Kleinitz, Cornelia, Till, Rupert and Baker, Brenda

Archaeology and acoustics of rock gongs in the ASU BONE concession above the Fourth Nile Cataract, Sudan: a preliminary report

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SUDAN & NUBIA

The Sudan Archaeological Research Society *Bulletin No. 19* *2015*

ASWAN
1st cataract
Middle Kingdom forts
Egypt
RED SEA
Wadi el- Allaqi
2nd cataract
Wadi Gabgaba
Seleima Oasis
Sai
3rd cataract
Sudan
ABU HAMED
Nile
Kurgus
El-Ga'ab Basin
Kawa
Jebel Barkal
4th cataract
5th cataract
el-Kurru
Dangeil
Debba-Dam survey
Berber
ED-DEBBA
Ganati
ATBARA
Wadi Howar
Meroe
Hamadab
Atbara
Muweis
Wad ben Naqa
Wadi el- Melik
6th cataract
Wadi Muqaddam
OMDURMAN
KHARTOUM
KASSALA
Wadi Muqaddam survey
Blue Nile
Eritrea
MODERN TOWNS
Ancient sites
WAD MEDANI
GEDAREF
White Nile
Jebel Moya
KOSTI
SENNAR
N
Ethiopia
South Sudan
0
250 km

SUDAN & NUBIA

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Contents

Front cover: QSAP Dam-Debba Archaeological Survey Project. Site DS7, Ganati: the re-erected columns in the church (photo: Fawzi Hassan Bakhiet).

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The Qatar-Sudan Archaeological Project – Archaeology and acoustics of rock gongs in the ASU BONE concession above the Fourth Nile Cataract, Sudan: a preliminary report

Cornelia Kleinitz, Rupert Till and Brenda J. Baker

An interdisciplinary study of a large and intensively used rock gong within the Arizona State University (ASU) Bioarchaeology of Nubia Expedition (BONE) concession was initiated in late 2014 and early 2015 by Brenda Baker (project director), with funding from the Qatar-Sudan Archaeological Project (QSAP). The goals are to situate this unusual rock gong within the surrounding landscape, document its physical and acoustical properties, and understand how it was used in the past and by present people in the adjacent village of Dar en-Njoum. Preliminary results of this first combined archaeological-acoustic study of a rock gong in its original position in the landscape of the Middle Nile are presented here.

The ASU concession covers more than 90km^2 in the Great Bend region of the Nile River, west of Abu Hamed, in northern Sudan, from the modern village of el-Juwabra in the east to Wadi Hamedain in the west, and extending roughly 3km into the desert from the right bank of the Nile (Plate 1). BONE research builds upon prior work conducted jointly with the University of California Santa Barbara (UCSB) as part of the Merowe Dam Archaeological Salvage Project (MDASP) from 2007 to 2009 (Smith and Herbst 2005; Baker 2014; Herbst and Smith 2014). Research on rock art within the project area was first conducted by Cornelia Kleinitz (Humboldt-Universität zu Berlin and University of the Witwatersrand) in 2009, when eight previously known rock art sites were documented and 23 new rock art localities were identified and documented. Petroglyphs are not as frequent in the ASU BONE concession as further downstream in the Fourth Cataract region (compare Kleinitz 2012 for references), probably due to the absence of extensive rocky areas and the resulting sparseness of suitable rock surfaces. As in other areas above the Fourth Cataract, motifs are dominated by cattle images (Kleinitz 2004; 2007; 2012). Depictions of rhinoceroses, camels, goats, dogs, birds and anthropomorphs, as well as geometric motifs, were also documented. Compositions include depictions of animal-animal interaction, such as dogs chasing birds, and human-animal interaction, such as anthropomorphs riding a cow or bull, or holding cattle by their tail. During the 2009 survey, the rock art landscape also was found to comprise an acoustic aspect in the form of rock gongs or lithophones, in keeping with other parts of the Fourth Cataract region (Kleinitz 2008 and 2010 for references). Amongst the rock gongs identified – some located in proximity to rock art and others some distance from rock art sites – one of the largest and most extensively played was found at Site ASU 09-26. On its upper surface, more than 100 percussion zones and cup marks were identified, roughly circular or oval depressions that formed over time as the rock surface was struck with hammer stones (Plate 2). These physical traces of producing sound testify to the popularity of this ancient instrument, which would have been played by numerous individuals or groups of people over a span of thousands of years. Because it is situated amongst graves and clusters of tumuli that appear to date to the Kerma period (*c.* 2500-1500 BC), this rock gong was – at least for part of its use life – located in the centre of an active mortuary landscape. Its investigation is, thus, of special interest within the ASU BONE research programme.

Plate 1. ASU BONE concession with the location of site ASU 09-26 (map: Christopher Sevara).

Multidisciplinary documentation of Site ASU 09-26

In late December 2014 and early 2015, documentation of this exceptional rock gong as part of an in-depth (and ongoing) interdisciplinary study commenced. Documentation of physical properties of the rock gong and visual traces of

Plate 2. The large Dar en-Njoum rock gong seen from the north east (photo: Cornelia Kleinitz).

sound making on its surface were accompanied by acoustic recording and analysis in the framework of a sound archaeology design (Till 2014). Multidisciplinary research included thorough description and documentation by Cornelia Kleinitz, evaluation of acoustic and musical properties by Rupert Till (University of Huddersfield), 3D-modelling by Christopher Sevara (University of Vienna), magnetometry survey of the area around the rock gong by Jakob Kainz (University of Vienna), and geological evaluation by Erich Draganits (University of Vienna). A start was also made to record local traditions regarding the rock gong with the help of Ahmed el-Ameen (Sokary), our inspector from the National Corporation for Antiquities and Museums (NCAM). Excavation of the area immediately surrounding the rock gong and of nearby graves is planned in future fieldwork. This innovative research is designed to enrich our understanding of the use of the rock gong in the past and present and its potential relationship to funerary ritual given the number of graves located within view of it. It also aides development of the public presentation of the region's heritage in the form of a playable rock gong replica for a museum display and/or the web.

Rock gongs are defined as 'ringing rocks used for the production of musical notes' by Bernard Fagg (1956, 31), one of the first to describe rock gongs on the African continent. His definition conceptualises them as musical instruments separated from sound and soundscape and noise produced by daily activity, ritual, and sonic environment. Technically, the correct terminology is 'lithophone', a type of idiophone that is an object with the potential when struck to make a musical sound without the use of strings or membranes. Lithophones may be natural objects, may sometimes be sound tools rather than a musical instrument, and their use may be part of a wider activity rather than as a separated musical behaviour. The cryptocrystalline microstructure of stone and the degree to which a rock is freestanding are what afford resonance (Blake and Cross 2008, 4). In some cases, where surrounding rocks have weathered away leaving the lithophone standing alone, this freestanding nature is facilitated. In other cases lithophones are propped up to help them ring. Scales and Malcolm's (2003) research suggests that different sounds are produced by rock gongs when struck in different places, as subtle variations in the lithic microstructure will scatter acoustic waves differently at different surface points. Thus, the specific geology and conditions of the rocks leave us with individual objects that ring when struck in a way that varies subtly when the position of striking is varied.

Here, we consider rock gongs as rocks that produce sustained sounds when struck, and where there is evidence of human sound-making agency. This definition encompasses a variety of differently shaped, placed, and played slabs and boulders with widely differing sound properties. As demonstrated by the study of several hundred rock gongs in the SARS concession above the Fourth Cataract, only a portion of the slabs and boulders documented actually appear to produce notes that sustain (Kleinitz 2004; 2008; 2010; Kleinitz and Koenitz 2006). While some produce metallic, bell-like sounds when struck, others only emit dull thuds. What unites the various rocks is evidence of their use as sound-making devices because they all show physical traces in the form of loose or dense percussion zones, or – when the percussion zones were struck with a hard implement for a prolonged period of time – cup marks with gently curving sides and edges. Although any rock featuring such wear marks may be regarded as a sound-making device, or lithophone, only those that produce sustained sounds can be described as rock gongs.

Archaeological evaluation of the Dar en-Njoum rock gong

Rock gongs and rock-gong complexes have been identified and recorded at two other sites (ASU 09-13 and ASU 09-28) in the BONE concession. The rock gong at Site ASU 09-26 is by far the largest and most intensively used lithophone known to date in the project area and is the focus of this research. Located about 500m from the Nile in the desert margin beyond the fields and houses of the village of Dar en-Njoum, this large lithophone is surrounded by a number of graves and tumulus clusters provisionally dated to the Kerma period. It is a boulder composed of granite gneiss weathered out of the surrounding bedrock, standing out from the surrounding area due to its large size (estimated weight of 3 tons) and lighter colouring related to removal of desert varnish (patination) from its use (Draganits, pers. comm., February 2015).

The boulder measures 3.4m north-south by 1.9m east-west and varies in its width. It slopes toward its north-western side and only touches the ground at its north-western corner and at two smaller points in its centre, where it rests on the bedrock sheet in one case and on a smaller boulder in the other (Plates 3 and 4).[1] Magnetometry survey indicates that

Plate 3. The large Dar en-Njoum rock gong seen from the north west. A cluster of graves is located on the ridge in the middle distance (photo: Cornelia Kleinitz).

bedrock lies only a few tens of milimetres under the surface in the area surrounding the rock gong (Kainz, pers. comm., February 2015). Because the slab is lifted off the ground on three and a half of its four sides, it has excellent resonant properties. A total of 115 cup marks and distinct percussion zones measuring up to 120mm in width and nearly 40mm in depth were identified on the lithophone. A second rock gong is an upright slab with only a few percussion zones and cup marks located a few metres to the north east of the large slab (see Plate 4). In addition, there are a few, much smaller lithophonic rocks in the immediate vicinity that showed very little or no evidence of use. Among the lithophones available, there is a clear focus on the largest slab, which allows a larger congregation to gather around the instrument and participate in using it.

Plate 4. The large Dar en-Njoum rock gong seen from the south west with the smaller rock gong slab in the right upper corner of the frame (photo: Brenda Baker).

Analysis of the position, shape and depth of the percussion zones and cup marks was used to assess how the rock gong was played in the past and understand where one or more players must have been situated when striking it. Most percussion zones and cup marks are located along the eastern, northern and southern edges of the slab, including the largest and deepest (see Plates 2-4). Two lines of shallow cup marks and percussion zones along the western and northern sections of the slab's surface are some distance from the slab's edges. The smaller size and depth of these cup marks indicate less intensive use for sound making on this part of the rock gong (see Plate 3). The location, shape and size of the cup marks, together with its slope, indicate that it was played primarily with players positioned around the slab rather than anywhere on the rock gong itself. The numerous large cup marks along the long eastern edge of the slab indicate this was the most heavily used section, where the rock gong lifts up to a convenient 'playing height' between 720mm and 780mm above the (present) ground surface. In addition the greater separation from the ground at this end affords greater resonance. Players would have been positioned immediately to the east of the slab, standing upright and facing to the west toward an open space, where larger numbers of people may have gathered (Plate 5). The northern and southern narrow ends of the rock gong only rise up to 400mm above the ground, which means that users must have crouched to reach these surfaces (Plate 6).

Plate 5. BONE team members, Salah Mohamed Salah and Bela Yusuf, playing cup marks at the long eastern side of the rock gong (photo: Cornelia Kleinitz).

Cup mark shapes provide information on the direction of impact and, thus, on the way the lithophone was used. Cup marks on the rock gong vary in size from 40mm to 120mm at their openings and measure between 3mm and 38mm in depth. Depending on the direction of impact, the cup mark depressions are circular or oval. Along the eastern edge of the rock gong, where players would have stood upright and impact on the rock surface would have been directly from

[1] Project members had rather different opinions in regard to the question of whether the slab had been propped up to enhance its sound qualities. Investigation is ongoing.

Plate 6. Bela and Salah playing the lower register of cup marks at the northern and southern narrow ends of the rock gong (photo: Cornelia Kleinitz).

Plate 8. Bela and Salah playing cup marks at the little used western side of the rock gong (photo: Cornelia Kleinitz).

above, cup marks have circular openings. On the low northern and southern edges, where players would have sat, squatted, or kneeled in front of the slab, impact was diagonal, resulting in cup marks with oval openings. A second 'register' of oval cup marks is situated somewhat higher on the rock surface at both narrow ends of the rock gong indicating that players were standing and slightly bending over playing these parts of the lithophone. Impact was diagonal (Plate 7). The western, sloping side of the rock gong was also used, albeit to a significantly lesser degree. Here, roughly circular percussion zones and cup marks show that players were situated at the foot of the rock gong, and that impact on the sloping surface was diagonal (Plate 8).

Plate 7. Bela and Salah playing the upper register of cup marks at the northern and southern narrow ends of the rock gong (photo: Cornelia Kleinitz).

The number of possible players using the lithophone simultaneously may also be estimated by the positioning of cup marks. One or two individuals could have used each of the narrow ends of the slab simultaneously and five to six individuals could have played the long eastern side of the slab at the same time. These correspond to areas with the greatest evidence of use over time. Players may have been stationary or moved around the rock gong, but the strong differences in the overall size and depth of the cup marks suggest that players at most times were stationary, especially since heavily played cup marks seem to be grouped into similarly sized pairs with their centres between 170mm and 240mm apart. This distance is roughly that at which a player would hold his or her hands during two-handed play (Plate 9). Apart from same-size pairs of cup marks, pairs of larger and smaller cup marks were observed, which are located immediately adjacent to each other. Here, it seems that the play of a main note was combined occasionally with a secondary note.

Plate 9. A pair of equally sized cup marks (photo: Cornelia Kleinitz).

The inner sides of the cup marks are smooth and gently rounded and impact marks are small, pointing to gentle impact rather than users hitting the rock gong with force. During experimental play of the rock gong, during which one of the cup marks (number 58) was hit with a large hammer stone and with force by a local resident, significant damage resulted on the sides of the cup mark. The large, deep and irregular impact marks that resulted differ strongly from the characteristic smooth inner surfaces of the cup marks typically found on lithophones. Indeed, good sound effects can be achieved by just dropping a fist-sized hammer stone on the rock surface or into a cup mark from a low height and letting it jump back into one's hand. The wear on the rock surface is negligible from this type of gentle impact, which means that the cup marks will potentially have taken a long time to form.

There is some evidence of changes in playing traditions over time, not the least from strong differences in the (re-) colouration of the cup marks and percussion zones, indicating that different amounts of time have elapsed since the last time they were played/struck. Dark, fully re-patinated cup marks would last have been played hundreds if not thousands of years ago and not significantly since, while cup marks of light colour were used much more recently. While some cup marks were discontinued, others remained in use or gained in popularity. Contemporary and recent playing traditions use the rock gong in ways that are not evident from the physical traces of past rock gong play.

Ethnographic insights into use of the rock gong

Documentation also involved conversations and unstructured interviews with local residents on their knowledge and use of the rock gong. Many local residents of various ages visited the team while the documentation of the lithophone was in progress, some expressing fear that we would take away their rock gong, or locally: *hajjar en-nugara* (rock drum). Most residents visiting us contributed personal stories and memories about using the *nugara* (drum) in one way or other. Two informants were of special help, Ibrahim Suleiman Moussa, an engineering student 21 years of age, and Mohamed Gibril Saad, an elderly man who was locally claimed to be between 98 and 140 years old.

Games demonstrated by Ibrahim Suleiman used sound properties of the lithophone. A stone rolling game involved one or two players letting stones roll over the 'back' of the *nugara*, as well as a game in which a stone was thrown from a distance, bounced, rang, and came to rest on the horizontal slab. The most recent use of the cup marks involved a mysterious liquid that had been observed in some of the cup marks in 2009 and again in 2014 and 2015, which was revealed to have been the result of a (now discontinued) local tradition of small boys aiming at and urinating into the cup marks on their daily toilet trips.

Mohamed Gibril Saad provided nearly a century of perspective on the recent use of the *nugara* and how it was played. He stated that, when he was very young, the instrument was played communally, by children and by adults, and only one hammer stone was used by each player. There was no specific occasion for rock gong play, which appears to have been a pastime with some people playing the rock gong, others dancing and singing. During his childhood, the visitation and play of the *nugara* was temporarily discontinued when a local resident observed a female devil or spirit in its vicinity and the place was deemed dangerous. Mohamed Gibril's son, Ali, volunteered information on how he witnessed the *nugara* being played. He recounted that one hammer stone was used by each individual, alternating between two cup marks. Rock gong play would be coordinated with other players, who would strike neighbouring sets of cup marks in an agreed rhythm. This account brings an added perspective to the archaeological study of the Dar en-Njoum rock gong, which isolated pairs of cup marks that may have been played together during two-handed play. In the recent past, pairs of cup marks were indeed used, but during one-handed play, with each set of cup marks representing the space a person would occupy when playing the rock gong.

Acoustical study of the rock gong

High fidelity location and studio recording equipment was used for capturing a large number of recordings of the rock gong, including a Sound Devices 744T four-channel portable audio recorder used to capture sounds at 44.1kHz in uncompressed .aiff format. Four microphones were used, two DPA 4006 omni-directional microphones for capturing impulse responses and ambient sound, and two DPA 4003 uni-directional microphones for focusing on specific positions and capturing stereo imagery. Two microphones at a time were placed within full Rycote windsocks, large zeppelin-like furry cases that prevent wind noise being recorded, and protect the microphones from sand and other damage. A 20-second swept sine signal was played through a B&O Beolit loudspeaker, and recorded to capture the impulse response of the space (although little of interest was captured) for control.

A range of experimental sounds was recorded, with care taken to limit marking or damaging the rock gong. For an initial recording of the rock gong's sound properties, each of the 115 cup marks and percussion zones was struck 10 times to provide a detailed record. Striking the rock gong created an audible metallic ringing sound, with a main single pitched frequency audible as well as other, weaker harmonics. The instrument makes an initial burst of sound when struck, a short wide band noise heard as a percussive 'clunk' followed by the ringing tone. The tone or frequency response of this ringing is inharmonic; in other words, it does not follow a simple pattern of ratios such as the harmonic series. Sound builds up as the rock is percussed, in particular a low frequency note becomes increasingly prominent. We experimented with a number of different objects for striking the rock gong. We tried marimba mallets and wooden sticks, but these made a sound that was very weak and quiet. Using quartz as well as other, softer stones as hammer stones was far more effective, with the harder quartz resulting in the most distinct sounds (see Kleinitz 2004 for hammer stones from the Fourth Cataract).

Recordings with various different source (playing) and receiver (hearing) positions were made (Plate 10). Initially the sound made seemed quite similar each time the rock gong was struck but, with increased familiarity, it became clear that each sound made was subtly different, with a slightly different pitch because the ringing harmonics would have different

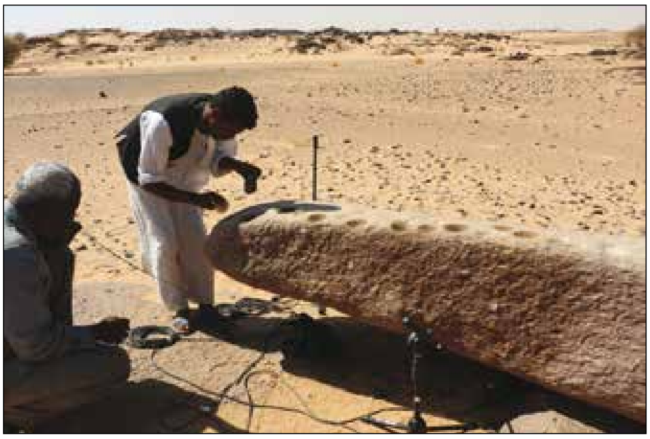

Plate 10. Ibrahim Suleiman playing the rock gong with Ahmed Sokary listening. Microphones recording sound under the rock gong (photo: Cornelia Kleinitz).

frequencies as acoustical analysis demonstrated (Figure 1 and see below). When played continuously, the sound built up in amplitude and the ringing became more sustained. The individual harmonics seemed to shimmer, as their intensity varied subtly. As one struck the hammer stone on different parts of the face of the rock gong, the sound changed. At different ends of the stone the sound was more substantially different. In some positions, especially on the western side of the rock gong, opposite to where most players would be positioned, one became aware of a low frequency resonance that was being produced, similar to a low hum or boom. The rock produces a different sound depending on a number of factors. There is more sustained sound at the end of the rock that is raised from the ground. Fractional movement or change in the position of percussion changes the sound subtly in terms of the harmonics produced. How you play it, how hard you play it, how many people play it, what you play it with, and where you hear it, all affect the sound heard.

To define how resonant a rock is, it is necessary to consider how long a rock has to ring in order for it to be recognised by the human ear as producing a pitched rather than an unpitched sound. This issue is complex and depends upon the number of cycles of the waveform, the amount of noise present in masking the sound, the experience of the listener, and the volume and frequency content of the source sound. In general, 10 cycles of a waveform should be enough to identify with some certainty a sound as being pitched (Robinson and Patterson 1995). For the purposes of studying rock gongs, a rock struck would need to ring for at least 0.05 seconds (s) to be perceived as pitched, but to be certain it would be perceived as a rock gong, sustain of at least 0.1s is ideal. An appropriate metric to quantify this sustain, or resonance, is reverberation time, in this case T(30). This terminology is usually used to identify the length of time sound is sustained in a space, but it can be used in this context to identify how long a note sustains. This metric is useful because it identifies the length of time taken for the

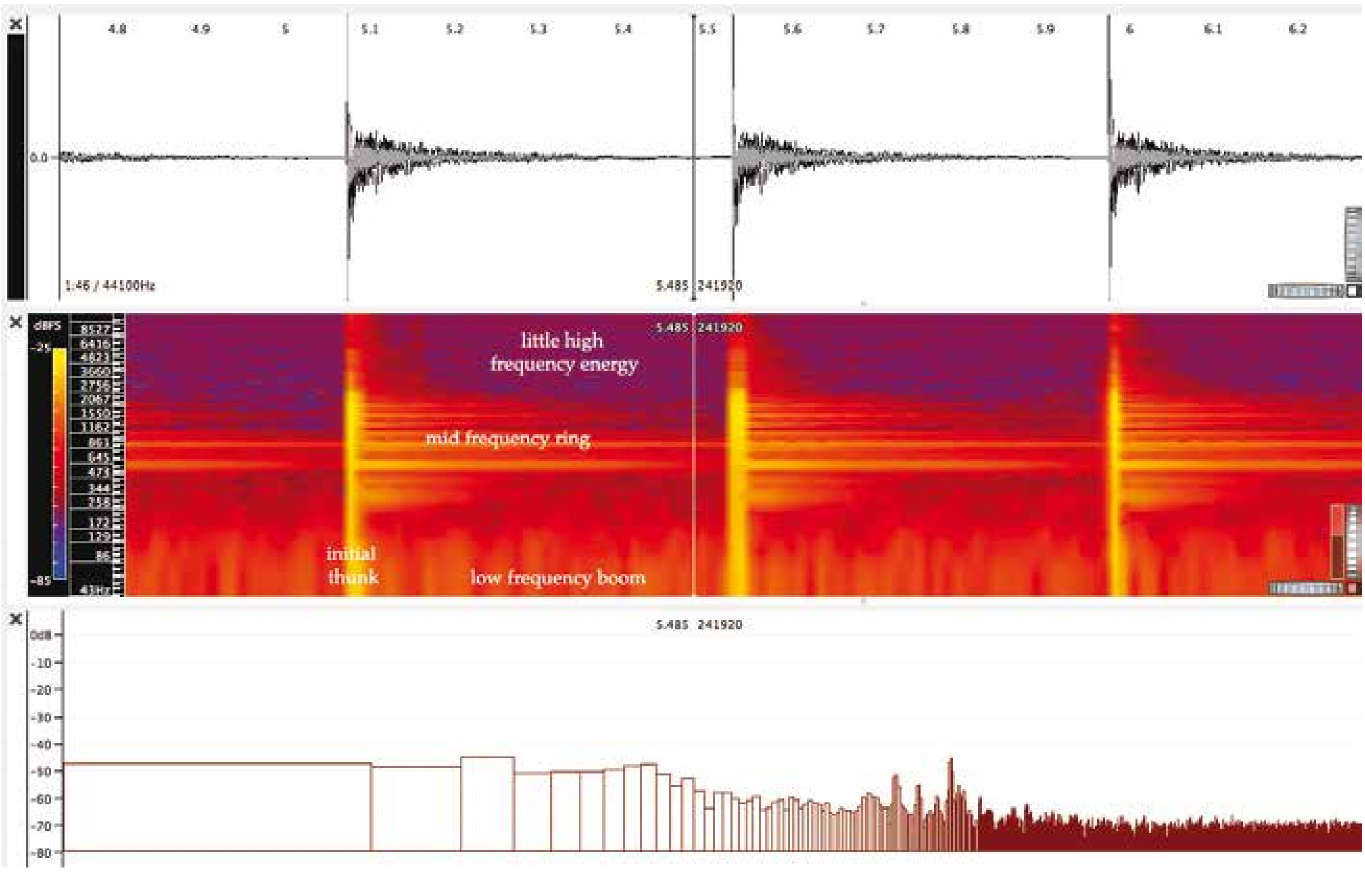

Figure 1. Audio waveform, sonogram and an averaged frequency response of repeated strikes of the lithophone (image: Rupert Till).

sound to decay in amplitude by 60dB. T(30) focuses on the decay of the signal from 5dB below the initial level, to 35dB below, a 30 dB drop, extrapolating from this figure (by doubling) the time taken to drop by 60dB from the initial sound into the noise floor. To measure T(30), a single note struck on the lithophone was recorded as an impulse response file, which extends from the moment it is first hit to the point at which the sound has faded out into the background noise of the location. Each recording was imported into Odeon acoustical modelling software, which generates a number of acoustic metrics. T(30) was, thus, described for a number of octave bands, starting at a low octave (63Hz) and continuing to a high frequency (8000Hz). The strongest resonance is at 500-1000Hz, which is where sound lasts the longest. The average T(30) is 0.9s, close to a second, and clearly audible as a pitched note. The lowest values are at low frequencies, around 250 and 500Hz, whereas the longest T(30) is at 1000Hz (Figure 2). The different resonant frequencies decay at different speeds and inconsistently, with some harmonics becoming more audible, as they last longer than louder harmonics that previously masked them. As shown in Figure 2, initially, the loudest frequencies present are at 500Hz, but these decay quickly. After 0.3s, 1000Hz is the loudest frequency range. Similarly 250Hz starts off louder than 2000Hz, but again this decays quickly, 2000Hz being louder after 0.1s. This pattern has the effect of beginning with a low sound, then higher frequencies take over, shining through as the sound tails off, lending a sparkling, twinkling quality to the sound as these higher frequencies increase in prominence. Figure 3 shows the frequency response of the lithophone, and sharp peaks can be seen at 600 and 940 Hz in particular. This frequency response gives an average of the frequencies present during the duration of the ringing of the rock. As Figure 2 shows, the frequencies present vary over time.

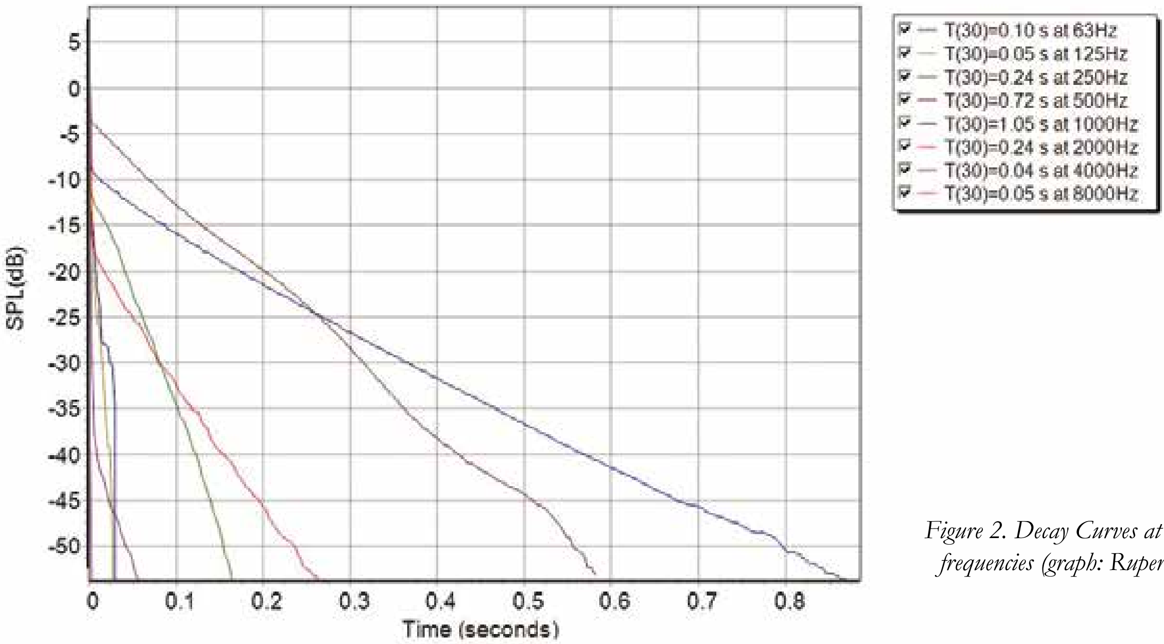

Figure 2. Decay Curves at different frequencies (graph: Rupert Till).

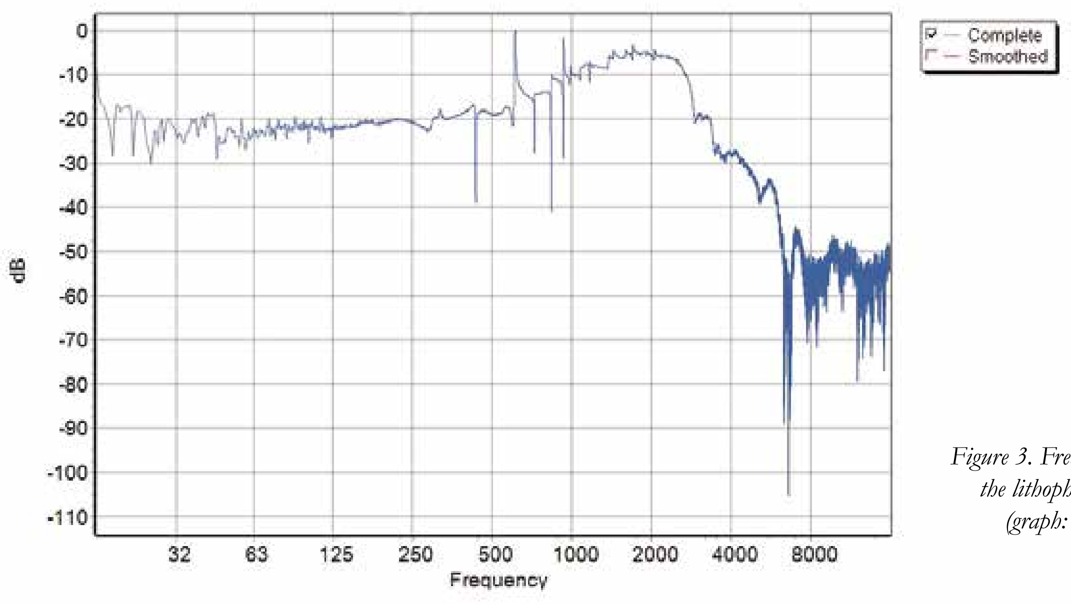

Figure 3. Frequency Response of the lithophone when struck (graph: Rupert Till).

It was noticeable in the field that a single strike produced a short ring, but a series of strikes, perhaps two per second, allowed resonances in the stone to build up and become more sustained. They did not fade away, and a mid-frequency shimmer and low frequency rumble/hum were both audible. The Odeon software could not detect enough signal to produce reliable results at 500Hz or below from a recording of a single strike, illustrating further how the low frequencies build up in the rock when it is repeatedly struck. This information suggests that the rock gong is most effectively played with repeated strikes, and perhaps with multiple players. Figure 1 illustrates how, in repeated strikes, the most strongly resonant frequencies sustain, becoming a yellow and red line across the central sonogram. There is an initial noise burst (clunk or tak sound) in all frequencies as rock strikes rock, which appears as a vertical yellow line. Mid-frequencies that ring appear as horizontal lines, the colour of this ringing moves and shifts as the frequencies generated depend on the exact positioning of the strike. Low frequencies are sustained in red/orange at the bottom of the sonogram. There is little sound in the highest frequencies at the top, indicated by purple.

Additional experiments were conducted to determine the distance over which the sound can be heard when the rock gong is struck. Sound produced by a single person was demonstrated to carry more than 90m away and could be heard at nearby graves and beyond them (Plate 11).

Conclusions

Initiation of multi-perspective research on rock gongs or *nugara* in the ASU BONE concession in the 2014-15 field season has provided detailed archaeological documentation, including geological characterization of Site ASU 09-26 and the rock gong, and insight into the production of sound and acoustic ecology of the rock gong and its surroundings at Dar en-Njoum. This work combines perspectives of archaeologists and a specialist in acoustic recording and analysis, allowing the reconstruction of decay time of struck notes and exploration of the frequency response of the sounds produced. This analysis confirms that the Dar en-Njoum rock gong is clearly capable of producing sustained musical sounds, and repeated striking of the lithophone creates the strongest resonant sound. The large number of cup marks formed from repeated percussion shows that the instrument has been used over a long period, possibly by a large number of people. This use is clearly musical; in other words, people have used the object in a way to produce music through playing the rock gong as an instrument.

Thorough analysis of the granite-gneiss rock gong at ASU 09-26 also provides evidence of how it was played by people in the past based on the dimensions and shape of cup marks and positions from which individuals struck it. This reconstruction was supplemented by ethnographic research that provided further insight into possible ways of playing the *nugara*, including use of one hand to strike side-by-side cup marks consecutively rather than using both hands simultaneously as we assumed. Some fully repatinated cup marks on the Dar en-Njoum rock gong indicate that they last were used some millennia in the past, possibly when burials occurred in the vicinity during the Kerma period. If so, the rock gong may have played a role in funerary rites, a possibility supported by evidence that sound produced by a single person carries far and could be heard easily at nearby graves. Most of the numerous Kerma period cemeteries in the concession, however, are not associated with rock gongs, suggesting that rock gong play could not have formed a regular part of funerary ritual in this region but may have been opportunistic in this case, perhaps stimulating its central position within the mortuary landscape.

Further work could include the comparison of different lithophones to reveal what characteristics cause different elements of the sound of a lithophone, whether length, width, thickness, suspension from the floor or material make-up affect the sound in particular ways, and whether this lithophone is typical in its acoustic characteristics. Future sound analysis will explore the effect of several people playing the lithophone simultaneously, including differences in the acoustic results with variation in strength of striking, number of

Plate 11. Recording sound produced by a single player (Rupert Till) at a nearby cluster of Kerma period graves (photo: Cornelia Kleinitz).

people playing and position of striking. The contemporary local word for the lithophone, *nugara* or drum, points to the (recent) use of the instrument to play repeating rhythms, which are regularly accompanied by other performance, such as singing, clapping, and dancing. Such activities usually do not leave traces in the archaeological record. Ethnographic work, as we have started, can provide some information on most recent performance types in association with rock gong play. Future excavation around the rock gong itself and the flat area to its west may provide traces of past activity at the site. The surrounding graves are significant in the case of the Dar en-Njoum rock gong, at least during a period of its use life. A number of factors have suggested that repetitive rhythms might have been played in antiquity, suggesting that the Dar en-Njoum rock gong may have been used in trance-like ancestor/death rituals, whether to assist the dead to navigate an afterlife, to facilitate grieving, or for the living to commune with the dead or the spirit world. Future excavation of surrounding graves may, minimally, provide insight into the lives of some of the people who may have played the rock gong in the past.

Acknowledgements

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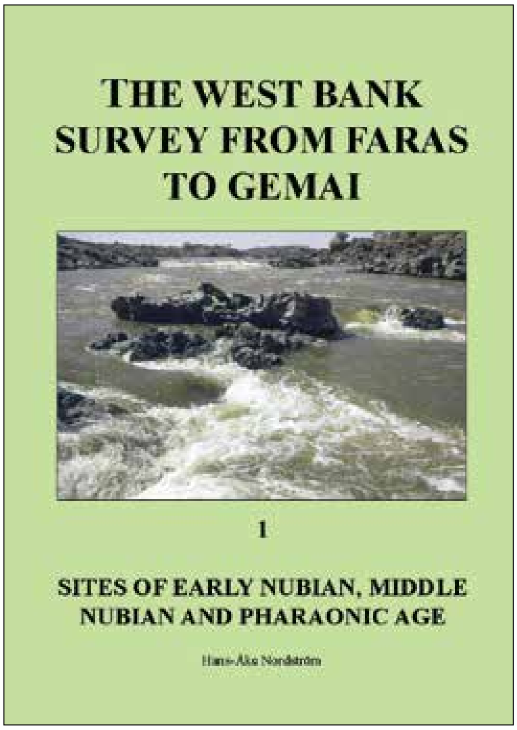

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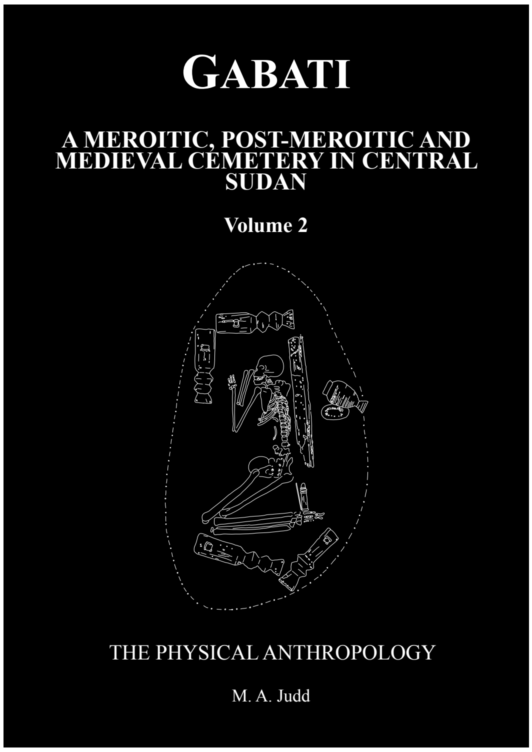

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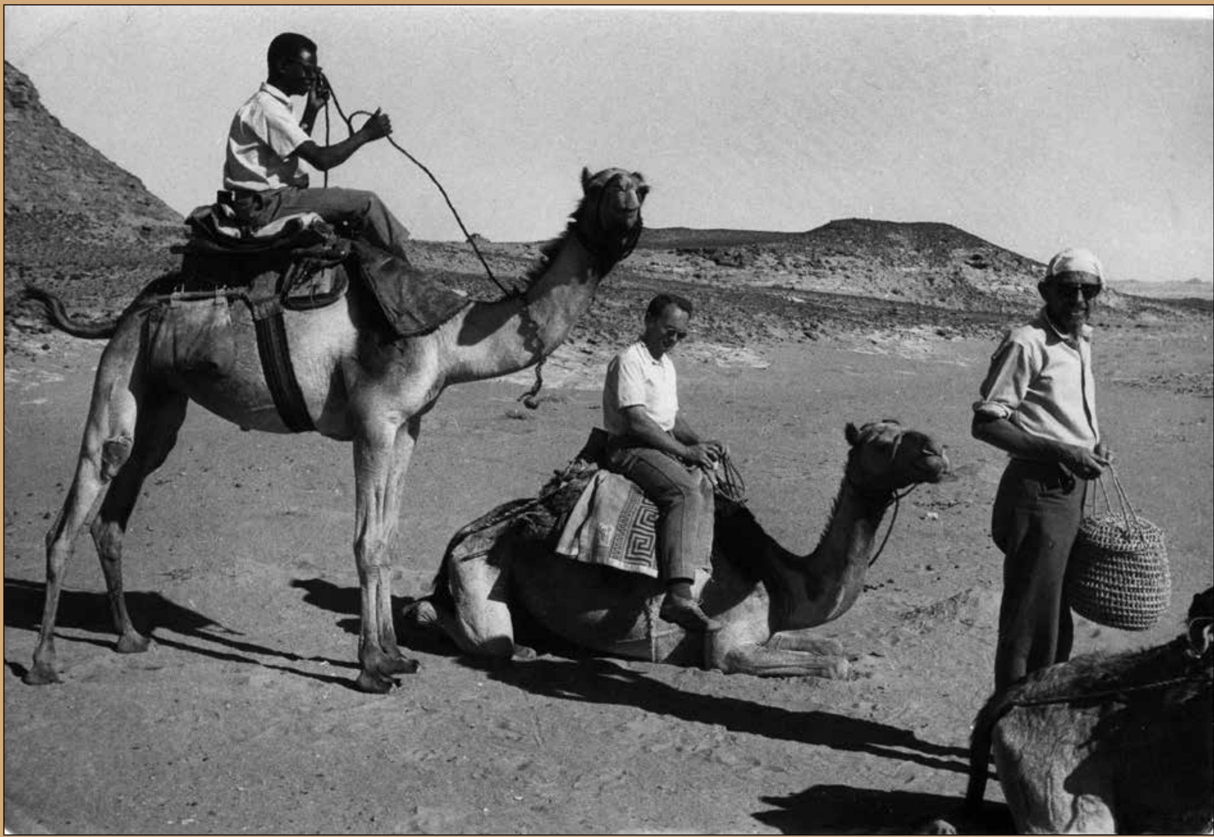
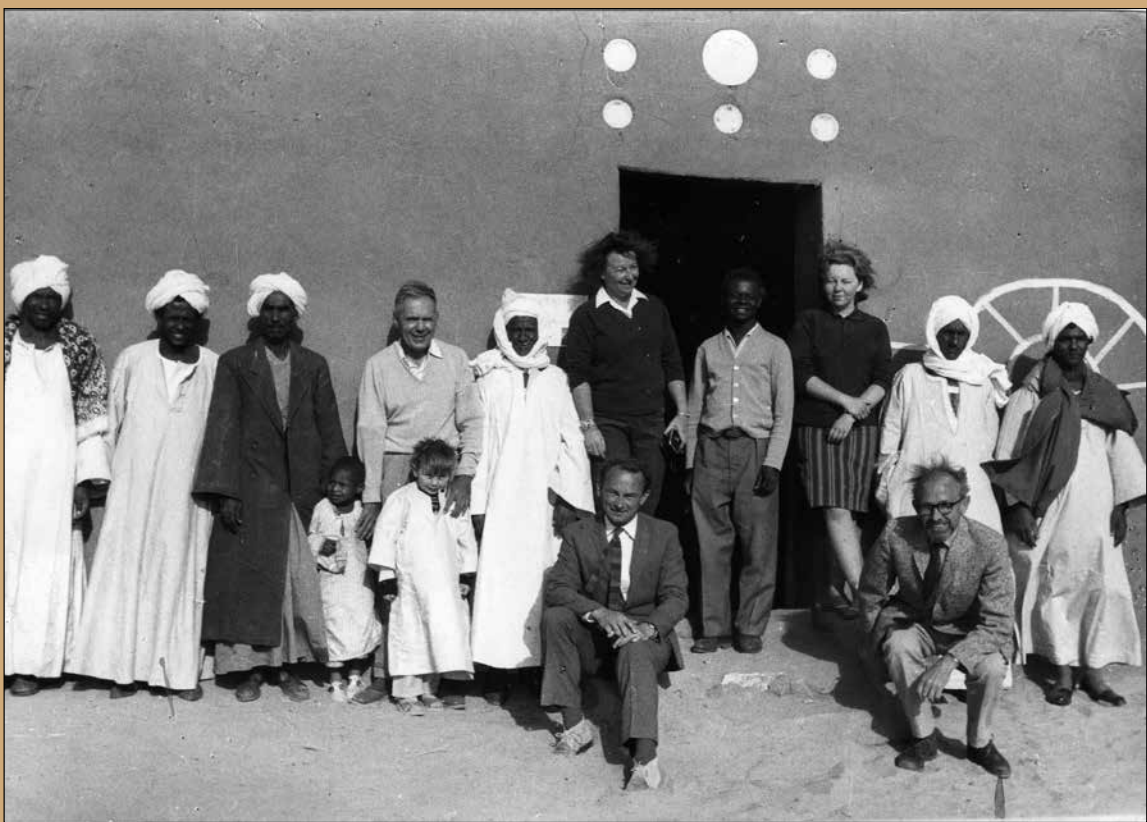


Members of the University of Ghana Expedition to Sudan. John Alexander (centre), James Anquandah (left), Tony Bonner (right) (photo: SARS Alexander Archive, ALE P003.05).



The Debeira West excavation team 1964 with amongst others, Peter and Margaret Shinnie, John Alexander, John Anquandah and Tony Bonner (photo: SARS Alexander Archive, ALE P003.04).

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