

Pots and drums: an acoustic study of Neolithic pottery drums

The author uses Neolithic pottery goblet drums to explore the theory that this type of drum evolved from domestic pots, with the practical part of the investigation focusing on the relationship between acoustic quality and drum shape.

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Introduction

The modern world is filled with a huge range of sounds. The earliest people lived in a world where the sounds around them were limited to those of nature, their own bodies and the noises made by the materials that they knew and used. When the sounds made by innovations such as fired clay and smelted metal were added to their experience, it is reasonable to assume that they explored the sound making potential of these materials too, as they used them to produce new artefacts. Writing in 1981, Cajsá. Lund describes artefacts which appear to be designed primarily for their sound production qualities as 'sound producing devices' (1981, vol 12, 246). The use of this term rather than that of 'musical instruments' reminds us that we must not assume that early people would have had a sense of 'music' in the way that we understand it today.

The research described here is concerned with the origins of the membrane covered drum or 'membranophone', (as named by Curt Sachs and Erich Hornbostel in their classification of musical instruments, 1914), which will be referred to in this work simply as a 'drum'. As described below, drums are known to have existed since the fifth millennium BC. For example, a wall frieze from Catal Huyuk, Anatolia, shows a group of dancers, one of whom is holding up a small frame drum. (Stockmann, in Lund, (ed), 1986 12). The available literature, outlined below, demonstrates that a wide variety of drum shapes and sizes were already known across a large area of the world from 3000 BC onwards. They are recorded on statues, figurines, in tomb scenes

and temple scenes on inscriptions, plaques and wall paintings. Most of the drums depicted are of a frame type, a type defined by Sachs as having a skin, or two parallel skins, which are held taut by some hoop or frame (Sachs, 1942, 33), and either struck by a stick or bare hands.

The drum type at the centre of this research is a hollow goblet shaped drum with a single skin, which is found in Central Europe in contexts dated to the Neolithic (see **table 1** for images). In terms of modern drums, it most closely resembles the darabuka or Egyptian tabla which is common across a large area of North Africa, the Middle East, Turkey and the Balkans, where it has a variety of names. This type of drum is played with the bare hands (Whitaker 2005). The survival of associations between drums and religion in many parts of the world is discussed at length in such works as Sachs (1940), Marcuse (1975), and Price (2001). Since over half of the goblet drums discovered were also found in religious contexts, a religious purpose must similarly be considered for these drums. As yet no evidence has been found of Neolithic goblet drums in Britain, and no tradition of hand drumming has been identified here.

This investigation uses the Neolithic pottery goblet drums to explore the theory that this type of drum evolved from domestic pots. The work is divided into two approaches, the first part focuses on the acoustic characteristics of both drums and pots by using replication work based on a type of drum from the Walternienburg Culture from Germany (**fig. 1**). The second phase uses the findings from the interpretation of the replication work to examine the images of 22 identified drums (and six pedestal bowls) and explore their characteristics in acoustic terms.

A summary of relevant literature

It is widely accepted among music historians and archaeologists that domestic pots with a piece of ani-

mal skin stretched across the top may have been used as the first pottery drums (for example; Lund, 1981, 24, Sachs, 1940, 32, Marcuse, 1975, 121, Stockmann, 1986, 18). Marcuse, (1975, 121), records the survival of several types of 'pot drums' in Asia, Africa and the New World, such as those of the Swazi of South Africa, who employ a primitive type of pot drum to exorcise evil spirits. She also refers to a variety of pot drum known as a water drum (1975, 155).

Archaeological evidence of pottery goblet shaped drums is almost exclusively limited to the group from Europe discussed here. By contrast, shallow, cylindrical 'frame' drums do not survive archaeologically, but their existence is indicated in other ways; Layne Redmond's book 'When the Drummers were Women', (1997), demonstrates that evidence for such drums, is common in the Near East and Southern Europe in depictions of goddess cults which date from the Neolithic until they were banned under Christianity. References to frame drums also occur in works on Shamanism such as 'The Archaeology of Shamanism' (Price, 2001), which contains a series of papers which explore shamanic ritual, material culture and architecture. Although the drums used by shamans are always depicted as being frame drums, they are likely to have been contemporary with the goblet drums mentioned here, and the distribution of the two types of drum may overlap.

Most of the drums investigated here originated from cultures of the TRB



■ **Fig. 8** Finished drums.



■ **Fig. 5** Details of brackets for skin fixing.



■ **Fig. 3** Drums A and B pre-firing.



■ **Fig. 4** Drum B solid, drum A hollow.



■ **Fig. 1** The walternienburg drum chosen for replication.



■ **Fig. 2** The original Brozny drum.

or Funnel Necked Beaker peoples who settled over a large area of Northern and Central Europe from the Early Neolithic. Magdalena Midgley's book 'TRB Culture' usefully identifies examples of drums and records where and when they first appear.

In her introductory paper for the 2001 ICTM Conference on Music Archaeology, Doris Stockmann reasons that the first membranophones were probably earth voids covered with skin. Hers is the most persuasive description of how pottery drums may have come about during the Neolithic;

"...two relatively separate trends of production came into close contact: the production of clay vessels and new kinds of treatment for the skins. To protect food (such as cereal grains, oil or water) from getting dirty and from parasites, the upper openings of the vessels were covered and the tying up with an animal's bladder or a blister or some other flexible skin suggested itself. To resist the attacks of mice or other gnawers the skins had to be tightened. We have no archaeological evidence for all this of course, but I think it possible that the upper rolls of storage pots, the bulges and convexities came into being for the tying of skins, to get it fastened better" (Lund (ed), 1986, 18)

A summary of research to date

In terms of previous work on pottery drums in archaeology, research suggests that the experimental work carried out to date consists of four replication experiments in Sweden and Germany in the 1980s, and a more recent one in Northern Scotland. In Sweden, around 1980, Cajska Lund's systematic search for prehistoric musical instruments in Swedish museums (Lund, 1981 246) led on to the replication of a drum by Anders Lindahl in 1984 and the associated research into drum skins and fixing materials by Lena Alebo (both in Lund, 1986, 27-40, and 41-51). The choice of ceramic vessel chosen by Lund and Lindahl for replication belongs to the group of pedestal bowls noticed by Midgley above.

The third investigation was carried out by Monika Lustig from Germany, who studied many of the Neolithic goblet drums already described above. Her work was summarized in

the ICTM report of 2001 (Hickmann, Kilmer and Eichmann, 2001, 171-186) and was mainly concerned with the description and classification of the 340 or so drums which she had recorded. Lustig's work begins to consider the criteria for identifying pottery vessels as having been intended for use as drums. More recently, work done at the Kilmartin Trust in Argyll, Scotland has included the replication of a prehistoric container as a drum (www.kilmartin.org/music), which is featured along with other musical instruments on a sound recording called 'The Kilmartin sessions; The Sound of Ancient Scotland'.

The investigation at the centre of this work follows on from an experiment carried out by this researcher in 2004, in which a replica was made of one of the Neolithic pottery drums from Brozny in Bohemia in the Czech Republic (Figure 2). This preliminary investigation (outlined below in the account of the practical investigation) demonstrated that this type of vessel when replicated and fitted with a skin drumhead would produce sounds of sufficient quality to confirm that it was made to be used as a drum.

The goblet shaped hollow drum of this investigation was found in an area of Europe stretching from Denmark and the Netherlands in the north and west, to the Czech Republic and 'Little Poland' in the south and East. The densest distribution of these artefacts is in an area of Southern Germany between the Rivers Elbe and Weser (Lustig, *op. cit.*, 172). The pottery shells are made with a larger upper conical section with the widest part at the top forming the mouth of the drum. They range from 12 cm to 46 cm in height, but most are between 20 and 30 cm. tall. It is on this upper section, and not necessarily around the upper edge, that any lugs or brackets for fixing the drumhead are attached. These vary considerably in their design, number and position on the vessel; apart from the pointed lugs already mentioned, some have pierced brackets around the upper rim, while others have rather unpronounced downward pointing lugs. Some drums have no provision at all for skin fixing. The upper section ends in a 'waist' in the middle section of the drum, and the lower section, usually an inverted cone, smaller than the top part, acts as a foot

or pedestal. Within this parameter, the drums also vary considerably in body shape and decorative detail. Some drums have a single bracket for fixing a carrying strap somewhere on the body of the drum.

As can be seen from their illustrations and the locations of their origins, (summarized in table 1), drums which are closely related in geographical terms may vary considerably in their details. Dated by radio-carbon dating of associated finds to between 3600 BC and 2400 BC, dating according to Midgley (1992) and Lustig, (*op. cit.*, 185), Lustig views these drums as a phenomenon which appears without precedent and disappears 'suddenly' (Lustig, *op. cit.*, 175).

The Practical investigation

Replications of the drum

The research design needed to consider these matters:

- What are the questions that the researcher wants to ask?
- What methods will provide the most accurate results?
- What materials will be used?
- How will the results be measured and evaluated?

There are many aspects which could be explored when considering the acoustic properties of pottery containers used as drums. The main focus of the practical part of this investigation is the relationship between acoustic quality and drum shape. The preliminary investigation in 2004 (Aiano, unpublished), involving the replication of a pottery vessel from Brozny in the Czech Republic, used only materials and techniques which would have been available to the prehistoric drum maker. This investigation produced an instrument with sufficient skin tension to produce a range of sounds which were clear and loud enough to confirm that the vessel was likely to have been used as a drum. The sound qualities were not dissimilar to those of the darrabuka, in that different pitched sounds could be obtained by striking the middle and the edge of the drum.

A visit to the National Museum in Prague brought to light a replica of a typical example of Walternienburg drums from Germany (figure 1), of

which drum 11 in table 1 is a further example. The Walternienburg drum differed from the Brozny example in two important ways;

- Although approximately the same height, it had a wider, much more rounded upper section, and a more pronounced 'waist'.
- It had a series of 8 brackets around the rim instead of the twelve pointed lugs of the Brozny example.

This vessel possessed the characteristics of a drum (**figure 1**), but its fuller shape would make it viable as a storage pot if it were not hollow. These factors suggested the drum as a suitable choice for an acoustic investigation. Two replicas of this drum would be produced which would be identical in every respect apart from one: one of them would be hollow all the way through, whereas the other would have a base to the upper part of the vessel. The drums would have identical skins added to them which would be fixed to the brackets by a medium such as sinew, hide strips or cord made from vegetable fibres. The design would attempt to answer the following questions:

- Can the bracket method of drum-head fixing produce sufficient tension to make the drumhead playable?
- What is the difference in the characteristics of the sound produced when a hollow drum is compared with an otherwise identical one that has a base (The domestic pots as drums theory)?
- What factors influence the quality of the sounds produced?

Methodology

In research which attempts to explore issues by replication work, it is acknowledged that there inevitably have to be aspects of compromise. It is impossible to recreate perfectly the conditions of the process that created the original artefact, or create an exact replica. In designing the investigation which focused on the relationship between drum shape and acoustic quality, the following factors were acknowledged:

- The replication was based on an artefact for which information had been obtained from photographs and written descriptions.

- The composition and characteristics of the clay, and any temper used in it, was unknown.
- The drum maker was not an experienced potter who had gained experience and cultural information about the drum making process.
- The drums would be fired in an electric kiln and not in a bonfire.
- The species of animal skin used to cover the drum and the details of preparing the skin were not known.
- The method of attaching the skin to the brackets was not known.
- The medium used for attaching the skin to the brackets was not known.

In terms of measuring and interpreting results, further issues concerning accuracy arise:

- We do not know how the instruments were played.
- We do not know in what acoustic conditions the instruments were played.
- We do not know the types of activities or occasions they were played for.
- We do not know how Neolithic people valued or assessed the sounds made by the drums.

Some of the above factors such as the exact physical details of the original drum and the composition of the clay used for it could have been addressed in a research project where time and money were not limiting factors. A more authentic firing of the drums would also have been possible if there had been sufficient time available to start again in the event of failure. Although the main focus of this investigation was concerned with the exploration of the relationship between sound production and drum shape, the influence of firing temperature and evenness of firing is acknowledged here as potentially significant in terms of the quality of sound production and it is felt here that it should be included in any further research activities on this theme.

Other factors which may affect the authenticity of a replication investigation are due to lack of knowledge; we simply do not know which animal skins would have been used. However the list of possibilities is limited to the species that would have been living in Central Europe at the time the drums

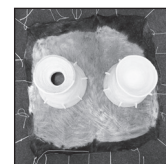
were made, unless skins were being imported from elsewhere. By using a practical assessment of which of these animal would provide skins strong enough and large enough to cover a drum of about 23 cm. diameter, then combining this information with data from similar extant drums and ethnological parallels, it is possible to produce a list of possible skin providers. These include goat, deer (red and roe), fox, badger, wildcat, otter, seal (in the maritime regions of Northern Europe), as well as domesticated species such as the bovid, pig, or horse. (Sterry, 1997, 46-56). It is important to bear in mind that a range of different animals may have been used and that selection may have been made on grounds of local availability or preference. Fish skin should be included in this list, since some modern drums in North Africa are still covered with this medium. Species of fish which may have been big enough to provide a sufficiently large area of skin include pike (*Esox lucius*), salmon (*Salmo salar*) and carp (*Cyprinus carpio*).

It is likely that several different media could have been used for attaching the skin. Research into possible choices for attaching the skins to the bases yielded three main possibilities: hide thongs, cordage - the plant source chosen here was nettle (*Urtica dioica*), or sinew (pig, cow, deer or goat). The advantages and disadvantages of these three materials, (whether for this researcher or the Neolithic drum maker), deduced by reasoning and experiment, are suggested below in **table 2**.






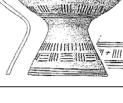


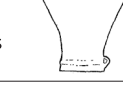






An account of the practical investigation

Producing the clay shells

The methods and materials used for making the two replica drums drew on the experience and insights gained from the original replication of the Brozny drum a year before. The drums were built in clay coils approximately 10 mm thick from a pinched ball base. The coiling technique used was the 'U' technique, where the coil is pressed downwards over both inside and outside faces. This technique has been identified as being one known from the Ertebølle phase of the Mesolithic (Lindahl, 1986, 33). The thickness of the coils was calculated to allow for around 12% shrink-



■ **Fig. 6** Drums set out either side of spine line.

	Source / Drum	Location	Culture	Date	Notes
1	Koch 433 	Lille Knabstrup Mose II	Ertebolle /Early Neolithic	3600 BC	Found in Danish bog fancy handle detail, has a base, no evidence of use
2	Midgley 135 	Klintebakke Vedsted Langeland	MNI6 Klintebakke	3400 - 3100 BC	Fragment associated with pedestal bowl
3	Midgley 97 	Forst Eversdorf Mecklenburg NE Germany	Early TRB	3600 BC	
4	Midgley 130 	Garup Denmark	Troldebjerg	MNIA 3400-3200 BC	This vessel is hollow
5	Lindahl 38 	Vastra Holby Sjane Sweden		3400 BC	Replicated by Lindahl, hollow, has holes around the funnel part and the body. Lindahl used these for fixing the skin
6	Heege and Heege 64 	Odagsen Landkreis Northeim			h. 17 cm, internal decoration inside base no skin fixing feature, has similarities with the pedestal bowl group
7	Midgley 75 	Pietrowice Silesia	Pietrowice	Pietrowice late phase 3400-3000 BC	
8	Masek 650 	Lílec Vylkova Bohemia			
9	Behrens 153 	Hlinsko			height 12.5 cm
10	Behrens 154 	Opatowice			height 18.5 cm
11	Midgley 189 	Hornsommern	Walternienburg	3200 BC	
12	National Museum Prague* 		Walternienburg	3200 BC	this is the drum used as the basis for the replications resulting in drums A and B, this study
13	MUFT** 	Wandersleben Landkreis Gotha	Walternienburg		
14	Midgley 57 	Mrowino Poland	Eastern TRB	3200 - 3000 BC	
15	Schloss-museum Quedlinberg 	Gatersleben LK Quedlinberg	Walternienburg		

■ **Table 1A** Details of a representative sample of the drums and pedestal bowls in the study group (Aiano, 2006). Based on sources acknowledged in the table, images not to scale (*photo: Aiano, **Museum für Ur- und Frühgeschichte Thüringens).

age before firing to result in a drum shell thickness of approximately 9 mm, which equates with that measured on the Brozny and Kralupy examples, and appears to be similar to that of the sections of those drums illustrated in **table 3**, where shown.

Every effort was made to produce the two vessels under identical circumstances, ensuring that they were exactly the same shape and size. The weight of both drums was kept the same during the building process, the initial clay balls both weighing 200 g, then 100 g of clay coil being added in turn to each drum until they were both complete. By ensuring that the weight and dimensions of both drums were kept identical throughout the pot building process, it was reasoned that the thickness of the walls of both drums would be as similar as possible in the different parts of the shapes (**figure 3**). When both were completed, the base of the intended hollow drum was scooped out, with the result that its final undried unfired weight was just over 130 g lighter than the other (**figure 4**).

The eight pierced brackets around each drum were more difficult to make than the simple but effective protruding lugs of the Prague replica. In order to ensure that the finished brackets would be strong enough to withstand the tension of the skin stringing process, they were attached to the vessel body by means of riveting at both the top and bottom of the bracket area, with a hole being pierced in each bracket close to the pot body after each bracket had been firmly attached (**figure 5**). The drums were lightly burnished both on the inside and outside with a smooth pebble. The decorative detail of the original drum was not added.

Both drums were dried in the same location for two weeks and then fired at the same time in an electric kiln. Details of the firing process were repeated from the earlier drum investigation, the ultimate temperature of 950 °C being built up initially in increments of 150 °C up to 450 °C, then achieving the ultimate 950 °C peak over the next hour.

The firing was successful. Both drums emerged with their brackets intact, and both produced clear ringing tones when tapped. As anticipated, the final dimensions of the fired





drums represented an amount of shrinkage of around 12% from those of the freshly made pots.

Preparing the drum skins

As used in the previous investigation, a cleaned but otherwise untreated goatskin was used to provide the membrane part of the drums. A large goatskin was selected, one large enough to supply the membranes for both drums. The skin was soaked in cold water overnight, and then stretched in order to achieve a smooth cockle free surface. This was done by attaching strings at regular intervals around the outer edge of the skin, then attaching these strings under even tension to a stretching rack. The skin was left to dry for three days.

The hair was removed from the goatskin while still stretched on the frame as soon as it was completely dry (figure 6). This was done with scrapers prepared from flakes of Beer flint. The hair removal was achieved without puncturing the skin, an outcome which would have rendered the punctured part useless in terms of providing a drumhead. A possible alternative method of removing the hair from the skin would be the soaking method of the Saami in Northern Sweden described by Alebo (1986, 41), where the hide is put into a lake, fur side upwards, for about two weeks for the hair to rot away. The advantage of this method when preparing a skin for a drum would be that there would be no danger of the skin being punctured, which is always a risk when using a sharp blade.

In order to provide two drum skins that were as similar as possible, the two circles were cut from corresponding areas either side of the spine line, in the middle of the goatskin. The circles were cut to overlap the drumhead and reach down the sides of the drum body as far as the tops of the fixing brackets. Additionally, ten strips measuring approximately 40 mm long by 7 mm wide were cut from the goatskin, as well as a spiral cut length measuring 3.2 m long by 5 mm wide, cut from a circle of 180 mm diameter. It was intended that these strips of goatskin would be investigated as a possible medium for fixing the drum skins to the clay bases.

	Source / Drum	Location	Culture	Date	Notes
16	Korner and Laux 129 	Barskamp, Landkreis Luneburg	Tiefstich		height 28 cm
17	Masek 651 	Holasovice Opavy Bohemia			
18	Midgley 186 	Gerstewitz	Southern TRB Salzmunde style	Late Baalburg 3200 BC	clay drum is new form here
19	National Museum Prague* 	Kralupy Bohemia			
20	LASA** 	Wallendorf Landkreis Meresburg -Querfurt	Salzmunde	3600 -3200 BC	height 17.3 cm
21	Portratz 184 	Wennekath, LK Luneberg	Tiefstich	3400 -3200 BC	
22	LASA** 	Zorbau, Landkreis Weissenfels	Salzmunde	3600 -3200 BC	height 27 cm has internal decoration inside the base
23 26	Midgley 190 	Dolauer Heide	Bernburg	3000 BC	
27	Städtischen Museum Halberstadt 	Aspendsedt, Landkreis Halberstadt		Late Neolithic -last phase of pottery drums known	height 33.5 cm
28	Dobes 158 	NW Bohemia Hrdlovka	Kugel-amphoren kultur		
29	Schutz 105 	Pevenstorf, west of Wittenberge		Bernburg 3000 BC	found in association with bulbous amphorae in an inhumation grave
30	Grimm 1936 	Klein Quenstedt Landkreis Halberstadt			height 18 cm
31	LASA** 	Derenburg Landkreis Wernigerode	Bernburge		height 46 cm, represents the group of largest drums, about 180 altogether
32	National Museum Prague 	Brozny Bohemia	Kugel-amphoren kultur	2800 BC	specimen, replicated in 2004

■ **Table 1B** Details of a representative sample of the drums and pedestal bowls in the study group (Aiano, 2006). Based on sources acknowledged in the table, images not to scale (*photo: Aiano, **Landesamt für Archäologie Sachsen-Anhalt).

Attaching the skins to the drums

It was decided to proceed with goat-skin as the fixing mixing. Both the drumhead for drum B, and several lengths of 7 mm wide thong were well soaked in cold water for six hours to ensure maximum flexibility. There were 8 fixing brackets around the top of each drum, with their central lacing holes located about four cm. down from the rim of the drum. The holes appeared to be far enough down the side of the drum to allow for a good amount of skin to overlap the rim and ensure an airtight fit.

The first method of lacing the skin to the brackets involved threading the wet skin strip through a bracket, then through a hole made in the skin half way between the first and second brackets. This lacing hole was pierced in the skin about two cm. inside from the edge, using a sharpened awl made

from red deer antler. This was rapidly seen to be an unsatisfactory method of fixing, because the interval of lacing it achieved was too wide to enable the skin to be gathered against the body of the drum. Furthermore, at 7 mm wide, the strips of skin were too wide to feed easily through the brackets or go through the holes in the skin, which needed to be kept as small as possible in order to prevent tearing and help maintain good tension.

The second method necessitated the running of a strip through all of the brackets to make a horizontal band to which the skin could be laced (figure 7). This band needed to be tied off in a way which would maintain it under strong tension, so that lacing from an increased number of holes in the skin could be laced to it. The skin strips were all halved in width to allow a better fit through brackets and increased number of

skin holes. This second method enabled a much higher level of tension to be achieved, and the skin was gathered more closely to the drum body. However, it proved difficult to join wet strips of skin without losing tension. Even the use of knotting methods claimed to prevent slipping were useless when used in the medium of wet skin. This problem was complicated by the fact that as the lacing went round the drum body, its tension was interrupted every time the strip went through a bracket, as the tensioning was difficult to maintain while the strip was threaded through the bracket.

The process of adding the skin to drum A was carried out in the same way as that devised for drum B, and although the task went more smoothly, the hour or so required to do the lacing and ensure the maximum tension possible still seemed excessive. Both drums were left to dry in

medium	Cordage (<i>Urticaria dioica</i>)	hide strips (goat)	animal sinew(deer)
preparation needed	Harvesting, stripping of fibres, soaking and twining	Cut from cleaned, stretched and de-haired hide.	Part of butchering process, can be tricky to extract sinew saved for use as needed
availability	Plentiful in spring and summer, quality depending on season	Plentiful, and likely to be available from source used for drum skin	Readily available but possibly requiring product of more than one animal
strength	Good ;long fibres, In trial, thin cordage produced from one large nettle had breaking strain of over 6 kilos	Good, even in strips as narrow as 3 mm.	Very good, especially thicker lengths.
ease of joining strips	Knots neatly especially when wet.	Knots are bulky when dry and very likely to slip apart under tension when wet.	Bulky if knotted, not as slippery as hide when wet. Can be joined by overlap of ends of threads then sucking to join them, followed by twining
Shrink to fit quality	fair	good	good

■ **Table 2** Comparison of cordage, hide strips and sinew as fixing media for the drum skins. (Aiano 2005).

Aspect of sound production	Drum A (hollow)	Drum B	Interpretation
Timbre (quality of sound)	Makes a clear well defined sound with some qualities of 'brightness'	Duller and less well defined sounds, has a flat, 'thudding' quality	This aspect of the evaluation is the most likely to be subjective, we do not know how Neolithic people would have evaluated these sounds, but of 10 people asked to state which drum sounds they preferred, all chose drum A
Amplitude (loudness); a dB or decibel is the unit of measurement of sound intensity or loudness.	Able to produce a maximum volume of 102 dB for 90% of test period when tested by sound measurement machine adjusted to the normal range of the human ear response. Tested over a 15 second period	Able to produce a maximum volume of 55 dB for 90% of test period when tested by sound measurement machine adjusted to the normal range of the human ear response. Tested over a 15 second period	Drum A can produce louder sounds than drum B. Graphic representation of these results available from the author
Pitch, measured by using a Seiko ST 727 digital pitch tuner*	Able to produce two well differentiated sounds;1).a bass(centre) note registering as D above middle C and 2.)a rim note registering as G or A above middle C	Could not get reading of a particular pitch for bass (centre) note. The rim note most nearly equated to D above middle C.	While the central note of Drum A is relatively deep and rich, its rim note has a higher pitch than drum B and with its ability to produce these 2 clearly defined notes at centre and rim, drum A offers more musical possibilities (For non musicians, the interval between D and A can be represented by the notes of 'Baa Baa', and 'Black Sheep' respectively).

■ **Table 3.** Comparison of acoustic qualities of drums A and B (Aiano) Note: *The machine cannot record a sound when it is comprised of too many frequencies together (these are known as partials)

the same room, ensuring they were both kept in the same temperature and humidity conditions. They were inspected and tested after 15 hours, when the drum skins and the lacing strips of both drums had dried hard (figure 8). The skins had shrunk to fit the drumheads tightly, and the skin strips of the lacing had stiffened, with the result that the knots had ceased to slip. Although they were potentially sites of structural weakness where they were joined to the drum body, the fixing brackets showed no cracking under the tensioning of the lacing. An account of the subsequent playing, recording, testing, and comparison of these two drums follows below in the results and discussion section.

Supplementary investigation

This double replication resulting in drums A and B made it possible to compare the effect on sound production quality of two pots which were identical except for the presence or absence of a base. This part of the investigation was based on an example already identified as a drum, rather than on a pot shape which could be viewed as being more of a domestic pot which might have a storage or cooking function. With this in mind the next part of the investigation involved taking a pot which could be considered to represent this generic group, then fixing a skin to it in order to evaluate the quality of the sounds it could produce. The pot chosen, whose characteristics are described below, was subsequently labelled G and is illustrated in figure 9.

Results and discussion

The clay bodies

The account of the making of the clay bodies of the twin drums demonstrates that care was taken to produce two vessels as identical as possible in terms of overall shape, size, wall thickness, and production method. This was achieved in all respects except one; this potter had some difficulty in achieving identically shaped upper body cavities for the two drums. As can be seen from the photographs of these drums, the curve of the bowl on one side is shallower than the corresponding part of drum A. However, the difference is

not large, and, according to research done on the impact of cavity shape on sound production of a similarly shaped African djembe (Haveman, 2002), it is unlikely to have an effect on the sound quality of drum B. The decision to remove the base from drum A after both drums had been built up using the same method, ensured that the body profiles of both drums were in other respects the same. The size of the opening was based on the internal measurements of the Brozny drum and an assessment of the outline of the base in the German replica in the Prague display.

At the stage when the drum skins were fixed to the drums, initial trials of the quality of the sound produced revealed that the rims of the drums should have been more accurately levelled. Small undulations in the profile of the rims revealed slight variations in tension at the edge of the drums which meant that the tone produced at the edge of the drum varied a little around the rim. The slightly ovoid profile which had resulted from the irregular body cavity shape of drum B may have contributed to this effect.

The drum skins

The decision to use goatskin for the drum skins ultimately rested on the fact that it was relatively easy to obtain a skin that would be big enough to cover both drums. Furthermore, the circles could be cut from corresponding areas each side of the spine line of the skin, ensuring that the source of the drum skins would be eliminated as a possible variable when comparing the drums. Goatskin had also been used in the previous replication of the Brozny drum. It had been demonstrated that despite concerns that it may be too thick a medium for a comparatively small drumhead, it ultimately produced clear and attractive sounds. Acoustic theory states that the thickness of the drum membrane has an effect on the sound produced, in that the thicker the membrane, the lower the resulting sound produced. In terms of sound production quality, it would be interesting to explore the relationship between the size of drumhead and the thickness of drumhead derived from different animals.

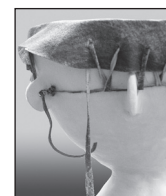
The skin fixing medium

The fixing brackets proved to be strong enough to withstand the tension exerted by the skin strips holding the drumhead under tension, including three showing cracking in the drying stage which had undergone repair before firing. However, as described above, practical experimentation on the best way to fix the drumhead demonstrated that the task was not straightforward. When the hide strips ultimately dried to provide sufficient tension for the drumheads, it was observed that the same 'shrink-to-fit' characteristic that makes a skin drumhead fit so tightly when dry is also a positive factor in hide strips used to fix the drumhead when the difficulties of working with it in the wet state are overcome. The length of strip required to provide both a fixing loop to encircle the drum via the brackets and the lacing between the 36 holes in the drumhead was measured at approximately 250 cm.







In terms of assessing the system of brackets as a means of attaching the drumhead to the body, it was considered by this researcher to be inferior to the previously tested system of 12 simple protruding lugs on the Brozny drums, for the following reasons;

- The bracket system involves the use of an extra medium, namely a lacing material.
- It is difficult to ensure a good level of tension because lacing strips need joining, and passing strips through the brackets reduces the ability to maintain continued tension.

The more efficient of the lacing systems trialled involves running a strip around the drum body through the brackets, and then lacing another strip through the brackets, around this encircling strip and through the holes in the drumhead edge. When compared with the simplicity of the lug system, this system appears to be inefficient in terms of producing and maintaining tension in the drumhead. The evidence of the Brozny drum also indicated that the lug method had been chosen over the bracket method, since there was also a bracket on the drum, lower down on its body, presumably intended as a way of attaching a fixing strap. The fact that this drum contains both



■ Fig. 7
Detail of second fixing method.

Description	Notes
Vessel is hollow 	Body shape promotes the production of sound waves which will produce resonance
It has a curved profile at outer edge of rim, which is level 	Square profile rim would produce a buzzing sound. Unlevel rim results in different tensions around rim, producing different sounds
Conical or convex shape to upper body of vessel 	Enables production of lower frequency sound waves
Lugs, brackets or holes which could be used to fix the skin 	Not always present. Some drums have none, and may have used glue as fixing medium
Overall shape which will fit against the body whilst playing	
Relatively thin body shell. Approx 9 mm	Samples examined suggest this
Refinements which may be present	
Bracket on drum body for carry strap 	Enabled the drum to be played while player standing or walking
Internal band of decoration on inside of lower rim 	Means the inside of drum is visible whilst being played
Features likely to be absent	
Evidence of food or other residue	
External decoration to upper part of vessel, above level of fixing medium	Deeply moulded, incised or applied decoration prevents the drum skin from fitting tightly over the rim and the area below it
Inner rim, bevel or moulding, collar or neck	Would affect the quality of sound produced
Handles, decorations or features on the upper drum body which may impede the fixing of the skin	

■ **Table 4**
List of criteria which may help identify vessels as drums (Aiano).

lugs and a bracket suggests that although both methods were available to the drum maker in this instance, the lug method had been chosen in preference to the bracket method for fixing the skin.

Having attached each drum with the maximum amount of tension achievable, it was necessary to compare them and make sure they had sufficiently similar tensions. A quick way to test the tension of a drumhead is to press down on the centre of the skin with a forefinger or thumb, as the amount of distance the skin can be depressed indicates whether the tension is low or not. Use of this test showed that drum A was slightly tighter than drum B. With the help of the technical support team in the School of Engineering, University of Exeter, a test was devised which confirmed this. However, this difference was so small that it could be offset if the skin of drum B were heated

by a warm hair dryer before testing the drum's sound production. This would slightly increase the drum-head tension.

Comparing the sound qualities of the two drums

The sounds produced by drums A and B were compared in three ways;

- The timbre or quality of the sounds produced.
- The amplitude or loudness that each drum could produce.
- The pitch of each drum and the difference in sound pitch between the centre and the edge of the drum. This information is summarized in table 3 below.

Drum A produces the more appealing sounds. Firstly, drum A is capable of producing at least two distinctly pitched sounds, and is therefore able to produce a large variety of sound patterns or 'music' which is not merely dependent on changing same-note lengths, (which is all a one note instrument can produce). Secondly, both of the sounds produced by drum A are clearer and more resonant than the sound produced by drum B. Furthermore, the bass note produced by striking the centre of the drum is both deeper and richer in drum A. The superior sound production qualities of drum A which have been identified by the comparison of these two drums represent technical improvements in the design of drum A, which it is suggested here are independent of matters of taste or cultural preference, and would have been recognised as such by listeners during the Neolithic.

While drum B resembled a domestic pot in that it had a base, it had been made in the shape of an identified drum, with a circle of fixing brackets. It had also been made with a pottery shell thickness identified as representing a drum, and possibly therefore was a little thinner than a domestic pot might have been. The decision to add a drumhead to pot G and then test its performance as a drum was taken because it was felt that the shape, weight and shell thickness of this vessel may more closely resemble the sort of 'domestic pot' mentioned by Sachs, Blades and Marcuse referred to previously. The pot had a plain rounded rim

and a shoulder profile which would accommodate the skin to provide a good fit. There were no deep incised patterns around the top. The mouth of the pot was 30 mm smaller than those of drums A and B but the overall interior cavity capacity was similar to that of drum B.

In order to eliminate variables associated with the drum membrane, the skin from drum A was soaked and removed then stretched over the top of pot G. As there were no lugs or brackets for fixing the skin, it was secured with a length of nettle cord (*Urticaria dioica*), which was wound twice around the neck of the vessel then knotted firmly in place. This drum was tested after six hours while the skin was still damp. At this point it made a deep rumbling sound which was not unattractive, although there was no difference in pitch whether the skin was hit in the centre or on the rim. When pot G had dried completely, the sound quality had changed. The low rumbling sound had changed to a higher pitched one, which like drum B lacked the definition of any particular tone, and was therefore immeasurable in terms of pitch production. There was still no difference in sound between centre and rim. This pot G failed to register a pitch when tested but achieved a level of 54 dB when tested for sound intensity under the same conditions as drums A and B. Testing done so far showed that the closed base drums, B and G, shared some acoustic characteristics. Neither of them produced clearly differentiated tones between centre and rim, and the sounds they did produce lacked definition, and tended to dullness. Neither could produce a rich bass note, or a sound level above 55 dB.

Sound production results explained in acoustic terms

In terms of understanding the acoustic difference between domestic pot drums and hollow drums it is necessary to remember that, in a drum, the sound waves generated by the struck membrane travel outwards until they hit the boundary (the drum body). In a closed drum body they are then reflected and bounce back until they hit the membrane again. This means that there are many vibrations occurring, and under these conditions no definite pitch can be created. In a

hollow drum there is less surface area to act as a reflective boundary, therefore fewer vibrations are set up and the sound generated is not so dense. When a drumhead is hit in the middle, it is striking the place where the fundamental (the wavelength having the lowest frequency) is at its loudest. In a hollow drum, it has been demonstrated that a Helmholtz cavity mode occurs (mode = behaviour pattern of waves). This involves the fundamental and creates the relatively loud bass sound of the drum. The hollow cavity of the drum is acting in the same way as a Helmholtz resonator in that the sound waves of the struck membrane move into the drum cavity in periodic patterns of compression and decompressions. The air in the cavity behaves like a spring reflecting back on the membrane, and under these conditions natural frequencies for vibration are set up which can generate resonance. Each resonator responds to waves of a particular frequency and the listener hears these notes more loudly (acoustic theory summarized from White and White, 1980, 54, Schmidt-Jones, www.cnx.rice.edu/content/m11063 and www.cnx.rice.edu/content/m12413 and Warm, www.kobushi.com/acoustics).

As in the bell shape at the end of a musical horn, the amount of flare in the shape of the lower section of the hollow drum will influence the efficiency of the sound transmission out of the drum body to the open air (*White and White, op. cit.*, 249). This explanation demonstrates the acoustic superiority of the hollow drum in hand drumming terms, and suggests that the introduction of the hollow drum represents a significant advance in drum design (double skinned drums and tympani are acoustically very different).

Summary of results of the practical investigation

The results of the practical aspect of this investigation can be summarized succinctly:

- Brackets can be used to attach a skin to a drum body, although the lug system of the Brozny example is simpler and more efficient.
- Skin tension, and, as a result, sound production quality is related to the efficiency of the skin fix-

ing system, and the ability of the skin to shrink tightly to the edge and sides of the drum body.

- Hollow drums represent a technological advance over 'pot' drums in that they represent improved sound production and increased musical possibilities in terms of clearer brighter sounds of a more definable pitch, increased volume potential and differentiated tones between the centre of the drum and the rim. Sounds generated at the centre can be deep and rich in quality.

Applying the results to the archaeological evidence

The drums of the study group

The practical investigations provided a valuable opportunity to consider the physical characteristics of this type of drum from both an acoustic point of view and the practical issues of construction. **Table 1** demonstrates a great number of differences in the physical features of the drums in the study group, with many combinations of the different feature styles. A close examination of the 32 or so images and descriptions collected during this research revealed further features that helped to identify how the drums were played, these are described below.

The results of the practical investigation could be used to examine the images of the drums in the study group and to assess the acoustic potential of individual drums. It was now possible to formulate a set of criteria which could be applied to a vessel in order to establish if it had been made specifically to be used as a drum. These criteria could then be applied in a study of the pedestal bowl group of vessels (described above).

All of the drums in the study group fall within a size range that indicates that they could be played relatively comfortably in the three ways identified as being appropriate to goblet drums of different sizes;

1. Held under the arm of the less dominant hand, supported by the bent elbow against the player's side with the hand supporting

the drumhead but middle fingers free to play the drumhead.

2. Cradled between the knees of a seated person, with the drumhead inclined slightly outwards from the vertical, enabling the player to use both hands equally. Likely to be used for larger drums.
3. Resting on the knee of the non-dominant hand side of the seated player, with the drumhead tipped slightly forward into the lap.

The presence of decoration inside the bottom rims of drums 6, 11, and 22 suggest that these drums would have been played either in the first position where the player could be standing or seated, or in the third position, both of which could have made the decoration visible to people standing or sitting behind the drummer.

The presence of a single bracket on the body of eight drums in the sample (9, 23-26, 28, 30, 31 and 32) suggest that these drums were fitted with a carry strap. This feature would enable the drum either to be hung from the shoulder, or suspended from the waist. A strap taking the weight at the shoulder would make it easier for the player to play while standing, walking or possibly dancing. It is very significant that drums 28, 30, 31 and 32 have carry straps shaped like the fixing brackets used elsewhere for fixing the skin, while the drum makers preferred to use protruding lugs as the skin fixing method. While Lustig's experimentation with both styles of fixing left her with a preference for the bracket style (*Lustig 2001*, 172), this researcher found that although the lug system (described above) is technically less difficult to produce, it represents a superior design solution to the problem of fixing a skin and maintaining it under tension. It is suggested therefore the presence of lugs around the rim represents an improvement in drum design.

The position and number of lugs or brackets for skin fixing on the drum group are also worthy of examination. Some (numbers 6-10 inclusive) have no provision at all, and it is assumed that in these examples, the skin was simply tied or glued on to the drum. These drums have the advantage that lack of protruding lugs or brackets mean that they would be more comfortable to play when held against the body. Some, (14, 17, 18, 9



■ **Fig. 9** Pot G as a drum.

and 20) seem to have six or less fixing points. The difficulties experienced by this researcher in attempting to fix a skin by lacing it directly to fixing brackets outlined above, suggest that direct lacing from holes in the skin to a small number of brackets would have been an inefficient method of producing and maintaining tension.

A more satisfactory use of the brackets may be that the skin, cut large enough to drape over the drum body to a point below the level of the bracket holes, was anchored by an encircling cord which was laced through the brackets which would protrude through holes made at corresponding points in the skin. This method represents a refinement on that which must have been used for the drums with no fixing points (if glue was not used), in that the skin would otherwise have been secured only by tying at the brace point at the waist of the vessel.

It is necessary to remember at this point that we do not know which animal skins were used as drum skins. It may be that different skins with differences in thickness and elastic qualities would require different fixing methods. Acoustic science states that sound production in membrane drums is influenced by both the thickness and tension

of the membrane used. The mass of the drum body also affects the quality of sound produced (*Haveman, op. cit.*). Further research to explore these relationships using a range of combinations of animal skin type, drum size and shell thickness would be appropriate in this context. When considering whether the presence of brackets or lugs on a vessel suggest that it is a drum, it is important to remember that the wide range of handles, lugs and brackets present on Neolithic pottery probably represent a range of alternative uses, not least that suggested by Stockmann above, of holding a skin on a storage vessel as a lid. It is beyond the scope of this work to explore the wider world of lugs brackets and handles, but an examination of the shape and location of some of these features in Midgley (*op. cit.*), suggested that they were not actually functional at all, but included as decorative features and examples of workmanship (see for example vessel 1 in figure 47, p.143).

Turning to aspects of the body shape and rim details of the Neolithic drums in the study sample, it is possible to identify further characteristics which they all share. These are;

1. A 'waisted' body shape with the upper portion usually larger, and often more bulbous than the lower one.
2. A simple rim profile which is rounded on both inner and outer faces.
3. Lack of an internal rim bevel or moulding.
4. No necks or collar.
5. Where the information is available from illustrations, the body walls appear relatively thin, not exceeding 10 mm thickness.
6. They do not have deeply incised, moulded or applied decoration around the rim,
7. They do not have handle or other protrusions which impede the fixing of the drumhead.
8. They have flat bases.

These are suggested here as additional to Lustig's (*op. cit.* 171) two 'typical criteria' for identifying vessels as drums, namely that they are hollow, and have lugs or brackets on the upper part for fastening the skin, (although later in her work she concedes that some of the vessels without fixing means are drums). Lustig is also of

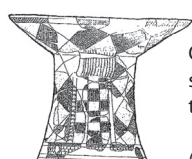
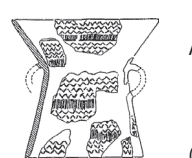

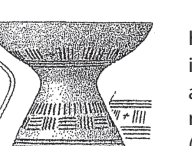
the opinion that any vessel which has decoration above the level of any lugs or brackets present cannot have been a drum. For this reason she argues that the vessel from Sweden replicated by Lindahl is unlikely to be a drum. In those drums which are decorated, the decoration does indeed stop below the level that would be covered by the skin. However, it is reasonable to expect that along the continuum of development of vessels into drums, a vessel which functioned both as a drum as well as in some other capacity may have been decorated up to the rim, until a time when the importance of the quality of fit of skin over the drum body was appreciated.

The preceding section describes how deductions made from the practical replication work outlined above have been applied to an examination of the diverse examples of Neolithic pottery drums in the study sample. The insights gained from this combined approach can be expressed as a list of criteria which indicate that a vessel may either have been made deliberately as a drum, or could have been played as a drum. This suggested 'drum identification checklist' provides a framework for assessing the suitability of other pottery vessels for use as drums, and it is set out in table 4 below.

The pedestal bowls

The hollow pedestal bowl (**table 1** no 5) from Västra Hölby, Sweden was replicated as a drum by Lindahl in the early 1980s. It is a very interesting first candidate for the checklist. Acoustically, the small upper body cavity which would form the primary sound waves is small, and it is decorated right up to the rim, but in other respects, it possesses eight of the 13 primary criteria on the list. It is particularly unfortunate that no evidence of the sounds produced by this drum was available at the time of this research.

The significance of this vessel is that it is surely related to other examples of pedestal vases which originate from Denmark and Germany, some of which are hollow, others having bases (see examples 1-5 in **table 1**). These bowls share similar decorative characteristics, and four of them feature two highly decorative handles at the point where the upper part of the

<p>Stage 1</p> 	<p>Ornate pedestal bowl with shallow bowl, decorated up to rim, 2 handles</p> <p>(Source: Koch 433)</p>
<p>Stage 2</p> 	<p>As stage 1, but hollow</p> <p>(Source: Midgley 130)</p>
<p>Stage 3</p> 	<p>Hollow without handles, but having holes which could be used to fix skin. Lindahl's replica shown here</p> <p>(Source: Lindahl 30)</p>
<p>Stage 4</p> 	<p>Hollow, no holes, or other fixing features, but body shape acoustically superior. Decorated around inside of base</p> <p>(Source: Heege and Heege 64)</p>

■ **Table 5** Suggested stages of evolution of pedestal bowl into drum (Aiano).

vessel meets the lower part. Apart from number 1, which was found in a Danish bog, all have been found in funerary contexts. When this group of pedestal bowls is viewed in terms of their potential for use as drums, their characteristics suggest that they can be ordered in a developmental sequence, illustrated below in **table 5**. Lindahl's Swedish drum could be seen as the point at which the pedestal bowl type has evolved into a drum where it is really only body shape which differentiates it stylistically from such accepted drums as numbers 6-10.

Functionally, the pedestal bowls have the appearance of high status vessels which from the shallowness of the bowl section, or indeed absence of a bowl altogether, have a limited range of practical uses. The position of the handles suggest that they are inappropriate for use in hanging the vessels, or carrying them over much distance, but they could be seen as being placed appropriately for being held up in front of the bearer, who would also be to use them to rattle any contents of the bowl.

These hypotheses about the archaeological context and functional analysis of these pedestal bowls point to their having a role in a ceremonial or ritual context, rather than a domestic one, but there seems to be no reason why a vessel with a primary ceremonial purpose may not also have been adapted as a drum. The ethnographic record demonstrates that there are a number of examples where a drum is filled with some medium before the skin is added (*Blades, 1970, 57-9, and 110*). This effectively produces an object which is both drum and rattle. The rattling materials recorded include images of gods, pebbles, bran, rice and even 'stones' originating from the stomach of a crocodile. It is possible that the original pedestal bowls may have been used in such a way.

The sequencing of the pedestal bowls was based entirely on their functional characteristics, and took no account of the geographical origins or dates attributed to the vessels. The remaining drums in the study sample were also sequenced according to the functional criteria which had been established. The suggested sequence covering all of the study group drums, including pedestal bowls, is reflected

in the order in which they are presented in table 1. A subsequent look at the dating of their respective contexts, as recorded by Midgley (1992), appears to suggest that the functional sequence may have some validity in chronological terms. Interestingly, the distribution of pedestal bowls is limited to the most northerly cultures of Denmark and Sweden in the early TRB, while the most sophisticated form of the drums examined in this study group appears approximately 600 years later in the Czech Republic.

Conclusion

This investigation has applied the results of replication work to the study of archaeological evidence in the context of acoustic science. The findings suggest that the wide variety of drum shapes in the archaeological record reflect early drum-makers' attempts to improve the quality of sound that could be produced by drumheads stretched across pottery shells.

The results of the practical experimentation suggest that domestic pots could have served as drums, but that the quality of the sound they produced would have been indifferent. However, perhaps the sound produced was interesting enough to stimulate further exploration, both of the vessel shape and the method of attaching the drumhead. The innovation of the hollow shelled drum meant that it became possible to produce different sounds between the centre and the rim, the central bass note having power and resonance, while the rim produced higher pitched sharper sounds. The amplitude levels would also be increased. These developments would have increased the musical possibilities of the instrument, whatever the context in which it was played.

The question of how and where hollow pottery drums emerged is intriguing, as is the question of what happened to them when they cease to appear in the archaeological record from the Early Bronze Age onwards. The list of criteria for evaluating vessels as potential drums, is offered here as a tool for exploring the development of the drum. The application of the criteria in the context of the pedestal bowls suggests one theory which attempts to address the question, and it is worthy of further investigation.

The goblet or chalice shape of these drums has a particular association with ceremony. As stated above, the ethnographic evidence indicates that drums are also strongly related to cult and ritual activities in many societies. Since a large percentage of the group of pottery drums found in funerary contexts, it is not unreasonable to infer that they had a religious purpose. What cannot be known is whether this was their exclusive role or whether they might also have been used in more recreational contexts.

The relationship between the pottery drum and the frame drum has been explored above. The relationship between these drums and the darrabuka is also interesting. The darrabuka is the type of drum nearest in shape and method of playing to the Neolithic drums, but it is used for celebrations, folk music and dance activities. Since the distribution of the darrabuka also extends into the Balkan states such as Hungary and Bulgaria, not far from the most southerly of the drums studied here, it is tempting to see it as a modern survival of the Neolithic drum.

It is impossible to know what meaning or value was given to different sounds in Prehistory. The acoustic investigation of material remains leads the experimenter to new ways of looking at the physical evidence, and asking new questions- could other containers make effective water drums? Would the bottomless bulbous amphora of the TRB make friction drums? How would the curious clay discs of the Beaker People sound if they were suspended and struck? Inevitably, the research has raised more questions than it has answered. Undoubtedly many more questions will be raised when we consider more closely the acoustic significance of the places where such musical instruments may have been played during Prehistory.

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Summary

Töpfe und Trommeln – Eine akustische Untersuchung der neolithischen Tontrommeln in Europa mit Hilfe von Repliken

Der Artikel untersucht die Verwendung von pokalförmigen Tontrommeln des Neolithikums, die zumeist in die Trichterbecherzeit datieren. Das Ziel ist dabei die Prüfung der Theorie, dass dieser Trommeltyp seine Grundlage in der alltäglichen Gebrauchskeramik hat. Die Arbeit besteht aus zwei Teilen: Der Schwerpunkt des praktischen Teils liegt dabei auf der Beziehung zwischen akustischer Qualität und der Form der Trommel. Der zweite Abschnitt nutzt die Ergebnisse der Interpretation des praktischen Teils, um eine möglichst genaue Vorstellung von 22 nachgewiesenen Trommeln zu erhalten.

Im praktischen Versuch stellte die Autorin zwei Gefäße her, eines mit hohlem und eines mit geschlossenem Fuß, wie sie von den Trommeln der mitteldeutschen Walternienburg-Kultur bekannt sind. Es wurde alles daran gesetzt, die beiden Gefäße unter möglichst gleichen Rahmenbedingungen herzustellen, um so sicherzustellen, dass sie eine möglichst gleiche Form und Größe erhielten. Um zwei möglichst gleichartige Trommelfelle zu erhalten, wurden zwei Kreise an vergleichbaren Körperstellen aus einem beiderseits des Rückgrates einer Ziege befindlichen Fell geschnitten. Diese doppelte Replik ermöglichte es, die Wirkung auf die Qualität der Klangerzeugung zweier Gefäße zu testen, die bis auf das Vorhandensein eines geschlossenen bzw. eines hohlen Fußes identisch waren. Der von ihnen erzeugte Klang wurde in dreifacher Hinsicht verglichen: Die Klangfarbe, die Amplitude und die Unterschiede des Klanges zwischen dem

Zentrum und dem Rand des Trommelfells. Die Klänge, die von der Trommel mit hohlem Fuß erzeugt wurden, waren klarer und wiesen eine stärkere Resonanz auf; außerdem konnten mit ihr mindestens zwei verschiedene Tonlagen erreicht werden.

Die durch die Repliken gewonnenen Resultate wurden schließlich beim Studium der archäologischen Quellen zum Thema „Akustik“ angewendet. Die Arbeit bietet dabei eine Liste mit Kriterien zur Bewertung von Gefäßen als potentielle Trommeln und zur weiteren Erforschung der Geschichte der Trommel.

Veses et tambours, recherche acoustique sur les tambours néolithiques à l'aide de la reconstitution

Cette recherche porte sur l'utilisation des tambours néolithiques céramiques en forme de vase qui datent surtout de la période de la civilisation à vases en entonnoir. Elle a pour objectif de tester la théorie qui veut que ce type de tambours tire ses origines de la vaisselle. L'article est divisé en deux parties. La partie pratique vise le rapport de la qualité du son et de la forme du tambour. S'appuyant sur les résultats issus de l'expérimentation, la seconde partie examine les représentations de 22 tambours sélectionnés.

D'abord, l'auteur a réalisé deux vases d'après une pièce découverte à Walternienbrug (Allemagne), l'un d'entre eux sans fond, tout en prêtant attention à la conservation de conditions égales de fabrication pour assurer les mêmes taille et forme. Afin d'être pareilles le plus possible, les membranes pour les tambours, deux cercles de cuir, ont été découpées dans la partie intermédiaire d'une seule dépouille de chèvre, de l'un et de l'autre côté de la ligne vertébrale. Ce procédé a permis de comparer la qualité du son de deux vases tout à fait identiques, excepté la présence ou l'absence du fond. On a considéré le son des tambours sous trois aspects: timbre du ton, puissance et distinctions des hauteurs de son dans le centre et au bord des tambours. Le tambour ouvert émettait un son plus clair et plus résonnant, il était susceptible de donner au moins deux notes différentes.

On s'est servi des résultats de cette recherche pour examiner des pièces archéologiques du point de vue acoustique. En effet, ce travail propose une liste de critères pour pouvoir qualifier des vases en tant que tambours potentiels et pour étudier l'évolution des tambours.

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