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Reviewed Article:

Bone Pipes with Parallel Tone Holes. Materials from Medieval Poland (until the End of the 12th C)

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Bone and wood pipes are among the medieval aerophones which have been discovered during archaeological excavations in Poland. The ones that interested us are characterized by

a parallel arrangement of sound holes. They are short pipes, several centimetres long, with two holes cut in different places of the pipe body, either at one end or in the middle. There are pipes with three or even four holes cut in two rows. According to Włodzimierz Kamiński and Tadeusz Malinowski they were two-tone musical instruments due to having two tone holes (Kamiński, 1971, 46; Malinowski 1996, 24). The subject matter of this study is the verification of this hypothesis. Three pipes were subjected to sound experiments by professional musicians using replicas of such pipes, made with bone and elderwood. During the tests the possibilities of the embouchure (various positions of lips, tongue, teeth and facial muscles) were examined: as seen with flute, oboe and clarinet. The test results showed that the objects are used as reed pipes rather than a flute pipe.

> What could all these described pipes be, and what purposes did they serve? They may have been decoys; modified musical instruments used in hunting. Our research confirms such a use. However, it is also possible that they were used for other para-musical purposes, such as whistles, shepherd's tools or children's toys.

Introduction

Artefacts with holes either cut or drilled parallel to each other are known from various regions of Poland: Greater Poland, Lower Silesia and Opolian Silesia as well as Masovia. One of these is a pipe from Ostrów Tumski in Wrocław, Lower Silesia. The instrument was made from the humerus bone of a goose circa AD 1020 (Jaworski, 1990. pp. 80-81). At least two other similar instruments have been uncovered in Ostrówek in Opolian Silesia. The first of them dated to the second quarter of the 11th century, is made of bone and has four holes. It was uncovered in feature No 77, which may be a house (Bukowska-Gedigowa and Gediga, 1986, p. 48, Fig. 16/24; Malinowski, 1996, p. 24, Fig. 9:4). The other is made of wood and also dates to the end of the 11th century (Malinowski, 1996, p. 24, Fig. 9:8,). A similar instrument made of wood which dates to the same period was uncovered in Bródno Stare near Warsaw (Kiersnowska, 1951).

Description of the research subjects

Three pipes made of bird bones were subject to study. Only one pipe, the one from Bydgoszcz-Fordon was the subject of a previous publication (Rauhut, Rauhut, Potemski, 1959, p. 142-163, tabl. XXVII:10). All three were displayed at an exhibition "Music Culture during the Beginnings of the Polish State" organised by the Museum of the first Piasts in Gniezno and the Museum of Pabianice. The pipes were included in the exhibition catalogue (Popławska, 2020, pp. 230-232, 234). They have the following characteristics:

- Pipe from Santok: the middle of the 10th century (Institute of Archaeology and Ethnology, Polish Academy of Sciences, Poznań, on loan in Gorzów Wielkopolski, Catalogue No. 670/59). Comprises a piece of long bone (species unknown), length of the pipe: 60 mm,

inside diameter – ca. 11 mm, outside diameter – ca. 16 mm, diameter of two melodic holes: – 3 x 4 mm, holes almost in the middle of the pipe (See Figure 1).

- **Pipe from Gniezno**: 10th-11th (12th?) century, (Museum Number: MAP TPP2008:1.138), Comprises a bird long bone (species unknown), length of the pipe: 66/67 mm, inside diameter ca. 6-8 mm, outside diameter ca. 9 mm, diameter of two melodic holes: 2.8 - 3.5 mm, holes almost in the middle of the pipe (See Figure 2).
- **Pipe from Bydgoszcz–Fordon**: Early Middle Ages (MO Bydgoszcz, Museum Number MOB A -1164/5). Bird femur bone (species unknown), length of the pipe: 81/82 mm, inside diameter ca. 7-7.5 mm, outside diameter ca. 9 mm, diameter of two melodic holes: ca. 5x6 mm, distance from holes to the closest end of the pipe: 19 mm (See Figure 3).
- **Pipe from Giecz**: early Middle Ages (RAGW Giecz, Museum Number MPP/Gz4 110/99). Bird bone (species unknown), length of the pipe: 85/90 mm, inside diameter: ca 7- 9 mm, outside diameter: ca. 9-12 mm, diameter of three melodic holes: ca. 4 mm, distance of the lowest melodic hole to the closest end of the pipe - 17 mm (See Figure 4).

  Figures 1-4 are reprinted from *Katalog zabytków in: Kultura muzyczna w początkach państwa polskiego*, (ed.) Jabłońska, A., Robaszkiewicz M., Collectio Cathalogorum Gnesnensium, 3, p. 232, 2020. with permission from OSPiS IAIE PAN Poznań

The pipes from Santok and Gniezno are characterised by melodic holes drilled at approximately halfway point of the musical instrument. The pipe from Bydgoszcz-Fordon has melodic holes closer to one end, the pipe from Giecz has three holes drilled close to one end, however, two of them are side by side and the third one is drilled below them, in the middle.

Replicas of these three pipes were made from the following materials: the pipe from Santok was recreated in bone. The pipes from Bydgoszcz-Fordon and Giecz were made from black elder due to the unavailability of bird bones which would meet the criteria of pipes, which are discussed here. The pipe from Gniezno has the same layout of holes as the pipe from Santok; therefore, it was not subject to a musical study. Our primary aim was to find out whether the objects were really used as pipes; secondly what kind of tone they produced and what techniques of playing were possible. From our point of view, the pitch of they produced was irrelevant, the quality of the sound was more important. The range of intervals is given according to the principles of modern acoustics.

Oboe technique

VIDEO 1. OBOE-PLAYING TECHNIQUE TESTED BY AMELIA SKIBIŃSKA.

The first technique applied was the oboe-playing technique which was tested by musician Amelia Skibińska (See Video 1). A reed was placed into the designated top of the pipe, and the tone holes of the pipes were closed or opened in a variety of configurations, similar to the way the opening the end of the pipe was opened and closed. The technique used to carry out this experiment is a basic technique of playing the oboe. The air was blown into each of the pipes with a similar intensity, at equal as well as at stronger pressure. Other techniques could not be effective used as they would reflect the properties of the reed rather than testing the possibilities of the musical instruments. The first pipe with double holes close to an end (pipe from Bydgoszcz-Fordon, See Figure 3), was held with the tune holes down and produced quite a clear and relatively loud sound. The opening or closing of these holes only does not change either the pitch or the timbre. However, after closing the end of the pipe the sound changes to a more muffled and darker one and after closing one of the melodic holes the sound changes its pitch by a third (depending on the intensity of the stream of air either a minor or a major third can be produced). The sound is a nasal one and more delicate while playing with an open end of the pipe. After placing the reed into the opposite end of the pipe the tune holes are now at the upper end. The sound produced now is higher than it was when the holes were at the bottom of the pipe. After closing, the opposite end of the pipe a very nice warm sound is produced. It resembles the sound produced by a recorder. After closing the tone holes, the interval is higher by one second, a minor or a major one, depending on the intensity of the stream of air.

The other instrument: the instrument with three tone holes (the pipe from Giecz, See Figure 4) produces a louder and a lower sound than the previous pipe. Closing off the holes while the bottom end is open does not result in a change to the pitch of the sound; it is only after

the bottom end is closed that the sound of the pipe is modified, by becoming more muffled. By closing one of the melodic holes a minor second interval can be produced. By closing one of the parallel holes and the bottom end a succession of three different music keys can be produced (second minor, second major). After simultaneous closing of two upper melodic holes, the result obtained is the same as after closing one bottom and top hole: a major third is produced. After changing the reed's position so that the holes will be at the top of the pipe a higher pitch is produced. The sound produced by the pipe closed at the bottom end is clearer, it resembles the tone of the contemporary oboe in the middle register. Individual closing of the holes does not have any result; however, closing two of them raises the pitch of the sound/interval by a major second. The instrument made of bone produces the loudest sound (pipe from Santok, See Figure 1), closing one of the ends of the pipe does not result in any change to the pitch of the sound as is the case with the other instruments. By closing one of the tone holes, the pitch can be changed by a minor second. Due to its structure, it was possible to place the reed at only one end of the pipe. However, because the tone holes were cut in the middle of the pipe, it could be assumed that placing the reed into the other end of the pipe would produce a similar result.

Flute technique

VIDEO 2. FLUTE TECHNIQUE TESTED BY ANITA KANDER-MARCHEWKA.

The second technique which was applied was the duct flute. A flautist Anita Kander-Marchewka performs (See Video 2). Using the traditional flute method, and keeping embouchure (position of lips, tongue, face muscles and teeth used in playing a wind instrument) loose, no sound can be produced. After placing one of the ends of the pipe in the hollow under the lower lip at an angle of 45 degrees, with the instrument resting on the chin,

it was possible to produce a few sounds, sometimes whistling ones, sometimes clear very sharp ones (i.e, the pipes from Santok and Giecz). The sounds produced were different and depended on the position of the lips, and the direction of the air: “upwards” or “downwards”. The technique can be compared to the Piano dynamics on flute or modified “whistle tones". The embouchure hole is very small so muscles in the middle of the upper lip are tense and therefore the upper lip moves closely to upper teeth by changing tension, it was possible to produce more tones (two, three). The further the pipe with tone holes at the end opening (pipe from Bydgoszcz-Fordon) was rolled from the player, the more difficult it was to produce the sound. With a different angle the blown air immediately “ran out” through the drilled holes. It was possible to produce a variable sound by closing both melodic holes. No difference in the pitch of sound was produced when drilled tone holes were closed alternately. However, closing and opening the end produced a change in the pitch of sound. Playing the pipes in this manner required a lot of effort and breathing work. It was necessary to change the angle of the air column: from playing “straight” to playing downwards so that the blown air would hit the walls of the instrument. In comparing the diameters of the instruments, it turned out that it was much easier to produce sounds while playing instruments with a smaller diameter than the larger ones. The flute technique of playing such instruments turned out to be difficult.

Clarinet technique

VIDEO 3. CLARINET TECHNIQUE TESTED BY PIOTR ZAWADZKI.

The third technique was the clarinet, which was presented by Piotr Zawadzki, DMA (See Video 3). The aim of the experiment was to produce a sound by the pipes using a reed made from the cut end of a bird’s feather. The reed made in such a way evades attempts at classification

used for contemporary sources because it can be classified as somewhere between a single and a double reed. The technique of playing the reed invokes connotations of double reed instruments because it is held deeper in the mouth, with both lips and unlike the clarinet way of playing music with top teeth planted firmly on the mouthpiece. However, its structure shows some affinity with single reed instruments. The reed was made by cutting the feather near its closed end. The cut is initially diagonal, then parallel to the remaining part of the feather. In this way a small vibrating element of the reed was made, which joins at the bottom with the rest of the feather. It is worth noting that if we call the source of sound a single reed, then the feather is both the reed and the mouthpiece. Such a reed is considerably smaller in diameter than other reeds which were used in the experiment. The reed and the pipe were connected to some straw, a piece of a leather strap or any other material of this kind that could be used as a temporary measure. High tightness in the connection was not necessary and did not materially influence the height of the note. During the experiment the holes were held facing down. In this way each of them managed to produce sounds. The first pipe, the one with two holes (pipes from Bydgoszcz-Fordon), produced a very nasal, piercing sound with moderate intensity. Closing the holes one at a time did not result in any differences in the pitch of the sound, however, by closing them simultaneously it was possible to transpose a note pitch down approximately one half-step. The timbre which was produced by the second pipe, with three holes (the pipe from Giecz), was very similar to the timbre produced by the first one. It was possible to produce differences in tone by closing two upper tone holes or all three simultaneously. Closing the holes in any other configuration did not result in any differences in pitch. It was agreed that closing the open end of the pipe changed the timbre. The registered experiment made it possible to hear other ways to change the pitch and modulation of the play, of which of special interest is the change of tension of the lips, position of the tongue as well as playing by breathing in air through the reed. The pitch produced by the third pipe with two holes (pipe from Santok) in the middle is a bit more resonant. To produce changes in pitch it is also necessary to cover two melodic holes simultaneously. Closing open end results in changes in timbre, but also some delicate differences in the pitch of the sound. Frullato technique (wind instrument technique, produced by making the tongue or uvula vibrate while playing) was also used in the registered experiment.

Conclusions

In concluding the results of the experiments, which were carried out with various embouchure techniques: oboe, recorder and clarinet, it needs to be emphasized that first of all the artefacts discussed here with holes cut parallel were beyond any doubt pipes and not objects used for any other purposes. Experiments carried out by professional musicians did not confirm the hypothesis put forward by W. Kamiński and T. Malinowski that the pipes discussed here can produce various pitch by opening or closing melodic holes. While playing parallel cut out holes the same pitch is produced, which is obvious from the point of view of

acoustics. However, by using the technique of opening and closing the open end and moreover while operating finger holes it is possible to produce a few close intervals with each of the pipes. The experiments indicate that the pipes discussed here were reed pipes rather than flutes, and that thanks to the reeds, it was possible to produce a clear sound. Relaxed embouchure is very difficult and the sound produced is a kind of buzz - it is uncommon for a “clear” sound to be produced. What could all these described pipes be, and what purposes did they serve? They may have been decoys; modified musical instruments used in hunting. Our research confirms such a use. However, it is also possible that they were used for other para-musical purposes, such as whistles, shepherd’s tools or children’s toys.

Keywords music & musical instruments

Country Poland

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FIG 1. BONE PIPE FROM SANTOK. PHOTO BY MACIEJ JÓRDECZKA

FIG 2. BONE PIPE FROM GNIEZNO. PHOTO BY ALEKSANDRA WALCZAK

FIG 3. BONE PIPE FROM BYDGOSZCZ-FORDON. PHOTO BY MARCIN KŁUSAK

FIG 4. BONE PIPE FROM GIECZ. PHOTO BY ALEKSANDRA WALCZAK