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EURYALE FEROX SALISB. IN THE PLEISTOCENE OF POLAND

Euryale ferox Salisb. w polskim plejstocenie

INTRODUCTION

At Stanowice near Rybnik on the southern border of the Silesian Plateau a brick-field is at work, in which thick loam and Pleistocene sands are exploited (Fig. 1). The geological situation and detailed litho-

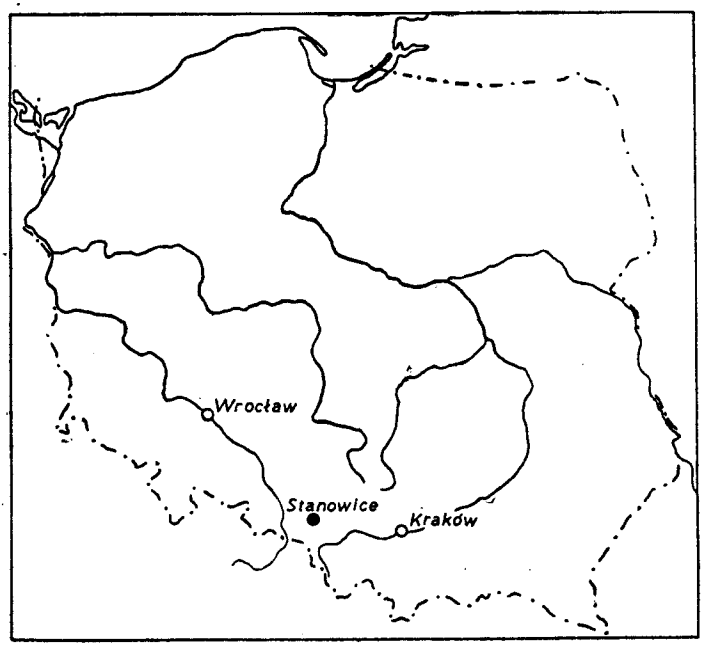

Fig. 1. Sketch map of Stanowice near Rybnik
Ryc. 1. Plan sytuacyjny Stanowic koło Rybnika

logical description of the exploited layers were given by J. Cegła and K. Klimek (1968). The sediment dealt with in the present paper occurs in the bottom of the profile at depth of 7·40 to 8·0 m, in the form of strongly humified, pressed peat, containing numerous and perfectly preserved macroscopic remains of aquatic and swamp plants. Among fruits and seeds of such plants as *Aldrovanda vesiculosa, Caldesia* sp., *Cladium mariscus, Menyanthes trifoliata, Najas flexilis, N. marina, N. minor, Salvinia natans, Trapa natans, Typha* sp., and many others removed from the peat macroscopic remains of *Azolla filiculoides, Dulichium spathaceum, Brasenia* and *Euryale* sp. were also found, these plants being foreign to the contemporaneous flora of Europe.

The results of the still uncompleted pollen analysis from Stanowice seem to indicate that the peat mentioned derives from the fir and hornbeam decline of the Masovian (=Holsteinian) Interglacial.

A full analysis and description of the locality of fossil flora from Stanowice will be presented in a separate publication, while in this work the author only reports on the seeds and numerous spines of *Euryale* sp., found for the first time in the Pleistocene of Poland.

DESCRIPTION OF MACROSCOPIC REMAINS OF *EURYALE* FROM STANOWICE

So far, nine whole *Euryale* seeds, many of their fragments, and numerous spines occurring on the petiole and upper surface of the leaf of this plant have been found.

The dimensions of the whole seeds are listed in Table 1. The seeds have no nodules, their testa is smooth and without lustre. In the upper part of the seed a hollow operculum is visible, which on account of beeing crushed is oval in shape. The hilum set on the raphe has been preserved unchanged; it is elliptically elongated, with a visible trace left by the vascular bundle. Where the hilum is set the raphe is broad and protruding beyond the seed, whereas lower down it narrows and flattens. In some specimens the hilum touches the operculum directly, in others it is separated by a narrow saddle of testa. On two fragments of seeds an embryotheca is visible.

The thickness of testa (Plate I, Phot. 11, 12) ranges from 0·475 to 0·725 mm, 0·640 mm on the average (36 measurements). It consists of three well distinguishable layers. The external one consists of a one-layered epidermis built of long palisade cells. These cells have thickened walls, on which fissured apertures are visible. Their height ranges from 66μ to 98μ, 84μ on the average (36 measurements). The middle part is multilayered, composed of thick-walled, sclerenchymatous, more or less round cells. The internal layer, thinner than the middle one, is also composed of thick-walled cells, but these are more elongated and lie closer together.

The spines of *Euryale* running out from a broad base, are thin and flat, 2·4 to 10·6 mm in length. Their epidermis consists of elongated, narrow cells, among which round or oval ones are found (Plate I, Phot. 13). According to M. Villaret v. Rochow (1957), these cells form a basis for two kinds of hairs: long and not branched and short, glandular.

EURYALE IN THE EUROPEAN PLEISTOCENE AND IN THE NEOGENE OF POLAND

Macroscopic remains of *Euryale* in the European Pleistocene were found for the first time in 1907 by C. A. Weber, who described one seed of this plant from interglacial sediments occurring in the locality Likhvin near Kaluga. He considered that this seed belongs to an extinct species and called it *Euryale europaea* foss. A year later (1908) V. Sukachev found two further seeds, which he identified as *E. ferox*, in the same sediments from Likhvin. In 1957 P. A. Nikitin removed from Likhvin sediments a fragment of *Euryale* seed with preserved embryotheca. In 1959 Ushko found fossil remains of this plant in the same locality (Tralau 1963).

From the Pleistocene of Germany remains of *Euryale* are so far known from three localities. In 1937 K. Gripp and M. Beyle reported six seeds from the locality of Billstedt near Hamburg, classifying them as *E.* cf. *limburgensis* Reid, while in 1957 M. Villaret v. Rochow found in peat from Wunstorf near Hanover five fragments of seeds, which could not be identified with certainty, as well as numerous spines of anatomic structure corresponding to that of *E. ferox*. Finally, several seeds classified as *E. ferox* come from sediments of the Holsteinian Interglacial from the locality Tönisberg near Krefeld (E. K. Kempf, 1966).

The genus *Euryale* has so far been known in Poland only from the Younger Tertiary. W. Szafer (1947, 1954), on the basis of two seeds removed from Pliocene sediments at Krościenko and Mizerna, described a new species, calling it *E. carpatica*, whereas J. Raniecka-Bobrowska (1959) assigned seven seeds from the Miocene of Konin to *E.* cf. *europaea*.

The question is to which of the mentioned *Euryale* species (*ferox, europaea, limburgensis, carpatica)* the specimens from Stanowice ought to be assigned. Remains of *Euryale* so far found in Quaternary sediments mostly come from the Masovian Interglacial. They were assigned to the species *E. ferox* living at the present time, or to the closely related to it fossil species *E. europaea*. Seeds found in Eemian sediments from Billstedt are an exception, classified as *E.* cf. *limburgensis*, a fossil species known from the Tertiary of Holland. This classification arouses some doubts. For, if the stratigraphic position of the sediment is certain and the determination of the species correct, then on the basis of the hitherto existing

findings of *Euryale* in the European Pleistocene up to the present time it migth rather be assumed that remains of this plant did not occur *in situ* in the locality under consideration, but proceed from Tertiary sediments. Consequently, the conclusion reached by H. Tralau (1959) that it was only the Vistulian glaciation which put an end to the occurrence of *Euryale* in Europe does not stand up to criticism.

SYSTEMATIC APPURTENANCE OF *EURYALE* SEEDS FROM STANOWICE

Table 1 lists measurements of seeds proceeding from Stanowice and Likhvin, and of those of the contemporaneous *Euryale ferox* from the locality on the river Ussuri (carpological collection of the Institute of

Table 1
Tablica 1

Measurements of fossil and recent seeds of genus *Euryale*
Pomiary wykonane na kopalnych i współczesnych nasionach rodzaju *Euryale*

Locality Stanowisko	Name of plant Nazwa rośliny	Seed — Nasienie		Operculum — Okienko		Hilum — Znaczek	
		length długość	width szerokość	length długość	width szerokość	length długość	width szerokość
		mm		mm		mm	
Stanowice	*Euryale* sp.	12,8	12,0	2,2	1,4	3,0	1,7
		12,8	11,4	1,5	1,4	2,9	1,6
		12,6	11,4	destroyed zniszczone		3,0	1,7
		12,0	11,2	,,		destroyed zniszczony	
		11,8	10,4	,,		2,4	1,7
		11,6	10,4	2,0	1,2	2,4	1,2
		9,0	8,4	1,7	1,1	2,1	1,3
		7,8	7,0	1,5	1,0	2,2	1,2
		5,4	5,2	1,3	0,4	2,2	1,3
Lichwin	*Euryale ferox* after Sukachev wg Sukaczewa	11,6	10,4	2,1	1,9	destroyed zniszczony	
		12,4	10,2	1,9	1,2	,,	
	Euryale europaea after Weber wg Webera	5,6	4,5	2,14	1,25	2,64	1,24
Ussuri	*Euryale ferox*	13,0	11,8	2,2	2,2	3,0	1,4
		12,2	10,0	1,8	1,8	3,0	1,8

Botany of the Polish Academy of Sciences). As can be seen from these measurements, the width and length of the operculum and hilum are relatively stable features, whereas the length and width of the seed show a considerable variability. Large seeds (12·8 to 11·6 mm in length) form a numerous group in the material from Stanowice. They approximate in size seeds of *Euryale ferox,* fossil seeds from Likhvin, and contemporaneous specimens from the locality on the river Ussuri. Among the smaller seeds in one the dimensions are the same as in *E. europaea* (length 5·4 mm) and two show intermediate values (length 9·0; 7·8 mm). According to W. Szafer (1947), an important feature of great help in the deter mination of *Euryale* species is the thickness of testa and the ratio of the length of epidermal cells to those composing the other layers of testa, measured in cross-section. Such measurements were carried out on sections of testa of a seed from Stanowice (36 measurements) and on a specimen of *E. ferox.* It was found that this ratio for *E. ferox* calculated on the basis of 10 measurements differs slightly from that reported by Szafer and is as follows:

	Euryale ferox	*Euryale* from Stanowice
W. Szafer (1947)	1:1,2	
Author's own measurements	1:4,6	1:6

Considerable individual variability occurs in seeds of the family *Nymphaeaceae.* This was reported by Weber (1907), but did not prevent him from describing a separate species *Euryale europaea* foss., although he had at his disposal only one seed differing from those of *E. ferox* only in size. Both J. Raniecka-Bobrowska (1959) and V. Sukachev (1908) mentioned of the considerable variability of morphological features in *Euryale* seeds. Measurements of the dimensions of specimens from Stanowice corroborate these observations, at the same time indicating the uniformity of other morphological features. Sukachev's (l. c.) opinion that the seed described as *Euryale europaea* was an immature or abnormally developed seed of *E. ferox* seems therefore, to be correct.

Euryale seeds from Stanowice, identical with those of *E. ferox* in regard to morphological features, differ from the latter in the ratio of the layers of the testa above mentioned. This probably results from the fact that the thickness of testa on the seed is not uniform, which was already observed by C. A. Weber (1907) and V. Sukachev (1908). The thickness of testa could possibly be of taxonomic significance if the examined sections came from exactly the same parts of seeds.

It seems most reasonable to assign the seeds from Stanowice to *Euryale ferox.*

CLIMATIC REQUIREMENTS OF *EURYALE FEROX*

Nowadays this plant occupies lakes and old river beds with calm and shallow waters up to 1·3 m deep (Flora of the USSR, 1957). It grows in tropical and subtropical Asia: Hindustan (Kashmir and Bengal), on the islands of Hainan and Taiwan, in Peking, Japan (the Nippon and Kyushu Islands), and in Manchuria (V. Sukachev 1908). Being an annual aquatic plant it withstands the fairly severe climatic conditions, reaching the upper course of the river Ussuri, approximately 46° N. lat., where the mean January temperature is —18°C, that of July +21°C, while the mean annual temperature is +4°C. In Manchuria the following plants grow together with *Euryale ferox* (C. A. Weber 1907):

Salvinia natans
Lemna minor
— *trisulca*
— *polyrrhiza*
Typha latifolia
Potamogeton natans
Najas major
Alisma plantago
Sagittaria sagittifolia
Butomus umbellatus
Glyceria aquatica
Scirpus paluster
— *Tabaernemontani*
— *maritimus*
Eriophorum angustifolium
Iris Maackii
Polygonum amphibium
Nymphaea tetragona
Nuphar pumilum
Ceratophyllum demersum,
and others.

On the basis of this vegetation Weber (l. c.) assumed (correctly as it seems) that in the European Quaternary *Euryale* grew under conditions milder than those prevailing at the present time in its northernmost localities. P. J. Dorofeev (1960) held a slightly different opinion in this matter. According to him, the climate on the Russian plain during the Masovian Interglacial was cool, favourable to the development of the taiga, and only slightly more humid than that of today. A climate of this kind favoured the wide distribution of boreal and Arctic-Alpine species. However (as reported by Dorofeev), this did not exclude the possibility of the existence of refuges in which Tertiary relicts found shelter. According to this author, the Likhvin lake may be an instance of such a refuge.

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REFERENCES

Cegła J., Klimek K. 1968. Osady kopalnych zagłębień bezodpływowych jako wskaźnik degradacji moreny dennej w obszarach starszych zlodowaceń. Przegl. Geograf. 40 : 333—342.

Dorofeev P. J. 1960. Novye dannye o lichvinskoj (Mindel-Risskoj) flore. Biull. Kom. po izučeniju četvertičnogo perioda. 24 : 47—55.
Flora SSSR, 1937 t. VII.
Gripp K. und Beyle M., 1937. Das Interglazial von Billstedt (Öjendorf). Mitt. geol. Staatsinstitut Hamburg 16 : 19—36.
Kempf E. K. 1966. Das Holstein-Interglazial von Tönisberg im Rahmen des niederrheinischen Pleistozäns. Eiszeitalter u. Gegenwart 17 : 5—60.
Nikitin P. A. 1957. Pliocenovye i četvertičnye flory voronežskoj oblasti. Bot. Inst. im. V. L. Komarova AK Nauk SSSR, Moskva—Leningrad.
Raniecka-Bobrowska J. 1959. Trzeciorzędowa flora nasienna z Konina. Inst. Geol. Biul. 130. Z badań trzeciorzędu w Polsce 2 : 159—252.
Sukatscheff W. 1908. Über das Vorkommen der Samen von *Euryale ferox* Salisb. in einer interglazialen Ablagerung in Russland. Ber. d. Deutsch. Bot. Gesell. B26a : 132—137.
Szafer W. 1947. Flora plioceńska z Krościenka n/Dunajcem. Rozpr. Wydz. Mat.-Przyr. PAU 72 : 1—213.
Szafer W. 1954. Plioceńska flora okolic Czorsztyna. Inst. Geol. Prace 11 : 5—238.
Tralau H. 1959. Extinct Plants of Europe. Bot. Not. 112, 4 : 385—406.
Tralau H. 1963. Asiatic Dicotyledonous affinities in the cainozoic Flora of Europe. Kungl. Svensk. Vetenskpsakademiens Handlingar 9 : 7—87.
Ushko K. A. 1959. Lichvinskij (Czekalinskij) razrez mežlednikovych ozernych otloženij. Lednikovyj Period, Moskwa.
Villaret v. Rochow M. 1957. Stacheln von *Euryale* im norddeutschen Pleistozän, ein neues Interglazialfossil. Geob. Inst. Rübel 34 : 136—142.
Weber C. A. 1907. *Euryale europaea* nov. sp. foss. Ber. d. Deutsch. Bot. Gesell. B25 : 150—157.

STRESZCZENIE

EURYALE FEROX SALISB. W POLSKIM PLEJSTOCENIE

W położonych na południowym obrzeżeniu Wyżyny Śląskiej Stanowicach koło Rybnika eksploatowane są w cegielni piaski i gliny plejstoceńskie o miąższości 8 m (ryc. 1). W ich spągu występuje warstwa torfu zawierająca liczne i doskonale zachowane makroskopowe szczątki roślin wodnych i bagiennych, a wśród nich nasiona i kolce *Euryale* sp. Jest to po raz pierwszy stwierdzone występowanie tej rośliny w czwartorzędzie Polski. Wiek torfu został oceniony na podstawie wyników nie ukończonej jeszcze analizy pyłkowej na jodłowo-grabowy schyłek interglacjału mazowieckiego.

Nasiona *Euryale* ze Stanowic porównano pod względem cech morfologicznych i budowy anatomicznej z nasionami kopalnymi *E. europaea* i *E. ferox*, opisanymi przez Webera i Sukaczewa, oraz z współczesnymi nasionami *E. ferox* ze stanowiska nad rzeką Ussuri (tab. 1). Badania wykazały, że nasiona *Euryale* ze Stanowic należą do obecnie żyjącego gatunku *E. ferox*.

Dzisiejsze występowanie *Euryale ferox* ogranicza się do tropikalnej i subtropikalnej strefy południowo-wschodniej Azji. Najdalej na północ wysunięte jej stanowiska sięgają górnego biegu rzeki Ussuri, mniej więcej do 46° półn. szer. geogr.

W plejstocenie Europy szczątki kopalne *Euryale ferox* znane są dotychczas przede wszystkim z interglacjału mazowieckiego (holsztyńskiego). Ich nieliczne stanowiska są rozproszone na obszarze obejmującym północno-zachodnią Europę i Polskę oraz sięgają aż po miejscowość Lichwin na Równinie Rosyjskiej.

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Plate

Tablica

Plate I

1— 9. Fossil seeds of *Euryale ferox*. ×3
10. Operculum and hilum. ×3
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12. Cross section of a recent seed testa of *Euryale ferox*. ×63
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14—15. Spines of the fossil *Euryale ferox* from Stanowice. ×5 and ×10

Tablica I

1— 9. Nasiona kopalne *Euryale ferox*. ×3
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Phot. *L. Łuczko* and *A. Pachoński*
Fot. *L. Łuczko* i *A. Pachoński*

Plate I
Tablica I


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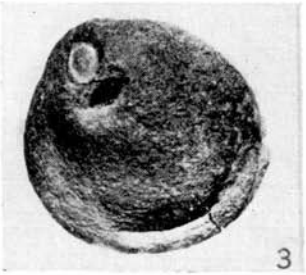
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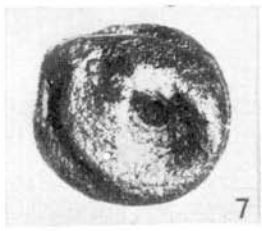
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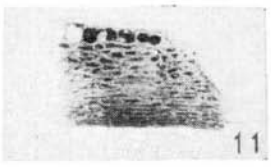
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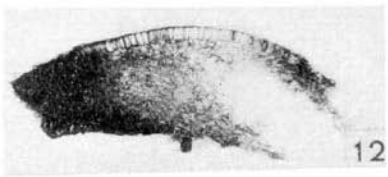
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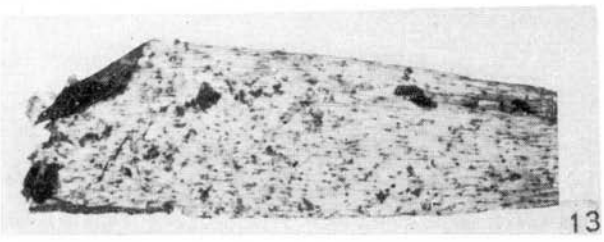
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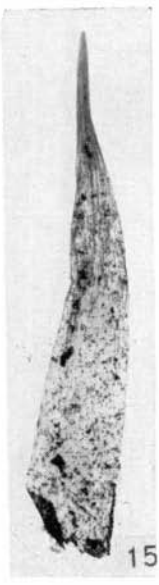
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