THE MARI-CHA LION – DID IT ONCE ROAR?

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1 INTRODUCTION

The Islamic lion of the Mari-Cha Collection is a medieval hollow bronze statue, most likely originating from the Mediterranean region in the early part of the last millennium. The lower sections of its legs are missing and the statue now stands at 73cm in height. There is a large rectangular opening in the belly of the lion and a small circular opening at the mouth. Inside the lion, attached to the rear of the body, is a vase-like vessel which is orientated at a slightly downward angle (see Figure 1).

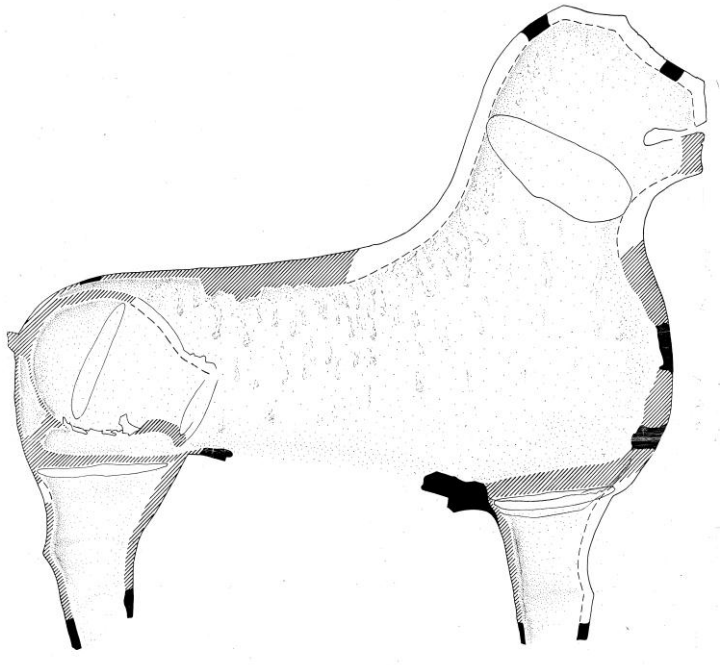

Figure 1. Drawing of Mari-Cha lion (by Kikar Singh, Museum of London; taken from [1]).

Descriptions in the literature suggest that the lion may have once roared[1]. The ancient Ghumdan palace in Sana'a, Yemen is reported as having a "yellow brass" lion statue on each of its corners and it is stated that the wind would pass through these statues and make the sound of a wild beast roaring[2]. Also, the Byzantine emperor's throne is described as having lions positioned around it (made either of bronze or gold-covered wood) which gave a "dreadful roar" [3].

This paper speculates on the mechanisms by which the Mari-Cha lion may once have roared and presents some very basic measurements of the resonance frequencies of the surviving lion structure.

2 POSSIBLE SOUND GENERATION MECHANISMS

For the Mari-Cha lion to have once roared, there must have been a sound generation mechanism of some sort. Unfortunately, there is not sufficient evidence remaining to be able to determine conclusively what that mechanism might have been. However, it is possible to speculate.

As stated previously, the lion is hollow with an access hatch on its underbelly and a circular opening at its mouth. This leads to the idea that air may have been pumped through the lion (see Figure 2).

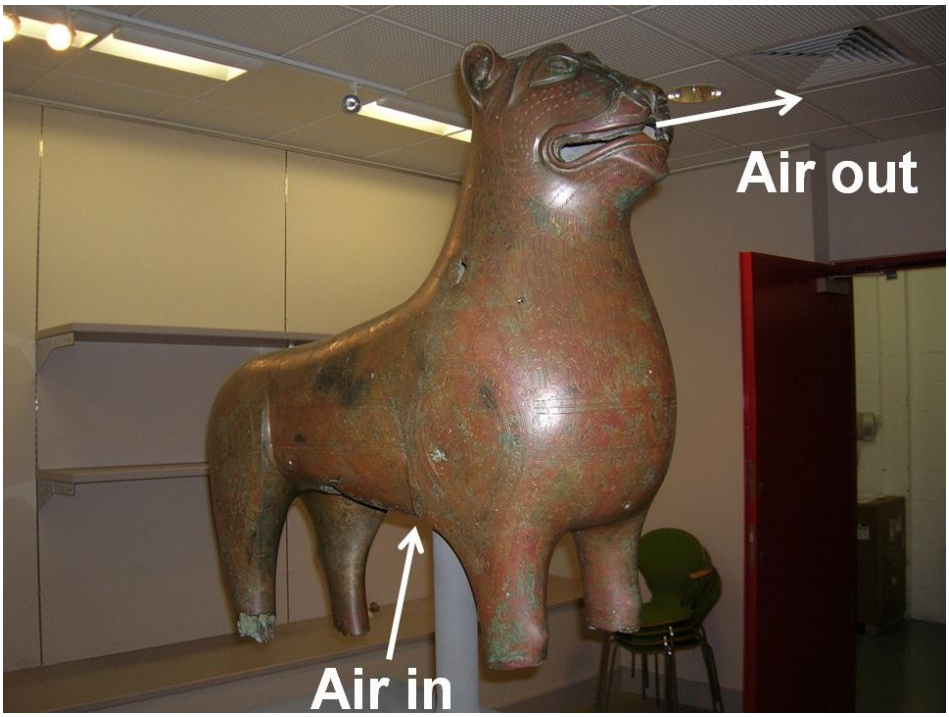

Figure 2: Mari-Cha lion.

The air may have been simply passed directly through the lion via some form of hose and emerged as a jet at the mouth. In this case, there would have been some noise generated due to the turbulence of the jet. However, for an impressive roaring sound, the flow rate would have needed to be very large. Also, the generated sound would have most likely been more of a hissing type sound, somewhat like white noise, rather than the rumbling roar reported in the historical literature.

An alternative possibility is that air was pumped in through the belly and then directed to a sound producing device housed within the body of the lion. This device may have involved directing the air against an edge (as with a flute or a pipe organ) or passing it over/through a reed (as with a clarinet or a reed organ). In either case, the end result would be to convert the steady flow of air into a fluctuating air stream containing regions of higher pressure and regions of lower pressure, thereby generating sound. In this scenario, the hollow body of the lion may have acted as a resonator, amplifying certain frequencies in the generated sound.

It is also worth considering the possible function of the vase-like vessel positioned within the lion's body (see Figure 3). This may have been completely non-sound related, although the vessel's downward pointing orientation and the imperfect quality of its casting appear to rule out the possibility of it ever have been used to hold liquid, and there is no evidence to suggest it once acted as an incense burner. Alternatively, the vessel may have had a sound-related function. In particular, it may have been designed to house a sound-producing device of some sort or it may have acted as a further resonator.

Figure 3: Vessel positioned inside the Mari-Cha lion, towards the rear of its body.

3 MEASURING THE LION'S RESONANCES

In this section, very basic measurements of the resonances of the Mari-Cha lion are reported. These measurements were taken during a one-hour session while the statue was housed in Christie's Fine Art storage centre in London, ahead of it going on display at the Royal Academy of Arts as part of the *Bronze* exhibition of Autumn 2012. The constraints of time and location placed significant restrictions on what it was possible to do. A fairly crude external excitation approach was taken, with no account taken of the responses of the loudspeaker and microphone.

Figure 4: Measuring the resonances of the Mari-Cha lion (during measurements the loudspeaker was held up against the opening in the belly).

A loudspeaker connected to a laptop computer was positioned directly under the lion's belly access hatch and a 10 second long chirp signal containing frequencies up to 5 kHz was played. While the signal was being played, a microphone (also connected to the laptop) recorded the response. This was done three times, with the microphone at different positions; at the mouth (see Figure 4), inside the vessel, and in the main body of the lion.

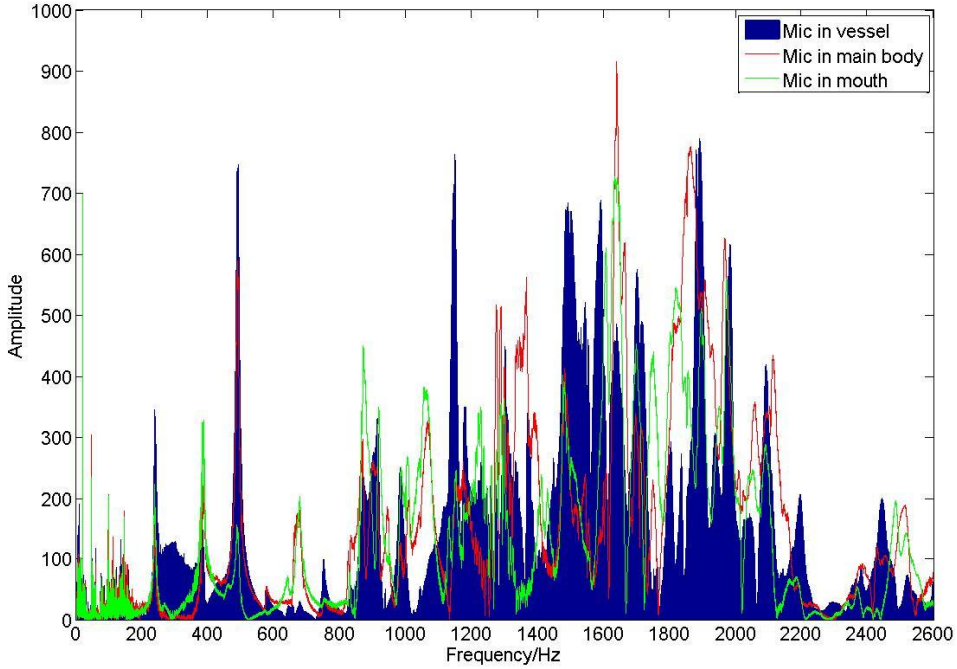

Figure 5: Resonance frequencies of Mari-Cha lion measured at three different positions.

Figure 5 shows the results of the resonance measurements for the three different microphone positions. As the loudspeaker and microphone responses were not taken into account, no conclusions can be drawn regarding the relative strengths of the different resonances.

It is clear that the lion's body cavity has numerous distinct resonances. If the hollow body of the lion did act as a resonator, then the many resonances below 200 Hz would have certainly amplified the lower frequencies in the generated sound; a feature desirable for producing an impressive roar. Meanwhile, the resonances at higher frequencies might have given the sound a hiss-like nature but they may also have given it tonal features.

The resonances at approximately 500 Hz, 1150 Hz, 1500 Hz and 1600 Hz appear to be associated with the vessel (as the response at these frequencies is strongest for the case when the microphone was positioned within the vessel). However, it is worth noting that the vessel is not complete; a section of wall is missing. This may have always been the case or this defect may have appeared during the past millennium (in which case the resonance frequencies would also have changed over this period).

4 CONCLUDING REMARKS

Although reports in the historical literature suggest that the Mari-Cha lion bronze statue may once have produced a roaring sound, the remaining structure does not provide sufficient evidence to establish conclusively if this actually was the case, nor does it yield many clues as to how such a sound may have been generated.

It can be speculated that if the lion statue did once roar, this might have involved pumping air through some kind of sound-producing device housed within its body. It is possible that the lion's body cavity may then have acted as a resonator, amplifying certain frequencies in the generated sound. However, unless further evidence is discovered, this can only remain speculation.

5 REFERENCES

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