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HANTKENINA (FORAMINIFERIDA) IN THE EOCENE AT BUJAKÓW (POLISH CARPATHIANS)

(Pl. I—II and 11 Figs.)

Otwornice z rodzaju Hantkenina w osadach eocenu Bujakowa w Karpatach

(Pl. I—II i 11 fig.)

Abstract. *Hantkenina mexicana* Cushman, *H. liebusi* Shokhina and *H. dumblei* Weinzierl et Applin were described and the degree of variation of size and shape in *H. liebusi* was presented on the basis of 300 specimens measurements. The question of identity of *H. liebusi* and *H. dumblei* remains open. The studied specimens come from the assemblage of Foraminifera of Middle Eocene marls at Bujaków village (Western Polish Carpathians).

INTRODUCTION

The studied microfossils come from variegated marls of Middle Eocene age at Bujaków village, situated in Carpathians between Bielsko and Kęty, about 8 km SSW from Kęty (see Fig. 1). In this area marly Palaeogene and Upper Cretaceous sediments, belonging to the Sub-Silesian series are exposed in fragmentary outcrops. Geological structure of the area is complicated composed of Silesian and Sub-Silesian tectonic units. Fig. 2 presents the lithostratigraphic section of the Sub-Silesian series from the neighbourhood of Bujaków, compiled by Dr W. A. Nowak (Geological Institute, Kraków). Nowak (1954) first reported the discovery of *Hantkenina* in Polish Carpathians.

The studied assemblage of microfossils consists of planktonic Foraminifera, ca. 95% (mostly *Globigerina, Globorotalia, Globigerapsis, Hastigerina*) and of benthic ones, ca. 5% (mostly calcareous forms). *Hantkenina* comprises ca. 1% of the total assemblage (Fig. 3).

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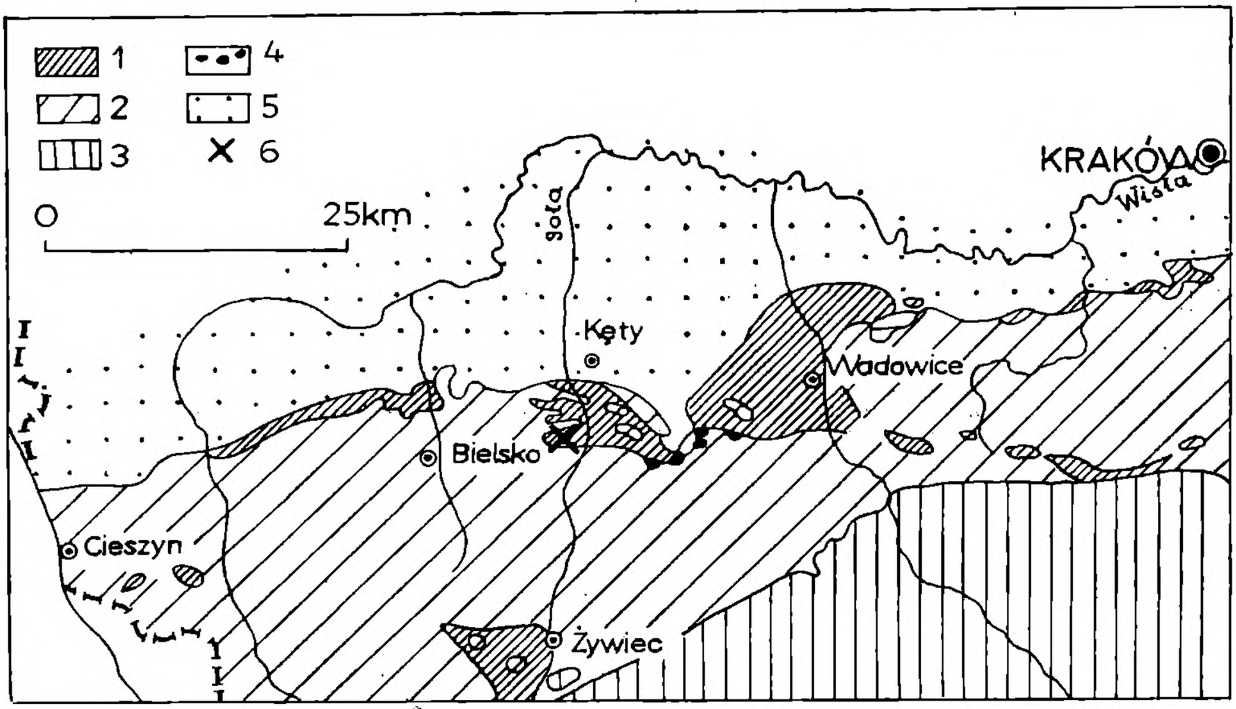

Fig. 1. A fragment of the tectonic map of Western Polish Carpathians (Budowa Geologiczna Polski, IV, Tektonika cz. 3, fig. 40, 1972). 1 — Sub-Silesian nappe; 2 — Silesian nappe; 3 — Magura nappe; 4 — Andrychów klippen; 5 — Miocene; 6 — Bujaków village

Fig. 1. Fragment mapy tektonicznej Polskich Karpat Zachodnich (Budowa Geologiczna Polski IV, Tektonika cz. 3, fig. 40, 1972). 1 — płaszczowina podśląska; 2 — płaszczowina śląska; 3 — płaszczowina magurska; 4 — skałki andrychowskie; 5 — miocen; 6 — Bujaków

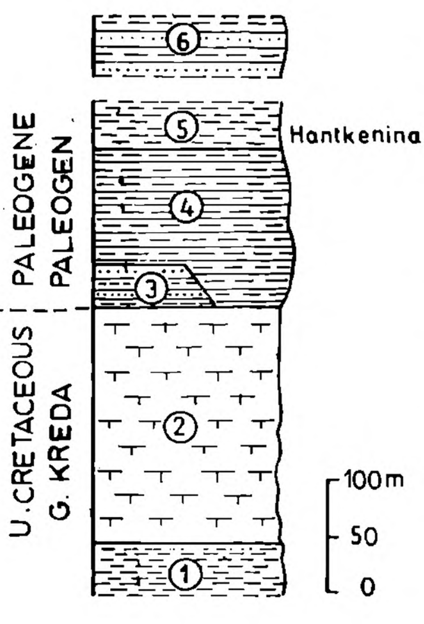

Fig. 2. Position of marls with *Hantkenina* in the sequence of beds in the Sub-Silesian series (after W. A. Nowak, in S. Geroch, 1967, fig. 67). 1 — variegated shales (Turonian-Lower Senonian); 2 — variegated marls (Upper Senonian), 3 — dark shales, sandstones and conglomerates of Istebna Beds (Paleocene); 4 — green-brown shales, marls, glauconitic sandstones, variegated marls (Paleocene-Eocene); 5 — variegated marls, partly marls with *Hantkenina* (Middle and Upper Eocene); 6 — micaceous sandstones and marly shales of Krosno Beds (Oligocene)

Fig. 2. Pozycja margli z *Hantkenina* w profilu jednostki podśląskiej (wg W. A. Nowak, 1958, S. Geroch, 1967, fig. 67). 1 — pstre łupki (turon-senon dolny); 2 — pstre margle (senon górny); 3 — ciemne łupki, piaskowce i zlepieńce — warstwy istebniańskie (paleocen); 4 — zielonobrunatne łupki, margle, piaskowce glaukonitowe, pstre margle (paleocen-eocen); 5 — pstre margle, częściowo margle z *Hantkenina* (eocen środkowy i górny); 6 — piaskowce mikowe i margliste łupki — warstwy krośnieńskie (oligocen)

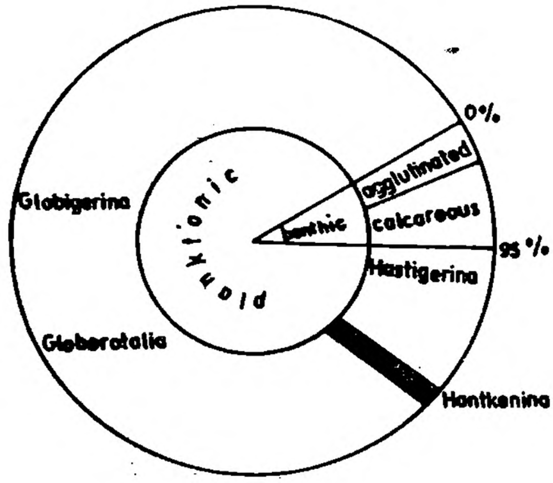

Fig. 3. Foraminiferal assemblage from *Hantkenina* marls at Bujaków (diagram)

Fig. 3. Diagram ilustrujący skład ilościowy otwornic w próbce marglu z Bujakowa

INCOMPLETE LIST OF SPECIES:

Rhabdammina sp.	R [2]
Hyperammina sp.	F
Ammodiscus siliceus (Terquem)	F
Glomospira charoides (Parker et Jones)	R
Reophax pilulifer Brady	R
Cribrostomoides subglobosus Sars	F
Haplophragmoides walteri (Grzybowski)	F
Recurvoides sp.	R
Trochamminoides coronatus Brady	R
Ammobaculites agglutinans (d'Orbigny)	R
Vulvulina eocaena Montagne	R
Textularia agglutinans d'Orbigny	F
Clavulinoides cf. *midwayensis* Cushman	R
Dorothia sp.	R
Nodosaria annulifera Cushman et Bermudez	R
Nodosaria cf. *hochstetteri* Schwager	R
Chrysalogonium tenuicostatum Cushman et Bermudez	F
Lagena crebra Matthes	R
Nuttallides trümpyi (Nuttall)	C
Hastigerina micra Cole	C
Globorotalia broedermanni Cushman et Bermudez	F
Globorotalia densa (Cushman)	A
Globigerina boweri Bolli	A
Globigerina eocaena Gümbel	A
Globigerina yeguaensis Weinzierl et Applin	A
Subbotina linaperta (Finlay)	A
Truncorotaloides topilensis Cushman	F
Globigerapsis kugleri Bolli, Loeblich et Tappan	F
Globigerapsis mexicana (Cushman)	R
Globigerapsis rubriformis (Subbotina)	R
Globigerinita corpulenta (Todd)	F
Hantkenina mexicana Cushman	F
Hantkenina liebusi Shokhina	C

[2] R — rare; F — frequent; C — common; A — abundant.

Hantkenina dumblei Weinzierl et Applin	F
Eponides umbonatus Reuss	C
Cibicides cushmani Nuttall	C
Pleurostomella sp.	R
Aragonia sp.	R
Anomalinoides granosus (Hantken)	F

The occurrence of species: *G. densa, T. topilensis, G. yeguaensis, G. kugleri* defines the above assemblage as a Middle Eocene.

SYSTEMATIC DESCRIPTION [3]

Superfamily: Globigerinacea Carpenter, Parker et Jones, 1862
Family: Hantkeninidae Cushman, 1927
Subfamily: Hantkenininae Cushman, 1927
Genus: *Hantkenina* Cushman, 1925

Hantkenina mexicana Cushman

Fig. 11 (42—46) pl. II fig. 6

Hantkenina mexicana n. sp. Cushman, 1925, p. 3, pl. 2, fig. 2;
Hantkenina mexicana Cushman, 1927. p. 160, fig. 18;
Nuttall, 1930, p. 284, pl. 23, fig. 13, 17; Shokhina, 1937, pp. 432—433, pl. 2, fig. 5—8, p. 433, text-fig. 55; Rey, 1938, pp. 322—323, 328, 331, pl. 22, fig. 4—5, p. 328, text-fig. c; Subbotina, 1953, pp. 131—132, p. 131, text-fig. 6; Ramsay 1962, pp. 81—82, pl. 16, fig. 1; Samanta, 1973, p. 473, pl. 7, fig. 16—17;
Hantkenina liebusi Shokhina, 1937, p. 428, text-fig. 9—10, 16—19, p. 429, fig. 25, p. 431, fig. 36—37.

M a t e r i a l: 50 well preserved specimens
D i m e n s i o n s (according to fig. 4): R=0,50-over 1 mm
G=0,25 mm (average)
H/d = 1,73, H/h = 1,44, H/R = 0,52
D e s c r i p t i o n. Test planispiral, involute, chambers of the last whorl are stellate in arrangement, distinctly separated. (There are the specimens with a visible penultimate whorl.) In the last whorl one can see 5—6 chambers increasing rapidly in size as added. Chambers are triangular in outline and convex in the part near the umbilical depression, and are compressed near the periphery.

Spines are situated in the prolongation of the chamber axis. They are of different length, and either equals the height of a chamber or shorter or very rare longer than chamber. Sutures vary from straigth through more or less curved to sigmoidal. The aperture is an interiomarginal equatorial slit, bordered by a non-porous apertural flange. The surface of the test is perforate (except the apertural flange and spines). Pores are densely and regularly distributed.

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[3] According to Loeblich A. and Tappan H., 1964.

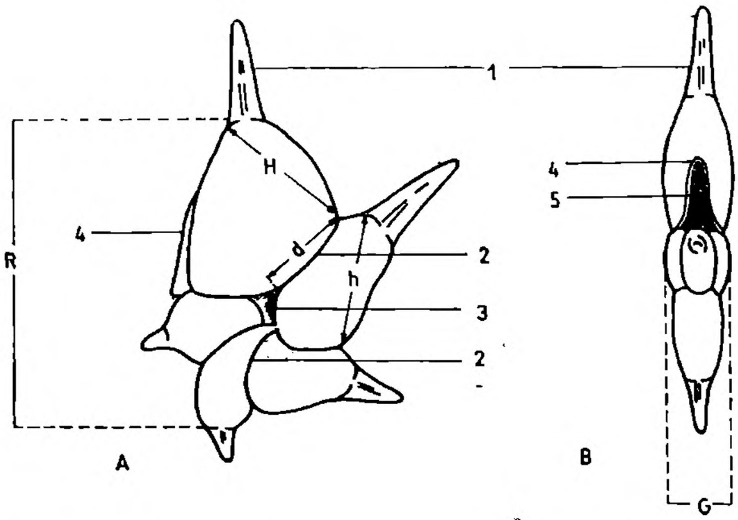


Fig. 4. *Hantkenina liebusi* — sketch. A — side view; B — apertural view; 1 — spine; 2 — sutures; 3 — umbilical depression; 4 — apertural flange; 5 — aperture; R — max. diameter (without spines); H — the height of the last chamber; h — the height of the chamber before the last one; d — breadth (width) of the last chamber; G — thickness of the test

Fig. 4. *Hantkenina liebusi* — rys. schematyczny. A — widok z boku; B — widok od strony ujściowej; 1 — kolec; 2 — szwy 3 — zagłębienie umbonalne; 4 — listewka ujściowa; 5 — ujście; R — większa średnica (bez kolców); H — wysokość ostatniej komory; h — wysokość przedostatniej komory; d — szerokość ostatniej komory; G — grubość skorupki

Remarks. *H. mexicana* differs from *H. liebusi* in the arrangement of chambers and spines and in thickness of test (see the description of *H. liebusi*). The length of spines as a taxonomic feature is not essential, because (as it was mentioned above) is a changeable feature.

Hantkenina liebusi Shokhina

Fig. 9 (1—20), fig. 10 (21—35), fig. 11 (36—38) pl. I, fig. 1—7, pl. II, fig. 1—5

Pullenia kochi (Hantken) Liebus (non *Siderolina kochi* Hantken); Liebus A. 1911, p. 942, pl. 11, fig. 9, 10.

Hantkenina liebusi nov. sp. Shokhina, 1937, pp. 427—432, text-fig. 1—8, 11—15, 20—24, 26—35, 38—49.

Hantkenina liebusi Shokhina; Rey 1938, pp. 326—329, pl. 22, fig. 7—9, pl. 329, text--fig. a, b; Vašiček 1951, p. 121, pl. 4/14, fig. 4; Subbotina 1953, pp. 132—133, pl. 1, p. 133; fig. 11 a—b, Toumarkine et Bolli 1975, p. 175, pl. 1, fig. 6, 7, 14, 15,

Hantkenina cf. *mexicana* Cushman; Shokhina 1937, p. 433, text-fig. 50, 51.

Hantkenina longispina Cushman; Rey 1938, p. 328, p. 328, text-fig. e, pl. 22, fig. 1, 2; Subbotina 1953, p. 137, pl. 1, fig. 8, 9 a—b, 10 a—b.

Hantkenina (Applinella) liebusi Shokhina; Brönnimann 1950, p. 410—411, pl. 56, fig. 1, 2, 18, 19, 23, p. 406, text-fig. 2;

Hantkenina (Aragonella) liebusi Shokhina, Ramsay 1962, p. 83, pl. 16, fig. 6, 7.

Hantkenina aragonensis Nuttall; Premoli Silva et Luterbacher 1966, p. 1192, fig. 5.

Material: about 500 specimens, 300 used for statistic
Dimensions: R = 0,40 — 0,70 mm (adult specimens)
G = 0,20 mm (average)

mean magnitudes:

H/h = 1,29, σ = 0,25, (V = 19,1)
H/h = 1,36, σ = 0,27, (V = 19,6)
H/R = 0,51, σ = 0,07, (V = 12,9)

$$\bar{X} = X_0 + l \left[\frac{\Sigma f_i (X_i - X_0)}{N} \right]$$

$$\sigma = l \sqrt{\frac{\Sigma f_i (X_i - X_0)^2}{N} - \left[\frac{\Sigma f_i (X_i - X_0)}{N} \right]^2}$$

$$V = \frac{\sigma \times 100}{\bar{X}}$$

σ — standard deviation, V — coefficient of variation (according to Perkal 1958, Heller 1968).

Description. Test planispiral, involute or almost involute (the penultimate whorl can be seen more frequently than in *H. mexicana*). The chambers of the last whorl are slightly leaned towards the front of test. The last whorl has generally 5—6 chambers with a great degree of growth. The chambers are very closely connected with each other, thus the outline of the test is less stellate. This feature is changeable, from specimens with distinct interchamber incisions (although not so big as in H. mexicana) to specimens with a complete fusion of the neighbouring chambers, which eliminates the interchamber incisions. The chambers are more depressed than in the previous species, however we can distinguish more convex part half-way of the chambers height and more flat parts: one near the umbilical depression, another on the periphery of the test.

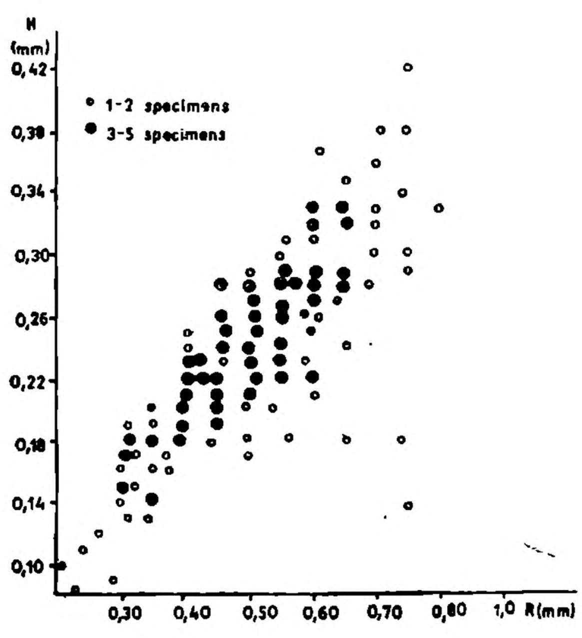


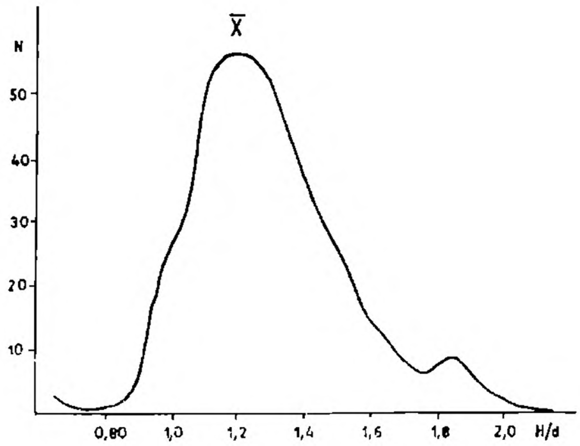
Fig. 5. *H. liebusi* — diagram showing the relation H/R. For symbols see fig. 4

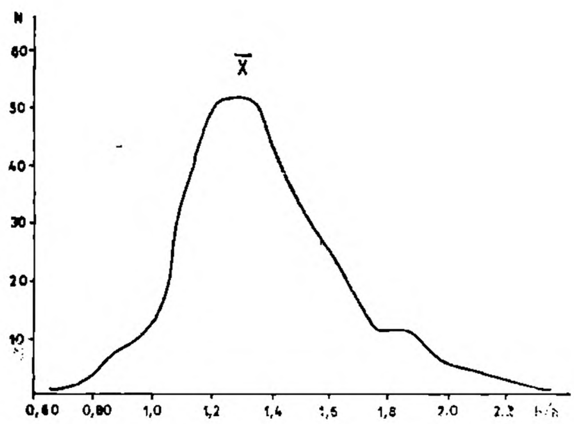
Fig. 5. Diagram ilustrujący stosunek H/R u *H. liebusi*. Objaśnienie patrz fig. 4

Thickness in the middle of a chamber height = 0,23 mm[4]
Thickness of the part close to umbilical depression = 0,21 mm[4]
Thickness of the circumferent part = 0,16 mm[4]

Spines are situated in the prolongation of sutures and are slightly inclined towards the front of the test. They are of different length, non-porous (pl. II, fig. 4) and are hollowed out inside to about half of their length. Sutures are of variable shape, from straight to sigmoidal.

The shape of the aperture and porosity is similar to that of *H. mexicana*.





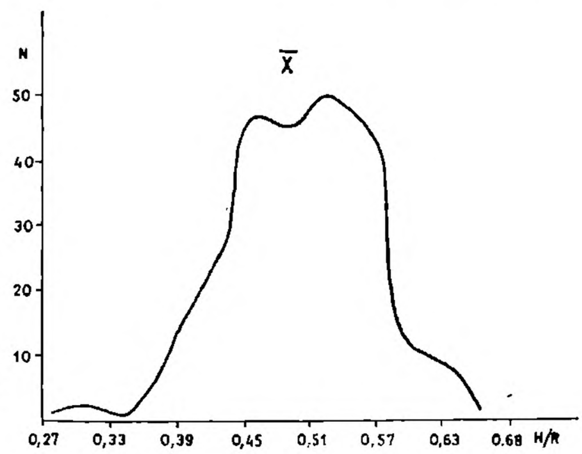


Fig. 6—8. Curves of variability for 300 specimens *H. liebusi* (N — the number of specimens) according to: H/d (fig. 6): H/h (fig. 7): H/R (fig. 8)

Fig. 6—8. Krzywe zmienności dla 300 okazów *H. liebusi* (N — ilość okazów) w zależności od: H/d (fig. 6), H/h (fig. 7), H/R (fig. 8)

R e m a r k s. *H. liebusi Shokhina* is a species of great variability. Already Shokhina mentioned, that some features are very variable (a size of the last chamber, a differentiation of sizes of the last whorl chambers, a shape of sutures). Variability of those features was observed in the investigated material. We must stress, that Shokhina's treatment of *H. liebusi* is too broad. Illustrations in her work rather suggest, that some specimens distinguished as *H. liebusi* nov. sp. belong to *H. mexicana* Cushman (vide synon.). Those features as: chambers slightly inclined towards the front of the test, the spines situated at the anterior

[4] mean magnitudes.

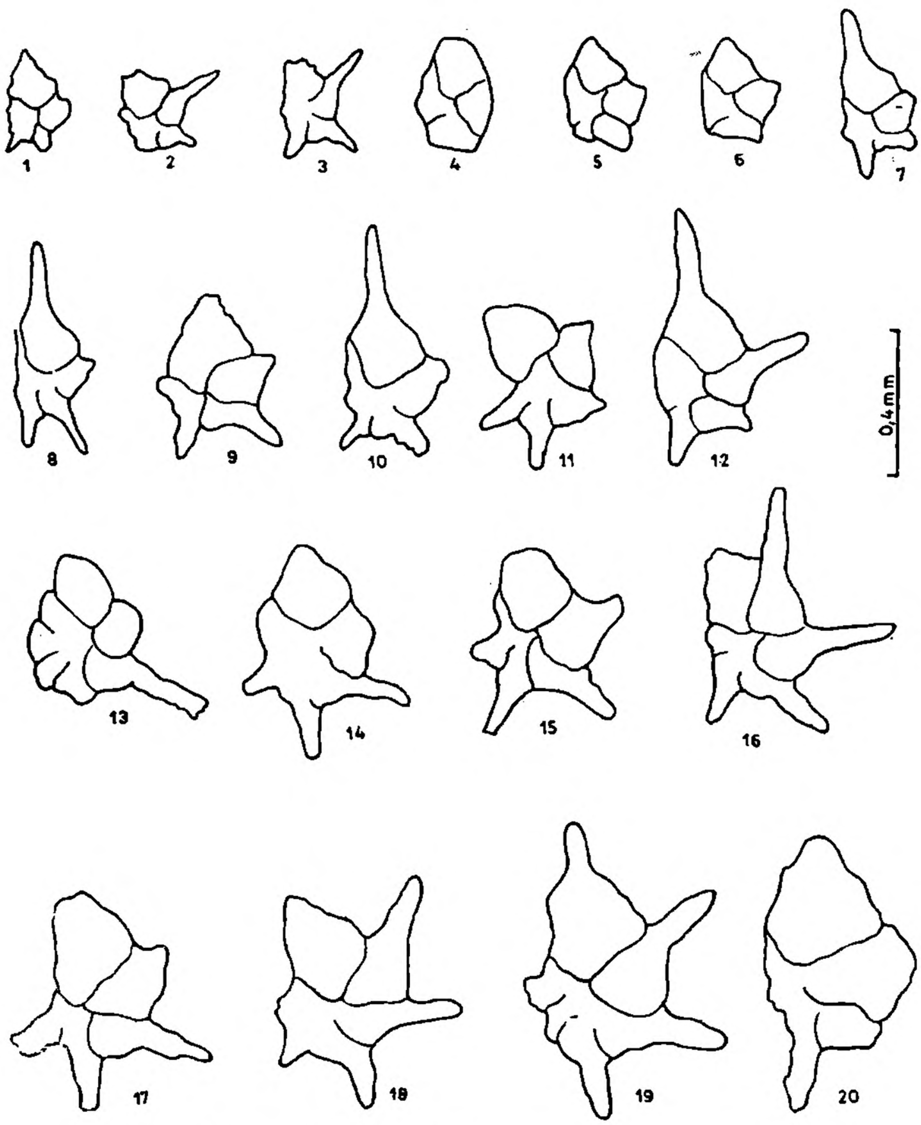


Fig. 9. *Hantkenina liebusi* Shokhina (1—20)

angle of the chambers, periphery slightly lobate, little thickness of the test, do not show a great variation, and were used in this paper as diagnostic feature for *H. liebusi.* Analysis of variation by statistical method is used basing on measurements of 300 specimens according to fig. 4 and mathematical and graphic interpretations (fig. 5—8). Of course, some features (given in the description) could not be measured, because of the technical reasons, e. g. chambers tangentially arranged. The greatest difficulty in measurements was caused by the poor state of preservation of specimens. A number of specimens had broken chambers and spines, and it was also difficult to asses certain points of measurements (e. g. a point when a chamber ends and spine begins).

Hantkenina dumblei Weinzierl et Applin

Fig. 11 (39—41) pl. I, fig. 8

Hantkenina dumblei n. sp. Weinzierl et Applin, 1929, p. 402, pl. 43, fig. 5 a—b; *Hantkenina dumblei* Weinzierl et Applin; Rey 1938, p. 329, text-fig. c, d, pl. 22, fig. 10, 11; Postuma 1971, pp. 222—223; Toumarkine et Bolli 1975, p. 175, pl. 1, fig. 4, 5. *Hantkenina (Applinella) dumblei* Weinzierl et Applin, Brönnimann 1950, pp. 408—410, pl. 55, fig. 17—18, 22—24, pl. 56, fig. 5.

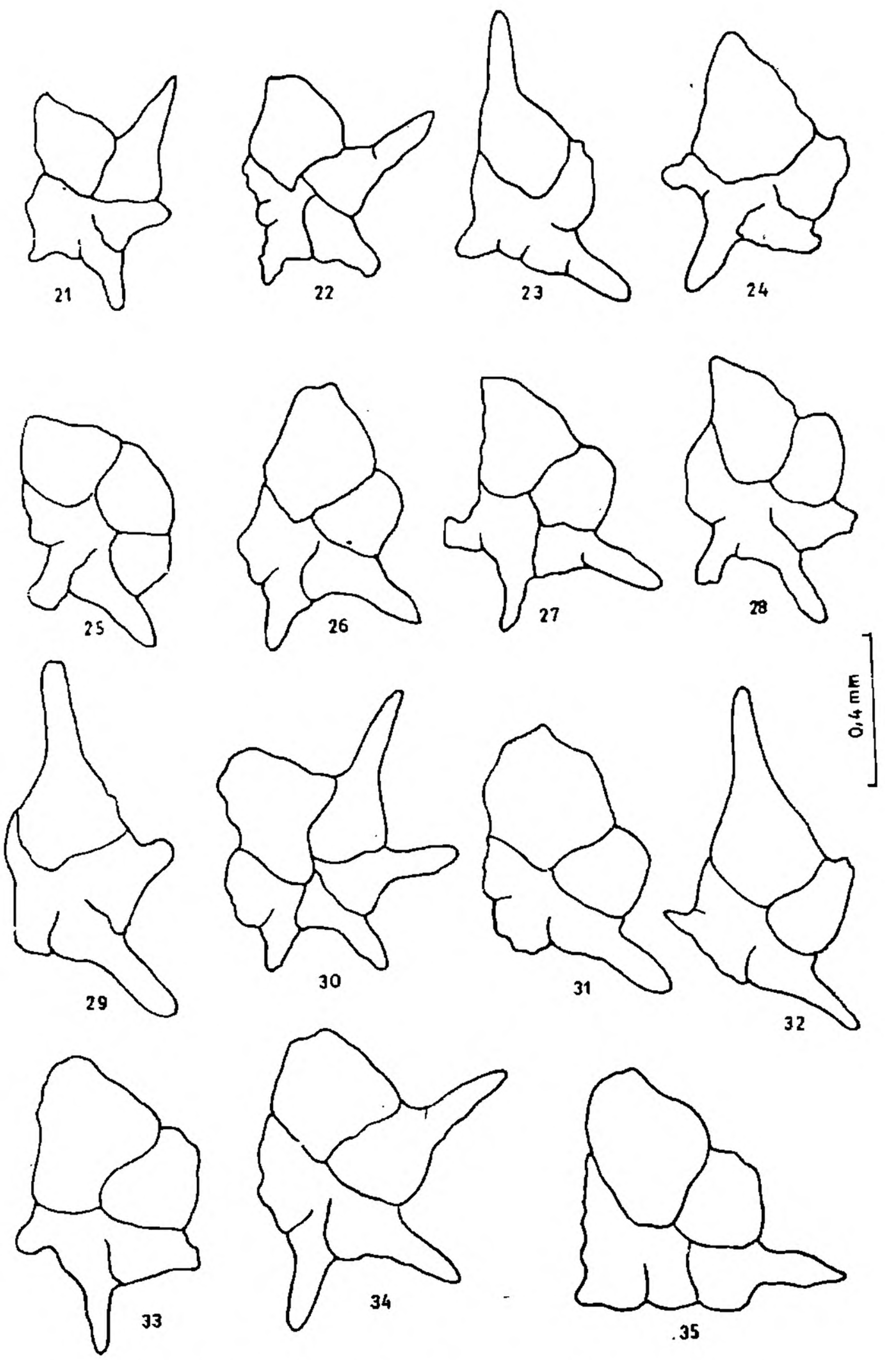


Fig. 10. *Hantkenina liebusi* Shokhina (21—35)

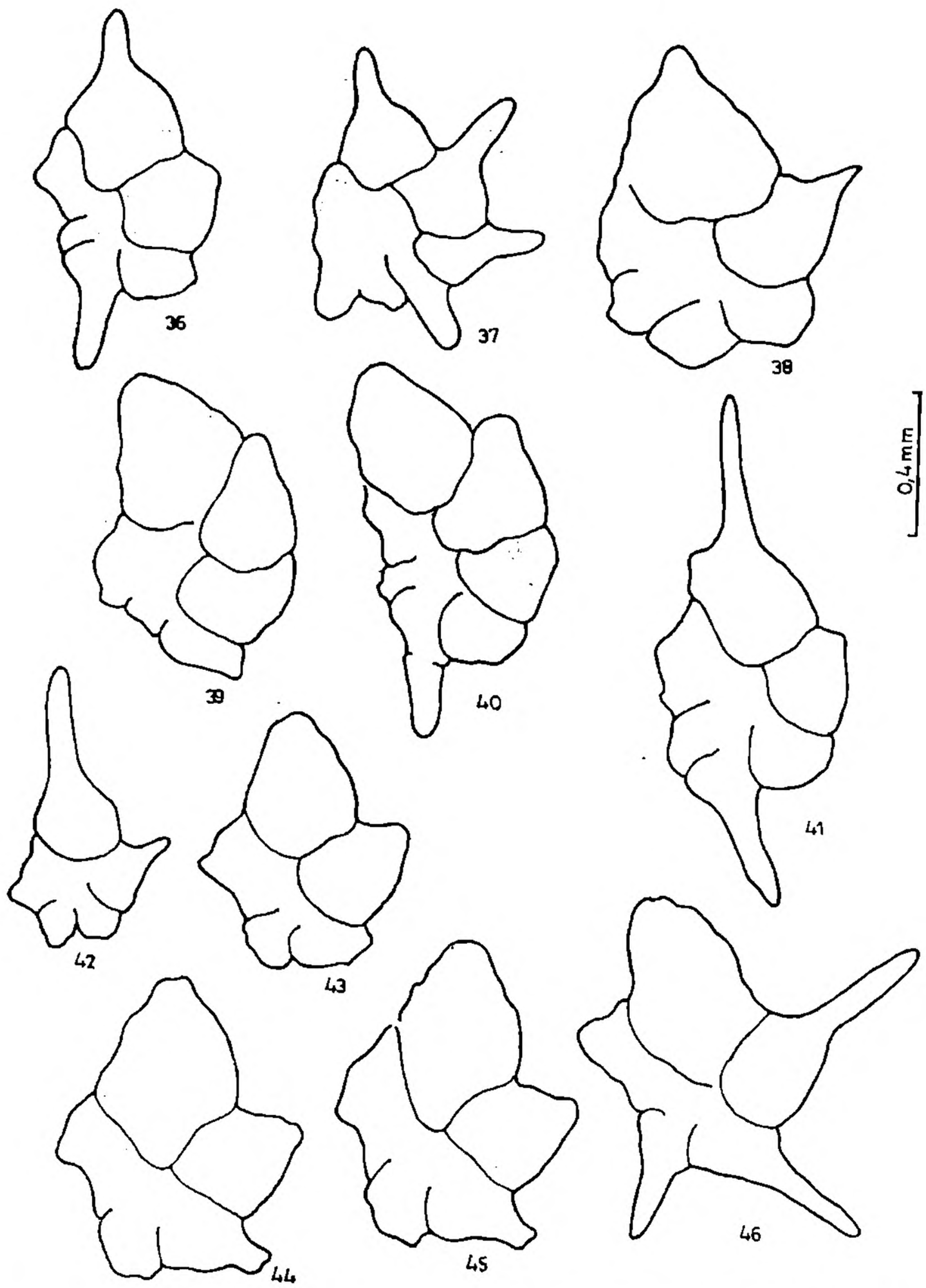


Fig. 11. *Hantkenina liebusi Shokhina* (36—38); *Hantkenina dumblei* Weinzierl et Applin (39—41); *Hantkenina mexicana* Cushman (42—46)

M a t e r i a l: about 50 specimens
D i m e n s i o n s: R = 0,60 — 0,90 mm (adult specimens)
G = 0,20 mm (average)
mean magnitudes: H/d = 1,30, H/h = 1,37, H/R = 0,51

D e s c r i p i o n. Test planispiral, involute, also (as in *H. leibusi*) the penultimate whorl can be seen more frequently than in *H. mexicana*. All other features are similar as in *H. liebusi*, but the longitudinal axes of chambers are distinctly more tangential than in *H. liebusi*. (Remarks in discussion).

DISCUSSION

Apart from the problem of variability another arises from identification of species. In American and West European literature we rarely find the description of *H. liebusi* Shokhina. In publications concerning the Middle Eocene microfauna reference has been made to the species *H. dumblei* Weinzierl et Applin described from North America (Coastal Domes, Texas). Shokhina mentions *H. dumblei*, but her description is based on the literature only. She does not mention any finding of the species in question in samples of Eocene sediments from Caucasus. The descriptions of *H. liebusi* and *H. dumblei* are so similar, that it is difficult to asses the real differences between these species. However, we may infer from the literature, that *H. dumblei* has spines and chambers more inclined in the direction of coiling. Both species are typical for the Middle Eocene this causes further difficulty in identifying the Bujaków specimens as *H. liebusi* or *H. dumblei*. While describing the holotype, Shokhina distinguishes it from *H. dumblei* by the way of coiling of test. According to Shokhina, the last chamber of *H. liebusi* partly covers the first chamber of the last whorl, while in case of *H. dumblei* the first chamber of the last whorl uncovered and is oriented at right angle to the last chamber. Recently, Samanta (1973) describing *H. dumblei* has suggested, that the specimen used for the description of the holotype by Weinzierl et Applin was damaged (the last chamber broken). Rey (1938) expressed the opinion, that *H. liebusi* and *H. dumblei* can be distinguished through a comparison of size relation of the final chamber to the preceding one. But already Shokhina emphasise that the size relation, mentioned above, is particularly variable in *H. liebusi*. In specimens from Bujaków this size relation also showed a great variability.

The picture of the holotype and illustrations in papers referring to *H. dumblei* do not show such feature. E. g. Vašiček (1971) indicates, that *H. dumblei* is bigger than *H. liebusi* but the growth of the successive chambers is gradual. According to Rey (1938) the difference between *H. liebusi* and *H. dumblei* can be seen while comparing the shapes of sutures of both species. In Rey's opinion the sutures of *H. liebusi* are sigmoidal and of *H. dumblei* are rectilinear. Shokhina (1937) asseses that the shape of sutures of *H. liebusi* is very variable. *H. liebusi* from Bujaków have both sigmoidal and rectilinear sutures.

According to Brönnimann (1951) in the case of *H. liebusi*, the spines are situated in the prolongation of the sutures. Majzon's opinion (1960) on this question is similar.

Jenkins (1960) in his description of *H. australis* Finlay from New Zealand compares it to *H. liebusi* and *H. dumblei*. From his comparison it is evident, that *H. dumblei* has spines inclined towards the front of the test, while *H. liebusi* has spines only slightly bent in this direction. Jenkins sees here an important difference between those two species, but in most instances specimens have the spines broken and this inclination of spines is difficult to observe. It seems that the inclination of spines is strongly correlated with the inclination of chambers towards the front of the test, this is regarded as typical for *H. dumblei* (Postuma, 1971). Tangential arrangement of chambers is used in this paper as a diagnostic feature for separating *H. liebusi* from *H. dumblei.*

Many authors deal with *Hantkenina* but their descriptions do not provide sufficient information, which could be used as the ground for distinguishing *H. liebusi* from *H. dumblei* (Brönnimann, 1950, Crespin, 1958, Ramsay, 1962, Dieni, Proto-Decima, 1964, Bratu, 1969, Martinez, 1969, Samanta, 1973).

Very interesting is Berggren's opinion (1966), who identifies *H. liebusi* with *H. dumblei* (as synonyms).

Acknowledgements

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REFERENCES — WYKAZ LITERATURY

Bé A. W. H., Tolderlund D. S. (1971), Distribution and ecology of living planktonic Foraminifera in surface waters of the Atlantic and Indian Oceans. The Micropaleontology of Oceans. *Proc. of the Symp. Held in Cambridge.* Ed. Funnel and Riedel. Cambridge Univ. Press. pp. 105—151.

Berggren W. A. (1957), Some Planktonic Forminifera from the Lower Eocene (Ypresian) of Denmark and Northwestern Germany. Stockh. Contr. in Geol. 5, pp. 42—102.

Berggren W. A. (1966), Problemy taksonomii i filogeneticzeskich otnoszenij niekotorych trieticznych płanktonnych foraminifer. *Wopr. mikropal.* wyp. 10, pp. 309—332.

Bratu E. (1969), Distribution des Foraminifères planctoniques dans le Flysch Interne Paléocène Eocène à la Courbure des Carpates Orientales (Roumanie). *Proc. First. Intern. Conf. plankt. Microfossils.* Ed. Brönnimann and Renz, 1, pp. 15—20.

Brönnimann P. (1950), The genus Hantkenina Cushman in Trinidad and Barbados. B. W. I. *J. Paleont.* 24, 4, pp. 397—420.

Brönnimann P. (1951), Weitere Beobachtungen an Hantkeninen. (Mit 3 Tekstfiguren). *Ecl. Geol. Helv.* 2, 7950, pp. 245—250.

Cita M. B. (1950), L'Eocene della sponda occidentale del Lago di Garda. *Riv. Ital. Pal. e Stratigr.* 56, 1, pp. 81—115.

Crespin I. (1958), The occurrence of Hantkenina in Western Australia. *Micropaleontology* 4, 3, pp. 317—319.

Cushman J. A. (1925), A new genus of Eocene Foraminifera. *Proc. U. S. Nat. Mus.* 66, 30, p. 1—3.

Cushman J. A. (1950), Foraminifera, their classification and economic use. Oxford Univ. Press. pp. 327—328, 474.

Dieni I., Proto Decima F. (1964), Cribrohantkenina ed altri Hantkeninidae Nelléocene Superiore di Kastelnuovo (colli Euganei) *Riv. Ital. Pal.* 70, 3, pp. 552—592, pls. 43—46.

Geroch S. (1967), A some assemblages of microfauna from the Silesian Series of the Western Polish Carpathians. *Inst. Geol. Biul.* 211. (Z badań mikropal.), 5, pp. 370—383.

Hantken von M. (1875), Die Fauna der Clavulina száboi Schichten. Mitt. Jahrb. Ungar. Geol. Anstalt. 4, 1, pp. 1—93, (p. 79, pl. 16, fig. 1).

Heller R. (1968), Manuel de statistique biologique. Ed. Gauthier Villars, Paris.

Jenkins D. G. (1960), The genus Hantkenina in New Zealand. *J. Paleont.* 4, 3, pp. 312—316, pl. 21.

Loeblich A. R., Tappan H. (1964), Treatise on Invertebrate Paleontology, Protista, Sarcodina Chiefly „Thecamoebians" and Foraminifera. Part. C. pp. 663—666, fig. 532.

Majzon L. (1960), The Hantkenininae of Hungary. Földtani Közlöny, 90, 4, pp. 428—441, pls. 22—24.

Martinez R. (1968), The genus *Hantkenina* Cushman in Chile. *Proc. First Inter. Conf. Plankt. Microfossils*, 2, pp. 399—404.

Ellis B., Messina A. (1940), Catalogue of Foraminifera. Spec. Publ. Amer. Mus. Nat. Hist. 26.

Nowak W. (1954), O stratygraficznym znaczeniu rodzaju *Hantkenina. Prz. geol.* R. 2, 9, pp. 377—380.

Nuttall W. L. F. (1930), Eocene Foraminifera from Mexico. *J. Paleont.* 4, 3, pp. 271—273.

Phleger F. (1965), Ecology and Distribution of Recent Foraminifera. The Johns Hopkins Press. Baltimore.

Perkal J. (1958), Matematyka dla rolników. P. 1, Warszawa.

Postuma J. A. (1971), Manual of Planktonic Foraminifera. Elsev. Publ. Co. pp. 222—227.

Ramsay W. R. (1962), Hantkenininae in the Tertiary Rocks of Tanganyika. Contr. Cush. Found. Foram. Res. 13, 3, pp. 79—89, pl. 16.

Rey M. (1938), Distribution stratigrafique des Hantkenina dans le Nummulitique du Rharb (Maroc). *Bull. Soc. Geol. France.* ser. 5, 8, pp. 321—340.

Samanta B. K. (1973), Planktonic Foraminifera from the Paleocene-Eocene Succession in the Rakhi Nala, Sulaiman, Pakistan, *Bull. British Mus. (Nat. Hist.)*, 22, 6, pp. 471—473, pl. 7.

Shokhina V. A. (1937), The Genus *Hantkenina* and its stratigraphical distribution in the North Caucasus. *Probl. Pal.* 2—3, Publ. Lab. Pal. Moscow Univ. pp. 425—452, pls. 1—2.

Silva Premoli I., Luterbacher H. P. (1966), The Cretaceous-Tertiary boundary in the Southern Alps (Italy). *Riv. Ital. Pal.* 72, 4, p. 1192, fig. 5.

Subbotina N. N. (1953), Izkopajemyje Foraminifery SSSR. Globigerinidy Hantkeninidy i Globorotalidy. *Trudy WNIGRI*. Nov. ser. 76, pp. 127—135, pl. 1.

Toumarkine M., Bolli H. M. (1975), Foraminiferes Planctoniques de l'Eocene Moyen et Superieur de a Coupe de Possagno. *Schweitz. Pal. Abh.* vol. 97, pp. 69—83, 175, pl. 1.

Vašiček M. (1951), Representatives of the Genus *Hantkenina* in the Paleogene of Moravia. *Sborn. Geol. Survey Czechoslov.* 18, pp. 101—129, pl. 4 (14).

Weinzierl L., Applin E. R. (1929), The Claiborne Formation on the Coastal Domes. *J. Paleont.* 3, 4, p. 402, pl. 43, fig. 5 a, b (in Cataloq. Foram., 1940).

STRESZCZENIE

Z pstrych margli wieku eoceńskiego z miejscowości Bujaków (fig. 1,2) opisano otwornice z rodzaju Hantkenina. Wyróżniono trzy gatunki: *H. mexicana* Cushman, *H. liebusi* Shokhina i *H. dumblei* Weinzierl et Applin. W opisie gatunków starano się przedstawić te cechy, które nie wykazują dużej zmienności.

Do cech charakterystycznych dla *H. liebusi* (odróżniających ten gatunek od *H. mexicana*) należą: mniejsza płatowatość skorupki, tzn. mniejsze wcięcia międzykomorowe; usytuowanie kolca w położeniu blisko przedniego szwu każdej komory, nachylenie komór ostatniego zwoju w kierunku zwinięcia skorupki, mniejsza grubość skorupki (vide opis *H. liebusi*).

W opisie *H. liebusi* przedstawiono zakres zmienności wewnątrzgatunkowej na podstawie analizy statystycznej 300 okazów w oparciu o pomiary wykonane według fig. 4. (fig. 5—8). W części dyskusyjnej przedstawiono poglądy według różnych autorów na temat identyczności lub odrębności gatunków: *H. liebusi* i *H. dumblei*, nawiązując do analizy materiału z Bujakowa. W pracy wyróżniono *H. dumblei* na podstawie większego nachylenia komór ostatniego zwoju w kierunku zwinięcia skorupki, chociaż szereg cech tego gatunku mieści się w zmienności *H. liebusi*.

Do opisów gatunków starano się włączyć elementy ultrastruktury skorupki (pl. II). Dołączono diagram (fig. 3) i listę gatunków otwornic oznaczonych z pelagicznej mikrofauny środkowego eocenu margli z Bujakowa.

EXPLANATION OF PLATES = OBJAŚNIENIA PLANSZ

Plate — Plansza I

Fig. 1—7. *Hantkenina liebusi* Shokhina (fig. 5, 6 — the apertural sight):
Fig. 1—7. *Hantkenina liebusi* Shokhina (fig. 5, 6 — widok od strony ujściowej):
Fig. 8. *Hantkenina dumblei* Weinzierl et Applin

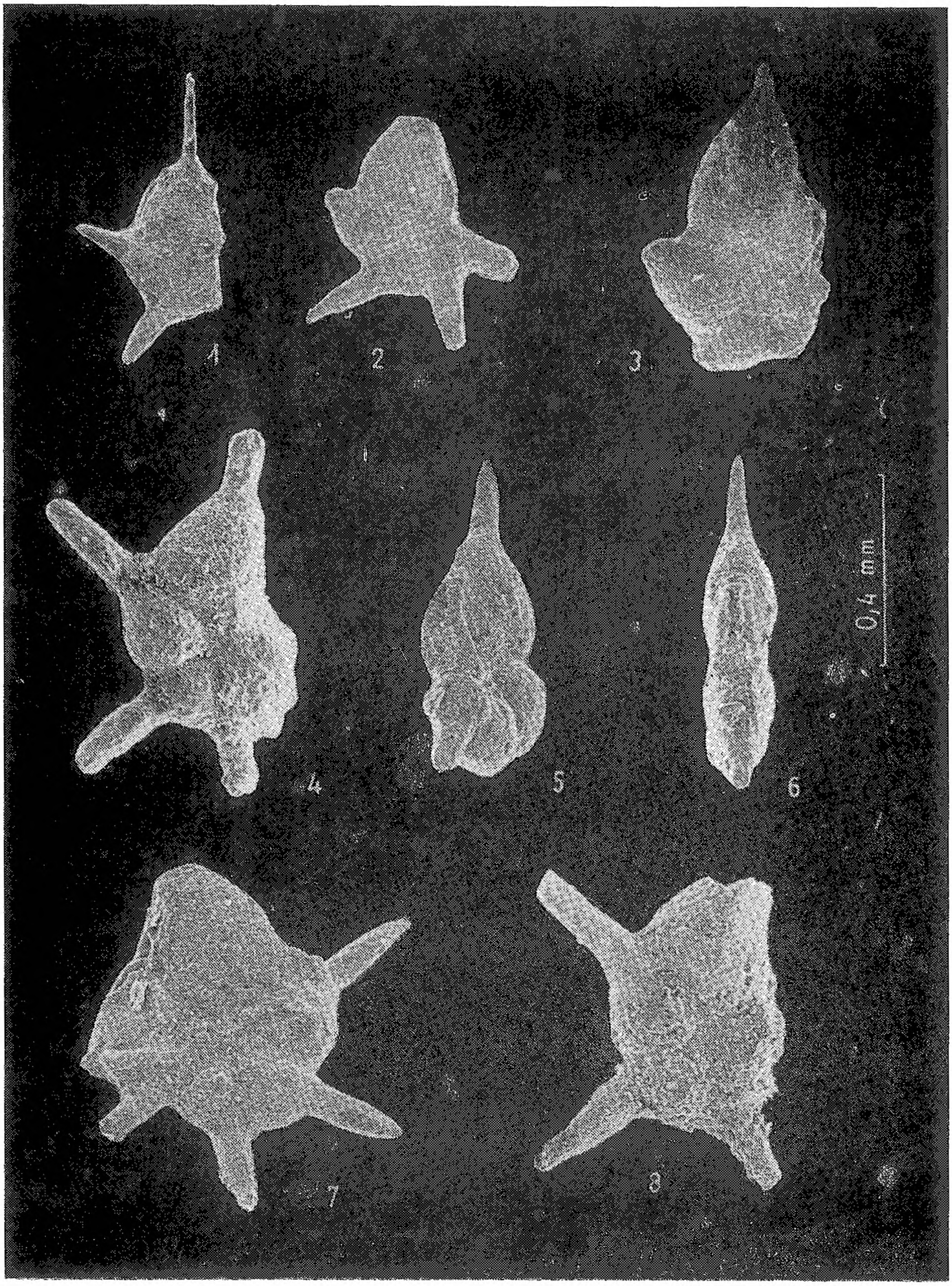
Plate — Plansza II

Fig. 1—5. *Hantkenina liebusi* Shokhina (fig. 2 — the structure of the test's surface, pores are exposed, fig. 3, 5 — aperture — arrows point to the apertural flange, fig. 4 — a fragment of the chamber with spine)

Fig. 1—5. *Hantkenina liebusi* Shokhina (fig. 2 — struktura powierzchni skorupki, uwidocznione pory, fig. 3, 5 — ujście — strzałki wskazują listewkę ujściową, fig. 4 — fragment komory z kolcem)

Fig. 6. *Hantkenina mexicana* Cushman

SEM — photomicrographs were made in the Laboratory of Electron Microscopy Zoological Institute of Jagellonian University by using Scanning Electron Microscope JEOL-JSM-35.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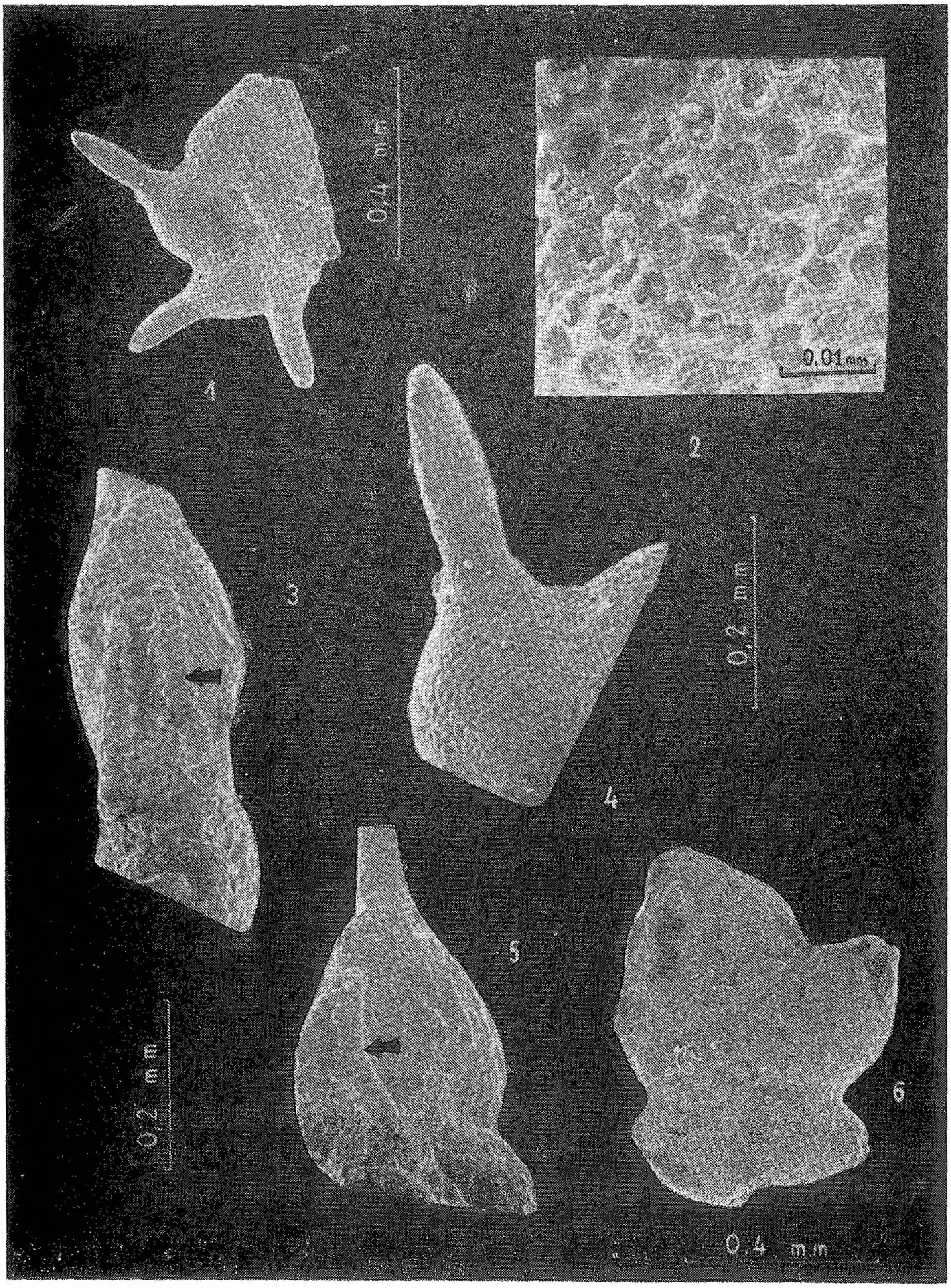
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