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An unusual occurrence of the Dytiscidae (Coleoptera) in the siliceous flowstone of the Upper Miocene cave at Przeworno, Lower Silesia, Poland

ABSTRACT: The discovery of well preserved fragments of Dytiscidae, including the extant species *Hydaticus laevipennis* Thomson (Coleoptera, Dytiscidae) in the Upper Miocene siliceous flowstone deposits at Przeworno, Lower Silesia, is discussed. These deposits were formed during a rapid precipitation of silica from hot spring water flowing through a bog area into a karst sink. Describing the site of discovery, the writers also give some notes on the ecology of the species found and on their evolution.

INTRODUCTION

Remnants of a cave with siliceous flowstone deposits (*cf.* Głazek & *al.* 1971), containing surprisingly well preserved imagoes of water beetles (*cf.* Głazek & *al.* 1972) of the family Dytiscidae were revealed, along with vertebrate faunas, during geological investigations of the fossil karst phenomena in an old marble quarry at Przeworno (Lower Silesia, SW Poland, 17° 10′ 40″ of eastern longitude and 50° 41′ 41″ of northern latitude; Fig. 1).

The fossil insects have never been described from such unsual deposits. Localities containing more than only single insect fragments are known either from lacustrine and fluvial deposits (*e.g.* Heer 1847, 1862; Pongrácz 1935; Statz 1939; Gersdorf 1969, 1971), or coastal, mostly deltaic or lagoonal ones (*e.g.* Papp & Thenius 1954, Britton 1960, Zeuner 1962, Bekker-Magdisova 1964). Some insects were also reported from the Baltic and Mexican ambers. In all such occurrences, strongly predominant are terrestrial insects, while water beetles make up less than 10% of insect necrocoenoses (*e.g.* Zeuner 1962, Bekker-Magdisova 1964, Gersdorf 1971; for necrocoenose concept — *see* Davitashvili 1945, 1964).

The beetles in question are assigned to the family Dytiscidae, so far never found in the pre-Pleistocene deposits of Poland, except for questionable specimens from the Baltic amber (*cf.* Helm 1896, Statz 1939).

About 50 dytiscid species have hitherto been described from the Tertiary deposits of Europe and North America (*cf.* Händlirsch 1908, Guignot 1931—1933, Statz 1939, Rodendorf & Ponomarenko 1962). Recently, a dytiscid larva of a genus supposedly related to *Agabus* Leach (*Angaraagabus* Ponomarenko) has also been reported on by Ponomarenko (1963) from deposits as old as the Lower Jurassic of Siberia (USSR).

The specimens here described are housed at the Warsaw University Institute of Geology, where they are numbered *IGPUW-Gł. P. 3.1—16.*

Acknowledgements. The writers' thanks are extended to Professor S. Dżułyński for suggesting a hot spring origin of silica; to B. Drozd, M. Sc., for taking photos of the specimens; to T. Wesołowska, M. Sc., Ł. Karwowski, M. Sc., and A. Kozłowski, M. Sc. for the geochemical investigation.

GEOLOGICAL SETTING

The marble quarry at Przeworno is situated on the slope of a metamorphic-rock inselberg, 204.2 m above sea level. The marbles are dipping NNE under quartzite and sericite schists of the Jegłowa Formation (Fig. 2), their age being still debatable, but not younger than older Devonian (*cf.* Głazek & *al.* 1971, 1972). The metamorphic formations, strongly varying in morphology, are covered with regoliths and clayey-sandy deposits of Miocene age and overlaid along an erosional surface by the clays assigned to the Poznań Formation (Upper Miocene through Pliocene, *cf.* Oberc & Dyjor 1969, Dyjor 1970).

All the formations presented are pierced by basaltic necks (*cf.* Fig. 1); the volcanic activity probably lasted herein from the Oligocene to the Pliocene (Jerzmański & Maciejewski 1968).

Numerous karst forms exposed at the Przeworno quarry, mostly widened fissures, are filled with clays, some of them containing vertebrate fauna described by Dr. A. Sulimski (*in* Głazek & *al.* 1971).

The older fauna (Przeworno *1*) occurs in the kaolinite-illite clay which fills a horizontal karst passage. The following animals were found in the bone material transported by water: Mustelidae gen. et sp. indet., *Pseudailurus* cf. *quadridentatus* (Blainville), *Aceratherium silesiacum* Sulimski, *Hyotherium* aff. *soemmeringi* v. Meyer, *Dorcatherium* cf. *crassum* (Lartet), Castoridae and tortoises. This fauna indicates a swampy wood environment of the early Miocene and corresponds in age (Głazek & *al.* 1971) to the second brown-coal measure (Ścinawa measure = 3 Lausitzer Flöz).

The younger fauna (Przeworno 2) occurs in an illite clay, slightly cemented with amorphous silica and which fills the fissure. The bone material includes following vertebrates: *Pseudailurus lorteti* Gaillard, *Hyotherium simorrense* (Lartet) and *Euprox furcatus* (Hensel), moreover, so far undescribed Mastodontinae, Rhinocerotidae, Suidae and Pliopithecinae, along with small fragments of tortoises, lizards and birds. This assemblage is indicative of a steppe-forest environment and a warm savanna climate of the younger Vindobonian (Głazek & *al.* 1971, 1972; Prof. K. Kowalski, *letter communications in* 1971—1972). It corresponds in time, to the uplift and erosion in this area, which was marked by a huge sequence of detrital deposits of the third cycle of brown-coal sedimentation which terminated in the Lusatian

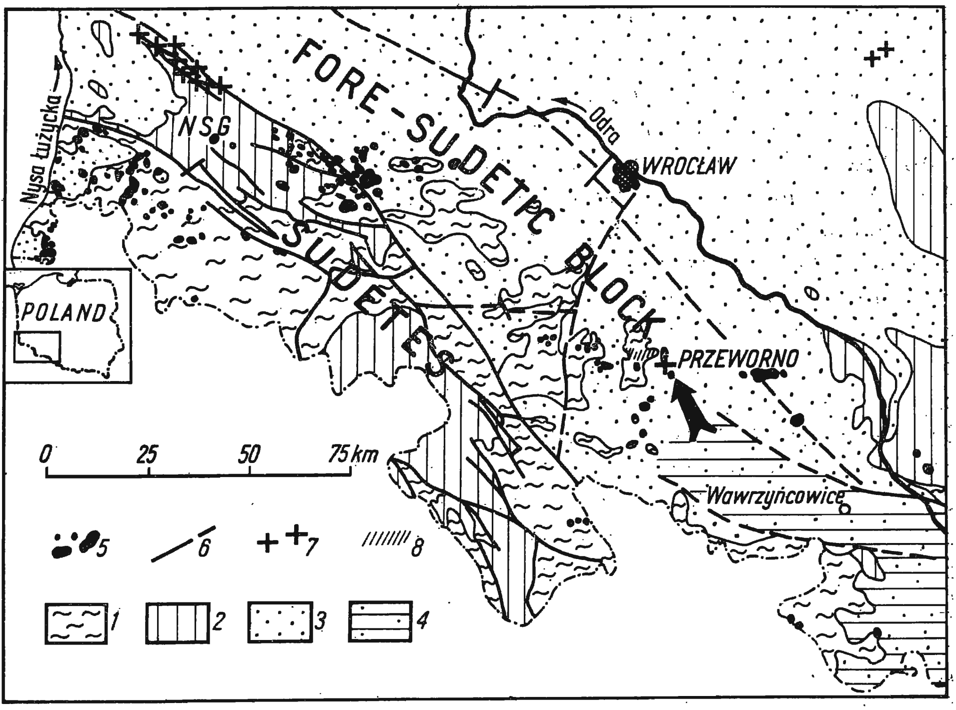

Fig. 1

Geological sketch map of Lower Silesia (compiled from maps published by Geological Survey of Poland); inset shows location of the discussed area in Poland

1 pre-Variscan substrate composed mainly of crystalline rocks, *2* post-Variscan cover (Upper Paleozoic and Mesozoic), *3* Tertiary sediments, *4* extent of Lower Tortonian marine deposits in the Wawrzyńcowice graben, *5* Tertiary basalts, *6* major faults, *7* siliceous deposits of hot springs (arrow marks Przeworno), *8* Tertiary (?) kaolinized crystalline rocks in the vicinity of Przeworno

Quaternary deposits omitted; NSG — North Sudetic Graben coal measure (*Lausitzer Unterflöz*) further to the North (Oberc & Dyjor 1969; Głazek & *al.* 1971, 1972). In this thick sequence there occur irregularly so-called quartzites which really are sandstones cemented by silica. According to Oberc & Dyjor (1971), they are connected with fault lines and may be interpreted as a result of the activity of hot springs.

The secondary silica, forming flints in interbedding spaces and fractures within marbles, and impregnating greenish clays in fissures, abundantly occurs in the SW part of the quarry. Two fragments of cave with siliceous flowstone, identical with the silica which forms flints in marbles and impregnates clays, are preserved in the southern wall of the quarry (Fig. 2).

DESCRIPTION OF THE SITE

Cave with siliceous flowstone

The most interesting is the western remnant of the cave with the siliceous flowstone (*3* in Fig. 2, Fig. 3; Pl. 2). It is a steep channel deeping into the quarry from the south and coated with a tawny-brown silica flowstone. On the cave walls, silica locally covers a thin layer of calcite crystals (*see* Fig. 10 *in* Głazek & *al.* 1971). The brown silica flowstone is compact with a dark lamination and spots parallel to the wall. The lamination and shape of flowstone indicates a downward direction of a silica-bearing flow from SW. Pieces of surrounding marble occur in the silica. An irregular, surface part of siliceous flowstone is white and porous. This outer white crust cuts primary lamination (*see* Pl. 4, Fig. 1 *in* Głazek & *al.* 1971). As revealed by an *X*-ray analysis, brown flints consist of an amorphous material with only a trace of quartz (*see* Fig. 11*A in* Głazek & *al.* 1971). According to an *X*-ray diffractogram, the white matter consists of an amorphous material with an admixture of clay minerals of the smectite group and quartz (*see* Fig. 11*B in* Głazek & *al.* 1971). The investigation indicates that the white matter originated as a result of the etching of tawny silica. The etching solution brought a small amount of clay minerals into pores and enabled some recrystallization of silica into quartz. According to recent experimental data of Harder & Flehming (1970) such recrystallization at low temperature may be a quick process if the solution is undersaturated with amorphous silica and if hydroxides of Fe, Al, Mn, Mg and other elements are present.

Horizontally laminated dark olive clays occur in an about 30 cm thick layers in the lower part of the center of channel (Fig. 3). According to a thermal analysis (*see* Głazek & *al.* 1971, Fig. 9*D*) these clays are composed of hydromica, smectite and organic matter. Three pollen analyses, made by Dr. A. Sadowska (*see* Głazek & *al.* 1971, Table 1), show that the

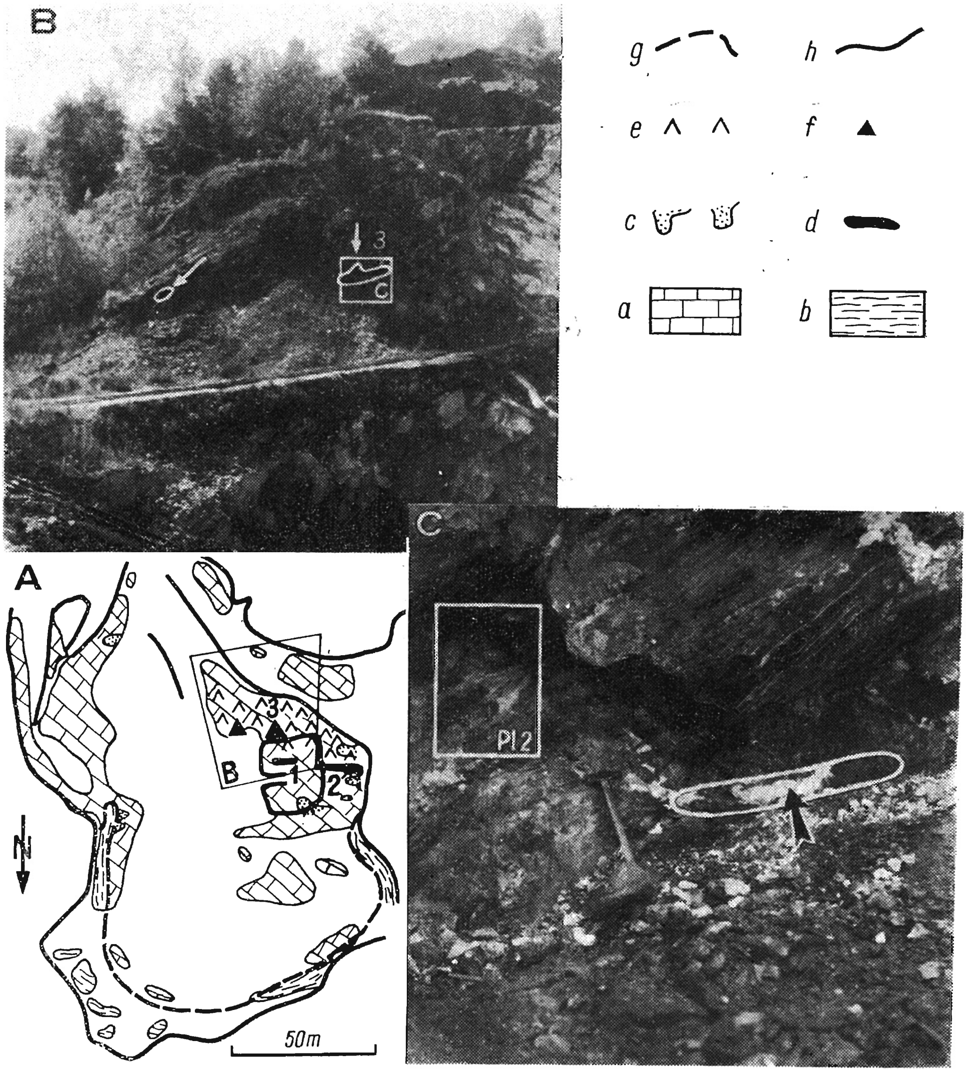

Fig. 2

Situation of the beetle-containing deposits at the Przeworno quarry

A sketch map of the quarry (after Oberc 1966, modified): *a* marbles, *b* Jegłowa Formation, *c* karst forms filled with clays, *d* clays with vertebrate faunas in the karst forms (localities Przeworno *1* and *2*), *e* area of siliceous deposits in joints and cavities in marbles or older clays, *f* remnants of the cave with siliceous flowstone (beetle locality Przeworno *3*), *g* tectonic contact, *h* escarpments

B general view of the southern wall of the quarry; arrows indicate remnants of the cave with siliceous flowstone; rectangled is a part of the cave presented in *C*

C close-up view of the cave with siliceous flowstone; arrowed is the collection site; rectangled is a fragment of the flowstone presented in Pl. 2

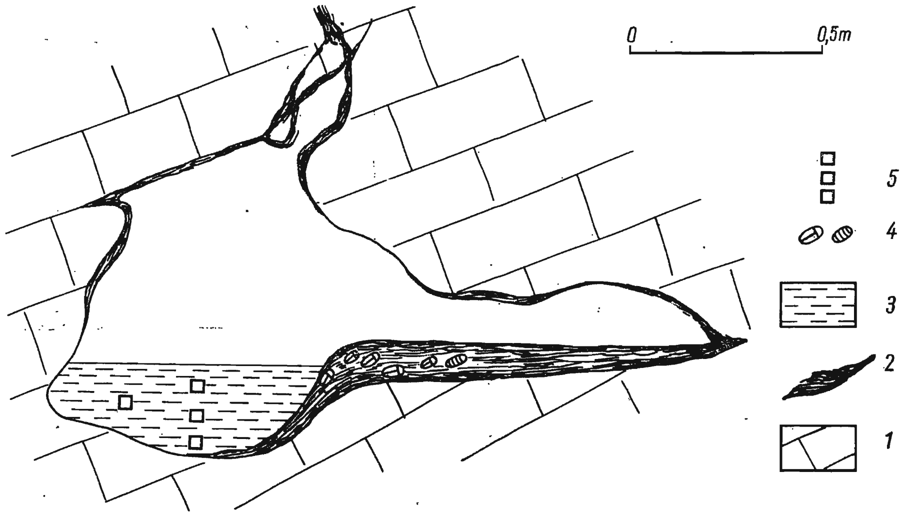

Fig. 3

Schematic section of the Miocene cave, and situation of the beetle necrocoenosis

1 marbles, *2* siliceous flowstone, *3* clays, *4* beetles, *5* samples for pollen analysis (*cf.* Głazek & *al.* 1971, Fig. 10*A*)

clays are of the Tertiary and not older than Middle Miocene age (*cf.* Głazek & *al.* 1971, p. 485). The composition, appearance and pollen assemblage are similar to those of the Poznań Formation (*cf.* Dyjor & *al.* 1968).

Occurrence of beetles

Further investigations revealed the occurrence of water beetles in brown compact silica (Głazek & *al.* 1972). A dozen or so beetles were found in the western, lower part of that cave. Some of them are nearly complete imagoes, most of them — fragments only. The beetles are slightly compacted and partly empty. They are devoid of extremities and often only thorax, or thorax with abdomen (*cf.* Pl. 1), or, at most isolated leg fragments are preserved.

The etching in H_2F_2 gave no satisfactory results since, like those found in amber, the bodies of beetles disintegrated in solution to small pieces. To separate the insects from the surrounding rock, the writers chose a simple mechanical method, whereby either the upper or lower surface of the body was exposed, and, to avoid damage, they gave up any further manipulation.

The beetles were found laying parallel to the flowstone lamination which suggests that they were washed with surface waters through the sinkhole into the cave, deposited near its bottom and subsequently covered with silica gel. In all probability, they were already dead and partly damaged when transported.

Three easily identifiable fragments were determined (Galewski & Głazek 1973) as parts of *Hydaticus laevipennis* Thomson. The excelent preservation of the shape of beetles with distinct sutures, microsculpture and body coloring is sufficient for their identification. Diving beetles of the genera: *Acilius* Leach (*cf.* Pl. 1, Fig. 4), *Hydroporus* Clairv. and *Canthydrus* Sharp were also found at the same site in addition to another *Hydaticus* species, whose identification requires a further study.

AGE AND ORIGIN OF THE SITE

Stratigraphical position

Since the clays containing the vertebrate remains are slightly cemented by silica, particularly so their upper part (*cf.* Fig. 2; and Głazek & *al.* 1971, 1972), the beetle-bearing silica deposits are younger than the Przeworno *2* fauna. On the other hand, they are older than the clays which fill the cave and contain an Upper Miocene or Pliocene pollen assemblage (*cf.* Fig. 3, and Głazek & *al.* 1971). The paleogeographical situation implies that the silica was deposited under the erosional regime prior to the sedimentation of the Poznań Formation. These premises suggest the age of fossil beetles may be determined as Upper Miocene.

Ecological remarks

All beetle genera found at Przeworno represent living beetles. The Recent species *Hydaticus laevipennis* Thomson seems to prefer marshy areas with grassy vegetation (grasses, sedges) and mosses. Much the same as other representatives of this genus (*cf.* Galewski 1971), it was found in various kinds of small, temporary water-bodies and sporadically in small rivers with a slow current.

Origin of the site

The age coincidence of siliceous flowstone and "quartzites" in brown-coal deposits, as well as the low alcaline environment, in which silica was mobilized, have been pointed out in previous papers (Głazek & *al.* 1971, 1972). Further speculations were made, with respect to the younger Miocene "paleogeographical conditions facilitating activation of silica on vast areas during weathering" (Głazek & *al.* 1971, p. 494). Current investigations do not confirm the existence of such a great mobility of silica during weathering even in humid tropics (*e.g.* Douglas 1967, 1969). Under such circumstances, a different model has to be adopted.

Harder & Flehming (1970) indicated that the amorphous silica precipitated from a solution highly supersaturated with respect to the amorphous silica (*i.e.* much more than c. 120 ppm — *cf.* Siever 1962, Harder & Flehming 1970). Such a great content of dissolved silica of natural surface waters was stated only in alcaline hot springs water (*e.g.* White 1957a, 1957b; Arnorsson & *al.* 1969). In the areas of alcaline hot springs siliceous sinter deposits, composed of entirely opaline silica, are most common (Allen 1934a, 1934b; Allen & Day 1934; Barth 1950). Usually, these deposits are finely banded and when frequently moistened by spring water they remain dense and glassy (Allen 1934b). Such conditions could have occurred at Przeworno.

Since the volcanic hot spring waters and the siliceous sinter they deposit are enriched with lithium, titanium and zirconium (Barth 1950, White 1957a, b), it was possible to check up on the hypothesis of silica formation by spectral emission analyses of silica fragments, which was done by T. Wesołowska. A relatively high content of the elements mentioned above (Li ∾ 100 ppm, Ti ∾ 10 ppm and Zr ∾ 3 ppm) confirmed the hypothesis of the origin of silica from volcanic hot spring waters.

In the site under study the hot spring water which probably flowed through a marshy or bog area inhabited by various aquatic Coleoptera, could mix with peat water. The peat water drastically reduced solubility

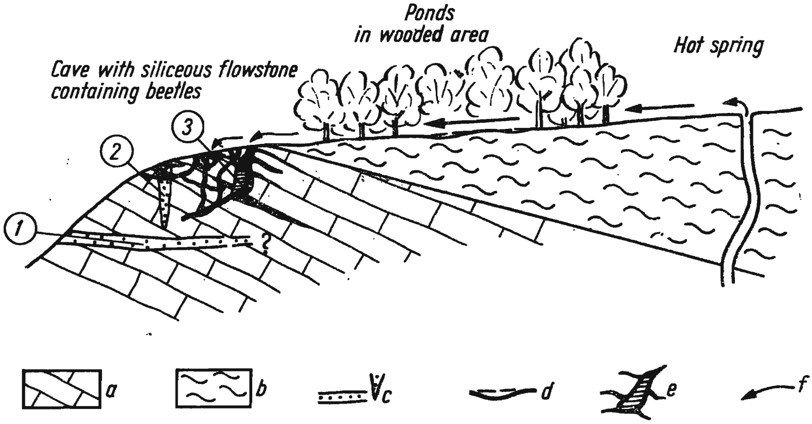

Fig. 4

Supposed environmental conditions of silica precipitation at the Przeworno cave

a marbles, *b* Jegłowa Formation (kaolinized quartzitic schists), *c* vertebrate-bearing karst fillings (*1* Upper Burdigalian, *2* Younger Vindobonian), *d* ponds or related water-bodies, *e* cave and crevices with siliceous deposits, *f* inferred trend of water from a hot spring of silica (according to Siever, 1962, the solubility of silica in peat water reaches 14—23 ppm only) and accelerated its precipitation. Although no siliceous sinter deposits on the surfaces are known, such an explanation may be suggested for the situation observed (Fig. 4). Such fossil products are very hardly recognizable and, being superficial, they would be easily crushed and destroyed by glacial action and erosion even in such volcanic areas as Iceland (*cf.* Barth 1950). As far as the writers know, the pre--Quaternary siliceous sinter deposits are extremely rare, only one example being described by Cuvillier (1925, *fide* El Ramly 1969) from the environs of Cairo, Egypt.

The situation observed in which the siliceous sinter was deposited during the sinking of a supersaturated silica solution into karst holes and fissures may be explained if we keep in mind the „response time" (*cf.* Roques 1964) of the precipitation. The deposition of silica sinter has to be slower than the velocity of water flow before its sinking and the "response time" had not been reached by the supersaturated solution before it sinks into karst holes and cracks. Similar conditions may cause the formation of silica sinter along streams at a considerable distance from some hot springs (*cf.* Allen 1934b, Barth 1950).

Silica was probably precipitated after the cooling of water. This supposition can not be proven, because the siliceous flowstone does not contain any gaseous-liquid inclusions, which might be used to determine temperatures at which silica precipitates[1].

Paleogeographic situation

Since the silica-bearing solution was flowing down into the cave, the deposition of silica sinter in the cave and fissures took place above the groundwater table in marbles. Such conditions resemble those under which the Przeworno *2* vertebrate fauna was accumulated (*cf.* Głazek & *al.* 1971, 1972). Thus, this process probably occurred not much later than the formation of this locality. A longer time interval might separate the formation of the siliceous flowstone and the deposition of clays with pollens which were subsequently deposited in the cave in a different chemical environment. Such a conclusion is in conformity with Oberc's & Dyjor's (1971) statement, and indicates another site of a hot spring activity during the late Miocene in the fore-Sudetic block.

Both sites of hot spring activity in the late Miocene are located in areas in which the rigid fore-Sudetic block was downwarped then to the North Sudetic Graben in the north-west and to the Wawrzyńcowice Graben in the south-east. The locality described is situated in the latter of the two slopes, of the fore-Sudetic block, namely in its upper part, and

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[1] Search for such inclusions was made by Ł. Karwowski, M. Sc.

during its formation the subsiding Wawrzyńcowice Graben was invaded by the Lower Tortonian sea from the fore-Carpathian depression (*cf.* Krach 1958; Głazek & *al.* 1971, 1972). It is possible, that the hot spring activity coincided with an extensive hydrothermal kaolinization and rock-crystal formation in the neighboring Jegłowa Formation (*cf.* Kozłowski & Karwowski 1972, Szpila & *al.* 1972). During the rock alteration caused by acid and nearly neutral hot waters, the conditions were suitable to the development of minerals of the kaolinite and montmorillonite groups (*cf.* Barth 1950).

Considering the recent area of volcanic and hot springs activity with active faults and broad rock alterations, the rapid changes in chemical composition of water in these springs, as well as the individual variability in chemical composition of dissolved matter in the same group of sources (*cf.* Allen & Day 1934, Barth 1950) these supositions are not contradictionary to each other. Moreover, considerable changes in the chemical composition of solution were stated even during crystallization of a single rock crystal at Jegłowa, as such crystals were intermittenly etched during their growth (Kozłowski & Karwowski 1972).

SYSTEMATIC PART

(by K. Galewski)

Class **Insecta** Linnaeus, 1758
Order **Coleoptera** Linnaeus, 1758
Family **Dytiscidae** Latreille, 1825
Genus *HYDATICUS* Leach, 1817
Hydaticus laevipennis Thomson, 1867
(Figs 5—6 and Pl. 1, Figs 1—3)

Material. — A well preserved imago with a visible, nearly complete upper part (No. *IGPUW-Gł. P. 3.8*) and fragments of the ventral side of thorax (No. *IGPUW-Gł. P. 3.7a* and *2b*); all specimens from the locality Przeworno *3.*

Dimensions. — Body length 15 mm, head length 1.3 mm, width 2.4 mm, pronotum length 2.1 mm, width 2.4 mm (in the middle), elytra length 11.6 mm, width 7.4 mm.

Description. — The visible part of the beetle consists of the upper surface of head, a larger part of pronotum, an almost completely preserved right elytra and a larger part of the left elytra (Fig. 5 and Pl. 1, Fig. 1). Body sides streamlined, pronotum and elytra forming a continuous line. Head dirty-reddish with a faint dark oblique streak. Lateral margins of pronotum strongly arcuate, posterior angles prominent, acuminate, their inner edges sinuous. Pronotum dirty-reddish, its base with a dark band, relatively narrow, hardly extending over a half of pronotum length and having in the center an only small, blotch-like anterior protrusion. Microsculpture of pronotum consisting of tiny meshes with distinct strong punctures between them.

Elytra blackish, with a faint dirty-reddish streak at its base, relatively broad in distal part and with irregular, excised margins; however, posterior processes ("fringes") of the streak (visible in Recent specimens) are lacking. Elytral "striae" distinct. Elytral microsculpture similar to that of pronotum. The punctures, however, seem to be larger, deeper and more irregularly distributed than in the Recent forms; larger punctures scattered among the smaller ones, denser and stronger than in the latter. A general pattern of puncturation is unmistakably different from that in the closely related *Hydaticus transversalis* **Pontop.**

Metasternum. The fragment of the ventral side of thorax (Fig. 6 and Pl. 2, Fig. 3), found together with the upper part of the specimen described, most probably belongs to the species, but the apices of metasternal wings are slightly broader than in typical Recent forms. The differences may at least be partly due to the displacement of sutures resulting from compaction.

Discussion. — The conspicuous characters of the upper part of the insect suffice for its identification. Thus, the pronotum shape, body contours, microsculpture of elytra and body coloring place the insect in the Dytiscid genus *Hydaticus* Leach. The ventral part of the thorax with excellently preserved metasternal wings and metacoxal plates found in the same site also indicate this genus. The size of body and its color pattern, faintly indicated, relatively broad at sides and the pale streak at the base of elytra suggest a male of *Hydaticus laevipennis* Thomson. This is more strongly corroborated by the elytral sculpture, in particular the absence of irregular, strong, vermicular cuts at the sides of pronotum and elytra, characteristic of females of *Hydaticus* Leach.

ECOLOGICAL REMARKS AND SOME PROBLEMS OF INSECT EVOLUTION

Hydaticus laevipennis Thomson is a north and central European species (it occurs in the southern and central part of Scandinavia, in Denmark, Holland and northern part of Poland and Germany); it was also found in the taiga zone of Siberia. In Europe, it is rare and sporadic. In Poland, only single specimens have been found (Galewski 1971) in the environs of Warsaw and in the Białowieża Forest (National Park, the Hwoźna River). The species seems to prefer marshy areas with grassy vegetation (grasses, sedges) and mosses. It has been collected in various kinds of small temporary water-bodies, rain-water pools and puddles, ditches, small ponds. A specimen was once found in a small river (the Hwoźna) with a slow current. Most probably it was an immigrant from temporary pools nearby. In winter, the adults most probably hibernate in forest litter, much the same as other species of *Hydaticus* Leach.

The Miocene discovery in Lower Silesia (Przeworno, the Sudetes foreland) c. 300 km south-west of the nearest Recent site (Warsaw), indicates a more southern distribution of the species than the actual one. This may surprise if we consider a warmer climate in the Upper Miocene. However, since *H. laevipennis* Thomson is associated with marshy and bog habitats which at the time covered wider areas in Central Europe due to the predominance of rain-forest vegetation, the species could well be at home in Southern Poland and might have ranged even further south.

Of interest is an extensive age of the species which remained practically unchanged over approximately 10 million years (*cf.* Gabunia & Rubinstein 1968, Berggren 1972) — a period marked by various climatic and environmental transformations. The geographical range of the species certainly fluctuated to a considerable extent during that period. Periodically retreating from certain sites, the species probably reoccupied the abandoned areas as the conditions gradually improved. When the cli-

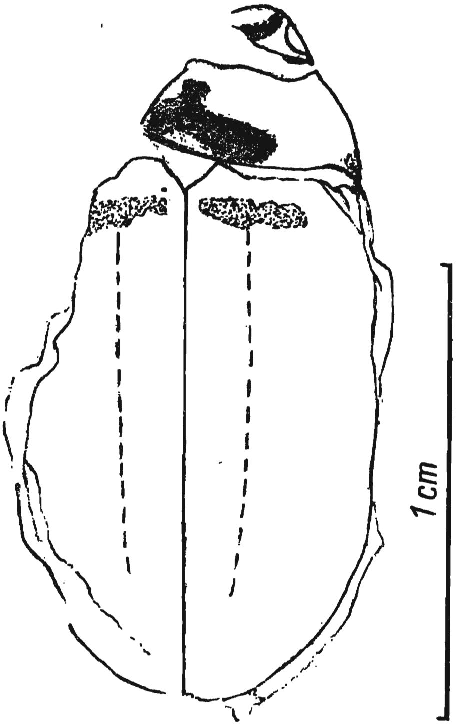


Fig. 5

Shetch-drawing of *Hydaticus laevipennis* Thomson; Przeworno *3*, Upper Miocene; specimen No. *IGP UW Gł. P.3.8*, presented in Pl. 1, Fig. 1

PLATE 1

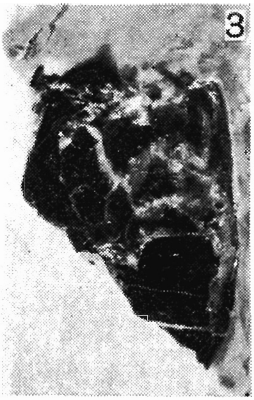
1-3 — *Hydaticus laevipennis* Thomson; Przeworno *3*, Upper Miocene

1 — dorsal view of specimen No. *IGP UW Gł. P.3.8*, × 6; *2* — ventral view of specimen No. *IGP UW Gł. P.3.7a*, × 11; *3* — ventral view of specimen No. *IGP UW Gł. P.3.2a*, × 3

4a-b — *Acilius* sp.; Przeworno *3*, Upper Miocene, × 4

a — ventral view of specimen No. *IGP UW Gł. P.3.1a*, *b* — imprint of the ventral side of specimen No. *IGP UW Gł. P.3.1b*

All photos taken by B. Drozd, M. Sc.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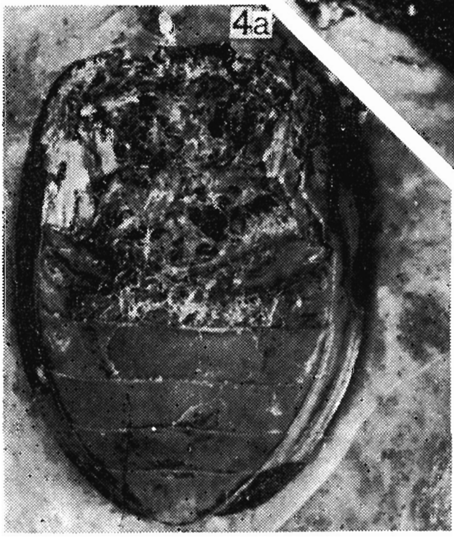
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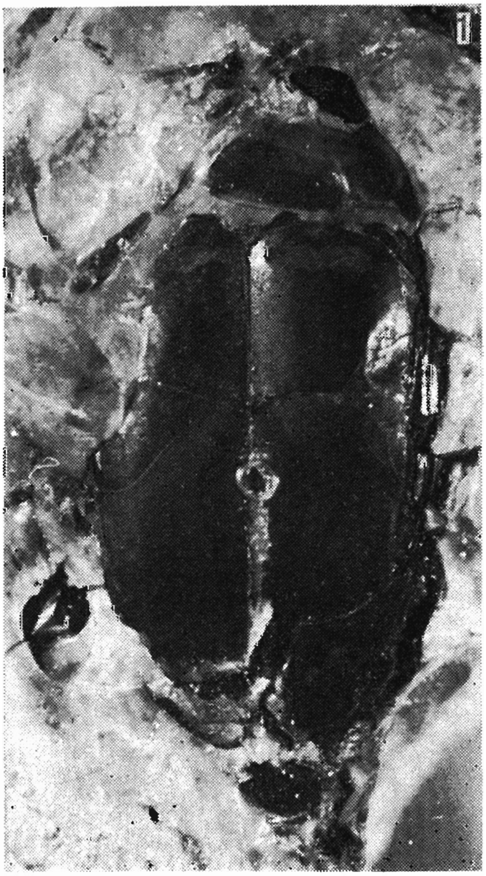
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4b

Siliceous flowstone in the Miocene cave at Przeworno (*cf.* Text-figs 2 and 3; coin diameter 3 cm)
Photo taken by Dr. J. Głazek

mate grew colder and more arid at the end of the Miocene, and the forests disappeared from southern Europe, its distribution became probably restricted. During the Pleistocene glaciations, the fluctuations in range were probably considerable, the species being driven to the south each time as the glaciers advanced in Eurasia and moving north again as they gradually receded. Still, despite its great agility (all *Hydaticus* species are perfect flyers) and an ability to change its domicile, it was probably a great ecological plasticity of the species which enabled it to survive for a period of over 10 million years in Europe.

The presence of a species of *Canthydrus* Sharp, a chiefly tropical and subtropical genus, in the fossil material indicates, moreover, different fauna composition of Central Europe at the time. Most probably, it also contained — aside from temperate zone species actually found in Central Europe — tropical and subtropical elements, the distribution of which definitely shifted south as the climatic conditions deteriorated.

So far, over 50 dytiscid species, none of them extant, have been described from the Tertiary deposits, about 30 of them found in Europe and about a dozen in North America. They belong to the genera *Hydroporus* Clairv., *Potamonectes* Zimm., *Laccophilis* Steph., *Agabus* Leach, *Ilybius* Erichs., *Colymbetes* Clairv., *Erates* Cast., *Hydaticus* Leach, *Graphoderes* Thoms., *Dytiscus* L., *Cybister* Curtis and *Megadytes* Sharp (one species described as *Cybister* Curtis). However, most of these species closely resemble — in the writers' opinion — extant forms and one may wonder if they are not currently living species. Unfortunately, we have not seen

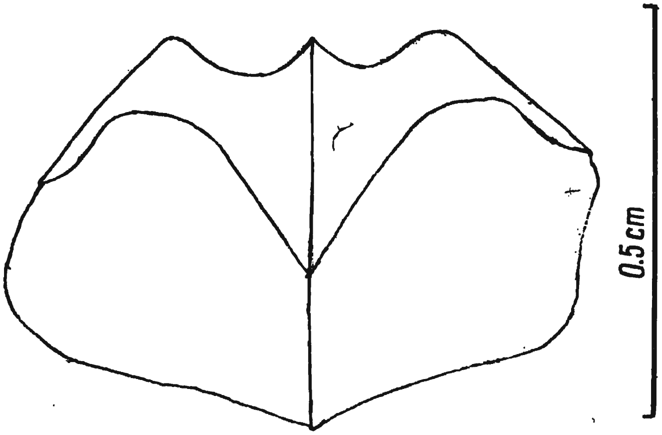

Fig. 6

Sketch-drawing of the ventral side of *Hydaticus laevipennis* Thomson; Przeworno *3*, Upper Miocene; specimen No. *IGP UW Gl.P.3.7a*, presented in Pl. 1, Fig. 2

the specimens described and it is difficult of course to judge from the available description.

The only Tertiary species of *Hydaticus*[2] Leach described so far — *H. zschokkeanus* (Heer)[3] — was found in the Upper Miocene deposits in Oehningen (Heer 1847). Unfortunately, the descriptions contain insufficient information to conclude on the systematic position of the species. A new, careful examination of the Tertiary material seems to be necessary before it could be definitely stated that the species described does not in fact represent an actually living form.

The evolution of insects, which display a fast generation turn-over, could be expected to be a swift process, particularly so during frequent and fast climatic changes in the Tertiary and Quaternary. However, numerous fossil insects belonging to extant genera, and some of the even to actually living species[4], indicate a considerable "conservatism" during the Cenozoic. They seem to have undergone principal radiative evolution and differentiation in the Late Paleozoic and the Mesozoic, and appear to have changed relatively little in subsequent periods. The Dytiscidae (beetles belonging surely to this family) so far recorded from the Tertiary deposits all belong to extant genera and are described as closely related to the Recent forms. The currently living species have solely been reported only from the Quaternary deposits.

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[2] Another species described by Heer (1861, *fide* Händlirsch 1908) as *Dytiscus areolatus* Heer, later revised and reclassified by this author (Heer 1862) as *Hydaticus areolatus* (Heer), does not belong to the genus *Hydaticus* Leach but to *Graphoderes* Thomson (*cf.* Guignot 1931—1933, Statz 1939), which seems to be born out by a "dotty" color patern indicated in the description as well as by Heer's (1862 p. 40—41) statement: "that the species resembles *Hydaticus cinereus* (L)" = *Graphoderes cinereus* (L.).

[3] This species was described by Heer (1847) as *Dytiscus zschokkeanus* sp.n., but later, in 1861, reclassified by this author as *Hydaticus zschokkeanus* (Heer) — *fide* Händlirsch (1908) and Guignot (1931—1933).

[4] So far only Gersdorf (1969, 1971) found extant insect species in deposits older than Pleistocene (but not belonging to the family Dytiscidae), namely in the Pliocene of West Germany.

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STANOWISKO GÓRNOMIOCEŃSKICH CHRZĄSZCZY WODNYCH (DYTISCIDAE — PŁYWAKOWATE) W NACIEKACH KRZEMIONKOWYCH W PRZEWORNIE

(Streszczenie)

Przedmiotem pracy jest opis unikalnego stanowiska kopalnych chrząszczy wodnych (Dytiscidae) zachowanych w naciekach krzemionkowych pokrywających ściany jaskini w Przewornie na Dolnym Śląsku (fig. 1—3 oraz pl. 2). Wiek nacieków zawierających chrząszcze określono jako górny miocen (Głazek & *al.* 1971, 1972).

Wśród znalezionych chrząszczy opisano gatunek *Hydaticus laevipennis* Thomson (*por.* fig. 5—6 oraz pl. 1, fig. 1—3) oraz stwierdzono występowanie okazów reprezentujących inny gatunek z rodzaju *Hydaticus* Leach, a także rodzaje *Acilius* Leach (*por.* pl. 1, fig. 4a—b), *Hydroporus* Clairville i *Canthydrus* Sharp, których dokładniejsze oznaczenie wymaga dalszych badań. Szczątki wszystkich chrząszczy odznaczają się bardzo dobrym stanem zachowania, przy czym zwraca uwagę zachowanie się ubarwienia i mikrorzeźby chityny. Brak kończyn oraz częste przypadki odpadnięcia głowy (*por.* fig. 5 i pl. 1) wskazują, że zespół ma charakter nekrocenozy (*sensu* Davitashvili 1945, 1964).

W badanym zespole na podkreślenie zasługuje pierwsze stwierdzenie w stanie kopalnym dziś żyjących rodzajów *Acilius* Leach i *Canthydrus* Sharp oraz gatunku *Hydaticus laevipennis* Thomson, co potwierdza fakt konserwatywności chrząszczy w kenozoiku.

Współwystępowanie rodzaju *Canthydrus* Sharp, żyjącego obecnie w strefie tropikalnej i sięgającego w obszar śródziemnomorski, z pozostałymi rodzajami żyjącymi obecnie w Europie Środkowej (w tym w Polsce — *por.* Galewski 1971) wskazuje, że pogorszenie warunków klimatycznych w młodszym kenozoiku wywołało znaczne zmiany zasięgów geograficznych chrząszczy, a nie prowadziło natomiast do ich przemian ewolucyjnych.

W środowisku otaczającym w górnym miocenie obszar Przeworna rozważane chrząszcze musiały żyć w śródleśnych zbiornikach wód stojących, zaś do jaskini były napławiane *post mortem* z wodą przesyconą krzemionką pochodzącą z wód gorących źródeł wulkanicznych (fig. 4). Występowanie gorących źródeł alkalicznych związane było z rozwojem trzeciorzędowej formacji bazaltowej, co potwierdza stosunkowo wysoka zawartość litu, tytanu i cyrkonu w naciekach krzemionkowych (*por.* Barth 1950, White 1957a, b). W działalności gorących wód na obszarze bloku przedsudeckiego (sygnalizowanych już uprzednio, Oberc & Dyjor 1971) widzieć należy także przyczynę hydrotermalnej kaolinizacji skał krystalicznych tego rejonu (*por.* Szpila & *al.* 1972, Kozłowski & Karwowski 1972).

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