

Notes on the Chambered Mound for Earth Sanctuary

By Aaron Watson and John Was (May 2021)

Introduction

Many thanks for forwarding your updated proposals (March 2021) for comment. Overall, we are very impressed by the attention to detail and research which has been invested into this exciting and ambitious project. Our intent with this document is to provide some further thoughts and feedback. We have also reviewed the document originally prepared by Aaron Watson and David Keating in 2004, *Comments on the 'Earth Mound' Project* and have made some additional suggestions where necessary. We cannot comment directly upon your mathematical modelling and will focus upon the archaeological associations that underpin your project.

The Chambered Mound

Watson and Keating (2004) suggested that acoustic effects within your original proposed design might be improved by using straight walls in the chambered, thereby improving the structures potential to generate standing waves. In addition, accessible side cells provide additional locations for listeners. In these respects, your selection of Maeshowe as an archetype is fitting. This site was one of the pinnacles of megalithic engineering in terms of its architectural scale and finesse. Its size would offer greater accessibility and comfort than more typical chambered cairns such as the Grey Cairns of Camster in Caithness.

Standing waves

We note your rigorous empirical approach to determining details of the Chambered Mounds construction but would urge caution in assigning special properties to specific frequencies, including 110 Hz. There is no robust scientific evidence that single frequencies can trigger specific physiological effects. Cook *et al.* 2008 is the only neurological study we are aware of suggesting the possibility, but there are some significant inconsistencies in their findings. Also, we would suggest if any tone did possess special qualities, then surely musicians over the millennia would have identified it and used it as part of their expressive palette. This is not the case. This is not to say that profound experiences cannot be generated by sounds inside your monument. On the contrary, our research has proposed a number of ways in which monuments can generate affecting experiences. The types of sound required to

generate such experiences are also a very important factor, but they will be complex sounds and sound patterns and need to be finely tuned to the acoustics of the particular environment they are heard within.

Furthermore, fieldwork reveals that multiple resonance frequencies are established within Maeshowe’s chamber, resulting from complex harmonics as sound reflects between the finely built walls. The Chambered Mound at Earth Sanctuary will also present multiple harmonics, enabling vocalists or sound-producing devices to produce complex soundscapes.

Before the use of impulse responses, acoustic profiling techniques commonly measured three modes of resonance in order to provide an assessment of the basic resonances produced by a space: axial, tangential and oblique. In our research, we have produced estimates for such resonances for the West Kennet tomb in Wiltshire, UK (shown below). This gives an example of how an even rudimentary estimate of resonances in an enclosed space reveals a complex reality. Based on these calculations, however, we have recreated these frequencies using contemporaneous organology (human voice and cow horn) to produce a recording of the ‘resonant sound’ of West Kennet.

	West Chamber	S. West Chamber	N. West Chamber	S. East Chamber	N. East Chamber
Length	2.58 m	1.72 m	1.77 m	2.08 m	1.96 m
Breadth	2.04 m	1.23 m	1.52 m	1.44 m	1.71 m
Height	2.44 m	1.66 m	1.78 m	1.94 m	2.16 m
Axial P	66.3 Hz	99.1 Hz	96.0 Hz	81.5 Hz	86.7 Hz
Axial Q	83.3 Hz	138.0Hz	111.5 Hz	117.8 Hz	99.1 Hz
Axial R	72.1 Hz	102.0Hz	96.2 Hz	86.7 Hz	78.0 Hz
Tangential P&Q	106.16 Hz	170.0 Hz	147.2 Hz	143.2 Hz	131.0 Hz
Tangential Q&R	110.2 Hz	171.7 Hz	147.2 Hz	146.2 Hz	126.1 Hz
Tangential P&R	97.7 Hz	142.2 Hz	136.0Hz	119.0 Hz	116.5 Hz
Oblique	128.3 Hz	198.3 Hz	175.0 Hz	167.4 Hz	153.0 Hz

This West Kennet study reveals the diversity of sound frequencies which may be present within prehistoric architecture, and it should also be acknowledged that these sounds will also transition as listeners move through the space. As an audience passes through nodes and antinodes, they will experience intricate soundscapes comparable to those present within

Neolithic chambers, but it is not easy to anticipate the precise character of these experiences using acoustic modelling due to their complexity.

Helmholtz Resonance

Maeshowe also offers a robust archetype since it is the only Neolithic structure where the effects of Helmholtz Resonance have been empirically measured. Aaron Watson and David Keating tested for infrasonic frequencies at two megalithic sites, Maeshowe and Newgrange, producing contrasting results. At Maeshowe, a 2Hz resonance was found to be excited air oscillated within the structure, triggered by beating a drum percussion and the movement of people along the passage (Watson 2001). The same methodology performed at Newgrange revealed that no infrasonic response (unpublished research). This contrast may reflect structural differences between these sites. Maeshowe's precise stone walls and corbelling limits sound absorption, and the walls themselves are embedded within a clay mound. In contrast, the water-rolled boulders used to construct Newgrange do not fit precisely together. Furthermore, cavities within the fabric of the mound allow sound energy to 'leak', negating Helmholtz Resonance.

As noted in Watson and Keating (2004), we do not consider Helmholtz Resonance to have been an intentional result of passage tomb design, even at Maeshowe. While mathematical modelling suggests that a number of sites theoretically have the potential to generate Helmholtz Resonance (Watson and Keating 1999), the ability of these sites to generate this remarkable effect remains empirically untested.

Infrasound

In your document *Creating a Modern Megalithic Artwork that Evokes Spiritual, Shamanic, and Magical Experiences*, it is stated that infrasound resonance such as 3Hz "can have physiological and psychological influences on people that some describe as shamanic, spiritual, and magical". We would like to reiterate that:

- 1) the anticipated resonance of 3Hz is inaudible to human ears, and the physiological impact of high amplitude infrasonics within stone chambers remains untested. Research into infrasound frequently reports on its unpleasant side effects, including nausea and disorientation, which may be detrimental to a meditative experience.

- 2) In the 2004 document, it was noted that wind blowing across the entrance has the potential to inadvertently excite significant resonances. A suggested solution was to shelter the entrance. The concave stone façade shown in one of the sketch plans of the proposed site may help to reduce unwanted effects of wind and has parallels at Neolithic chambered sites in Britain.
- 3) We also noted that there is no empirical evidence as to how a structure like this might react to the presence of thunderstorms and earthquakes, which may excite significant low-frequency sound even when distant.
- 4) Prolonged drumming at three beats per second might itself invoke unwanted effects upon the listener, especially in a confined space. During our field experiments, ear defenders were used to minimise the possibility of hearing damage as a result of the listener's proximity to loud drumming. Health and safety, or even the comfort of participants, was unlikely to have been a Neolithic concern.

Solar alignment

As noted in one of your documents, Maeshowe is one of a number of structures that is oriented upon the movement of the sun at turning points of the year. The axis of the chamber and passage opens towards the south-west, the direction of the midwinter sunset at the latitude of northern Scotland. We wondered whether you might have considered orientating the Chambered Mound such that the light from the sun illuminates the chamber or passageway at a pivotal time of year?

Camera Obscura

Since the Watson and Keating report (2004), further research has been undertaken into the potential for Neolithic chambered monuments to generate animated optical projections of the outside world within their chambers. This effect has now been witnessed at multiple chambered monuments across Britain and Ireland (Watson and Scott 2017; Was and Watson 2017). In the absence of a glass lens, optical projections within megalithic tombs are soft-focused, as well as appearing upside down and back to front. It is our view, however, that the effect is extraordinary and has potential for your project. We wondered whether you might consider camera obscura effects with the Earth Sanctuary Chambered Mound?

Carved Decoration

Watson and Keating (2004) make reference to the materiality of the finished chamber. We would emphasise that the aesthetics of stone contribute significantly to the experience of these monuments both visually and haptically. Surveys within Maeshowe have revealed this structure to be marked with abstract patterns of incised lines which date to the Neolithic (not to confused with Norse runes which are also found within this structure). A survey has since been undertaken of the images there (Thomas 2016). The tradition of carved decoration in Orkney is rather different to the more famous carvings allied to the Irish passage tomb tradition.

References

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