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Early medieval scales and weights from Polish lands. Archaeological and technological study.

Summary (English)

The presented work discusses the finds of early medieval folding scales and weights in Poland. In the last decades of the 8th century, a stream of oriental silver appeared on the Baltic coast associated with long-distance trade. The presented artefacts, together with hack-silver, silver jewelry and coins, are one of the key elements of the so-called the Baltic economic zone, which covered the Baltic Sea basin, the areas of Eastern, Central and Northern Europe along with the Volga and Dnieper rivers - which are specific trade routes. It is assumed that scales were initially used primarily to estimate the value of weighed silver in commercial transactions. Soon, along with economic development, they began to be used for weighing herbs, spices or portions of raw materials in jewelry workshops.

The dissertation is on the borderline of two research fields: archeology and technical sciences. The main aim of the work is an attempt to link the results of metallurgical research of finds of scales and weights with archaeological findings in terms of their chronology and typology. The presented research also touches on the issue of economic development and the formation of early statehood.

Currently, most researchers use the classification system of scales proposed by Steur (1997), divided into 10 types, based on the criteria of modeling the weighing arms and the construction of the hinge part. It is also worth recalling the earlier classification of Wachowski (1974), who, apart from the details of the modeling, drew attention to the length of the arms of the distributed weight. Their elongation, and thus the increase in sensitivity and lifting capacity, indicates a significant change in purpose and was probably associated with the disappearance of the ore economy. As indicated, the beginnings of the use of folding scales fall on the last years of the 8th century and function in an almost unchanged form until the 14th century. Chemical analyzes covered 82 artefacts.

The weight classification system is based on the division prepared by Khyllberg for a series of finds from the Birka cemetery (1980). The proposal was then supplemented by studies by Steur and Wachowski. The artefacts discussed in the dissertation are primarily cuboetahedral (type A) and spherical forms with a bimetallic structure (type B1/B2). Generally, the appearance of the above weights is in the late 8th century, and the earliest are said to represent a multiple or fraction of a

weight unit of the order of 3.6-4.2 g related to the Arabian dirhem, or 8 g representing the Scandinavian etrog unit. The preserved marking in the form of points stamped on flat surfaces, apart from weight information, is also interpreted as a position in a set of weights. It is assumed that they could have been used until the end of the 13th century. Due to the poor state of preservation of many artefacts, it is often not possible to accurately define them typologically. It seems, however, that the B1 weights and the more slender B2 weights function side by side, were produced in the same workshops, and their mixing was greatly influenced by traveling merchants at that time. Among the younger types of B3-B8 weights, the technology of connecting the iron core with a copper coating is disappearing in favor of a uniform copper or lead alloy. A biconical form appears and sometimes a circumferential groove. These are weights associated with the Cologne fine (233.8 g), and the preserved hallmarks in the form of an emblem often indicate the issuer. 163 weights were analyzed for the purpose of the work.

An important part of the work is the discussion of research methods and issues in the field of archaeometallurgy. The author tried to present various ways of using technical sciences in a better understanding of archaeological finds. The types of copper alloys and the nomenclature of historical alloys are discussed along with the influence of intentional alloy additions and impurities on the metal. Then, the spectrum of research methods used is presented: X-ray fluorescence, atomic absorption, X-ray imaging, isotopic ratios. On the basis of the obtained results of zinc, tin and lead content, alloy groups were distinguished (A-S). Various composed brasses and lead brasses turned out to be the most popular formulas for scales. A significant number of artefacts were made of zinc-rich brass, showing, apart from good functional properties, high aesthetic value. Among the weights, the most widely used metal was lead brass. In both categories of artefacts, a gradual dilution of the purity of brasses over time was noted. Markings of trace elements allow us to assume that the raw material of common Western European origin was used to a large extent. The separation of alloy groups showed that within one settlement complex, the artefacts show a diversity of raw materials, and their different types could be made with the use of the same metal.

In the last part of the work, the results of invasive technological tests performed on 4 weights and 8 elements of foldable scales were presented. For the weights, cellular structures with remnants of dendritic structure were disclosed. Observations largely confirm the reconstruction of the process of producing weights in clay molds. Prolonged annealing partly changes the primary dendritic structures. on the balance finds, with the exception of one sample, mainly the cellular structure was recorded as a result of plastic processing.