A C T A P A L A E O N T O L O G I C A P O L O N I C A
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ON GLOCHIDIA OF THE GENERA *UNIO* AND *ANODONTA* FROM THE QUATERNARY FRESH-WATER SEDIMENTS OF POLAND

Abstract. — Shells of larvae of fresh-water bivalves (known as glochidia) of the family Unionidae, belonging to *Unio* and *Anodonta*, have been found by the present writer in Holocene and Pleistocene fresh-water deposits of Poland. Fossil glochidia were never described before. Their size is the most important generic character distinguishing glochidia. Glochidia, which happen to be preserved on the apexes of young shells or on the fragments of older shells, in the form of what is known as prodissoconchae, allow one to determine the generic assignment of these otherwise indeterminable fossil specimens of Unionidae. Since the sediments, in which they are found, correspond to the spring-summer period, they also serve as indexes of temperature of a sedimentation environment.

INTRODUCTION

The material, described in the present note, comes from Holocene and Pleistocene fresh-water deposits of Poland. Free glochidia of the family Unionidae and young shells with glochidia of bivalves of this same family, together with fragments of older shells with glochidia, preserved on apexes as prodissoconchae, were found during the studies on the deposits from Poznań and Elbląg, as well as from a bore-hole at Czołpino.

Fossil glochidia were never described before. Since they are very small, they were probably not noticed during the studies on palaeontological materials. Their calcareous shells are very thin and fragile and, therefore, are easily destroyed and form an indeterminable shell detritus in sediments.

Recent glochidia of the European species of Unionidae were studied by many authors as Faussek (1895, 1901), Harms (1907*a*, 1907*b*, 1908, 1909), Israël (1913), Zhadin (1938, 1952) and others, who found that individual species have morphological characters of a considerable stability. The assignment to particular genera was determined by them on the basis of such features as shape, convexity, dimensions of shells,

character of beak with teeth, presence or absence of larval thread, its thickness and length. At the same time, they stated that the distinction between particular species of glochidia, similar to each other, requires considerable experience.

Since only the shape and size may serve as diagnostic characters, the specific identification of fossil glochidia presents considerable difficulties. A larval thread, with which a glochidium attaches itself to the body of its host, is destroyed together with the soft parts of the animal. A hooklike, projecting beak with teeth also cannot be preserved in fossil state. Morphological characters of fossil glochidia are, however, quite sufficient for an accurate determination of their generic assignment. The glochidia of Recent European species of Unionidae should be, therefore, studied from the viewpoint of a detailed recognition of the specific characters of shells, preserved in fossil state. This might allow one for a generic determination of fossil glochidia.

In addition, a more accurate knowledge of fossil glochidia would throw some light on the history of the development of European species of the superfamily Unionacea. Furthermore, taking into account glochidia, which occur in Holocene and Pleistocene fresh-water deposits, would allow one for a more complete reconstruction of the sedimentary environment studied.

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The material described is housed at the Palaeozoological Institute of the Polish Academy of Sciences in Poznań and marked Z. Pal. Mo. V/1–5.

MATERIAL

Shells of glochidia were picked up from the fresh-water deposits of the Eemian interglacial from the exposures at Szeląg in Poznań (Niezabitowski, 1928; Brodniewicz, 1960), from the Pheasantry Park in Elbląg (Halicki & Brodniewicz, 1961) and from the Holocene fresh-water deposits of the Littorina period from the Czołpino bore-hole (Brodniewicz & Rosa, 1967) (Text-fig. 1).

Poznań (Text-fig. 1, *1*). Fresh-water interglacial deposits contained a great number of free shells of glochidia of the genus *Anodonta* only. They were very thin, fragile and mostly strongly damaged; left and right valves were found separately.

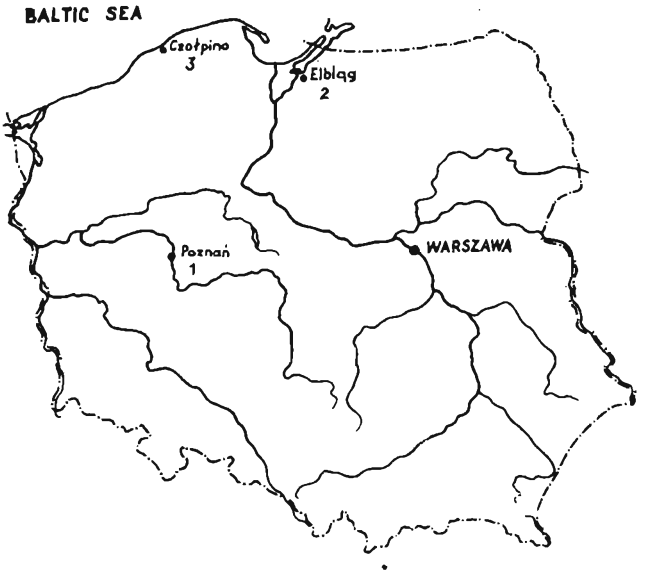

Fig. 1. — Sampling localities: *1* Poznań, exposure in Szeląg District, deposits of Eemian interglacial; *2* Elbląg, exposure in Pheasantry Park, deposits of Eemian interglacial; *3* Czołpino bore-hole, boring core with Holocene deposits from Littorina period.

Elbląg (Text-fig. 1, *2*). Free shells of glochidia of the genera *Unio* and *Anodonta* occurred in fresh-water interglacial deposits; left and right valves occurred separately. Shells of *Unio* were few, and of *Anodonta* very numerous. Most part of material was damaged. In addition, young (a dozen or so days) shells of *Unio* with glochidia on their apexes, as well as destroyed and indeterminable fragments of old shells with glochidia, preserved on their apexes in the form of prodissoconchae of the genera *Unio* and *Anodonta*, were also found.

Czołpino (Text-fig. 1, *3*). Only indeterminable fragments of older shells with apexes and clearly visible glochidia of *Unio*, occurring in the form of prodissoconchae, were found in Holocene deposits of the Littorina period.

MORPHOLOGY OF FOSSIL GLOCHIDIA

Both valves of shell of a glochidium are of equal size and, during an animal's life time, were connected with each other by means of an internal ligament along their upper margin. Shells triangular (Text-fig. 2), upper

margin straight, forming a base of an inverted triangle, sides arcuate and contacting each other in the lower part almost halfway the shell, forming a more or less rounded apex of a triangle. Shells more or less flattened, most convex in the middle or in the dorsal part, sides sometimes level. In inequilateral shells, the anterior and posterior ends may be easily

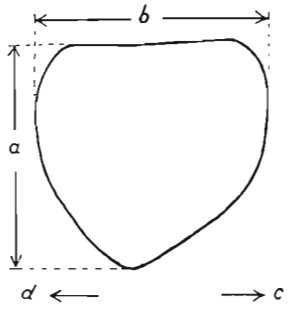

Fig. 2. — Morphological characters of a glochidium (on the example of an inequilateral right valve of the genus *Anodonta*): *a* height of shell, *b* length of shell, *c* anterior part, *d* posterior part.

recognized, since a larger and more bent side faces the anterior part of shell (Text-fig. 2c), which allows one to identify the right and left valves. Shells finely perforate, thin, fragile, sometimes slightly transparent, sometimes white and mat.

The size of shells is the most important character, distinguishing glochidia of the genus *Unio* from those of *Anodonta*. This fact is con-

Table 1

Dimensions of the glochidium shells

Superfamily Unionacea		
Family Margaritanidae	Family Unionidae	
Genus *Margaritana*	Genus *Unio*	Genus *Anodonta*
Little shells below 50 μ	Medium shells ca. 200 μ	Great shells above 300 μ

Table 2

Measurements of the glochidium shells (in μ)

Locality	Genus *Unio*		Genus *Anodonta*	
	length	height	length	height
Elbląg	208	186	347	332
	208	188	304	361
	202	188	—	—
	200	186	—	—
Czołpino	202	181	—	—
Poznań	—	—	375	351
	—	—	333	318

firmed by the comparison of glochidia of the genera *Margaritana*, *Unio* and *Anodonta* (Table 1). On the basis of these measurements, the material of the glochidia collected has been assigned to the genera *Unio* and *Anodonta*. The differences in the size of the shells of glochidia of both genera are shown in Table 2.

The specific assignment of the glochidia described is not certain and, therefore, the similarities of the specimens studied to the glochidia of some Recent European species of bivalves, known in literature, are given below.

The glochidia of the genus *Unio* (Text-figs. 3 *A-C*; Pl. I, Fig. 1) and the fragments of shells with glochidia (Text-figs. 3 *D*, *E*), as well as young shells with glochidia (Text-figs. 4 *A*, *B*; Pl. I, Fig. 5) resemble, in their equilateral and triangular-rounded shells, the shells of glochidia of *Unio pictorum* (Linné) or *Unio tumidus* Philipsson.

Glochidia of the genus *Anodonta* (Text-fig. 3 *G-J*; Pl. I, Figs. 3, 4) are similar, in inequilateral shells and their large dimensions, to *Anodonta cygnea* (Linné). Empty shells, identical with those here described and figured (Pl. I, Figs. 3, 4), were dredged out from Recent river sediments

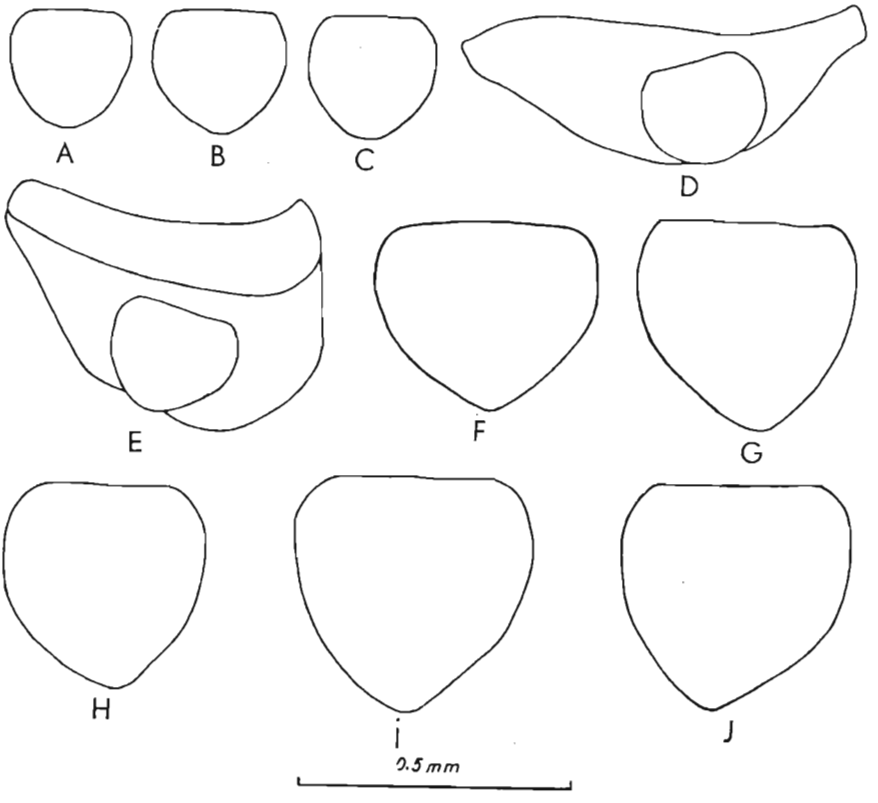

Fig. 3. — Outlines of fossil glochidia of the family Unionidae: *A-C* free glochidia of the genus *Unio*; *D*, *E* indeterminable fragments of shells with glochidia of the genus *Unio* on their apexes; *F-J* free glochidia of the genus *Anodonta*.

by Brady and Robertson (1870, Pl. 7, Figs. 10–13) who assigned them to ostracods and erected for them a new genus and species, *Goniocypris mitra* Brady & Robertson. These forms were later identified by Brady and Norman as larvae of *Anodonta cygnea* (Linné) (*fide* R. C. Moore, 1961).

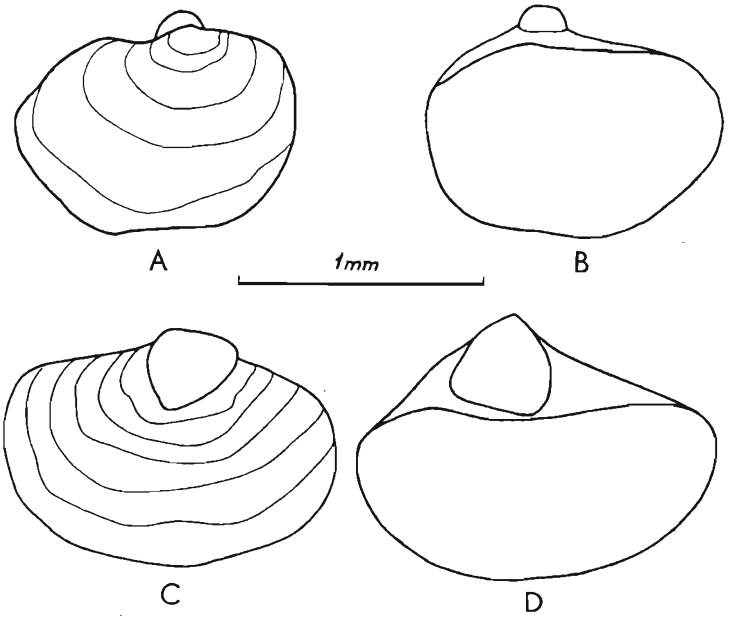

Fig. 4. — Outlines of young fossil shells of Unionidae with glochidia on their apexes: *A-B* of the genus *Unio*, *C-D* of the genus *Anodonta*.

Shells of glochidia, presented in Text-fig. *3F* and Pl. I, Fig. 2, are most similar to glochidia of *Anodonta complanata* Rossmaessler in their large, almost equilateral form, which are longer than high.

SIGNIFICANCE OF GLOCHIDIA TO THE STUDIES ON QUATERNARY FRESH-WATER DEPOSITS

The yearly cycle of reproduction takes place, in Recent species of the family Unionidae, according to the following order: laying eggs in mothers' gills, fertilization, maturing of glochidia in mothers' gills, throwing glochidia into water, parasitizing on fish, leaving of a host and a further growth of a shell on the bottom of a river or reservoir. In particular species, the development cycle takes place during different periods; laying eggs and throwing glochidia into water depend on temperature and take place in warm seasons of the year.

In the genus *Unio* eggs are laid in the spring and glochidia are thrown out by the females from mid-May to early August. In *Anodonta*, eggs are laid from mid-August to September. In October mature glochidia are already in mothers' gills, where they remain to May (in some species, even to early June) and are thrown into water in May or June.

Despite the differences in course of the cycle of reproduction of both genera, throwing out of glochidia takes place in the late spring and in the summer (Text-fig. 5). Released glochidia swim freely in search of

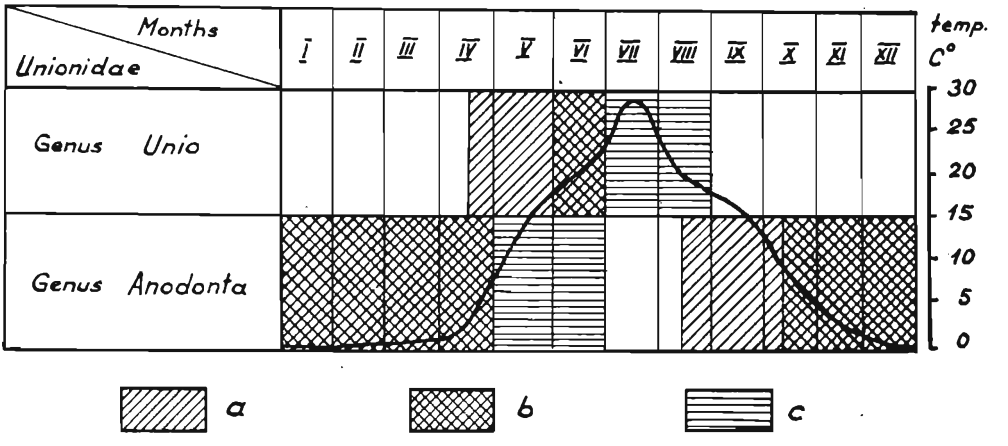

Fig. 5. — A diagram of the yearly cycle of reproduction of bivalves of the genera *Unio* and *Anodonta*, together with a curve of yearly temperature (according to Zhadin, 1952): *a* laying and fertilizing of eggs, *b* glochidia staying in gills of adult bivalves, *c* throwing glochidia into water.

hosts. After finding them, attached to a fish, they transform from larvae into young bilvalves. However, only few larvae can find a host, and the remaining ones are either devoured by different aquatic animals or fall to the bottom, where they die.

Acting on the principle of actuality, we may use these observations on the biology of reproduction of Unionidae for palaeontological studies. It may be assumed that the shells of glochidia, found in Quaternary deposits, reached them during the period when masses of mature glochidia were thrown by the females into water. In all probability, the glochidia found in deposits seem to indicate that the sedimentation of the layers, in which they occur, took place during a warm period. Single cases are, however, known in which the glochidia of Unionidae and *Margaritana* were thrown into water in colder periods and even in winter (Israël, 1913; Zhadin, 1938), but, according to the cited authors, it was probably caused by some irritation of pregnant females. Such incidental throwing out of larvae cannot be of a major importance to the climatic interpretations of sediments, since it happens very seldom and the number of such larvae is relatively small. On the other hand, the mass throwing out of glochidia

during a warm period, provides a chance for their preservation in fossil state and may serve for climatic interpretations of the fresh-water deposits studied.

If the layers containing glochidia of the genus *Anodonta* could be separated from those with glochidia of the genus *Unio*, we would be able to determine more accurately the temperature during sedimentation and, consequently, to determine more accurately the spring-summer season. Since glochidia of the genus *Anodonta* are thrown out from May to June, sediments with glochidia of this genus would indicate the late spring or early summer. On the other hand, since glochidia of the species of the genus *Unio* are thrown into water from late May to early August, sediments containing glochidia of this genus would indicate, that they were deposited during a warmer period, i. e. in the late spring or in summer. The presence of the glochidia of both genera, occurring together in deposits, would testify to a medium temperature, because late June is the only period during which the glochidia of both genera are thrown into water.

The living requirements of European species of the family Unionidae are much the same. They live in lakes, ponds, rivers and streams and their presence cannot be an evidence of the character of a reservoir. It is only *Unio crassus* Philipsson that lives exclusively in rivers, and glochidia of this species, found in deposits, might allow one to determine accurately the environment in which these deposits were formed.

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IRENA BRODNIEWICZ

O GLOCHIDIACH RODZAJÓW *UNIO* I *ANODONTA* Z CZWARTORZĘDOWYCH OSADÓW SŁODKOWODNYCH POLSKI

Streszczenie

Po raz pierwszy zostały opisane skorupki larw kopalnych małżów słodkowodnych — glochidiów — z rodziny Unionidae. Materiał pochodzi z plejstoceńskich osadów słodkowodnych interglacjału eemskiego z odkrywek w Poznaniu na Szelągu i z Parku Bażantarni w Elblągu oraz z holoceńskich osadów z okresu litorynowego z wiercenia w Czołpinie (Fig. 1).

Badany materiał obejmował pojedyncze, wolne glochidia i fragmenty skorupek starszych osobników z dobrze zachowanymi glochidiami jako prodissokonchy, jak również skorupki młodych osobników z glochidiami na szczytach.

Najważniejszą cechą glochidiów, odróżniającą rodzaj *Unio* od *Anodonta*, jest wielkość skorupki. Duże, powyżej 300 μ skorupki należą do rodzaju *Anodonta*, mniejsze zaś, o wymiarach około 200 μ — do rodzaju *Unio* (Tab. 1). Pozostałe cechy kopalnych skorupek glochidiów, to mniej lub bardziej równoboczna trójkątna skorupka, jej wypukłość i stosunek długości do wysokości skorupki. U nierównobocznych glochidiów można określić ich przód i tył, gdyż bok większy i bardziej wygięty wskazuje na przód skorupki (Fig. 2), a tym samym pozwala wyróżnić prawę i lewą skorupkę.

Zebrane okazy należą z całą pewnością do rodzajów *Unio* i *Anodonta*. Natomiast z mniejszą pewnością podano podobieństwo badanego materiału do gatunków: *Anodonta complanata* Rossmaessler (Fig. 3*F*; Pl. I, Fig. 2), *A. cygnea* (Linné) (Fig. 3 *G-J*; Pl. I, Fig. 3, 4) i *Unio pictorum* (Linné) lub *U. tumidus* Philipsson (Fig. 3 *A-C*; Pl. I, Fig. 1).

Analizując roczny cykl rozmnażania współczesnych Unionidae można przyjąć, że znalezione w osadzie glochidia służyć mogą jako wskaźniki temperatury środowiska, w jakim występują. Ponieważ samice masowo wyrzucają do wody glochidia w okresie wiosenno-letnim, przyjąć należy, że osadzanie sedymentu zawierającego glochidia odbywało się również w okresie ciepłym.

ИРЭНА БРОДНЕВИЧ

О ГЛОХИДИЯХ РОДОВ *UNIO* И *ANODONTA* ИЗ ЧЕТВЕРТИЧНЫХ ПРЕСНОВОДНЫХ ОСАДКОВ ПОЛЬШИ

Резюме

Впервые описано здесь створки ископаемых личинок пресноводных пластинчатожаберных — глохидиев — из семейства Unionidae. Материал происходит из плейстоценовых пресноводных осадков эемской межледниковой эпохи, из обнажений города Познань на Шелёнгу и города Эльблёнг из Парка Бажантарни, а также из голоцэновых осадков литторинового периода из бурения в городе Чолпин (Фиг. 1).

Изучаемый материал включал единичные глохидии и фрагменты створок старших особей, с хорошей сохранности глохидиями в виде продиссоконхов, а также створки молодых особей с глохидиями на макушке.

Самой важной чертой глохидиев, отличающей род *Unio* от рода *Anodonta* является величина створки. Большие, свыше 300 μ створки принадлежат к роду *Anodonta*, а меньшие размером, около 200 μ — к роду *Unio* (Таб. 1). Остальные признаки ископаемых створок глохидиев это более или менее равносторонняя треугольная створка, её выпуклость и соотношение длины к высоте створки. У неравносторонних глохидиев можно определить их переднюю и заднюю часть, так как более выгнутая и большая сторона указывает на переднюю часть створки (Фиг. 2), а тем самым разрешает выделение правой и левой створки.

Собранные экземпляры несомненно принадлежат к родам *Unio* и *Anodonta*. Менее уверенно можно говорить о сходстве изучаемого материала с видами: *Anodonta complanata* Rossmaessler (Пл. I, фиг. 2; Текст-фиг. 3 *F*), *A. cygnea* (Linné) (Пл. I, фиг. 3, 4; Текст-фиг. 3 *G*—*J*), *Unio pictorum* (Linné) или *U. tumidus* Philipsson (Пл. I, фиг. 1; Текст-фиг. 3 *A*—*C*).

Анализируя годичный цикл размножения современных Unionidae можно принять, что найденные в осадках глохидии могут быть использованы как указатели температуры среды, в которой находятся. Так как самки выбрасывают глохидии в массовом количестве в воду в весенне-летнем периоде, можно принять, что отложение осадков в которых находятся глохидии, происходило тоже во время теплого периода.

PLATE

Plate I

Fig. 1. A shell of glochidium of the genus *Unio*; Pleistocene, Elbląg (Z. Pal. Mo. V/1).

Fig. 2. A shell of glochidium of the species *Anodonta complanata* Rossmaessler; Pleistocene, Elbląg (Mo. V/2).

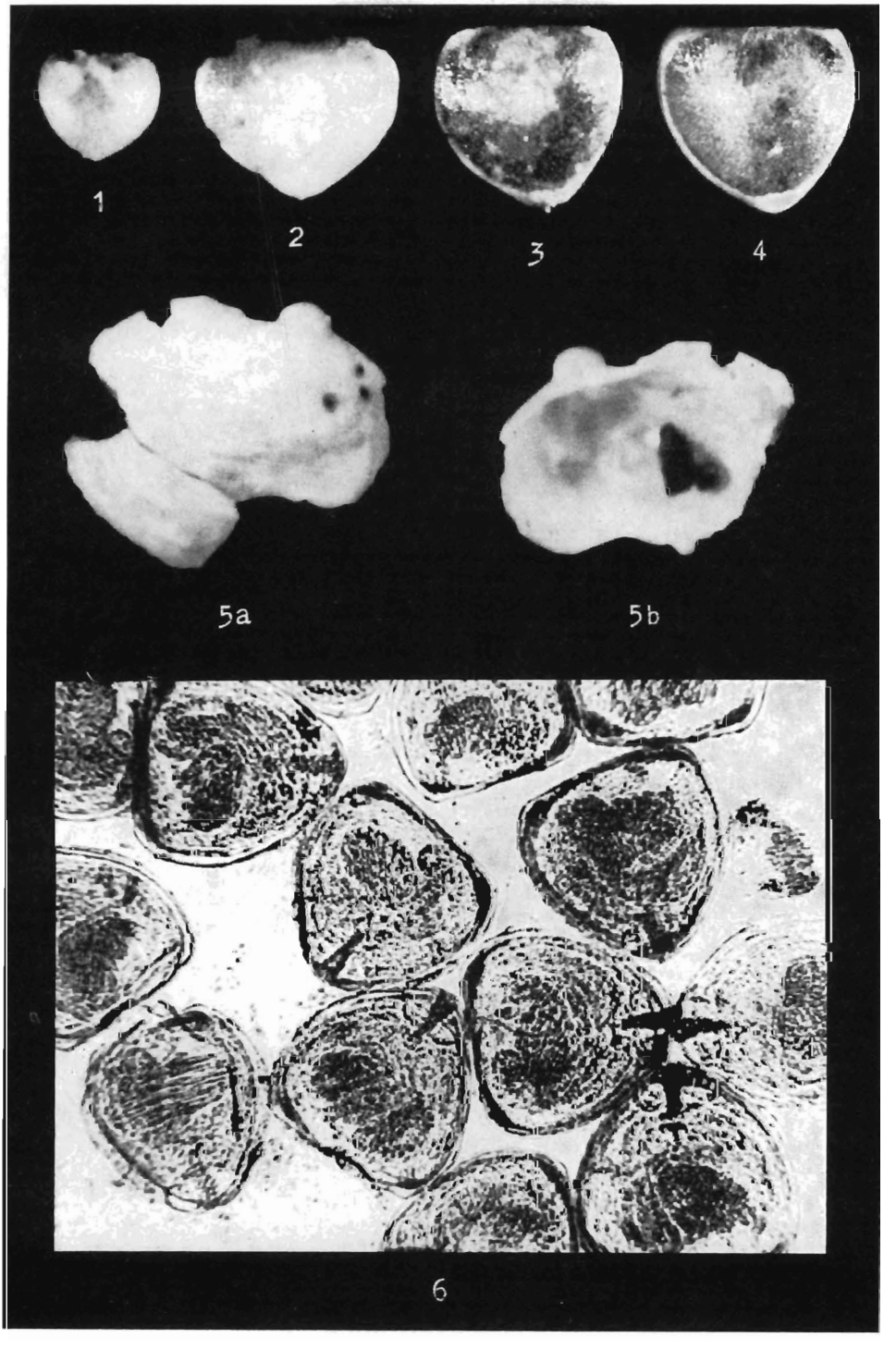
Fig. 3. A left valve of glochidium of *Anodonta cygnea* (Linné); Pleistocene, Poznań (Mo. V/3).

Fig. 4. A left valve of glochidium of *Anodonta cygnea* (Linné); Pleistocene, Elbląg (Mo. V/4).

Fig. 5. A young shell with glochidium of the genus *Unio* on its apex: *a* outer view of shell, *b* inner view of shell; Pleistocene, Elbląg (Mo. V/5).

Fig. 6. Recent glochidia of *Anodonta cygnea* (Linné), found in winter in the shell of an adult bivalve.

All specimens × 85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