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## **Archaeological and nature reserve "Krzemionki Opatowskie" (Góry Świętokrzyskie Mts., Central Poland)**

Edward BRÓŻ

The Gory Swietokrzyskie Mts. and their northern foreland were penetrated by the primitive man as early as the Pleistocene. The earliest traces of the presence and activity of the Neanderthal tribes on these territories come from 50-60 thousand years. They indicate that even the Paleolithic man used local raw materials to produce primitive stone tools and for ritual purposes as well (RUBINOWSKI and WROBLEWSKI 1986).

In the following epochs, the whole northern part of the Gory Swietokrzyskie Mts. became an important mining and metallurgic centre on the European scale (BROZ 1992). This is manifested by the relicts of old technologies preserved up to our times: the Neolithic flint mines, traces of ancient metallurgy from the Iron Age, old marble quarries and, at last, iron ore mines and ruins of metallurgic furnaces and of other metallurgic works dating from the beginnings of the 19th century (JASIUK 1962). These relicts are now protected and secured in various ways. The archaeological and nature reserve "Krzemionki Opatowskie" is a protected object of this type. The reserve itself is located on the NE foreland of the Gory Swietokrzyskie Mts., about 9 km NE of Ostrowiec Swietokrzyski (Fig. 1). The reserve covers an area of 378.8 ha. The main object of protection in Krzemionki Opatowskie is a unique flint mine from the Neolithic Period, considered as the biggest and best preserved one in Europe.

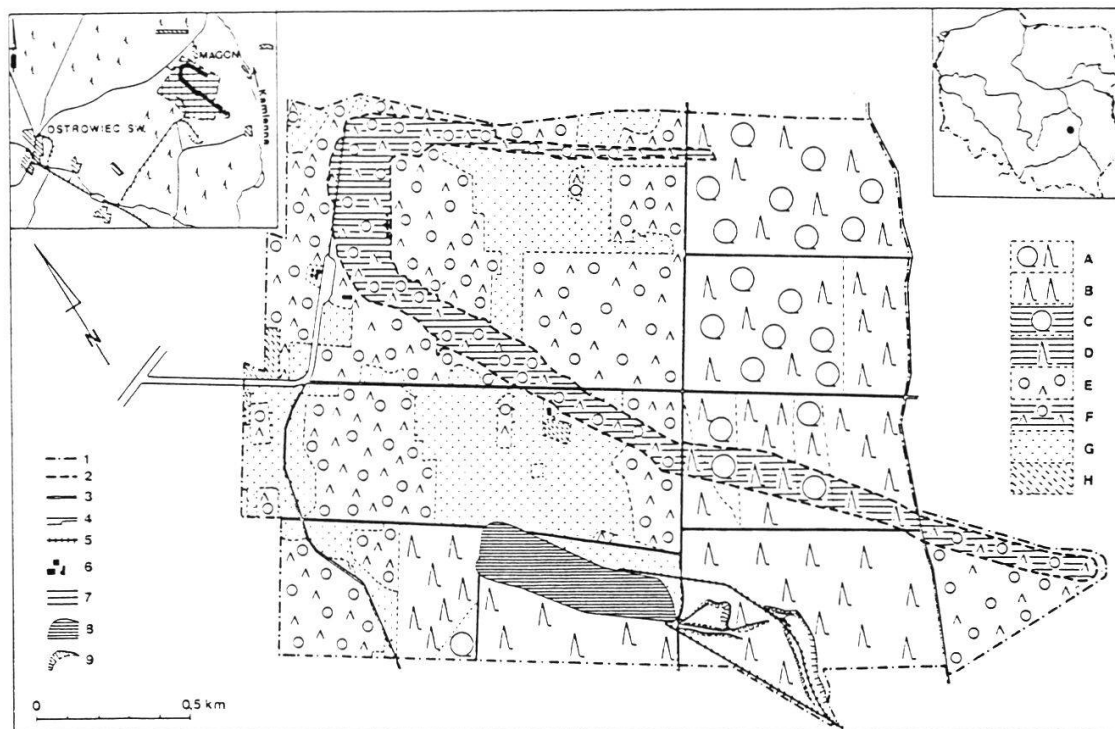
Natural values of the reserve were noticed only some years ago. The discovery of many protected and rare vascular plant species and plant communities

(GLAZEK 1974, 1976) provoked measures towards its protection.

### Archaeological monument

The flint mine protected in the reserve was active 3.5-5 thousand years ago i.e., in the Neolithic and Early Bronze Age. The exploited flint-bearing area (the so called "mining field") up to 5 km long and 30-80(120) m wide, covers an area of 36 ha (Fig. 1). The area of the mine shows tips of limestone debris and numerous hollows and craters (ca. 3'000), the remnants of pit shafts. A labyrinth of corridors and workings extends 4-12 m deep below the ground. Only a small part of the corridors has been cleared of rubble for archaeological studies (KRUKOWSKI 1939, SALACINSKI and ZALEWSKI 1987, ZUROWSKI 1962).

Flint concretions ("nodules") occur in 2-8 m deep beds of Jurassic limestones



**Fig. 1.** Location and vegetation of the archaeological and nature reserve "Krzemionki Opatowskie".

1 - limits of the reserve, 2 - limit of the "mining field", 3 - forest boundaries, 4 - roads, 5 - railway, 6 - buildings, 7 - "mining field", 8 - technological waste-heap of Ostrowiec iron-works, 9 - excavations of inactive quarries.

A - *Quercus-Pinetum*, B - *Pinus sylvestris* monoculture on *Quercus-Pinetum* habitat, C - *Tilio-Carpinetum*, D - *Pinus sylvestris* monoculture on *Tilio-Carpinetum* habitat, E - scrubs and brushes on *Quercus-Pinetum* habitat, F - scrubs and brushes on *Tilio-Carpinetum* habitat, G - grassland communities on *Quercus-Pinetum* habitat, H - fields and fallows.

covered by residual clay and a mantle of Pleistocene sediments. Remnants of workshops found by archaeologists indicate that flint-processing was applied on the spot. Next, intermediate products were transported to neighbouring settlements where the processing was finally finished. Flint was used as a material for production of tools (mainly axes, chisels). Finished products were "exported" to Central Europe within a radius of 600 km from Krzemionki Opatowskie.

The decline of the Neolithic mining in Krzemionki Opatowskie, which was active for 1500 years, took place at the time when the world was already in the Age of Bronze. After a rapid downfall of flint mining 3500-3800 years ago, the area of the mine was dominated by forest vegetation. In the beginning of the 20th century, part of the forest was cut out and a village Krzemionki was set up.

### Vegetation

The reserve is located on a denuding plain, built of Jurassic limestones, covered by a thin layer of sandy and sand-clay Pleistocene sediments. The whole area is dry, warm, and bereft of any water reservoirs and streams. Before the Neolithic mining ruled the area, the mixed pine-oak wood (*Querco-Pinetum*) had been the dominant type of vegetation there. The present vegetation of this protected object has been shaped, to a greater extent, by long-term and diverse human activity. The earliest stage of anthropogenic changes in the primary vegetation occurred as early as the Neolithic.

In the area of mining there occurred deep and irreversible changes in soil conditions. On the tips of limestone rock deposited on primary podzolic soils, secondary post-industrial soils with features of lime rendzinas developed. After the reoccurrence of woods on the already exploited territory, the former acidophilous forest vegetation was replaced by the mesophilous oak-hornbeam phytocoenosis (*Tilio-Carpinetum*) of calciphilous and thermophilous plants.

After about 3500 years there followed a second stage of anthropogenic changes of the vegetation of the present reserve connected with colonization. The then deforested areas became plough land. Together with the spread of synanthropic plant communities the anthropophytes began to play an important role. The area of the old mine, not suited for cultivation because of surface deformations and dumps of rock debris, was abandoned as wasteland. The communities of xerothermic vegetation of the *Festuco-Brometea* class gradually appeared (GLAZEK 1975) and as a result of further succession a scrub phy-

tocoenosis of *Trifolio-Geranietea* and *Rhamno-Prunetea* classes (with *Juniperus communis*, *Berberis vulgaris*, *Prunus spinosa*, *Corylus avellana*, and others) occurred.

After the establishment of the reserve the plough land of the former village was left as permanent wasteland. As a result of secondary succession on the formerly arable land, a rich mosaic of different types of grassland, scrub, and regenerated forest developed which belong to a dynamic group of communities of two forest associations (mixed oak-pine wood [*Quercus-Pinetum*] and eastern Polish oak-hornbeam wood [*Tilio-Carpinetum*]; Fig. 1).

The vascular plant flora of the reserve (ca. 510 species) is composed of the dominant forest plants (c. 100 species), fresh meadows (50), xerothermic grasslands (45), and sandy (30) or thermophilous thickets and forest outskirts (35). At present, the quantitative proportion of synanthropic plants (mainly anthropophytes) is decreasing and the regression of xerothermic species is intensified as a result of dynamic changes in the flora and vegetation (BROZ 1991).

The floristical value of the object is determined by the occurrence of numerous protected species (27 taxa) and of interesting geographic elements, such as *Adenophora liliifolia*, *Allium angulosum*, *Aster amellus*, *Anemone sylvestris*, *Carlina acaulis*, *Cephalanthera rubra*, *Cimicifuga europaea*, *Cirsium pannonicum*, *Clematis recta*, *Cotoneaster integerrimus* and *C. niger*, *Cypripedium calceolus*, *Daphne cneorum*, *Gentiana cruciata*, *Inula ensifolia*, *Koeleria pyramidata*, *Laserpitium latifolium*, *Polygala brachyptera*, *Prunus fruticosa*, *Senecio nemorensis* ssp. *fuchsii*, *Seseli libanotis*. Recently, some rare adventive species have been found here: *Centaurea diffusa*, *Epilobium dodonaei*, *Gypsophila trichotoma*, *Linaria genistifolia*, *Verbascum blattaria*.

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