

Chapter 1

Exploring ancient sounds and places: The challenges of hearing intangible heritage in the past

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Abstract

This introductory chapter explores the diverse ways in which sound can be integrated into archaeology. Three major perspectives are presented: the first focuses on objects that produce sound, including musical instruments, sound-producing objects, and geophonies in natural soundscapes. The second block examines the contexts in which sound is transmitted and heard, such as enclosed or semi-enclosed spaces, urban environments, and landscapes. The final section investigates the functions and uses of sound. Examples of all three ways of studying sound in archaeology are found in the chapters of this book. This interdisciplinary volume presents a collection of essays that illuminate the sonorous dimensions of the past, highlighting how sound has influenced cognitive, cultural and spiritual aspects of human societies across different periods and locations. A general overview of the book is provided in the last section of the chapter.

Keywords: archaeoacoustics, music archaeology, soundscapes, urbanscapes, room acoustics

Since the 1980s, scholars in the humanities have been increasingly drawn to sensory research (Howes 1991; Rodaway 1994; Feld 2012), a leaning that, albeit with some delay, has also included archaeologists (Gosden and Hather 1999; Ouzman 2001). However, in contrast to senses such as taste or touch, and, perhaps because of its role as the most important sense after vision, at least in the Western World (Classen 1993, 2), hearing – and sound in general – had already attracted scholarly attention from early on. This was already the case with musical instruments from the 18th century

(Smith 1750; B.B. 1763). However, from the 1960s an interest also emerged in how sound was propagated at archaeological sites and the effect that sound events may have had on past communities. The latter developments, however, were largely unknown to the archaeological profession, given that behind them there were architects (Canac 1967; Shankland 1973; Lehmann 1983), historians (Giedion 1962) and historians of art (Reznikoff 1981; 1987), who only very occasionally collaborated with archaeologists (Reznikoff and Dauvois 1988; Dauvois 1989; Dauvois and Boutillon 1990).

Therefore, for most of the history of archaeology the past was largely imagined as being voiceless. This silence was contrary to the experience of past people: sound is an essential source of knowledge about our surroundings and constitutes the basis of communication with others (see Brabec in this volume). It may also have advantages over sight on particular occasions; for example, when visibility is impossible because of darkness or dense vegetation, or when the emitter is at a distance beyond sight recognition (Letowski and Letowski 2012). Sound is also employed to convey emotion and feelings (Blood and Zatorre 2001; Juslin and Västfjäll 2008) and group cohesion (Morley 2013, 280–283). It may elicit stress, annoyance or therapeutic effects (Bruscia 2014; Stanhope and Weinstein 2020) and is used to express identity (Connell and Gibson 2002; Stocker 2013).

Ethnomusicology and ethnohistorical sources can assist archaeologists in establishing questions (Arsenault and Zawadzka 2014; Liwosz 2017; Díaz-Andreu *et al.* 2021, 170; and see Alarcón-Jiménez *et al.* in this volume and Díaz-Andreu *et al.* in this volume). However, the closer these sources are to the particular period under study, the better. As Blake and Cross mention when discussing music, “With regard to ethnographic analogies to prehistoric populations, care should be taken in presuming, or ascribing, apparent similarities in ‘musical’ behaviours of hunter-gatherer societies from very different temporal and geographic proveniences” (Blake and Cross 2008, 15).

As this book reveals, there are many ways in which sound can be introduced into archaeology. In the following pages, an overview is provided of this kaleidoscopic field by subdividing the research undertaken into three major blocks. The first focuses on the objects that produce the sound (musical instruments, sound-producing objects or geophony in a soundscape). The second major block centres on the type of context in which sound is transmitted and heard (an enclosed or a semi-enclosed space, urban spaces and sound in the landscape). The final section looks at the research undertaken into some of the functions and uses encompassed by sound.

Producing sound

If the focus is placed on the origin of sound, four main themes can be identified: musical instruments; other sound-producing devices; sounds produced as a result of human actions whose purpose is not related to this result; and finally, the sound produced in the landscape. Regarding the first, it would be impossible to provide a good, rounded summary of the research into the music and musical instruments of the past, given that

there is a staggering bibliography containing general approaches to this (Hickmann 2001; Both 2009). Archaeomusicologists work with “musical instruments or parts of instruments; scenes of music-making in cave paintings [i.e. rock art], reliefs, frescoes and mosaics; more rarely, written sources such as inscriptions or descriptions of music; and, even more rarely, specimens of musical notation” (Hickmann 2001). In addition to archaeological evidence, archaeomusicologists can make use of historical accounts and iconography (see Đorđević and Knighton in this volume). Myths and legends, oral tradition and ethnography may also provide useful information (Hickmann 2001; see Díaz-Andreu *et al.* in this volume). It is important to take into account the fact that musical taste is cultural and, therefore, as Scullin and Boyd argue for the case of the Moche ceramic whistles, “sounds which often appear harsh and unwanted to modern ears (and bodies) – sounds routinely categorized as noise – may not have been viewed as unwanted sound/noise in certain past contexts” (Scullin and Boyd 2014, 362). In the last few decades, most research on musical instruments has been led by members of the International Council of Traditional Music (ICTM), with sessions organised on an irregular basis, and also the International Study Group on Music Archaeology (ISGMA), in that case gathering every two years. The proceedings of both these meetings have been compiled in many volumes (e.g. Lund 1986; Hickmann and Eichmann 2000; Hickmann *et al.* 2006; Jiménez Pasalodos *et al.* 2013; Homo-Lechner 2015; Kolltveit and Rainio 2020). There was once also a journal, *Music Archaeological Bulletin* (1984–1986), followed by *Archaeologia Musica* (1987–1990) and now the book series *Flower World* published by the Ekho publishing house, in addition to other books.

Topics under discussion in music archaeology are manifold and here only a couple will be mentioned. The most popular is typology and cultural classification in the whole spectrum of human evolution, from the earliest periods (Cross 2016; Montagu 2017), and see Brabec in this volume) to the Palaeolithic (Morley 2013; and see Wyatt this volume) and modern times (Neuenfeldt 2020). In some cases musical instruments may be created out of geological forms, such as lithophones and rock gongs, i.e. rocks that sound when struck (Fagg 1997; and see Jiménez Pasalodos *et al.* in this volume and Martorano in this volume). Performance practices are also the focus of some research projects (García Ventura *et al.* 2018). Experimental archaeology has also been useful in the reconstruction of musical instruments (for example García-Benito *et al.* 2018; Pomberger *et al.* 2018; Kumbani 2023; and see also chapters by Martorano and Rusch in this volume). A final topic relates to outreach, museums and the public (Both 2019; Milosavljevic 2020). It may be worth mentioning that the number of publications included in this paragraph could be multiplied many times.

In an often-referred-to article, Casja Lund distinguished between five classes of sound objects. The first is those artefacts that were distinctly used as sound-producing devices. In this type, she includes musical instruments (see above) and others that might (also) be used for communication, such as bells. They fulfil both roles, music and communication, depending on their size and location. A small bell, for example, is a multifunctional sound object that may perform many purposes:

it can be a signal/noise instrument, an acoustic offensive weapon, a prestige object, a status object and an apotropaic protective shield (Pomberger *et al.* 2023, fig. 10). Large bells, as well as other large percussion instruments such as semantra, are mostly used in religious buildings like churches. Their main role is to act as religious sound markers and to communicate religious or civil messages to audiences some distance away (Djordevic *et al.* 2023).

Lund (1981) also mentions items that may have served more than one purpose. These include sound-producing ornaments such as teeth, molluscs or small stones attached to garments or as accessories and as portable pendants found, for instance, in burials in Northern Europe (Russia and Sweden) dated to the Late Mesolithic and the Neolithic. The study of their wear patterns through traceology allowed Riitta Rainio to argue that they acted as rattles. These pendants created sound when the wearer moved, perhaps to reinforce the effect of dancing (Rainio *et al.* 2021).

Some objects were not musical instruments *per se*, but the sound they produced generated sensorial experiences (the fourth type in Lund's 1981 typology). In addition to the silver bracelet from Hammarlöv (Sweden) she mentioned, we can illustrate this with the jangling rings for chariot axles found in the Netherlands. These were included by Joan Rimmer in her review of musical instruments and soundmakers from the Netherlands between the Iron Age and the medieval period (Rimmer 1981). Finally, some objects were clearly sound-producing devices with functions other than music, such as decoys for hunting (Lund *et al.* 2015; García-Benito *et al.* 2018).

A sixth category in Casja Lund's scheme could have been the sound derived as a by-product of producing or handling objects. There have been some studies of this, especially regarding the sound produced at the time of manufacture: pounding plants for food or drink, such as sakau or kava in the South Pacific (Rainbird 2002, 97), or in mortars at rock art sites such as Writing Rock (Devereux 2008, 22), lithics (Mills and Pannett 2009) and rock art (Lødøen 2015, 73–74; Vergara 2019).

In some cases, it has been claimed that particular sonotopes, i.e. landscapes with particular acoustics, attracted the attention of those living in the area. We can illustrate this with scholarly work linking archaeology and underground noises originating either with fire or water. In the first case, volcanoes can be mentioned. There have been some studies into the relationship between them – and therefore their sound – and archaeological sites in Mesoamerica and Central America (Sheets 2001; Holmberg 2013). Sounds sometimes originating in the subsoil may also have been perceived as magical and this may have been the case in Kinomagewapkong or Teaching Rocks in Petroglyphs Provincial Park near Peterborough, Ontario, Canada. In this place 'the sound of underground water can be heard issuing from its depths. Witnesses describe the sound as similar to the babble of human voices' (Devereux 2008, 27–28). In Scandinavia, it has also been suggested that the choice of sites at which to create rock art may have been linked to the sound of water in the area (Coles 1991, 133; Goldhahn 2002; Lødøen 2010, 45–46).

The acoustic effects of sound propagation at archaeological sites

An alternative way of exploring ancient sounds and places is to look not at the sound source, as in the previous section, but at the space in which the sound is propagated. Four types of approach can be highlighted: the acoustics of enclosed and semi-enclosed spaces, urbanscapes and sounds in the landscape. The way in which sound performs in enclosed spaces has been one of the major topics of study among architects and acoustic engineers for the last two and a half centuries (Mills 2016, appendix 4), although it is only since the 1960s that this interest has been reflected in the study of ancient buildings. In the last few years special attention has been paid to caves in areas and periods as diverse as the European Palaeolithic (Fazenda *et al.* 2017; Jouteau 2021, 384), the Mesopotamian (McMahon 2013) and Greek eras (Yioutsos *et al.* 2018) and Mayan caves (Bruchez 2007). In addition to caves, megaliths and hypogea can be added to the types of sites. The acoustic analysis of megalithic sites in Britain and France has highlighted their good reverberant properties, especially in relation to low voices (Devereux and Jahn 1996; Manaud and Watson and Keating 2000; Barrandon 2014). Regarding hypogea, their plans are more regular than caves, as are perhaps megaliths, but still less so than built environments. One of those that has attracted more attention is the Hal-Saflieni Hypogeum in Malta dated to the 3rd millennium BCE (Till 2017)

In contrast to the above, most scholarly attention has focused on built environments. In addition to acoustic testing *in situ*, the regularity of spaces has also allowed an alternative method of analysis: the reconstruction of acoustics using computational modelling techniques and dynamical estimations. In other cases, the approach is based on the information from ancient texts that are read through the lens of the archaeological remains. Research has focused on prehistoric sites such as Neolithic structures for group gatherings located in the area of southern Anatolia and Syria (McBride 2014), or ancient buildings such as Egyptian temples (Warusfel and Emerit 2021), Greek temples and halls (Vassilantonopoulos and Mourjopoulos 2001) and pre-Columbian palaces in the Andean area (Rick 2008; Collecchia *et al.* 2012). Studies of the acoustics of enclosed spaces in the medieval and postmedieval periods have been undertaken at a number of religious sites, including Christian churches (Girón *et al.* 2017; Djordevic *et al.* 2020; Adeeb and Sü Gül 2022), mosques and Buddhist temples (Gül 2019; Gupta 2021; Zhang *et al.* 2024). The different faith traditions within the Christian church and the changes in liturgy practices throughout the centuries have led to a series of studies including the acoustic analysis of Hagia Sophia in Constantinople (Abel *et al.* 2013) and eight relatively well-preserved Byzantine churches in Thessaloniki (Antonopoulos *et al.* 2017; Foteinou *et al.* 2023). There have also been studies of meeting rooms (Alvarez-Morales *et al.* 2020). In some cases, the acoustic reconstruction of historical spaces is allowing the general public to experience the lost acoustics of past buildings, such as the damaged cathedral of Notre Dame in Paris (Katz *et al.* 2020).

The earliest acoustic analyses undertaken of archaeological buildings did not focus on enclosed spaces, but on architectural structures that are not fully covered by a roof, such as Roman theatres (for a summary see Girón *et al.* 2020). In Europe there have been other studies dealing with the prehistoric period with positive results at sites such as Stonehenge (Till 2009). Moreover, many prehistoric rock art sites are located in concave shelters whose acoustics have also attracted scholarly attention (Rainio *et al.* 2018; Alvarez-Morales *et al.* 2023; Santos da Rosa *et al.* 2023). Other studies have dealt with the medieval (Bertoldi *et al.* 2022) and modern periods (Boren 2022), including the sound of courtyards and gardens (Almagro-Pastor *et al.* 2022). Across the Atlantic, interaudibility has been demonstrated between various locations in the central area of Pueblo Bonito at Chaco Canyon in the United States (Loose 2008), as well as the role at the same site that a platform mound may have played as a speech podium or performance space, for example, to play a sound object such as a conch shell trumpet (Witt and Primeau 2019). In another research project undertaken in Mexico, acoustic tests were made at a sunken patio on the site of Peralta and a great stone bell outside it (Ramos-Amezquita 2014).

In addition to the acoustic analysis of enclosed and semi-enclosed spaces, a different set of studies could be subdivided into those focused on urban and non-urban areas. In relation to the former, urban soundscapes have been researched on the basis of written documentation (e.g. Terpstra and Rose 2016; and Knighton in this volume) and archaeological information. Regarding the latter, acoustic analyses have been carried out in particular built spaces, including the Maya ritual centre of Chichen Itza, specifically focusing on the acoustic phenomenon of the chirped echo created by short percussive sounds such as handclaps at the pyramid of Kukulcan (Lubman 1998; 2008). There has also been research into the acoustic raindrop effect at the same place (Cruz Calleja and Declercq 2009). Furthermore, sound (together with vision and movement) has been simulated at the Maya site of Copán (Honduras), generating viewsheds and soundsheds from Stela 12 (Richards-Rissetto *et al.* 2023). At the Inca site of Las Pailas (Argentina) (Izaguirre and Ferrari 2018) the authors mentioned that one of the weaknesses of their simulation was that they had not considered the noise caused by people moving in the space, which may have deeply affected sound dispersion. This has been the precise focus of a series of studies contextualised in the Roman (Holter, Muth, and Schwesinger 2019; Kopij *et al.* 2023) and post-medieval periods (Boren in this volume). Regarding the latter, in this volume Braxton Boren has analysed whether the written sources were correct in the number of people and the space of a particular audience listening to a speech given by 18th-century preacher George Whitefield (Boren in this volume). In a different vein, Stephen Miles on has examined the connection between power and sound and the role of the latter in creating and maintaining a feeling of attachment to a village, speaking of the role of bells and other sound tools and sounds (Miles on 2018).

Finally, in non-urban areas it is useful to think about three types of sonotopes: geophonies (natural sounds produced nonbiologically), biophonies (biologically

produced natural sounds) and anthrophonies (sounds produced by humans) (Farina 2014, 17). The last of these was discussed in the section above relating to the production of sound. Regarding biophonies, the location of Greek temples such as that dedicated to Hera in Poseidonia in an area of lush vegetation has been linked with sound and nature, given the goddess' role as a patroness of nature (Bellia 2023). The importance of daily sounds has also been proposed in a variety of prehistoric areas such as the Teleorman River Valley (Romania), Çatalhöyük (Turkey) and West Penwith (England) (Mills 2016), as well as in Mesoamerican Oaxaca (King and Sánchez Santiago 2011). The sound of volcanoes and water would have created geophonies (see the section on producing sound above).

Sound waves hitting rock surfaces created acoustic effects that might have impacted the way people perceived the landscapes in which the sound was propagated. The following will be discussed in relation to this: music and speech clarity, echoes, resonance, augmented audibility and reverberation. Music and speech clarity have been proposed as acoustic properties that fit well with the likely social and ritual activities taking place at Altai rock art sites (Díaz-Andreu *et al.* 2023). Echoes seem to have influenced the selection of rock art sites in particular areas of the world, including Spain (Díaz-Andreu and García Benito 2012), Finland (Reznikoff 1995, 551–554; Lahelma 2010, 48; Rainio *et al.* 2018) and North America (Waller 2005; Waller and Arsenault 2008). In turn, resonance has been linked to the presence of rock art, for example at the Herschel petroglyph site in Saskatchewan, Canada (Steinbring 1992; 1993). Finally, augmented audibility, the perception of sound amplified above the expected level, seems to have been behind the selection of sites in the Sierra de San Serván (Spain) (Mattioli and Díaz-Andreu 2017).

Reverberant landscapes have also been discussed by scholars as having been especially chosen for rock art production. This is illustrated in the case of Didima, where the impressive reverberation leads Mazel to see this as the reason for the high number of rock art sites in the valley (Mazel 2011, 291). A similar relationship has been ascertained thanks to some basic acoustic tests in some areas of Spain (Díaz-Andreu and García Benito 2015). Moreover, at Writing Rock in North Dakota, it has also been argued that the exceptional acoustics of the natural amphitheatre in which the site is located would have enabled the sound of a ringing stone to reverberate along the valley (Devereux 2008, 26). Reverberation and sound amplification are two connected but distinct phenomena. Devereux also tells us that “in one experiment, five drums were beaten within the rock-shelter by American Indian musicians and the sound produced was broadcast so effectively that traffic stopped on a highway several kilometers distant as drivers got out of their vehicles to investigate the source of the sound” (Devereux 2008, 22). Sound propagation is mentioned by Devereux regarding the White Shaman rock shelter in Lower Pecos, Texas, where conversations at the site may be understood by someone on the opposite side of the canyon. At Wikwip (Echo Rock) in San Diego County, it is possible to hear a conversation held at the site from a distance of some 100 m. Finally,

at the Canebrake Wash site, the sound of someone talking in front of its paintings is broadcast across the landscape (Devereux 2008, 26–27). As seen above, in the last few years sound transmission has also been explored through GIS tools (Díaz-Andreu *et al.* 2017; Primeau and Witt 2017; Witt and Primeau 2019; García Atiénzar *et al.* 2022; Santos da Rosa *et al.* 2023; van Dyke *et al.* 2024). Some work has also been carried out on sound propagation in non-rock art prehistoric (Sciuchetti 2023) and medieval landscapes (Mlekuz 2004; Bertoldi *et al.* 2022)

Sound, emotion and the brain: the combination of archaeoacoustics with psychoacoustics and neuroacoustics

Since the 2000s there has been some research combining two disciplines that until then had ignored each other: psychology and archaeology. In the field regarding sound, one of the main challenges of the auditory system is making sense of the multitude of sound waves arriving simultaneously at our ears. This process is essential for clear auditory perception, such as identifying the elements of language in a conversation, the notes in a melody or interpreting a specific sound correctly. Psychoacoustics is the science of the hearing system as a receiver of acoustical information (Fastl and Zwicker 2007). It attempts to understand how humans perceive and are affected by elements of sound such as pitch, loudness, timbre and spatial location.

Psychoacoustics has been the focus of one of the lines of research undertaken at the Andean Formative site of Chavín de Huántar (c. 1500–300 BCE). In one of the projects carried out at the site, the acoustic characteristics of an ancient mortared-stone complex were analysed using a swept exponential sinusoidal test signal emitted at a height corresponding to that of the average human head at the time. Recordings were taken at two sets of receiver locations to determine reverberation time (RT), echo density, interaural cross-correlation coefficients and lateral energy fraction (Abel *et al.* 2008). These measurements were then used to construct a computational acoustic model of the site's interior architecture (Collecchia *et al.* 2012). Additionally, an on-site psychoacoustics experiment involved 45 volunteers who were tasked with locating sound sources within Chavín's interior galleries. It was reported that “participant responses to systematic testing of sound source/receiver ‘perceiver’ location combinations demonstrated broad consensus regarding the perceptual effects of gallery acoustics on sound transmission, providing verifiable ‘mappings’ of sonic communication dynamics within those spaces” (Kolar 2017, 49). Subsequently, the same researchers developed an archaeoacoustics method, comparing human-performed sound sources and standard electronic acoustical test signals across various survey points at the Inca administrative complex of Huánuco Pampa. By integrating ecologically valid acoustic measurements with subjective observations, they mapped sound transmission and reception for different types of sounds, identified environmental influences, and evaluated the site's acoustic properties (Kolar *et al.* 2018).

A different project involving psychoacoustics was undertaken at the Greek sanctuary of Mount Lykaion, Zeus' birthplace. There, Pamela Jordan speaks of soundlines, places that have a sonic connection between them (Jordan 2020, 13), denoting that people could indeed feel such a connection. Fieldwork was conducted at the site to ascertain whether the visual connection between the starting blocks of the Lower Sanctuary and a hill could be matched by a sonic link. Although the results were unclear, the author argued that this type of research "helps to reposition sonic experience as a driver in archaeological work... it produces a new way of moving through the site, of reading meaning into sound that may have been consequential for the experience of ancient users" (Jordan 2020, 25). While Jordan's experiments were conducted *in situ*, in other cases scholars make use of auralisations using several scales to rate perception and emotion (see López-Mochales and Escera in this volume). Through auralisations, a comparison was made between the sonic behaviour of sites with and without art in the area of the Caroig Massif in Valencia. The results from the analysis of the contingency tables determined that the differences in reverberation between the groups (slightly higher in the sites with rock art) were perceived by the individual participating in the experiment (López-Mochales *et al.* 2023b). In a different study, the contrasting morphology of the Diosa I and Horadada rock art caves was perceived by listeners (López-Mochales *et al.* 2023a). Other ways in which psychoacoustics and archaeology have been combined have led Valenzuela to propose the term psychoarchaeoacoustics (Valenzuela *et al.* 2020).

Beyond subjective perception, neuroacoustics investigates the cognitive effects of present-day sound and music by measuring brain activity in response to different auditory stimuli (see Aparicio-Terrés and Escera regarding ritualistic music in this volume). A few neuropsychological experiments related to sound have been undertaken in recent years (for example Devereux and Jahn 1996; Cook *et al.* 2008; Gaona *et al.* 2014), but this field is in need of further study. However, some of the results of research undertaken into subjects such as the relationship between music or speech and emotion (Huels *et al.* 2021; Janata and Parsons 2013; Loui *et al.* 2013; Koelsch 2014) can be applied to archaeological sites where it is known or suggested that music was played.

This volume

This volume presents a comprehensive collection of essays that explores the sonorous dimensions of the past through an interdisciplinary approach. Integrating archaeological insights with sound epistemology, this book's contributions illuminate the ways in which sound has influenced and shaped the cognitive, cultural and spiritual facets of human societies across different periods and locations around the world. From the auditory enchantments of the natural world to the application of digital tools for reconstructing historical soundscapes, this compilation expands our understanding of sensory experiences in the past and underscores the importance

of incorporating sound into archaeological research. Each chapter offers a detailed analysis of how people perceived and engaged with their sonic environments, establishing this volume as an essential resource for scholars and students at the crossroads of archaeology, anthropology and cognitive science.

In Chapter 2, Bernd Brabec explores the evolutionary aspects of sound, examining how the auditory experiences of early humans facilitated the development of speech and song and thus complex social structures. The author proposes that the “auditory enchantment” of the natural world was a crucial element in the cognitive evolution of *Homo sapiens*, aiding in the shift from basic communicative gestures to sophisticated symbolic communication. His work is followed by the contribution of Simon Wyatt (Chapter 3), who introduces the concept of “archoustemology” to study Upper Palaeolithic aerophones. Wyatt’s work highlights how these ancient instruments are not just artefacts but also representations of the profound acoustic knowledge of early humans. He bridges cultural, ecological and psychological dimensions to suggest that musical instruments were integral to the social and ritualistic dimensions of ancient societies. In a similar vein, Neil Rusch (Chapter 4) discusses how the concepts of re-enactment and actualisation in archaeology can shed light on the cognitive engagements and material interactions of past cultures with their sound-making tools. In this study, Rusch employs Material Engagement Theory to demonstrate how such engagements enhance our understanding of prehistoric societies’ interactions with their material world and the soundscapes in which they were immersed.

Chapters 5 and 6 delve into the cognitive dimension of auditory experiences. In this regard, Raquel Aparicio-Terrés and Carles Escera examine the effects of music in ritual contexts, linking historical practices with contemporary neuroscience research to explore the impact of sound on human behaviour. Subsequently, Samantha López-Mochales joins Carles Escera to discuss the use of psychoacoustic methods in the analysis of archaeological soundscapes. Their focus on auralisation and its application in studying ancient environments highlights the innovative approaches being taken to preserve and understand the acoustic heritage of archaeological sites.

In Chapter 7, Ana-María Alarcón-Jiménez and colleagues use ethnohistorical sources to explore and interpret the acoustic environments of rock art sites in South-Central California (United States), offering a critical examination of how these data can enhance our understanding of past sound-worlds. This contribution also considers the challenges and biases inherent in interpreting such sources, highlighting the complexities of translating ethnohistorical information into meaningful archaeological interpretations. Similarly, Chapters 8, 9 and 10 present case studies that highlight the archaeological dimension of sound research. In the first, Marilyn Armagast Martorano expounds her work on portable lithophones from Colorado (United States), offering a new methodology for identifying and analysing these ancient musical instruments. In a different context, Raquel Jiménez Pasalodos and her team explore the archaeoacoustics of cup-marked sounding rocks found in the Gredos Mountains (Spain), discussing the cultural significance of these sonorous elements in past cultural contexts. In Chapter 10, Margarita Díaz-Andreu and her

colleagues explore the rock art soundscapes of the Karakol Valley in the Republic of Altai (Russia), an area associated with shamanic practices characterised by intense auditory experiences. In this study, the authors also analyse representations of shamans in rock art and delve into the complex relationship between sensory experiences and ritualistic practices.

Chapter 11 examines Zorana Đorđević's research on how frescoes in medieval Serbian Orthodox churches enrich the auditory dimension of religious services. In her study, Đorđević identifies key elements of sound imagery, including musical instruments, musical gestures, voices inscribed on scrolls and in books, and celestial sounds depicted in Heavenly Liturgy, to address the link between the visual art and sonorous dimension of these sacred spaces. Chapter 12 presents Tess Knighton's exploration of digital tools, including virtual reality and auralization, to reconstruct historical soundscapes. Her research illustrates how modern technology can integrate historical data with sensory anthropology, offering new perspectives on the auditory experiences of historical environments. Finally, in Chapter 13, Braxton Boren reviews the history of research on speech intelligibility and highlights the relevance of the lessons learned from an experiment conducted by Benjamin Franklin, whom the author refers to as the first archaeoacoustician.

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