum - x_{max}	0.780 mm	0.580 mm
standard deviation	0.100 mm	0.080 mm
THICKNESS OF TEST		
mean - $\bar{x}$	0.107 mm	0.060 mm
maximum - x_{max}	0.140 mm	0.105 mm
standard deviation	0.021 mm	0.026 mm
CORRELATION COEFFICIENT		
diameter-thickness of test	0.54	0.47

measured parameters as $\bar{x} \pm 2s_d$. In the discussed set of measurements including both non-translucent and translucent forms, the diameter ranges from 0.174 to 0.586 mm, the thickness ranges from 0.020 to 0.134 mm, and the flattening ranges from 0.12 to 0.32. Single specimens display values lying outside the above ranges. This concerns especially the thickness of test and the flattening (e.g. specimen 6: Fig. 2—6). The relation between the diameter and thickness of test is distinct and significant, and the correlation coefficient calculated for these two parameters has the value of 0.65 (Fig. 3a). Assuming that the original shape of tests was spherical or nearly spherical (H.J. Plummer 1945, J. Conkin 1961 in: B. Ellis and R. Messina), the above relation shows the degree of deformation of the specimens, resulting from the diagenesis and compaction of the enclosing sediment. The high value of the correlation coefficient and the regression lines (Fig. 3 A) indicate, that the tests with larger diameter which are thicker and less flattened, were less deformed than the tests with smaller diameter.

In the described material the specimens with white, non-translucent tests are generally larger than the specimens with yellowish-gray, translucent tests. The statistical description of these differences in size is presented in Table 2.

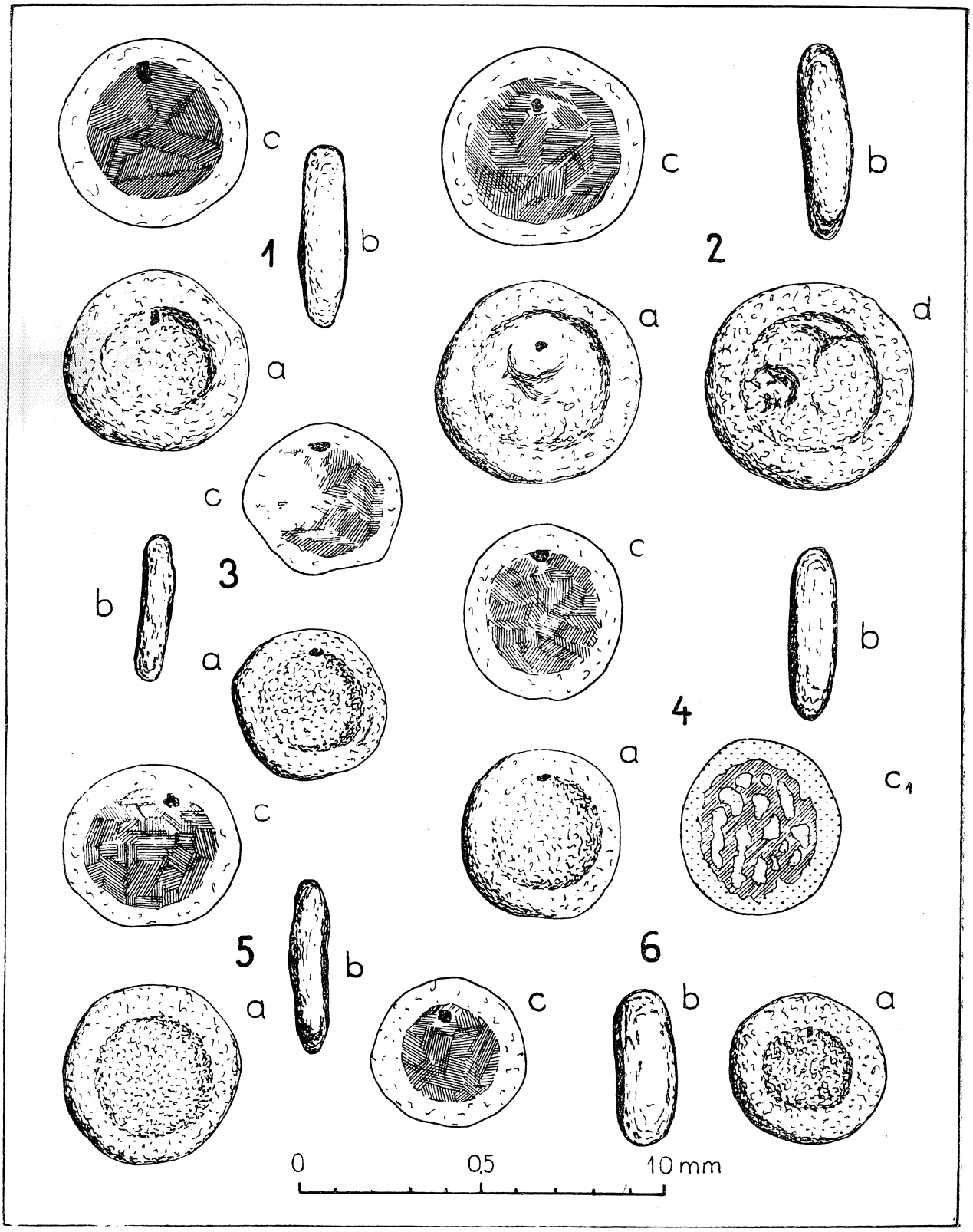

Fig. 2. *Thuramminoides sphaeroidalis* Plummer from Middle Cambrian shales of the vicinity of Sandomierz. 1—6 a — apertural side view of test; 1—6 b — side view of test (view of the flat surface produced by secondary deformation); 1—6 c — view in transmitted light in oil immersion; 4 c_1 — polished test, labyrinthic structure visible; 2 d — opposite side view of test

This differentiation of tests of the described Foraminifera is also shown by the regression lines calculated separately for the specimens with white test (Fig. 3 A — R_N) and for those with yellowish-grey test (Fig. 3 A — Rp). Histograms of test diameter and thickness drawn for

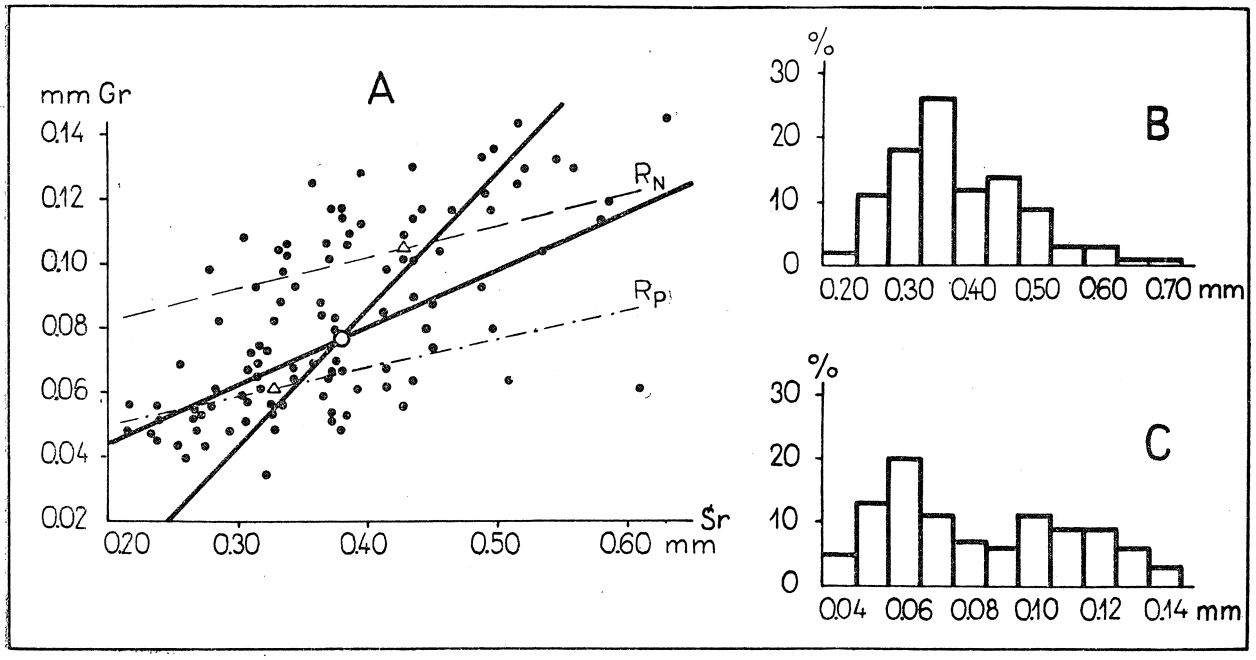

Fig. 3. Results of measurements of 100 specimens of *Thuramminoides sphaeroidalis* Plummer. A — plot of thickness and diameter of test and regression lines (R_N — regression line and mean thickness and diameter of white, non-translucent tests, R_p — regression line and mean thickness and diameter of yellowish-grey translucent tests); B — histogram of test diameter; C — histogram of test thickness

the whole material also confirm the differentiation, as both the diameter and the thickness values show a bimodal distribution (Fig. 3 B, C). However the described differentiation does not provide a basis for establishment of two systematic units, as the thickness of tests is a secondary feature reflecting only their post-depositional flattening. Forms with one distinct aperture are most frequent in the material studied. Future research may reveal that this feature has a larger diagnostic value in primitive arenaceous Foraminifera with labyrinthic structure of tests.

Analogies: The described Foraminifera from the Cambrian of the Sandomierz area can be compared with the description of the holotype of the species *Thuramminoides sphaeroidalis* given by H. J. Plummer and supplemented by J. Conkin (in: B. Ellis and R. Messina), and with descriptions of this species of other quoted authors. The greatest similarities with the material described here are shown by the forms described by J. Conkin and B. Conkin from the Upper Ordovician of North America. Also there the specimens are differentiated into two groups one consisting of thin-walled light-grey tests, the other of thick-walled pinkish-white tests. Some specimens described by the above quoted authors are larger than the Cambrian specimens described here: their diameter reaches up to 1.46 mm, usually ranging from 0.32 to 1.38 mm. The ranges of diameter values are varying from locality to locality. Large tests of the discussed species

were also found by I. Crespin (1958) in Permian sediments of Australia. According to the quoted authors besides the shape and size, the labyrinthic structure present also in the specimens from the Cambrian of the Sandomierz area is characteristic feature of the described forms.

Occurrence: *Thuramminoides sphaeroidalis* Plummer is a long-lived form. In geological literature it was described from the Upper Ordovician and Carboniferous of North America, from the Upper Carboniferous of Poland and from the Permian of Australia. The presence of specimens of this species in the Cambrian of the Sandomierz area extends its stratigraphic range over the whole Palaeozoic Era, i.e. on a period of c. 300 million years.

Department of Geology
Academy of Mining and Metallurgy
Kraków

REFERENCES

Alexandrowicz Z. (1959), Otwornice karbońskie z Kozłowej Góry koło Bytomia. Carboniferous foraminifers from Kozłowa Góra near Bytom (Upper Silesia). Summary. *Kwart. geol.* 3, z. 4, Warszawa.

Conkin J., Conkin B. (1965), Ordovician (Richtmondian) Foraminifera from Oklahoma, Missouri. Illinois and Kentucky. *Oklah. Geol. Not.* 25, nr 8, Norman-Oklahoma.

Conkin J., Conkin B., Canis W. (1968), Mississipian Foraminifera of the United States, part 3. *Micropaleontology* 14, nr 2, New York.

Crespin I. (1958), Permian Foraminifera of Australia. *Bur. Min. Res. Geol. Geoph. Bull.* 48, Canberra.

Ellis B., Messina R. (1940—1968), Catalogue of Foraminifera. *Amer. Mus. Nat. Hist.* New York.

Orłowski S. (1964), Kambr środkowy w Górach Świętokrzyskich. The Middle Cambrian in the Holy Cross Mts. — Summary. *Acta geol. pol.* 14, nr 4, Warszawa.

Samsonowicz J. (1920), O stratygrafii kambru i ordowiku we wschodniej części Gór Świętokrzyskich. Sur la stratigraphie du Cambrien et de l'Ordovicien dans la partie orientale des montagnes de Święty Krzyż (Sainte Croix), Pologne Centrale. — Résumé. *Spraw. Pol. Inst. Geol.* 1, z. 1, Warszawa.

STRESZCZENIE

W szarych łupkach, reprezentujących górny poziom środkowego kambru (odpowiedniki łupków ałunowych — J. Samsonowicz, 1920; S. Orłowski, 1964), a pochodzących z płytkiego wiercenia w Sandomierzu (fig. 1) znaleziono liczne otwornice z gatunku *Thuramminoides sphaeroidalis* Plummer. Są to formy o skorupkach okrągłych lub owalnych, spłaszczonych, o zaokrąglonym brzegu i płaskich ściankach bocznych. W prześwietlonych okazach wyraźnie zaznacza się duża ko-

mora, wykazująca w naszlifie ślady labiryntowej struktury (fig. 2). Ścianka skorupki jest aglutynująca, ujście stanowi mały otwór, umieszczony zwykle w pobliżu brzegu skorupki. Wielkość skorupek jest zmienna (fig. 3), średnica ich wynosi średnio 0,38 mm, a grubość 0,08 mm (tabela 1, 2). W opisywanym materiale można wyróżnić formy o skorupkach białych, słabo przeświecających, które są większe i grubsze, oraz formy o skorupkach żółtawoszarych, przeświecających, mniejsze i silniej spłaszczone (fig. 3).

Omawiane otwornice wykazują zgodność z definicją gatunku *Thuramminoides sphaeroidalis* podaną przez H. J. Plummera i uzupełnioną przez J. Conkina (in: B. Ellis and R. Messina), oraz z opisami tego gatunku cytowanymi przez innych autorów. Obecność *Thuramminoides sphaeroidalis* Plummer w osadach środkowego kambru Gór Świętokrzyskich rozszerza zasięg stratygraficzny tego gatunku na całą erę paleozoiczną.

Akademia Górniczo-Hutnicza,
Katedra Geologii Ogólnej