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# THE IDENTIFICATION OF CHARCOAL FROM ARCHAEOLOGICAL FINDS IN RISAN (MONTENEGRO)

*The research aimed to identify two sets of charcoal found in a Hellenistic house in Risan (Montenegro) on the Kotor Gulf. The finds date from the 3rd century BC. The study included macroscopic and microscopic observations. Based on macroscopic observation and taking into account the habitat requirements and the range of particular species near Risan and the Kotor Gulf, the first set of charcoal found near a ceramic vessel was attributed to fir wood (Abies sp.), while the charcoal found in the room "with the treasure" was attributed to oak wood (Quercus sp.). The study has added to the body of evidence in favor of the effective botanical identification of charcoal from archeological finds.*

**Keywords:** Risan, archaeological excavation, wooden charcoal, identification of charcoal

## Introduction

The remains of wood from archaeological excavations usually fall into two types of findings. The first type is uncharred wood with a high natural durability, such as oak, ash, elm, pine, larch, and probably yew, alder and spruce. The second type of findings is the charred wood of the species listed above and wood species with a low natural durability, but which could survive in the form of charcoal [Dzbeński 1977; Dzbeński, Kozakiewicz 2002]. Wood charcoal forms as a result of the slow pyrolysis of wood when burned in an inadequate supply of oxygen [Asouti 2006]. Identifying charred wood involves technical difficulties but identification is usually possible because the anatomical features of the wood remain intact during the carbonization process [Smart, Hoffman 1989; Prior, Gasson 1993]. Thus identification of wood charcoal can be made at family or genus level. But due to the very similar cellular morphology of the taxa within the same genus, making

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species-level identification is usually impossible [Tennessen et al. 2002]. The ideal method for identification requires microscopic observation by transmitted light [Koeppen 1972]. Charcoal has reflective surfaces, which means that a standard microscope using direct light sources generally creates too much contrast to view the cells. A metallurgical microscope, with a light source that is transmitted directly down onto the sample through the objectives, and then retransmitted from the sample back through the objectives, eliminates reflection. Charred wood retains its original structure, but preparing microscope preparations are severely hampered due to the significant friability. This is why only the external structural features visible in reflected light on fracture can be taken into account at the identification stage [Hawes, Graham 2009].

A charcoal reference collection is relatively simple to prepare. The first step is to accumulate a collection of wood of known identity and then convert it to charcoal. Wood specimens should be large enough so that after charcoaling they can be split and broken to show the sharp structural details of the cross, radial, and tangential surfaces. In exceptional cases, for example quite charred fragments of wood, after using the technique of embedding the samples of wood in binders to consolidate the weakened tissue, making microscopic preparations is posible. The observation of microscopic preparations in transmitted light often reveals details of the internal structure of the material, allowing accurate identification [Dzbeński, Umgelter 1974]. Despite the significant degree of difficulty of the work, identification of charred wood is possible. This is confirmed by numerous reports, such as the identification of samples of charred wood from excavations in Krzemionki, Grodzisk and Izdbeki, Krzesk, Haćki, Krosno [Dzbeński, Kraińska 1985, 1986, 1991, 1992], Grodziszcz Mazowiecki [Kozakiewicz, Dzbeński 1997], Lovosice in the Czech Republic [Petrlíková, Beneš 2008], Yenibademli Mound in western Turkey [Yaman 2010], Oiartzun in the Basque Country [Moreno-Larrazabal et al. 2011] and Novae in northern Bulgaria [Jankowska, Kozakiewicz 2011].

## Material and method

The study was conducted on two sets of charcoal found in June 2011. This material came from the old town of Risamium (Rhizon, present-day Risan in Montenegro), situated on the Kotor Gulf, on the Adriatic coast.

Archaeological excavations in Risan have been conducted by the Centre for Research on Antiques from South-Eastern Europe, Warsaw University, since 2000. During excavations carried out in a Hellenistic house, a ceramic dish filled with coins was discovered under the floor of one of the rooms. The very clear archaeological layout allowed researchers to conclude that the vessel was covered with rubble, in the form of charcoal, after a fire. Charcoal was found in two layers – one layer lying below (probably material from the first set) and the other layer

lying above or in the floor of the room (probably material from the second set). The hidden ceramic dish dates from 229 BC.

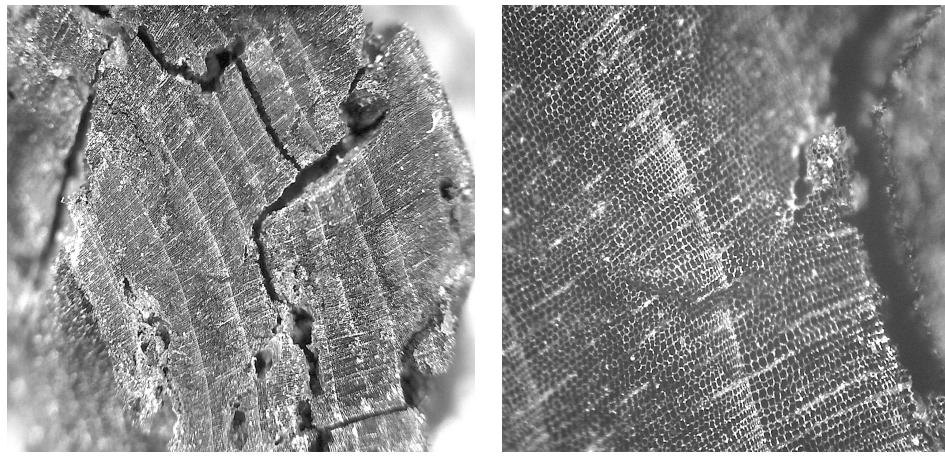
The first set of charcoal was found at a depth of 1.06 m with the ceramic vessel. The charcoal was in the form of several small pieces in the shape of cubes with side lengths equal to approximately 15 mm. The second part of the material was found at a depth of 0.87 m, described as material found in the room "with the treasure". The material was in the form of small pieces similar to the shape of a cube. The length of the largest piece was approx. 35 mm.

The scope of the study included macroscopic and microscopic observations. On the basis of literature data concerning the range and the occurrence of selected tree species in Europe, the supporting analysis predicted the likelihood of a type of wood used in Risan in the 3rd century BC.

## Results and discussion

### Identification of charcoal found near a ceramic vessel

The visible macroscopic features supported the conclusion that all the pieces of charcoal came from coniferous wood. In the charcoal elements, there was a lack of items such as vessels or the grouping of parenchyma cells, which may indicate another type of wood. However, the tracheids indicated coniferous wood - elements forming the structure of the material (fig. 1).



**a)** **b)**

**Fig. 1. Charcoal – a) 20x, b) 200x**
***Rys. 1. Węgiel drzewny – a) powiększenie 20x, b) powiększenie 200x***

The earlywood created made from thin walls and high diameter tracheids. The closer to the end of annual growth, the smaller the diameter of the tracheids

and the thicker the walls of the tracheids. In latewood, the tracheids flattened in the radial direction. No resin conductors on the cross-sectional and longitudinal crosssections were observed. The transition from earlywood to latewood was soft. Among the timber species from the temperate zone this set of features is characterized by only fir *Abies*.

Many species of the kind *Abies* are known in Europe: *A. alba* Mill., *A. cephalonica* Loud., *A. cilicica* Carr., *A. nebrodensis*. Given the habitat requirements and range of particular species, it can be said that the wood stored in the form of charcoal found in Risan may have come from the tree of the genus *Abies cephalonica* Loud. – Greek fir. Based on the microscopic observation of charcoal in reflected light the species could not be determined and thus wood of the fir *Abies alba* Mill. [Kapa 2010] could not be excluded.

**Identification of wood found in the room „with the treasure"**

Visible macroscopic features allowed the conclusion to be drawn that all the pieces of charcoal were formed from oak wood (*Quercus* sp.). The identification of oak was certain as clear distinctive features could be observed even in the charred fragments (fig. 2). This was ring-porous wood with tight rings of large vessels in the earlywood. The vessels in the earlywood with large diameters (from 0.1 to 0.4 mm) were clearly visible to the naked eye. The small vessels in the latewood formed characteristic, radially extending, aggregations often looking like flames of fire. Wide wood rays were clearly visible in all three anatomical sections.

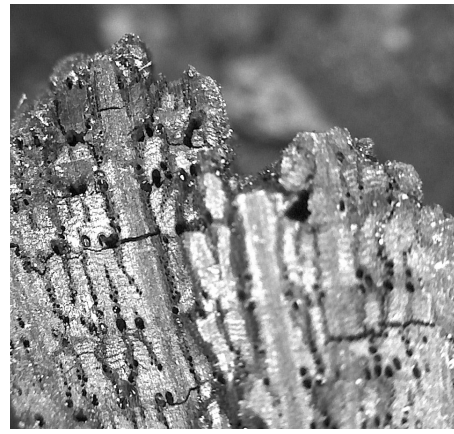


**Fig. 2. Charcoal (magnification 20x)**
***Rys. 2. Węgiel drzewny (powiększenie 20x)***

Among the timber species from the temperate zone this set of features is characterized by only oak. However, even taking into account the microscopic methods, secondary and tertiary recognizable features did not enable the distin-

guishing of different species of oak among the oak trees growing in Europe. The most widely occurring in Europe is the European oak (*Quercus robur* L. and *Quercus petraea* Liebl.) and other oak species (*Q. pubescens* Wild., *Q. cerris* L., *Q. ilex* L., *Q. suber* L.). Given the habitat requirements and ranges, it could be concluded with a high probability that the wood charcoal found in Risan could be from wood of a species of European oak (*Quercus robur* L.) [Kapa 2010].

## Conclusions

The study confirms that the identification of charcoal is possible due to the good state of preservation of the structural elements of the wood, particularly the woody parts (vessels, tracheids, fibers).

Botanical identification was limited by the possibility of only observing the primary and secondary structural features, referring to the relevant species of wood. Due to the considerable fragility of the material making microscopic preparations is not possible. Identification was limited to observation of the material in reflected light.

Based on the results of microscopic analysis and taking into account the habitat requirements and the range of particular species, it was found that:

1. The charcoal found near the ceramic vessel was attributed to fir wood (*Abies* sp.).
2. The charcoal found in the room "with the treasure" was attributed to oak wood (*Quercus* sp.).

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# IDENTYFIKACJA WĘGLI DRZEWNYCH ZE STANOWISKA ARCHEOLOGICZNEGO W RISAN W CZARNOGÓRZE

**Summary**

Przeprowadzone badania potwierdzają możliwość identyfikacji gatunkowej węgli drzewnych. Trudności wiążące się z identyfikacją wynikają z ograniczenia obserwacji analizowanego materiału w postaci preparatów mikroskopowych w świetle przechodzącym. W niniejszym artykule zaprezentowano wyniki identyfikacji gatunkowej dwóch zbiorów węgli drzewnych znalezionych na obszarze domu hellenistycznego w Risan w Czarnogórze. Znaleziska są datowane na trzeci wiek p.n.e. Zakres badań obejmował obserwacje makroskopowe i mikroskopowe. Na podstawie wykonanych obserwacji i po uwzględnieniu doniesień literaturowych z zakresu wymagań i występowania poszczególnych gatunków drzew w okolicach Risan nad Zatoką Kotorską stwierdzono, że węgle należące do pierwszego zbioru (rys. 1), znalezione przy ceramicznym naczyniu wypełnionym monetami, pochodzą z drewna jodły. Drugi zbiór węgli (rys. 2), znaleziony w pomieszczeniu „ze skarbem", to pozostałości drewna dębowego.

**Słowa kluczowe:** Risan, znaleziska archeologiczne, węgle drzewne, identyfikacja węgli drzewnych.