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Dendrochronology of Biskupin – Absolute Dating of the Early Iron-Age Settlement

by

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Summary. In spite of 60 years of archaeological investigations on the settlement of the Lusatian culture from the Iron Age at Biskupin the questions when the settlement was built and how long was it functioning have not been, up to now, answered. The performed dendrochronogical investigations have brought the solution to this problem. The age of the wood in question was determined on the basis of exact investigation of the oak samples taken from constructions dated at 747–722 BC which are at present 2716 to 2741 years old. The obtained results change by 100–250 years backwards the preliminary datings gained with the classic archaeological methods.

In 1933 the well-preserved wood constructions belonging to the settlement of the Lusatian culture of the Iron Age were discovered on a small peninsula of the Biskupin Lake on Pałuki (north-western Poland). For 60 years Biskupin was the site of intensive interdisciplinary investigations and the stand in which several generations of the Polish archaeologists have been educated. The major part of the settlement was uncovered but many relicts of material culture were excavated and elaborated. Nevertheless, it remains an open question when the settlement was built, how long it functioned, when and why it was abandoned.

On the base of the analysis of ceramics and objects of material culture the settlement of Biskupin was estimated by the archaeologists at the first half of the first millenium BC, between the years 550 and 400. Recently, however, more and more frequent opinions appear on the necessity to set back the date of settlement beginning [7, 12]. It is not possible to clarify this problem using

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the classic archaeological methods. On the other hand, the methods which originate from natural and exact sciences, namely dendrochronology and radiocarbon dating introduce a new chance to solve that problem.

First trials on the precise determination of the age of the discovery were undertaken before the Second World War. Pieces of Biskupin timbers were sent to the Institute of Geochronology in Stockholm. In 1956 the few existing models involving the chronology of Norwegian pines and American sequoias [4] were used for comparison to the mentioned samples. These results cannot be accepted from the present point of view because the various species of wood growing in quite different climatic conditions were compared.

The next attempt to solve the Biskupin problem was the sending of samples to the dendrochronological laboratory at Neuchatel and in Vienna in the eighties. No conclusive results were, however, obtained.

Much light on dating of the settlement was thrown by the radiocarbon analyses. On the basis of the first published results Biskupin was located between 880 and 700 BC [8]. These results have been, however, assessed as not fully reliable. Later ^{14}C datings dispersed within the range of several hundreds of years which have dimmed this picture even more. Disturbances in the content of ^{14}C carbon isotope in the atmosphere in the Hallstatt period as well as the specific course of the calibration curve and first of all a small accuracy of the method happened to be a difficult hindrance to overcome. In 1991 the systematic dendrochronological investigations on timbers from Biskupin have been undertaken by the dendrochronological laboratory of the Academy of Fine Arts in Warsaw in cooperation with the State Archaeological Museum in Warsaw.

The basical aim of the project was:

– to determine the usefulness of the archaeological timber from Biskupin for the dendrochronology as well as the possibility of taking samples in the present conditions;

– to date relatively the constructions, to determine the age of the construction and its development;

– to determine the "floating chronologies" of oak from Biskupin;

– to date the settlement absolutely on the base of the present European master chronologies or through the prolongation of the Polish chronologies into the past.

Material and Methods

The 71 oak elements belonging to the rampart and foundation of dwellings in the north-east part of excavation and to the gate, the transversal street and the breakwater from the west part of Biskupin peninsula were selected for dendrochronological investigations. In this selection one was guided by the dimensions of the elements and the tree-ring structure estimated on the spot. Our intention was to obtain the tree-ring sequences being as long as possible. Very bad technical properties of elements located above water or ground surface, namely the numerous fissures and deformations limited considerably or even excluded them for the dendrochronological investiga-

tions. On the other hand, there were well preserved fragments of vertical pillars embedded in the ground and of breakwater pales driven obliquely.

Investigations were carried out according to the classic, many times described, dendrochronological methods. Details of the principles were presented previously [2, 3, 10]. Basical dendrochronology of oak elaborated for Poland [13, 14] was used. Measurements of the tree-ring widths were performed with the use of the Ecklund measuring device and the results were analysed with the CATRAS programm [1].

Results and Discussion

Samples were taken from the selected elements on which tree-ring widths were measured. Results of the measurements as well as tree-ring curves estimated on their basis have brought the following observations:

– Biskupin inhabitants utilized the oak trees of a diameter up to 25 cm, rarely exceeding 100 years of age. The longest growth sequence accounted for 142 years;

– the rhythm of growth underwent considerable changes, a distinct influence of strong external factors on the cambial activity of the trees was evident;

– the sapwood of as many as 30 samples was fully preserved with bark edge what has given the chance to determine the age with an accuracy to one year;

The cross-correlation of all the tree-ring sequences has brought numerous results in spite of their bad condition. A very similar course of investigation of the tree-ring curves has provided that 61 among 71 analysed samples could be relatively dated.

Dispersion of investigated elements in time was surprisingly small. From the survey of the results concerning the chronology of Biskupin settlement which was prepared by Mikłaszewska-Balcer [7] it appears that the period of the settlement existence was estimated for 50 to 120 years. Meanwhile only about 25 years had elapsed between the year of cut of the youngest and the oldest element out of the investigated ones. Since the samples originated from the different constructions and places the further investigations are needed, i.e. small series analysis, in order to verify their reliability.

The groups of tree-ring series of the greatest similarity were helpful to establish the middle-curves. Subsequently, a common chronology of oak from Biskupin composed of 24 single sequences was prepared. This chronology comprised 166 years. By the chronology of this kind all sites and forest complexes from which came the construction material are represented. Owing to this fact one could try to synchronize it with the reference chronologies of the neighbouring regions. They indicated, as it was proved when comparing the standard chronologies of Poland and of neighbouring countries [13], a very broad – in some periods – territorial extent (Fig. 1).

The nearest to Poland oak chronology which covers the second half of mil-

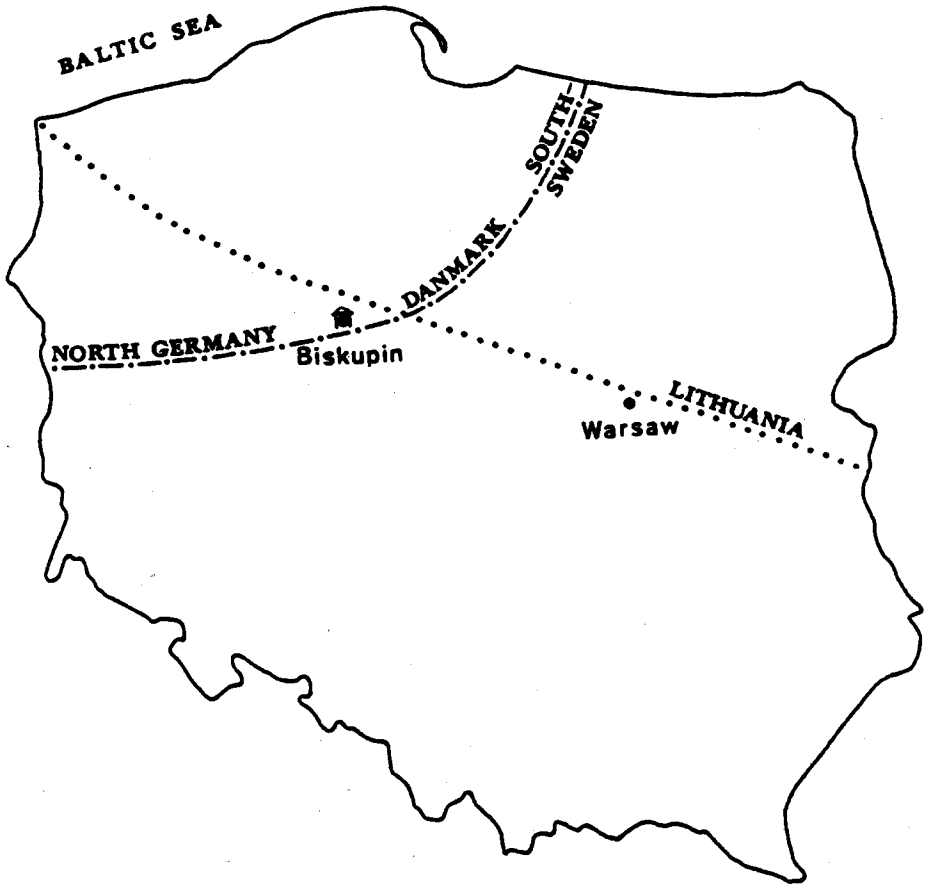

Fig. 1. Range of European oak chronologies in Poland in the years 1820–1950

lennium BC is the Göttingen master chronology for the territories of Low Saxony [6]. By the courtesy of Dr H. H. Leuschner they have been rendered accessible for dendrochronological investigations on wood from Biskupin. Synchronization of the Biskupin middle-curves with the Göttingen master chronology resulted in a full success. Both the visual similarity of the tree-ring curves and the statistic parameters of the comparative analysis issued an unmistakable results.

The chronology of Biskupin covers the years 887–722 BC. The investigated timbers come from trees cut within the years 747–722 BC while the great majority of samples with a fully preserved sapwood comes from the winter cut 738/737 BC. It refers particularly to the elements from the north-eastern excavation of the rampart construction and of dwelling foundations.

The obtained results can be presented on the example of the west part of the excavated breakwater which is at present situated above the ground surface. Samples in number of 16 were taken from the breakwater and it was possible to date them all, three of four exactly to a year. The position of measured annual rings sequences is presented in the diagram (Fig. 2).

Fragments of bars which are marked with black colour depict the years in

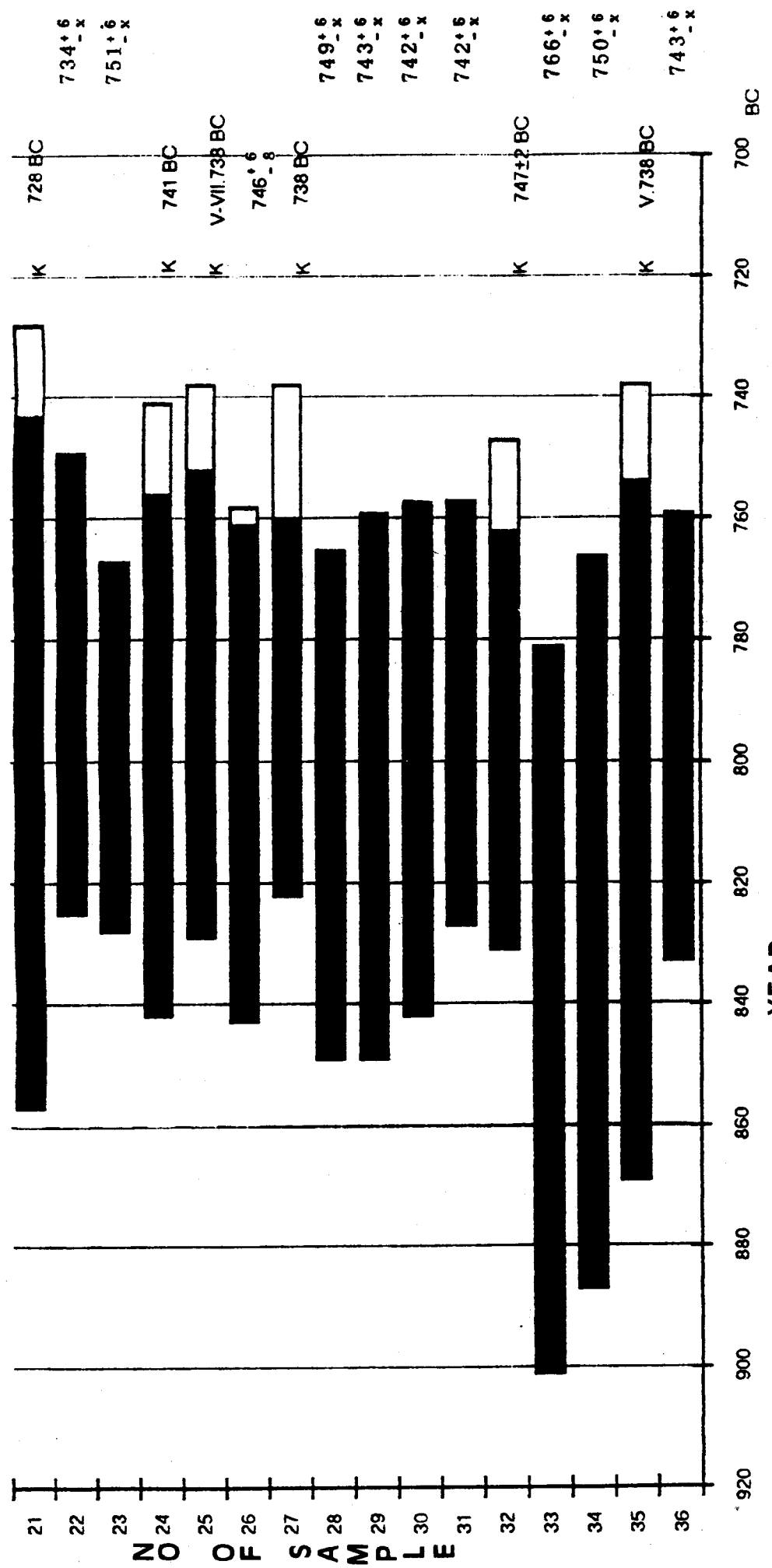

Fig. 2. Bar diagram showing tree-ring results from the breakwater structures from Biskupin

which there appeared the measured hardwood rings, those marked with white colour – the preserved fragments of sapwood. Final results of dating are given in two columns next to the bars. In the first column the results of samples with preserved sapwood are comprised, in the second one – those devoid of sapwood and with unknow number x of hardwood rings.

Pales nr 25 and 35 come from trees cut during the vegetation period of the year 738 BC, several months before the period of the greatest building activity of Biskupin inhabitants. The youngest pales of nr 21 and 22 are placed next to the gate from which there come both the oldest and the youngest construction elements of Biskupin dated up to now. The pale nr 32 is 20 years older and is dated at 747±2 BC, the pale nr 33 is probably from the same time. These results show the permanent complementing and strengthening of the construction that played the role of the breakwater however its basical part was made also about 738–737 BC.

The problem of determining the age of the Biskupin settlement has been solved in this way. Results of dendrochronological dating differ from the age of Biskupin which was settled with the classic archeological methods. Such a remarkable difference indicates the necessity of performing some corrections of the recently accepted opinions.

The dendrochronological data of places such as Hallstatt, Magdalenenberg/Villingen, are commonly used by archaeologists as the reference points to Biskupin. They were published among others by Hollstein and Spindler [5, 11]. Their results are, however, encumbered with an error of +71 years, i.e. they are in fact 71 years older. The fragment of the oak chronology for Central Germany which covered the period from before 500 BC was the source of the error. The chronology was corrected in 1984 [9] and the dendrochronological datings published after 1984 were already the reliable ones.

Dendrochronological investigations on the Biskupin settlement will be continued, and they should concentrate on following subjects:

– systematic studies on the development phases of the settlement,

– ecological and climatical interpretation of the tree-ring curves with particular consideration of the periods of a deep growth reduction.

Dating of Biskupin provides also a perfect starting point for an elaboration of the settlements chronology of the Lusatian culture in this part of Europe. Continuation of studies can contribute to the knowledge of this still weakly recognized episode of the European history.

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