

## ARCHAEOPHONY: (RE)CREATING ANCIENT SOUNDSCAPES

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### ABSTRACT

This paper results from my participation in an interdisciplinary research project titled *City Life: Experiencing the World of Teotihuacan*. The aim of the project was to present daily life in the Mesoamerican city of Teotihuacan at the time of its peak, around the year 250 AD. I was involved in the conceptual development of the project as well as the exhibit research and was enlisted to create soundscapes depicting the sonic ambiance of certain central locations in the city of Teotihuacan for presentation in a purpose-built listening environment utilizing advanced 3D surround sound technology.

Sound has a unique ability to evoke, delineate and describe different spaces and trigger memories and associations to activities and situations and thereby offer unique insight into time, place and culture. Digital audio technology, especially technologies for immersive sonic spaces, can be utilized to create an *archaeophony*, a sonic environment constructed based on the archaeological record and transform how archaeological data is presented, experienced and understood. This paper discusses the rationale for using sound to present archaeological findings, with the research and compilation of material for this particular project at Teotihuacan as the starting point.

### INTRODUCTION

This paper results from my participation in an interdisciplinary project focusing on the Mesoamerican city of Teotihuacan, located about 40 km northeast of Mexico City. The project, titled *City Life: Experiencing the World of Teotihuacan*, was initiated by the Museum of Anthropology at Arizona State University in the US in 2003, with the bulk of the research on site in Teotihuacan taking place in 2007 and 2008. The final exhibit of the project was held from September 2013 to May 2014, however in a format that was significantly more scaled-down than was originally planned.

Teotihuacan as an archeological landmark and world heritage site is mostly known for its immense pyramids, which are among the biggest in the world and its impressive main avenue, *The Avenue of the Dead*, 40 meters wide and more than 3 km long. Teotihuacan was a major prehistoric urban center that rose in the first or second century BC and lasted until around 700 AD, when it saw a relatively rapid collapse, most likely due to internal political upheaval that reduced the power of the elite and thence its overall political influence and prestige in the region at the time. The population of Teotihuacan decreased, but the area was never completely abandoned. The name Teotihuacan, meaning "The birthplace of the gods," was given by the Aztecs, who encountered the city several hundred years after its heyday. Most of the early descriptions we have of Teotihuacan come from the Aztecs. No grammar or phonetics of a written language have been identified

that originates from the Teotihuacanos themselves, so there are no written sources from them directly. [1 - 3]

The aim of the project was to present daily life in Teotihuacan at its peak, around the year 250 AD, when it was the sixth biggest city in the world with a population of at least 80,000 people living in the urban center or an estimated 250,000 when also counting surrounding areas with close ties to the city's markets and services. I was involved in the conceptual development of the project, which started already in 2003, as well as the initial exhibit research in 2007 and 2008 and my task was to create soundscapes depicting the sonic ambiance of certain central locations in Teotihuacan for presentation in a purpose-built listening environment utilizing advanced 3D surround sound technology. The 3D listening space for the exhibit was originally planned as a "room within the room" in the exhibition space, intended to incorporate a 36-channel (5th order) ambisonic surround sound system, but due to change in personnel and funding structure for the project, it was unfortunately not built for inclusion in the final exhibit. Research and preparation of the sound material was done with such an immersive listening environment in mind, however and this paper will primarily concentrate on the process of choosing and collecting material and my approach toward composing soundscapes as a means to convey archaeological data.

### ARCHAEOLOGY AND SOUND

Archaeology is about making sense of the past by gathering evidence from where ancient peoples lived and worked, interpreting the evidence and telling the story of how they lived and worked. Traditionally, the evidence on which the lives of people of ancient cultures were mapped was found in material remains. Elusive elements such as sound have largely been left out of the story. However, this is beginning to change as technologies and methods that look at a greater variety of evidence in and around archaeological sites, including sensory information, are employed. [4]

Sound is an inherent quality of things and activities. Different materials have different sonic qualities and different uses of things produce different sounds. Sound has a unique ability to evoke, delineate and describe different spaces and trigger memories and associations to activities and situations and has the potential to offer insight into time, place and culture in ways that are different from text and visual cues. Conventional archaeological exhibitions are primarily centered around exhibiting material remains. Incorporating the sounds of such objects being handled according to their assumed purpose and context adds another dimension to the understanding and insight into the objects and the places and situations associated with them. Utilizing digital audio

technologies, especially technologies for immersive sonic spaces, makes it possible to manipulate and present complex acoustical features such as directionality, density, distance, movement, envelopment and perspective in ways that transform how archaeological data is presented, experienced and understood. The audience can be put in the midst of an *archaeophony*, a *sonic environment that is constructed based on knowledge extracted from the archaeological record*.

### SOUNDSCAPE AND ACOUSTIC COMMUNITY

The term *soundscape* is used in the literature in a variety of ways to describe the interplay between an environment and the sounds in it. The concept of the soundscape often implies a human/nature interaction, as the emphasis tends to be on how the soundscape and its components are perceived by the individual or a community. The term is used in connection with actual sonic environments as well as constructed, virtual sonic environments, such as immersive computer games or certain forms of electroacoustic music. Soundscape analysis can be listening-based – mapping of sounds heard at a specific location by listening alone – or instrument-based using audio recording devices and digital measurement tools. The inhabitant of an environment is both a sound producer that contributes to the soundscape while going about daily tasks and activities and a sound percipient that hears and reacts to the acoustical feedback of the physical surroundings and the sounds produced by others – the action and reaction that categorizes interaction in social and cultural contexts. Thus, the sonic environment is a dynamic flow of information and response being exchanged between inhabitant and environment. [5]

There are two approaches to analyzing soundscapes that I have found particularly helpful when developing the investigative framework for composing archaeophony. Firstly is the model of soundscape ecology proposed by Krause and Pijanowski et.al., where sounds are categorized based on the origin of their source:

biophony: sounds created by non-human biological organisms, from microfauna to megafauna

geophony: non-biological sources of natural sound and sounds of geophysical origin, such as wind, water, thunder, volcanoes, earthquakes, etc.

anthrophony: sounds caused by humans, both intentional and incidental, including sounds of human-made tools and machinery. Soundscape ecology combines elements of landscape ecology, bioacoustics, psychoacoustics, geophysics and other related fields to create a multidisciplinary model where the components of biophony, geophony and anthrophony together form the complete soundscape. The feedback mechanisms of elements of the soundscape influencing the sound producers and vice versa are recognized. Another important aspect of soundscape ecology is the niche hypothesis that suggests that sounds of biophonic

origin are partitioned into temporal, spectral and spatial niches where different animal species occupy different frequency ranges, temporal ranges and spatial ranges in the natural soundscape. The distribution of acoustic niches is an indication of the health of the ecosystem and the relationships of the species inhabiting it. The categorization proposed by the model of soundscape ecology is useful for sound source identification and classification of components needed in the composition of the archaeophony. In the research stage of developing the archaeophony, the model is also helpful for identifying the archaeological speciality which is likely to be the source of relevant information for investigating and determining specific and potential sound sources. [6], [7]

The second approach to soundscape analysis is found in R. Murray Shafer's and Barry Truax's work on acoustic ecology, including the theory of acoustic communication, which looks at the relationships and interactions of living organisms and their acoustic environment from primarily a semantic point of view. It has more of a human-centered bias than soundscape ecology and seeks to describe features that define sounds of particular meaning and value to a locality or community. Hence, the analysis and categorization of components in the soundscape are intrinsically linked to the social, communal and environmental contexts in which the sounds exist. From this point of view, the experience of the soundscape is different for each individual inhabiting the community and also different for people visiting from outside of the community. Central notions of acoustic ecology are:

keynote sound: sound that is heard frequently enough by a community to form a background against which other sounds are perceived  
 soundmark: sound that is unique to a community or has qualities that makes it particularly noticed or regarded by that community  
 sound signal: a foreground sound toward which attention is particularly directed  
 Inhabitants of the community are likely to perceive keynote sounds and soundmarks differently than visitors, who may hear them as sound signals or, depending on circumstance and intensity, not take notice of the sounds at all. The meaning attributed to certain sounds, whether perceived as keynotes, soundmarks or sound signals, is also likely to be different for visitors than for permanent members of the community. Sounds that bear particular communal significance and the effect of the environment upon the sounds, can be said to bind people together as an acoustic community. Acoustic ecology, therefore, helps direct attention toward sonic specificities of a community tied to a location and provides a helpful tool for recognizing aspects of the soundscape that can aid in creating a sense of place in which the community is situated. [8], [9]

### ARCHAEOPHONY

The archaeophony is a sonic environment intended to provide auditory information that triggers a sense of a certain place and time and is informed by and ties specific agents, actions, situations and spatio-temporal layouts to that place and time. A key function

of the archaeophony, therefore, is to point to a context outside of itself and provide a link to the sound producing environment and socio-interactive settings it seeks to present.

Depicting urban sonic ambiance of nearly 2000 years ago requires a broad interdisciplinary approach. Some established disciplines investigating aspects of sound in ancient cultures exist, such as music archaeology, that specifically looks at musical practices, including song, dance, instrument building and rituals involving music and dance and archaeoacoustics, that primarily studies acoustical properties of ancient spaces and instruments as well as listening practices of ancient societies, mainly related to ritual and ceremony. My work draws on these fields, as well as several others, archaeological and non-archaeological.

As sound has no material remains, there is nothing there that can be dug up and directly utilized. Any component of the archaeophony has to be inferred from data unearthed in a relevant field that studies sites, cultures and activities of the past. Archaeology itself has numerous sub-specialities, such as archaeoanthropology, ethnoarchaeology, archaeozoology, archaeobotany, geoarchaeology, bioarchaeology and others, that each contributes to the archaeological record in a unique way. There is a significant amount of detail available both as material remains – more than a million artifacts have been recorded in Teotihuacan – and as hypotheses deduced from the remains. A selection has to be made based on the focus of the archaeophony, which in the case of this project is the sound of a day in the life of the city of Teotihuacan with the aim to bring to life experiences of ordinary people of this ancient city and provide a context and enrich visitors' understandings of complexity and nuances of Teotihuacan society.

Like urban centers today, Teotihuacan was a city filled with sound. It may be challenging for modern audiences to imagine a busy urban soundscape without the sound of vehicular traffic, industrial machinery, roaring ventilation systems, sound signals at pedestrian crossings and the occasional helicopter and airplane flying overhead. While these were not yet the sounds of the urban environment, there were, however, other sounds of familiar activities, such as cries of vendors at the market, digging and scraping at construction sites, children playing, food sizzling and people gathering and conversing. The Teotihuacanos had no wheeled carts, even though children's toys with wheels have been found. Remains of several hundred craft workshops and ceramic workshops have been identified, each of which would have contributed to the soundscape at the time. Knowledge of such activities is helpful for creating an image of key sounds and ambiances to incorporate into the archaeophony.

## METHODOLOGY

Archaeophony is, as other archaeological presentations, an interpretation of archaeological evidence. The aim is to create a soundscape that is as true to the investigative results and current hypothesis as possible. However, in all practicality the

presentation of the archaeophony is likely to be time-limited within the constraints of the exhibition of which it is part. Further, attentive listening to soundscapes without a direct visual link is not a common activity among the general audience and the varying levels of listening experience, as well as consideration to attention span and ability to identify sound sources, need to be taken into account. This means, in order to convey as much relevant information as possible, the archaeophony cannot merely be a neutral snapshot of a time and a space. While the archaeophony should be believable in the known context, it cannot claim to be realistic as it is not possible to know exactly what constituted the soundscape at that place at that time. The sound material on which the archaeophony is based needs to be a representative selection of what may have been typical for the site, but may not necessarily be sounds that were likely to occur simultaneously or within the relatively short available timeframe of the orchestrated archaeophony. For instance, the afternoon thunderstorms and heavy rainfall that occur in the Teotihuacan valley in the summer are characteristic for the area and are likely to have shaped the daily rhythm of life in the city during that time of the year. At the same time, there are outdoor activities that may have taken place at other times of day when there was no chance of rain or even during other seasons, that also need to be included. Likewise, climatic features such as migratory birds that were present only during certain parts of the year may be incorporated in order to underline the importance of certain avifauna. Therefore, a selection of key sounds and sonic events that are particularly descriptive and representative, in this case of daily life in Teotihuacan, need to be made and orchestrated into a compressed narrative of coherent scenes. Just like the narrative of a movie can span a much longer time frame than the actual duration of the screening, so must an archaeophony compress time in order to present essential sonic events in an interesting, believable and informative way.

The method of collecting cues includes researching found tools, assumed activities, architectural layout, building materials, environmental features and other relevant characteristics and information. Field recordings can be incorporated as well, however, avoiding present-day elements of the soundscape may be a challenge and a good amount of knowledge is needed to know what was not present at the time. For instance, the now ubiquitous house sparrow was not introduced onto the American continent until the 1850s and, despite rapidly declining bird populations in our time, is now very difficult to avoid in a field recording in almost any urban area.

The theories of what is the story of the people of an ancient culture are based on materials from a variety of sources such as maps, photos, murals, objects, architecture oral histories and written records from contemporaries, descendants, later occupants, explorers and other cultures as well as agriculture, flora, fauna and geological data. For any specific auditory and acoustic feature that is found, there is the question of whether it was intentional or accidental. And with regard to sound producing objects, one

has to interpret whether they are musical instruments intended for sound production, perhaps primarily for ritual and ceremony or if they had other functions. For instance, objects may have been used to mimic animal sounds for use in hunting, clay vessels (pottery) may have been used as percussion instruments, certain necklaces and bracelets of shells or bones may have had a dual purpose of also being used as sound producing devices or maybe solely for generating sound, as we find in today's percussion arsenal. Further, there may be already catalogued objects that are mislabeled as something not related to sound when sound production may have been their main or sole intent. With musical instruments and other sound producing devices, playing technique as well as the social purpose of sound making may also be unknowns.

Source material of the archaeophony cannot be collected in the social context in which it originally occurred, but must be deduced from material remains, architectural and natural layout, acoustical features and impressions and experience of weather and geological features of the surrounding area. Likewise, the sound of tools, instruments and utensils in use most likely cannot be recorded using the original artifacts directly. One solution that was chosen for the Teotihuacan project was to engage artisans utilizing traditional materials and techniques to create replicas of such objects for the purpose of handling them specifically for capturing sound source material. Recordings were made also of the process of creating the objects as additional source material for inclusion into the archaeophony. Further, Foley techniques, known from film production for designing ambient and everyday sounds in a controlled studio setting as opposed to recording on location, are useful for developing sound material to incorporate into a believable archaeophony. Foley techniques are used for creating sound material with replica objects, but also with other devices that in and of themselves are not necessarily related to the archaeological evidence, but are still useful for developing plausible archaeophonic components.

### SPATIAL STRUCTURE

Any sound has a spatial context – whether it is apparent in the recording stage or in the playback setting or both. For sounds recorded in a natural environment, the recorded sound carries with it information about the spatial environment in which it was captured, but also sounds recorded in a non-reverberant studio environment inherently contain spatial cues. Digital audio technologies, especially technologies for immersive sonic spaces, opens for enormous possibilities for composing archaeophony with regard to spatial structure. Taking architectural layout as the starting point, 3D surround sound technologies can be utilized to mimic acoustical properties of the particular archaeological site. For the Teotihuacan project, impulse responses, the recording of the reverberation – or “acoustical signature” – of open and enclosed spaces, were captured at the archaeological site for use in convolution at the post-production stage. Convolution using impulse responses is a technique of adding reverberation to a

sound in a way that aims to be realistic as it is based on recordings of sonic characteristics of real spaces rather than digital models. This way sound material can be incorporated into the recorded reverberation in order to put archaeophonic components into an acoustical space that is or is assumed to resemble, the space in which they were likely to have originally been heard. However, knowing the history of an archaeological site is important, as in Teotihuacan many of the structures in the public areas of the site were reconstructed and the acoustical authenticity of these structures is uncertain. [1], [10]

An immersive auditory space can utilize full surround sound possibilities in order to envelop the listeners with sound and create an experience of being transported to different environments with the aim to create a sense of “being there.” On the other hand, if the listening environment is directional, that is, if the visitors are facing a specific direction, placing the sound material in front of the visitor can, in a similar sense, transport the environment to the visitor, who in this case takes on an observing role from their “outside” position relative to the sound field. Regardless of directional layout of the listening space, dynamically working with foreground, middle-ground and background by manipulating distance, closeness and directional cues creates varying perspective with regard to the sound field and a sense of size and layout of the archaeophony as well as occupancy density and spatial distribution of sound producing agents. Playing with varying perspective ensures a certain level of dynamism, which again gives the visitor something to follow and hold on to. Hence, the archaeophony is orchestrated both as a temporal-structural composition and a spatio-structural composition. [10], [11]

The spatialization of sounds is determined by the architectural or structural layout of the physical site, but also by how the site is used. An archaeophony of a ceremony may incorporate the ceremonial arrangement where, for instance, the size and architectural layout of the ceremonial space indicates location of participants, location of audience, number of participants and configuration of participants with regards to audience. This is relevant if for instance it is important that the spatial structure of the archaeophony aims to give the visitor a sense of being in the midst of the audience at the ceremony.

### TIME AND PLACE

An important aspect of the archaeophony is to establish a sense of the time and the place of the ancient culture. Humans have a natural inclination to try to identify sources of sounds and sound events and relate them to past experience. Source recognition links sounds to known objects and situations and to known actions or gestures in order to detect the possible cause of the sound. Hence, visitors' listening abilities and range of associations triggered by the sound material are highly individual and are based on knowledge acquired through real-life experiences. The understanding of the archaeophony will be filtered through this present-day understanding of the soundscape.

In terms of space, familiar environmental cues can indicate the possible virtual dimensions of the archaeophony as well as the listener's position (point-of-view) relative to the sound field. Recognizable geophysical material, such as rain or thunder, wind or running water, have associative powers that can trigger knowledge the visitor has from past experience of places with similar features, whether mediated or in real-life. An experienced ear may be able to detect more specifically geological features of the area, especially with sounds covering large distances, such as thunder or the sound of an erupting volcano and recognize sound propagation typical of a valley, for instance. On a smaller scale, the presence of buildings and other structures can be perceived via perhaps more familiar patterns of reflections and absorption. The resolution of human spatial hearing is sufficiently detailed to be able to detect such layouts by listening alone and varying the auditory information by utilizing acoustical cues of different indoor and outdoor spaces and layouts contributes to establishing a perceivable spatial setting for the archaeophony. The ancient soundscape was of another richness than our present urban soundscapes due to its higher level of acoustic transparency. Without the ubiquitous roar of the combustion engine and other more or less constant background sounds heard today, more subtleties were apparent due to (most likely) lower ambient noise level and detail could be heard at longer distances with a greater sense of perspective. Listeners of the past could therefore take in auditory information of their city differently from what we are able to today. Due to the higher resolution of such a "hi-fi" soundscape, where sounds overall tend to be heard more clearly, the premises of engaging interactively with the soundscape are potentially better, which may have meant the sense of hearing had a higher communicational significance than is possible in today's urban environment. However, we cannot escape the fact that we are shaped by our modern-day existence and current auditory experiences and making assumptions of how peoples of ancient cultures experienced their contemporary soundscape may be presumptuous. [9], [12]

One important consideration when composing and presenting the archaeophony is how much to rely on the visitors' ability to accurately identify sound sources and acoustical characteristics that are intended to communicate the time and the place of the archaeophonic setting. Precise recognition of sound source and/or sound producing gesture assumes that the listener already has a frame of reference of the sound or action from past experience or from knowledge acquired specifically for interpreting the archaeophony. However, only specialist audiences can be expected to identify ancient sound producing devices by listening alone and ability to recognize the sound of certain objects being produced or used does not necessarily mean an equal ability to identify characteristics of other acoustical components of the soundscape. The archaeophony may therefore be seen as one component in a greater context of investigating and disseminating knowledge about ancient cultures. Its uniqueness lies in highlighting and conveying elements of the archaeological record

that traditionally have not been emphasized and in that way contributes to the story of ancient peoples by adding to the investigative framework as well as the base on which to build understanding and knowledge of ancient cultures.

## CONCLUSION

We can to an extent replicate the production of sounds of the past, but we cannot replicate how the sounds were perceived, responded to and used. Our modern day experience will remain our reference. Current audio technologies can, however, be utilized to create an archaeophony that is sufficiently detailed and acoustically plausible to present archaeological data in ways that make possible a new level of understanding, experience and engagement and can bring to life the story of the people archaeology attempts to tell in ways that visual cues and material remains alone can not.

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