Sand Song

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The mystery of the sand song heard emanating from sand dunes across the globe has scared, puzzled and amazed humans, striking fear and wonder in their hearts. Marco Polo commented when travelling across the Lop Desert in western China that "it is asserted as well-known fact that this desert is the abode of many evil spirits, which amuse travellers to their destruction with most extraordinary illusions." (Hope, NY Moon, 2008) North Africans ascribed the "za'eeq al raml", or shouting sand, to djinn as the loud, disembodied drone engulfed listeners and did not emanate from a clear epicentre. (Hope, The National, 2008) In the Arabian peninsula, legend tells of these evil spirits beguiling Bedouin and travellers from their way, seducing them further and further into the dunes to their destruction, like the Sirens singing to Odysseus and his men. In his 1888 travelogue, Travels in Deserta Arabia, Charles Doughty describes the sound triggered by walking on "certain booming sand hills" in the Sinai peninsula as "such a giddy loud swelling sound, as when your wetted finger is drawn about the lip of a glass of water, and like that swooning din after the chime of a great bell — or cup of metal." (Hope, NY Moon, 2008)

Despite these historic postulations as to the source of the sandsong, scientists have done little research into the cause of the mysterious droning dunes. To the modern ear, the sound is most often compared to low-flying airplanes, can last up to fifteen minutes, and has been heard as far a twelve miles away. (Merali, New Scientist, 2005) The singing dunes exist in about 40 locations across the globe, but not all dunes sing "with a baritone boom" like a "Gregorian chant." (Highfield, The Telegragh, 2013). Although sand on many flat beaches can squeak, whistle or bark underfoot (often referred to as singing), only dunes create the low musical hum when sand avalanches leeward either by wind destabilising the crest of the dune or by human interference (walking or driving). (Wikipedia, Singing Sands) For most of the twentieth century, the explanation of the droning related the size of the grains with their acceleration, so that the frequency came from the collision of grains as gravity pulled them downwards. (Vriend et al, Geophysical Research Letters, 2007). This hypothesis, although still maintained in some circles today, does not address why only certain dunes produce the music hum.

Within the last ten years, new studies have shed more light on the conditions of the sonorous dunes, however consensus is still lacking amongst the scientific community. The recent research of scientists from Paris Diderot University, Stephane Douady and Bruno Andreotti, even created dissension and a public falling out between the two. Comparing the sand and frequency in two locations, the scientists agree that grain size affects the frequency and pitch of the drone. The sand grains from a Moroccan dune were largely of a homogenous size of 160 microns and resonated at 105 Hz (low G sharp). In Oman, the dune they measured produced nine notes ranging from 90-150 Hz, and the grains also ranged from 150-300 microns. When the Omani sand was sieved to a more uniform 200-250 microns, a clear, single tone was produced. (Fischer, National Geographic, 2012) Dragging a hand across the sand quickly created a higher pitch than slower movements through the same sand, but an

avalanche creating collisions based on the pull of gravity, created synchronicity between the grains which maintained the constant frequencies listed above. Therefore, Douady and Andreotti follow the hypothesis that speed and grain size determined frequency, and by simply measuring sand grains, could accurately predict the frequency of other singing dunes around the world. (Merali, The New Scientist, 2005) Each sand appears to have its own characteristic frequency or note associated it, a soul note, so to speak, and this is unaffected by whether wind or humans initiate the avalanche. (Anon, Physics.org, 2006)

Douady and Andreotti disagree, however, on where the vibrations were amplifying. Douady believes that grains of sand colliding in the avalanche create a standing wave that squeezes out the surrounding air around the grains as they become synchronised or entrained by the vibration. (Merali, The New Scientist, 2005) Andreotti posits that the sound comes from the air just above the avalanche vibrating like a speaker, so the sound is produced by waves above the sand. (Anon, Physics.org, 2006) For both, the dune itself was irrelevant for either frequency or volume. The scientists even transport hundreds of kilograms back to their laboratory in Paris where sand only 2-3 centimetres deep continued to hum at the same frequencies as on their home dunes. Mysteriously, though, these sounds stopped within a month of being in the lab. Douady postulates that a coating on the sand of silicon, iron and manganese rubbed off after a month, and only sand with these minerals acquired when the sand once sat at the bottom of an ancient sea have the ability to resonate with a musical drone. (Merali, The New Scientist, 2005)

Research conducted by Caltech in the California desert under Natalie Vriend and Melany Hunt, argues that the dune itself is important in creating the frequency. Their research insists that the dune slope (greater than 30 degrees) and height (greater than 120 feet) as well as climatic conditions (low humidity, high temperature) are all necessary for droning dunes. Their research shows that while squeaking beaches resonant around 1,000 Hz, the dominant frequency of droning dunes range between 80-100 Hz (G, E, F) with several higher harmonics. (Vriend, Hunt, et al, Geophysical Research Letters, 2007) In the Californian dunes, resonance seems to depend on the depth of the layer of soft sand above a concrete layer approximately 1.5-2 meters down made up of sand mixed with either rainwater or groundwater and calcium carbonate. (Highfield, The Telegraph, 2013) This concrete surface reflects the sound waves while the slope and atmospheric temperature amplifies the sound waves from the avalanche, and helps to distribute the strong physical vibration felt by anyone standing on the humming dunes. The sound and physical vibration can continue up to a full minute after the shearing of the sand has halted.

Despite the obvious differences amongst scientists, certain salient facts resonant from the research that I have read. Specific dunes, even neighbouring dunes, can have their own frequency (soul note). These frequencies fall mainly in the low range (80-105 Hz), a range described by David Gibson as more healing, and by Tom Kenyon as Super High

Beta, a range that may produce out-of-body experiences. The drone is more than just sound vibration as standing on a singing dune vibrates the entire body like a sound bed. Grains of sand suitable to generate the hum seem to have a special coating of minerals and it is that coating which shapes the resonance as much as the grain size or dune. Once away from their original location in natural, the sands continue to hum but quickly seem to lose their memory. I believe that this specificity of locality implies that these sands know their home dune and it's their relationship with earth and their home environment that allows on certain, special dunes to share their musical, healing song with us.

References

Fischer, Shannon. "Singing Sand Dunes Explained", 31 October 2012. http://news.nationalgeographic.com/news/2012/10/121031-singing-sand-dunes-physics-science-whistling/

Highfield, Roger. "The Riddle of the Singing Sands", 10 September 2013. http://www.telegraph.co.uk/news/science/10297976/The-riddle-of-the-singing-sands.html

Hope, Bradley. "Singing Sand", August 2008. http://www.nymoon.com/pubs/desert/singingsand/

Hope, Bradley. "Symphony of the Sands", 4 August 2008. http://www.thenational.ae/news/uae-news/science/symphony-of-the-sands#full

Merali, Zeeya. "Dune tunes... the greatest hits". 17 September 2005. https://www.newscientist.com/article/dn8014-dune-tunes-the-greatest-hits/

Physics.org. "Enigma of the Singing Dunes", November 2006. http://physicsworld.com/cws/article/print/2006/nov/01/the-troubled-song-of-the-sand-dunes

Vriend, Hunt, Clayton, Brennen, Brantley, Ruiz-Angulo. "Solving the Mystery of Booming Sand Dunes". geophysical Research Letters, Vol 34, 23 August 2007. http://www.damtp.cam.ac.uk/user/nv253/booming/abstracts/papers/2007GL030276.pdf

Wikipedia. Singing Sands. https://en.m.wikipedia.org/wiki/Singing_sand