The Appreciative Ear: Sounds from the Ground Up

by Margaret Sabom Bruchez

I know of no more fitting way to show appreciation and gratitude than by helping others to understand, appreciate, and be grateful and by encouraging them to cherish and preserve whatever seems most worthy of being loved or admired.

— from *Life Ascending* by Alexander F. Skutch

The hills are alive with the sound of music that increasingly falls upon unappreciative ears. It is the claim of this article that an appreciation of underground sounds can spur real, relevant responses to the environmental crises of our time. When people are educated in the earthly sounds, their sources, and benefits, they are more inclined to feel a sense of obligation to steward the earth. The focus here is on sound artists and acoustic field researchers and scientifically measuring the sounds. Sounds underfoot, more than any other category of sensate phenomena, teach appreciation by beginning at the ground level.

To appreciate—not simply find pleasing—requires a thoughtful mind. An appreciative mind, as Alexander F. Skutch (1985) puts it, is an instrument on which the cosmos plays its tunes. Many enjoy the music, but only a few are prepared fully to appreciate the accomplished performance. According to the naturalist and writer, being appreciative is the equivalent of having studied music enough to recognize the technical excellence of the compositions and competence of the musicians and having reflected upon the long years of training and practice necessary to develop the skills. To enlarge upon Skutch's words, the appreciative ear hears in the underground the tunes that represent what the creative energy of the cosmos can accomplish when it finds the right conditions.

Ground melodies animate mountainsides, rock faces, and hills, alike. But the sounds are cultural and natural resources people are not sufficiently aware of to protect. At the simplest level, the sounds are acoustic signals, or disturbances involving mechanical vibrations in solids, liquids, and gases. Triggered in the underground as a result of natural processes—i.e. thunder, water movement, wind, barometric pressure change, wildlife, an earthquake, hurricane, tsunami, or volcano – the sounds are not easily dismissed. Animal responsiveness to the noises is innate, but an appreciation of their value results from a sensory attentiveness that is dependent upon teaching and cultural influence. Until now the requisites for appreciation have been passed along in rumors, anecdotes, legends, and myths. Knowledgeable people accept the obligation to preserve the information about the sounds that will nourish future generations of appreciative minds.

In the following paragraphs I point out several ways sound artists and acoustic field researchers prove vital in efforts to prioritize, using science, the relationships individuals and cultures maintain with underground soundscapes with respect to the past, memory, place, identity, community, and traditional cultural practices. Sensed, either as sound or vibration, natural sounds whose source is underground are codified or metaphorized into meaning in a variety of cultural contexts. The concerns addressed have developed in a study that considers natural sounds in a fundamentally new way. Soundscape is regarded here as a concept that articulates the way communities understand and engage in musical relationships with the underground, geophysical world. Considering the earth in terms of ecology of natural processes and cultural sound forms of music allows the traditionally subjective topic of ground melodies to be approached scientifically.

The Problems

Scant information has accumulated in the literature about traditional knowledge and wisdom of the geophysical landscape; next to nothing is published about natural underground sounds. Several reasons exist, chief among which are the limits imposed by western science. Legends and anecdotes transmit the knowledge, but are judged as fantasy and not as legitimate subjects of objective scientific research.

Offset by the restraint with which science operates, the tenacious hold people have on their traditions points out how much scientists have to learn. For example, scientists are discovering that sounds generated underfoot offer some of the only tangible clues to how the earth's geophysical processes operate. The problem for scientists is not in knowing how sound waves travel underground: they are transmitted like their counterparts in the air. Instead, the underground contexts are compositionally complex and challenge scientists' attempts to measure the sounds. In the case of seismic waves, for example, velocities vary (due to rock type) and frequencies are outside the range of human hearing. Even when they are audible the sounds are intermittent and unpredictable and overwhelm the existing capacities of recording devices.

Collecting the audible underground sounds implies knowing where they occur. Characteristically, material evidence of the occurrences is absent. More often the noises are barely audible and perceived in solitude or small assemblies. Occurring in contexts that restrict admittance—like passageways and crevices—limits are placed on activities and equipment when hearing and recording the sounds is the intent.

The Importance

Sounds are subjective, sensate ways of human knowing, and far exceed the benefits of seeing: hearing is omni directional; vision is unidirectional. Underground sounds are complex and multi-faceted occurrences that amount to "soundmarks" (c.f. Schafer 1977), a term used to typify sound phenomena that epitomize specific places. As Murray Schafer explains, soundmarks express a location's identity—like architecture and dress—to the extent that people recognize and characterize a place by their presence. In the underground the natural sounds mark locations where, for millennia, individuals have connected with the earth's natural powers—intellectually, emotionally, and physically. The sounds transmit messages that, when

put into narratives, are passed along to members of the culture. Mimicked in narrative form the sounds reinforce social norms and sometimes warn people of trouble underfoot.

In the U.S. protection of sounds is stipulated by the Antiquities Act (1906), the National Historic Preservation Act (1966), and the Archaeological Resources Protection Act (1979). As cultural and natural resources, sounds are preserved and maintained for the benefit of future generations, if they have the potential to yield information important in history or prehistory or concern activities of archaeological interest. Eligibility extends in the same way to intangible resources, such as cultural expressions, natural sounds, songs, stories, and practices concerning nature and cultural spaces as it does to tangible materials, such as buildings, structures, sites, and natural landscapes. Eligibility for inclusion in the U.S. National Register of Historic Places, for example, is prescribed under Section 106 of the National Historic Preservation Act (NHPA), regardless of whether material evidence exists for the occurrences of events or activities associated with the beliefs and views. Likewise, UNESCO recognizes locations as World Heritage sites, along with the associated local tradition bearers, traditional artists, forms of cultural expression that highlight oral traditions and expressions, performing arts, social practices, rituals and festival events, and knowledge and practices concerning nature and the universe that need to be safeguarded as a means of ensuring the cultural diversity in the world.

Examples

Cultures establish and reinforce differently the importance placed upon underground soundscapes. Some natural sounds in the underground are linked to beliefs of cultural origins, histories, or views about the natural world. Jicarilla Apache in northern New Mexico, for instance, assign life and language to the geophysical landscape: "You must consider rocks to be alive as much as you consider our bones to be alive…" (Opler 1994: 110). Flint Mountain is believed to be the result of efforts of turkey that gobbles and struts: "Every time the mountain grew there was a noise as though something was squeezed, a squeaking noise" (p. 17). Thunder Hactcin (one of supernatural beings that personify the power of objects and natural forces) is sent to live in the mountain, along with his groaning stick fashioned as a bullroarer by Lightning Hactcin.

The United States Geological Survey (USGS) reports that strong earthquakes affect the area and are accompanied by rumbling, loud subterranean sounds (2006). Calling to mind the thunder in rainstorms, Thunder Hactcin is told, "When you make your thunder, when the people hear you, they will all be happy. The noise will spread and everyone will be happy. They will say, "Grandfather, we like to hear you every year… but you must not come near to us. . . you must go around and above us, but you must not strike close to us" (p. 166).

Underground sounds are known to represent outstanding value from historical, artistic and ethnological points of view and reinforce the cultural identities of tradition bearer communities. With more than 350 miles of surveyed passageways, for instance, Mammoth Cave in hilly south central Kentucky is the longest recorded cave system in the world. Archaeologists document cave use dating back 4,000 years. National park authorization is extended in 1926, designation as a UNESCO World Heritage Site received in 1981, and the cave is named as an International Biosphere Reserve in 1990. The acoustical charm of the cave is described in Horace Carter Hovey's early 20th century report of Echo River:

> …the symmetrical passageway does not give back a distinct echo, as the term is commonly used; but gives a melodious prolongation of sound for from ten to thirty minutes after the original impulse. The tunnel has a certain keynote of its own, which, when firmly struck, excites harmonics with tones of incredible depth and sweetness, the lowest of them reminding one of the profound undertone heard in the tremendous music of Niagara.
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> The most extraordinary effects are produced when Echo River is allowed to speak for itself, and can only be had when the party is willing to maintain utter silence….The first sound to break the intense stillness is like the tinkling of myriads of tiny silver bells. Then larger and heavier bells take up the harmony…Then it is as if all chimes of all cathedrals had conspired to raise a tempest of sweet sounds. These die away to a whisper, followed by mutterings and a noise as if of an angry multitude, mingled with unearthly shrieks…Lo, as if from some deep recess that had hitherto been forgotten, comes a tone tender and profound; after which, like gentle memories, are reawakened all the mellow sounds, the silver bells, the alarm bells, the chiming cathedral bells, till River Hall rings again with the wondrous, matchless harmony (Hovey 1912: 84–85).

Mammoth Cave, Kentucky, USA

Ralph Waldo Emerson is inspired by the cave's Star Chamber and pens the poem, "Illusions". Emerson admits, "The mysteries and scenery of the cave had the same dignity that belongs to all natural objects, and which shames the fine things to which we foppishly compare them. I remarked, especially, the mimetic habit, with which Nature, on new instruments, hums her old tunes, making night to mimic day, and chemistry to ape vegetation" (Emerson 1860, 1876).

Sounds are an important focus of the first published accounts of the effects on the cave of the 1812 New Madrid earthquake. Accounts by workmen reveal that "five minutes before the shocks came on a heavy rumbling noise was heard coming out of the Cave like a mighty wind" (Ward 1816). Coupled with the Great Comet of 1811, the earthquakes and sounds inspire superstitious doomsday seers, miners, slaves, supervisors (Penick 1981) along with lantern-wielding black guides (Lyons 2006). The revivalist movement at the time swells with members called "earthquake Christians" (George and O'Dell 1992).

Underground sounds, mentioned in legends and myths, often refer to actual geophysical events. For instance, legendary accounts describe the earthquake that accompanies the famous descent of the Archangel Michael and his temporary dwelling in the sacred cave at Monte Sant'Angelo, Italy. Some claim the sacred legend is the most important one of the medieval western world, having influenced the cultural evolution and spread of Christianity to Europe; the local sanctuary has become one of the most important sites of religious pilgrimage (Carletti and Otranto 1994; Fischetti 1991; Piemontese 1997 in Piccardi 2005: 121). The earthquake associated with the legend is dated by tradition, AD 493 (e.g. Baratta 1901; Bonito 1691; Mercalli 1883, in Piccardi 2005: 121) and corresponds

in remarkable similarities to the location of actual ground ruptures. According to seismologist Luigi Piccardi, "Natural phenomena that occurred during the earthquake along the fault, strange underground rumors [loud roars or rumbles], lights and lightning, and in particular the opening of secondary ruptures" are unusual occurrences that suggest "the origin of the veneration of the place of the apparition of the Archangel Michael slaying the dragon as it emerges from a flame emitted chasm in the earth (Piccardi 2005:126).

Underground sounds are perceived where destructive events occur in the past and are frequently assigned to primary powers. The destruction is believed to follow the breaches of accepted norms and rituals and the occurrences of sounds merely reinforce the social moral codes. Mythological characters said to be responsible for instigating the sounds help establish the cultural perspectives and meanings of catastrophic events.

As McMillan and Hutchinson (2002) explain for the indigenous residents along the Northwest Coast region of the U.S.:

> Mythic accounts tell of the ancient past, when powerful transformers put the landscape and the animals into their present forms. Historical narratives set in more recent times also help to situate the people on their landscape, reaffirming their lengthy ties to the lands they occupy. These oral traditions also recount details of past natural catastrophes, including earthquakes and tsunamis that affected this region. Although they may not meet modern standards of scientific rigor for the study of such phenomena, the oral histories reflect the experiences and perceptions of aboriginal peoples in their lengthy occupation of this land. They provide, along with the archaeological record of the Native past, our only insights into the impact of past seismic events on human populations in this region, prior to about two hundred years ago (p.41).

Roughly 1,000 earthquakes are recorded per year in Washington and Oregon, most occurring in the Puget Sound region. The area, along with British Columbia and northern California, is considered as the Cascadia Subduction Zone.

Discussion

Traditionally, people learn to appreciate the earth's underground resources through stories and songs that teach about relationships between humans and natural world sounds. The lessons they pass along are beginning to be legitimized through scientific inquiry. Seismologists, for instance, report that underground seismic signals (vibrations) cause the earth "to ring like a bell" (Garcés et al 1998; Garcés 2003). Extracted from their effects, scientists employ the signals' mechanical elements to record the changes and track activities of quakes and volcanoes. Members of the growing discipline of acoustic seismology (Dombois 1999, 2001, 2002) study naturally-caused ground vibrations to understand the development of faults. The aural facets of seismic wave motions are recorded on seismographs and transferred to spectrograms. This enables the tension in subterranean structures existing in the past to be aurally compared with current conditions (Dombois 2002).

Loud, hushed, plaintive, or shrill, underground sounds often animate underground contexts. They can be equated to human expressions of emotions and moods, in that they evoke feelings of awe, introspection, and wonder. By utilizing the "aural models" and resulting sonic self-explorations (c.f. Levin 2006: 62) one learns to appreciate the earth's resources.

For example, some residents in earthquake-prone areas of Central America compare the earth to a drum. The sounds that result from seismic activities follow a musical beat (Sabom-Bruchez 2007). Resonance and reverberations form separable units of auditory waveforms and are easily repeated and reproduced: chanted, the singers are able to connect with the natural processes. The legendary carrying out of song rituals at location of underground springs are believed by the Hopi in Arizona to pacify Paalölöqangwt (Water Serpents) in order to prevent floods, earthquakes and landslides. Incorrectly sung songs are believed to have caused the fault underlying the village of Shungopavi. If it happens again the fault is expected to open and the community will sink into the ground (Malotki 2002: 15—23).

Some sounds mimic the murmurings of human voices. More than that, sound sequences form patterns in the mind and effect rhythmic movements. Native occupants of Vancouver Island and their relatives on the adjacent mainland include Nuu-chah-nulth residents who believe that earthquakes are caused by mountain dwarfs residing in houses inside of mountains where they entice the unwary "to dance with them around a great wooden drum" (Drucker 1951: 154). It is thought that a Nuu-chah-nulth individual, Yahlua, became an "earthquake man" after kicking a large box drum; thereafter "whenever he walked the earth trembled."

It is tempting to suggest that the effects are similar to other musical sounds in that they help to resolve emotional conflicts. Gelada monkeys, for instance, produce a wide variety of sounds of different pitches that accompany all their social interactions (Richman 1987: 199—223). The monkeys' rhythms and vocalizations are particular to emotional states and foster stable bonds between different individuals; synchronizing and coordinating vocals resolves tension. Jane Goodall (1999: 189) reports excited displays among chimpanzees caused by infrasound in waterfalls.

A variety of aural properties occur in volcanic events that range from discordant noise to pleasing fundamental frequencies (Garcés et al 1998; Garcés 2003). Substrate signals in earthquakes and volcanic tremors produce overtones of whistles and howls, with regular frequency spacing and melodies that change frequencies as a function of time, similar to a flute (Schlindwein et al 1995); several internet sites provide sound wav files of examples (see, for example, actual recordings, USGS 2007, innovative applications in *Kookoon: Inner Earth* http://www.traumton.de/label/releases). Specialized recording devices, however, are necessary to document and transform the signals into audible sounds, due to the low frequencies.

Overall, the sounds might be compared to well-organized symphonies in that they affect responsiveness and aesthetic sensibilities. For example, the sound qualities in totally dark zones of caves absent of visual correlates are not perceived as ground-generated effects – *the sounds are the ground*. An equivalent experience is "seeing with the ears"—a peculiar characteristic element of traditional ritual healing practitioners (Ingold 2000:279)—or "facial vision" experienced by the blind (p. 273), whereby the sense of pressure is on the skin of the face, rather than upon or within the ears. Instead of sound acting as an auditory guidance system to orient vision, it is a phenomenon of experience.

Sounds such as these require listeners to be present in the moment, alert, aware, quiet, observant and restrained. Aural scatters turn attempts to locate the source, even with acute perceptual skills, into exercises of patience and force intuitions to be strong. Intermittent murmurs, like the musings of rambling old people, reinforce respectfulness, caring, cooperation, and being supportive.

Natural sounds are an important reason why humans have been drawn to the underground for millennia. Sound artists and acoustic field researchers are central to understanding the various cultural representations of underground sounds. How, for example, are cultural memories projected into and reflected by geophysical soundscapes? How do individuals' and communities' changing relationships to their past transform the meanings and functions of the sounds? How does the interpretation and articulation of the sounds aid or suppress individual and cultural identity?

Objective sound data is vital to confronting a myriad of

challenges associated with the interpretation and understanding of legal rules and institution of cultures and assessments of the impact of social norms and biases related to the future of the earth's resources. Underground sounds are crucial because they can be used to initiate changes at the ground level, for instance in the long overdue reconsideration of cultural resource management laws and related ethical debates in environmental protection, archaeology, anthropology, and museum practices. Related questions that lack answers include, how does the regard of the earth, based upon sounds natural to the ground, affect indigenous concepts of property and communal resources, relative to land rights disputes between an indigenous group and a national government asserting jurisdiction over the territories claimed by that indigenous group? What are the actual and potential claims by an indigenous group for intellectual property rights to cultural knowledge drawn from earthly sound, and related disputes with governments or commercial interests seeking to make use of that knowledge?

Sound artists and acoustic field researchers are uniquely prepared to confront these and other questions that pertain to the raised concern for the intrinsic value of the earth's resources. If merely sources of enjoyment the earth's resources will continue to be regarded as expendable; appreciated as intrinsically valuable they will be cherished and protected. To appreciate does not necessarily mean to enjoy. Appreciation requires gratitude, humility, reverence, observation, quiet restraint, resourcefulness, respect, patience, cooperation, responsiveness, and sharing—qualities that are taught by listening to the natural underground sounds of the earth.

References

Baratta, M. 1901. Intorno ai fenomeni sismici avvenuti nella penisola Garganica durante il 1893. *Annali dell'Ufficio Centrale di Meteorologia* XV (I), pp. 297–315.

Bonito, M. 1691. Terra tremante. Napoli, 1691. Reprinted by Forni Ed. Bologna 1980, 822 pp.

Carletti, C. and Otranto, G. (Eds.) 1994. Culto e insediamenti Micaelici nell'Italia meridionale fra tarda antichità e medioevo. Proceedings of the International Congress, Monte S. Angelo 18–21 November 1992, Bari. 618 pp.

Chatwin, B. 1987. *The Songlines*. New York: Penguin Books.

Dombois, Florian.1999, *Earthquake Sounds*. Volume 1: Kobe 16.1.1995, 20:46. St. Augustin. Audio-CD.

_____2001. Listen to Seismograms. About Acoustic Interpretation of Seismometric Records. *Geophysical Research Abstracts* 3, 982.

_____2002. Auditory Seismology on Free Oscillations, Focal Mechanisms, Explosions and Synthetic Seismograms. Proceedings of the 2002 International Conference on Auditory Display, Kyoto, Japan, July 2–5, 2002.

Drucker, Philip. 1951. *The Northern and Central Nootkan Tribes*. Bureau of American Ethnology Bulletin 144. Washington, D.C.: Bureau of American Ethnology.

Emerson , R. W. 1860, 1876). *Conduct of Life*. Reprinted from http://www.rwe.org/works/Conduct_9_Illusions.htm.

Fischetti, F. P. 1991. Michael: da Israele all'Islanda. Centro Studi Garganici Ed. Foggia. 321 pp.

Garcés, M. 2003. Hawaiian infrasound: A mele of fire, wind, and water. American Geophysical Union Fall Meeting. Dec 10, 2003. San Francisco.

Garcés, M. A., R. A. Hansen, K. Lindquist.1998. Travel times for infrasonic waves propagating in a stratified atmosphere. *Geophysical Journal International* 135 (1): 255.

George, A. I. and G. A. O'Dell. 1992. The Saltpeter Works at Mammoth Cave and the New Madrid Earthquake. *The Filbon Club History Quarterly*, 66(1).

Goodall, J. 1999. *Reason for Hope*. New York: Warner Books.

Hovey, H. C. 1912. *Mammoth Cave of Kentucky: With an account of colossal cavern*. Louisville: John P. Morton and Co.

Ingold, T. 2000. *The Perception of the Environment*. New York and London: Routledge.

Levin, T. 2006. *Where Rivers and Mountains Sing*. Bloomington and Indianapolis: Indiana University Press.

Lyons, J. M. 2006. *Making Their Mark: The signature of slavery at Mammoth Cave*. Eastern National, Fort Washington, Pennsylvania.

Malotki, E. 2002. *Hopi Tales of Destruction*. Lincoln: University of Nebraska Press.

McMillan, A. D. and I. Hutchinson. 2002. When the mountain dwarfs danced: Aboriginal traditions of paleoseismic events along the Cascadia subduction zone of North America. *Ethnohistory* 49: 41–68.

Mercalli, G. 1883. Vulcani e fenomeni vulcanici in Italia. Milano, 1883. Reprinted by forni Ed., Bologna, 1981.

Opler, M. E. 1994 [1938]. *Myths and Tales of the Jicarrilla Apache Indians*. Lincoln: University of Nebraska Press.

Penick, J.L., Jr. 1981. *The New Madrid Earthquakes*. Columbia, Missouri: University of Missouri Press.

Piemontese, G. 1997. San Michele e il suo Santuario. Barstogi Ed. Foggia, Marzo. 181 pp.

Piccardi, L. 2005. Paleoseismic evidence of legendary earthquakes: The apparition of Archangel Michael at Monte Sant'Angelo (Italy), *Tectonophysics* 408: 113–28.

Richman, B. 1987. Rhythm and Melody in Gelada Vocal Exchanges, *Primates*, 28 (2), pp. 199–223.

Sabom-Bruchez, M. 2007. Artifacts that Speak for Themselves: sounds underfoot in Mesoamerica. *Journal of Anthropological Archaeology* 26 (1): 47—64.

Schafer, R.M. 1977. *The Tuning of the World*. New York: Knopf.

Schlindwein, V., J. Wassermann, and F. Scherbaum.1995. Spectral analysis of harmonic tremor signals at Mt. Semeru volcano, Indonesia. Geophysical Research Letters, 22, 1685–1688.

Skutch, A. 1985. Life Ascending. Austin: University of Texas Press.

USGS. 2006. Earthquake Hazards Program. http://earthquake.usgs.gov.

Ward, N. 1816. Wonders of Nature, *Kentucky Gazette*, September 9.

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