an upgrade of how we think narcissism. Because in the end, caring for the self is erotically caring for the other, in what could become an ever-expanding circle, or better spiral, of erotic care for all beings.

So no, thought at Earth magnitude is not grown-up thought that has accepted some preformatted reality principle and finally sees what pathetic little idiots we are, Nietzsche-style. Thought at Earth magnitude sees the cosmic joke that things like Earths and biospheres and species are also toy-like, necessarily incomplete entities that could evaporate under their own steam let alone something else's. Indeed, how they cease to exist is when one form of appearance – say a sound wave of sufficient amplitude and frequency – interferes with the way they appear, such that the rift, an invisible and irreducible rift, between what they are and how they appear becomes weirdly wider and wider, until all you are left with are appearances: memories, some flowers in a jar, a leftover piece of sandwich; or in the classic experiment of opera singer versus glass, fragments of glass, physical glass-memories, a glass only legible in the tiny chips that are strewn all over the floor. Even black holes evaporate.

So thought at Earth magnitude cannot possibly involve contempt or cynicism. It must instead involve a caring sense of hypocrisy, a compassionate laughter that one can never, ever get the ecological recipe just right so as to save all lifeforms all at once, all the time. Because very simply, if you're being nice to the bunny rabbits, it means you aren't being nice to the bunny rabbit parasites. Something is always missing from the ethical and political jigsaw, because something is always missing from the ontological jigsaw. So peel yourself off the floor and start to smile.

On Long-Wave Synthesis

Raviv Ganchrow

On 12 October 2014 Raviv Ganchrow gave an on-site research presentation of his large-scale infrasonic project *Long-Wave Synthesis*. The prototype was installed on a site close to Høybuktmoen, Kirkenes' airport, in Norway's northern extremes. In the months leading up to the presentation Ganchrow explored the outer edges of infrasound and the Northern sonic context, he made recordings, developed loudspeakers, and performed tests, working towards a land-art-scale sound installation. As he makes clear in this transcription of the lecture he delivered outdoors at the installation site, he discovered that we have only just begun to comprehend infrasound.

Raviv Ganchrow – This is a research presentation about a large-scale outdoor sound installation I'm working on titled: *Long-Wave Synthesis*. What you see and hear is not really the work itself yet; it's a gesture towards what the work can become. The piece is still very much in flux in terms of how it is going to manifest landscape. In this talk I want to share with you some insights into the different trajectories connecting to this piece.

Long-Wave Synthesis was one my 'drawer projects' – an idea sketched out on a piece of paper and dated and dropped into a drawer. Most of the drawer projects will never be realised, but I keep them there to remind myself that I had a particular idea at a certain moment in time. *Long-Wave Synthesis* waited in the drawer for at least three years until suddenly the context of the North and the issue of perceptions of landscape converged in the *Dark Ecology* project. Kirkenes is the optimal setting to test this idea of long-wave synthesis. The practical side of the work is based on an extension of a technical principle to produce sound *fields* rather than sound *sources*. In wave-field synthesis the coordination of phase and amplitude on a group of transducers allows for the *production* of acoustic territories rather than the *reproduction* of a sound. This aspect, and the ways sound weaves itself back into the structure of our acoustic environment, are what initially interested me in wave-field technology. This physical property is also the aspect that links back into the notion of landscape. In that sense, when a field recording is played back on this outdoor system, it does not appear

Raviv Ganchrow, *Long-Wave Synthesis*, installation, work-in-progress, Kirkenes, Norway, *Dark Ecology*, 2014. Overview of the site.

Raviv Ganchrow on the site for *Long-Wave Synthesis*, installation, work-in-progress, Kirkenes, Norway, *Dark Ecology*, 2014.

as a mimetic copy (as field recordings often do in indoor situations), but rather as a mediating element that permits points of entry into aspects of the immediate surroundings that we wouldn't be able to access otherwise.

Empirical experimentation is a crucial component in the development of this work. There is a whole experiential side to it that is very hands-on. There are theoretical interests driving the project, though the practical development really has to do with a long trial-and-error process. What you hear now on-site is, I hope, just the foretaste of what is yet to come. To explain the technical challenges a bit more: I'm trying to figure out how to transport large amounts of air. I have discussed this with several engineers. The primary frequency band for *Long-Wave Synthesis* is below 20 Hz. Those are physically long waves. 20 Hz is often mentioned as the lowest frequency that we humans can hear as a continuous tone. Below that, sound is still audible to a certain extent, but it is mostly perceived as pulses or tactile pressure. The initial plan was to be able to go down to around 4 Hz, in other words, frequencies in a range of roughly 10 to 85 metres long. But the deeper I immerse myself in the subject of infrasound, the more I realise that some of the tones in our immediate environment are much, much longer than that. Through this piece I am developing an awareness of a vast territory that I didn't know existed. *Long-Wave Synthesis* started with a question about the perception of landscape in relation to long-wave vibrations, and has now grown into this incredible, and mostly inaudible, world of colossal acoustic waves. This brief talk will reveal only a fraction of that world, as there are many aspects to it. Much of it has to do with discoveries in the nineteenth century that sparked fields of research that are still being pursued today.

The sound that we're hearing in the installation now was recorded just a few weeks ago, on 12 September, on an array in Bardufoss. 'IS37', as it's known, is an array of infrasound sensors that stream these sounds to a facility in Vienna, along with 49 other synchronised locations around the globe. And this is where it starts to get interesting in terms of the scale of the sonic events that are being addressed. An attention to the scale of such vibrations unravels particular perceptions of the surroundings. In simple physiological terms, the frequency band the human organism is oriented towards is roughly at a scale that interacts with small-

to medium-sized objects in our environment. In contrast, the scale of infrasound interacts with the scale of topography or even of the atmosphere itself. In other words, the landscape, the globe and its gaseous surroundings impart aspects of their properties to the propagating waves.

Part of my research involves investigating the acoustic properties of land – not in terms of some abstracted soundscape but rather in terms of the concrete transmissive properties of local materials and geo-activity. The higher terrain here in Norway is covered with a very specific kind of tundra lichen that Kirkenes-based curator Hilde Methi has told me is called 'lav'. The reindeer 'luv' it. It's their favourite food and in fact is generally known as 'reindeer moss'. What's interesting is that it provides a kind of anechoic layer on the ground that creates very specific outdoor acoustics where direct sound is accentuated and ground reflections are diminished. Part of the reason you can hear the fine details in these clicks so clearly (sounds from the installation at the site) is because of the vegetation on the ground. Sound is able to travel horizontally unobstructed, while angular surface reflections are absorbed in the vegetation. During the research residency we tried to record a variety of infrasound sources with experimental methods using ground transmission as well as really large-scale transducers – which were actually loudspeakers that were being used as microphones. We visited a reindeer herd that was being tagged. There's something interesting about the sound of hoofed animals moving through a landscape that may go back to some latent prehistoric form of attention. There is currently an attempt in the archaeoacoustics community to rethink certain ritual activities in early societies. Take petroglyphs, for example: Steven Waller proposes a hypothesis that the act of image-making is not only an act of drawing, but is also an act of drumming. Preliterate cultures didn't have this kind of separation of the senses or the separation of disciplines that we have grown accustomed to. The suggestion is that in such cultural contexts there is no clear division in ritual activity between acts of painting, sculpting and sounding. The boundaries between such activities were more fluid.

For instance, the Hall of Bulls in the Lascaux Caves is thought to be a ritual site for re-enacting the sound of herds moving through the landscape. Interestingly, only hoofed animals are depicted in the

Hall of Bulls. It's also the most resonant cavern in the Lascaux Cave complex. The suggestion is that drumming, painting, and landscape are connected. I don't know if you've ever had a chance to hear a wild herd, like the Tibetan kiang, in full gallop. Even in this day and age, with our modern tuned ears, these wild donkeys, galloping across dried salt flats, create a powerful sonic impression that stays with you. We were out there making recordings of reindeer as they move across dense ground. Some of the sensors available nowadays are sensitive enough to pick up these vibrations. It would be interesting to make recordings like this in every season, particularly in winter when the ground is frozen and vibrations transmit differently.

In prehistoric Scandinavian cultures there is a curious artefact named *brummer* – or 'bullroarer' in English. It consists of a large stick or a flat piece of stone, attached to a string, which is twirled and rotated. No one really knows exactly what purpose this simple tool served but it does produce a very low drone, which travels very well over long distances. It's thought to be a kind of Stone Age precursor to wireless communication. Here in northern Norway they found a *brummer* in Tuv that is at least 5000 years old. In other words, attention to large waves, and their role in perceptions of the geo-physical, extend quite far back in time.

Humans, in fact, occupy a rather quiet zone in air. There is tranquillity in our bandwidth. An interesting thing happens with the introduction of audio amplification – it spawns an idea of zooming into materials, listening-in on vibrations of matter itself. Such preoccupations appear in works of John Cage but also in texts of the Futurists; it has to do with an awareness that arises from the experience of amplifying small sounds. Nowadays there are even molecular microphones where you suspend a small glass bead in a laser beam to record tiny movements. This method has made Brownian motion audible – interestingly, it sounds just like Brown noise. But sonic activity also occurs when zooming out. If you scale things up to these larger sound events, you enter a bustling bandwidth. Infrasound is continuously roaring, although we can't hear it, and is filled with an astounding variety of events.

One central aspect of this spectrum is that it literally connects the solid earth to oceans and weather, as well as to modern industrial practices. At a particular point in the project I suddenly realised that infrasound is actually the bandwidth of the Anthropocene.

If there is a bandwidth in which the Anthropocene registers, it's in infrasound. We generally tend to think of it in terms of chemical and mineral evidence, if we consider these large-scale transformations in spectral terms instead, then environmental infrasound exhibits an intermingling of large-scale human industrialised activity with these other earth- and atmosphere-related frequencies.

To give you an idea of the diversity of events that occupy infrasound: you can hear exploding meteors. The Chelyabinsk meteor that fell in 2013 is the largest infrasound event recorded to date on the global infrasound-sensing network. They were able to trace its trajectory and pinpoint its location and the magnitude of the explosion based on infrasonic evidence. The meteor disintegrated about 50 kilometres above the Earth's surface. The air in the atmosphere is dense enough to cause friction that makes meteors glow and often explode. The friction and explosion produce ripples, which travel around the globe in the zone between the surface of the Earth and the upper atmosphere. In the atmosphere there is sonic activity up to an altitude of nearly 100 kilometres. Of course, we need a medium like air to transport vibrations, but the interesting thing about it is that its still proper sonic energy even if we go much, much lower in tone. It's still about sound, at least in the acoustic sense of the word.

Collapsing arctic glaciers produce a lot of infrasound; volcanic eruptions have a typical frequency between 1 and 5 Hz, which is actually a rather fast fluctuation in that bandwidth. Auroras – which are another category of infrasound – move huge amounts of air tens of kilometres up in the sky that can actually transmit to ground level. There's still some mystery around aurora sounds. Some researchers in Helsinki, as well as here in Norway and in Canada are studying this phenomenon. There is recorded evidence of aurora-related infrasound propagation. But there's another sound phenomenon, reported in aurora sightings, of much higher frequency. No one knows exactly what could be causing it and indeed if it really exists at all. The sounds are apparently very subtle and are only rarely heard. There's a lot of anecdotal information about them – one study from the 1970s collected nearly 200 anecdotal reports of aurora-related sounds, though to my knowledge no recordings have managed to capture them yet. There are many theories of likely causes for such effects, for example,

Raviv Ganchrow, *Long-Wave Synthesis*, installation, work-in-progress, Kirkenes, Norway, *Dark Ecology*, 2014. The concrete structures were enclosures for planes during World War II.

Raviv Ganchrow, on-site research presentation, Kirkenes, 12 October 2014.

infrasound friction activating ions in the air that then discharge at ground level. My personal favourite though is called 'Electrophonics', which proposes that immense amounts of electromagnetic radiation emitted by these auroras project down into the ground and charges plants and the materials in the surroundings with electrical potential. So what you would be hearing is locally produced material vibration caused by the discharges in the surrounding environment. Small-scale versions of this phenomenon have been recreated in the laboratory, but there is scepticism about whether auroras can produce such an amount of electromagnetic transmission. Nonetheless, the theory proposes that in certain conditions the environment itself behaves like a loudspeaker, and that is exactly what interests me: that this technical device so ubiquitous in man-made environments, with its basic coil and cardboard cone construction, may also manifest elsewhere naturally. Maybe there's a natural history of loudspeakers as much as there is one for radio.

In terms of anthropogenic contributions to the infrasound spectrum, we have mine explosions propagating in the ground and the air, such as the weekly detonations from the local Kirkenes mine that I haven't managed to record yet. Re-entering space debris (almost daily), aircraft sonic booms, oil refinery gas flares, and of course nuclear testing are all part of that spectrum. Particularly nuclear testing created a spike in man-made infrasound that also catalysed research into this bandwidth.

There's a difference between just making sound in a room where a certain amount of acoustic pressure can build up, and interfacing with the shifting surroundings of the open atmosphere. The strange thing about low frequencies, especially those below 15 Hz, is that they no longer obey the inverse-square law for loss of energy that the rest of sound adheres to. The physics of long waves is therefore a special case in acoustics. In the spectrum we do hear – from 20 Hz to 20,000 Hz – sound energy tends to decay rapidly as the distance from the source increases. Infrasound doesn't have that problem; it just continues to propagate. The lower the frequency, the less the resistance from the environment – in effect some of these sounds can travel thousands of kilometres. It also has to do with the fact that certain sounds in this bandwidth deliver massive amounts of energy at magnitudes greater than those we are used to in the audible spectrum. That level of energy along with the near lossless propagation even allows these sounds to circumnavigate the globe. Other factors that help infrasound propagate are differences in atmospheric temperature and prevailing winds. If you look at the atmosphere in sections, it's really interesting to see what happens up to the thermosphere in terms of these various hot and cold zones. The polar jet stream, which is a continuous movement of wind between a pole and the equator, and is exploited by airplanes that surf on it to increase speed and save fuel, acts as a kind of refractor for ascending sound, bending it back down again. Sounds that manage to get beyond the jet stream travel along a different atmospheric layer. Physical properties of the atmosphere, with its prevailing temperature and wind conditions, are like a vast ductwork through which these large waves travel.

The specific part of the spectrum and the prevailing temperature inversions create different conditions for the propagation of long wave frequencies. Interestingly, there does seem to be a lower limit to the bandwidth. Läslo Evers, an infrasound researcher in the Netherlands, mentioned that the highest sampling rate for recordings at the Royal Dutch Meteorological Institute (KNMI) infrasound array is 40 Hz. In other words 20 Hz waves are the highest pitches they want to bother with. When I asked 'What's the lowest tone of interest?', he said 'It's 500 seconds'. That's one cycle of a sound every 500 seconds. We would need to wait more than 4 minutes for one half of the phase of the tone to pass by. We're talking about a sound wave that is 171 kilometres long. Apparently this is the frequency cut-off of the atmosphere itself, bounded by the thickness of the atmospheric level through which long waves travel. At a certain moment I realised this was no longer sound as we know it. The *Long-Wave Synthesis* project had crossed a threshold where it interfaces with weather, with barometric pressure. When pitches slow down they resolve into pulses. When pulses slow down even further, they sustain in barometric conditions. When you go below 0.01 Hz, the amount of air that is occupied in one cycle of the sound becomes so heavy, that gravity starts to interact with the sound. There's a phenomenon called acoustic-gravity waves, and gravity waves in physics, where the force of air-mass displacement is counteracted by a restoring force of gravity, sort of like the ripples at the edge of a pond. Below 0.002 Hz, gravity waves take over from acoustic waves, and that is incidentally the 500-second cut-off frequency of the infrasound array at KNMI.

What all of this means is that the Earth's physical features start to interact with, and even create, such sounds. One example is mountain ranges. A mountain range of a certain height, coupled with a prevailing wind direction, can generate eddies that produce standing wave patterns. In certain areas of Germany and Switzerland, for instance, people have complained about what they call the 'hum'. The hum is a really interesting phenomenon. There are numerous conspiracy theories around such phenomena: one idea is that HAARP or other large technical facilities are somehow responsible for these sounds. One possible explanation is that mountain ranges interact with sound, producing very low, continuous sounds that can last up to three hours. Still other explanations point towards thermal and electromagnetic activity in our upper atmosphere that may produce very low drones. But the explanations don't interest me as much as the fact that people are expressing a particular kind of awareness of environmental sounds and that infrasound is summoned to provide the answers. At the very lowest end of the infrasound scale is the Earth's rotation itself: the friction between it and the atmosphere apparently also creates a tone.

Another interesting thing about infrasound is that it comes out at night. Why at night? It's because of differences in air temperature. During the day, the ground is warm, and the hottest part of the air is just above the ground, becoming cooler and cooler the higher you go. In the evening there's a temperature inversion that acts as a refractive layer for infrasound that produces a kind of waveguide that animals tend to exploit. For instance, lions, wolves and particularly elephants use infrasound for communication and they seem to be aware of this environmental characteristic. Elephants can produce deep tones on the infrasonic scale. They make their territorial calls at sunrise and sundown because they seem to know that their calls will travel much further. They can hear sounds from another herd up to ten kilometres away. At night it is possible for an elephant to have a calling territory upward of 300 square kilometres; during the day it's roughly half that.

This 'dark side' of infrasound also has other manifestations. If you type 'infrasound' into a search engine, you'll get a slew of hits linking physiological discomfort and even haunting with infrasound. An often-cited example is that of Tony Lawrence and Vic Tandy who proposed that standing waves of particular frequencies induce an

Raviv Ganchrow, custom-made speakers for *Long-Wave Synthesis*, installation, work-in-progress, Kirkenes, Norway, *Dark Ecology*, 2014.

Raviv Ganchrow, *Long-Wave Synthesis*, prototypes for the installation, 2014.

Raviv Ganchrow, custom-made speakers for *Long-Wave Synthesis*, installation, work-in-progress, Kirkenes, Norway, *Dark Ecology*, 2014.

equally specific range of affects in people. More precisely, they were trying to link the sense of the uncanny to a specific bandwidth and the resonance responses of the body. They found that a strong sense of discomfort, perspiration and even breathing difficulty is apparently connected with kinaesthetic immersion in 19 Hz. There could be different interpretations of such an idea. Evolutionists will argue that it has to do with some latent attention to the sounds of predators and that we fear deep tones because only lions and elephants produce such sounds, and therefore to us they represent an immediate threat. Tandy and Lawrence took a slightly different angle by citing a study where 18 Hz was also identified as the frequency at which, apparently, the eyeball starts vibrating in resonance, causing visual smearing. They suggests that exposure to low-frequency standing waves not only provokes psychological responses, but that physically shaking the eyeballs could account for visual aberrations associated with supernatural phenomena. Whether or not either of these explanations is feasible is still up for debate, but I'm more interested simply in the fact that in this contemporary moment of sonic awareness, we seem comfortable drawing correlations between enumerated fluctuations, material notions of the body and physiological categories of perception.

There is also ample online discussion of the supposed negative effects of exposure to very low frequencies, particularly with groups such as wind turbine opponents. Vladimir Gavreau, the Russian/French robotics engineer, whose name you might know if you're familiar with the history of sonic warfare, is an example. He applied a physiological hunch to develop an infrasound weapon. Gavreau's research group stumbled across the effect when the team mysteriously fell ill due to infrastructure anomalies in the workspace. The source of their illness, described as recurrent bouts of nausea, was traced to exhaust fans in the building. Apparently the rotation of the fans was causing a resonance in the ducts that subsequently produced a 7 Hz standing wave pattern in their workspace. Gavreau's experimental sonic weapon, an infrasonic whistle, was designed to produce and enhance such tones.

Our awareness of infrasound dates back to the eruption of Krakatau in Indonesia in 1883, where the eruption was recorded in weather stations around the globe on barographs, which are barometers that trace lines indicating air pressure fluctuations

onto graph paper. The eruption was recorded in Washington, Toronto, Aberdeen, Mumbai, Melbourne and South Georgia. The sound was powerful enough to circumnavigate the globe seven times, in some places continuing to register on barometers five days later. Before this, no one had any idea that pressure waves could travel such long distances.

Intensive research into infrasound detection truly started in the trenches of World War I and had to do with attempts at long-range artillery gun detection. The first primitive infrasound 'microphones', constructed from Helmholtz resonators and electrically heated wires, were developed at that time. Part of that history resonates with this site in Kirkenes. It used to be a shrapnel hangar from the Luftwaffe's Ice Sea Fighter Wing. During World War II, Kirkenes was one of the main staging grounds for air raids on Murmansk in Russia. If bombardment threatened, the planes were moved from the airstrip and parked between these walled enclosures. Each enclosure is oriented in a slightly different direction, such that if a bomb exploded, pressure waves and shrapnel dispersing horizontally would only take out one plane at a time. In other words, if the bomb exploded on the open side of the enclosure, only that one aircraft would be destroyed, but the three others in adjacent enclosures would still be operational. By the end of the war, there was a very specific awareness of pressure waves, their effects and how they propagate in a landscape. Paul Virilio has pointed out that Atlantic wall architecture, extending all the way up here to Kirkenes, is designed to deflect shock waves not only spreading in the air but also rippling through the ground. The sheer force of wartime bombardment was such that it sometimes made the soil more liquid than solid. The invention of high explosives and developments in aviation are central protagonists in the human component of the infrasound spectrum. Detection techniques in World War I involved cross-referencing data from scattered monitoring stations. But the major advances in such detection methods occurs between 1945 and 1958, with developments in nuclear technology and the detonation of more than 250 atomic devices.

Nuclear blasts were among the first man-made events that caused infrasound to circumnavigate the globe in a similar way to large-scale volcanic explosions. The Tsar Bomba nuclear weapon detonated in 1961 in the eastern Barents Sea region created infrasound that travelled around the globe several times, mimicking the Krakatau explosion. If a nuclear device explodes in the atmosphere, everyone knows about it, you can register it, you can even hear it over great distances. Pressure waves from the Tsar Bomba were strong enough to shatter windows in Norway and Finland. Explosions underground are much more difficult to detect, however, unless coordinated sensors are placed at multiple locations around the globe. Underground detonations transmit over such long distances that if recordings made thousands of kilometres apart are cross-referenced, the exact location, time and even the magnitude of an explosion can be determined. The idea for an extensive sensing network has its roots in the Cold War but the technology is still being improved and expanded. In other words, these interests are not relics from a bygone era. For example, the NORSAR Bardufoss microbarometer array was set up last year and officially inaugurated only a few weeks ago. Other large-scale arrays – components of the same global monitoring system from as far away as Chile – stream back data via radio and satellite to Vienna's Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) headquarters. The Comprehensive Nuclear-Test-Ban Treaty, only adopted by the UN General Assembly in 1996, provides nuclear test monitoring guidelines for an International Monitoring System (IMS) that is still under development. The IMS recorded nuclear testing as recently as 2013 beneath North Korea. Currently, 50 infrasound stations are operational; this number is expected to rise to 60 when the network is complete. It's interesting to see how this technology continues to develop in tandem with the culture of fear. At the same time, simply the existence of such a global network is an invitation to investigate our atmosphere in new ways. Researchers analysing this data are discovering all kinds of things about the behaviour of the atmosphere, the ocean, and volcanic activity.

I'd like to conclude this talk by describing some aspects of the two prototype 'loudspeakers' and the sounds that are incorporated in the work. The high frequency that you can hear, the kind of pulsing sound, is simply a real-time playback of the Bardufoss recording of infrasound that is directly converted to air pressure. Instead of outputting gradual waves, the pneumatic mechanism simply outputs an on-off signal. The resulting polyrhythmic pattern you hear, which is a kind of skeletal structure of the infrasound waves, is a record of all

the raw infrasound as it passes through that geographic location. The second rotary transducer exploits variable pitch impellers to push large quantities of air. The drone sound it's producing, which seems quite low, is in fact playing back at 80 times the rate of the original recording. I've sped it up exactly to the point where you can just start to hear 'microbaroms'. Microbaroms are affectionately known in the scientific community as 'the voice of the sea'. In early low-frequency research, they couldn't figure out why this part of the spectrum of infrasound was always saturated on barometric registers, regardless of their location on the globe. In 1939 two scientists in Pasadena figured out that it was cause by large-scale oceanic behaviour. Specific weather conditions create a very slow rising and falling of the entire surface of the water, which acts as an enormous drum producing infrasound that can propagate for thousands of kilometres and penetrates the upper reaches in the atmosphere. What you're hearing here is likely to be storms off the coast of south-west Iceland. If you tune in to this particular bandwidth – even if you're in the middle of the Sahara desert – you will hear these sounds. Läslo Evers mentioned that if I build an infrasound sensor and I don't hear this drone, then something is wrong with my sensor. This is apparently one of the most pervasive sounds in our atmosphere.

My aim for the *Long-Wave Synthesis* project is to continue developing one of those two sounding strategies and expand them into a larger array, capable of generating sonic territories that can then be explored through walking.

***Long-Wave Synthesis* for**
pneumatic compressor, 10 bar pneumatic hose, pneumatic transducer, birch plywood compression, motor-vehicle pistons, auroral air displacement, barometric pressure, Barents Sea offshore rig gas flares, wolf howls, relative humidity, Lord Rayleigh, pressure waves, travelling waves, Atlantic Ocean standing waves (microbaroms), wind speed, wind shear, wind orientation, kinaesthetic orientation, air mass, skin pressure, meteorographs, stomach resonance, ear-canal depth, woollen hat transmission, frost, fungus, rusted metal, concrete walls, mobile listeners, weather suits, shrubbery absorption, discarded wooden panelling, assorted gravel, distance between air molecules, mountain range turbulence, pond oscillations, moss, rock surface texture, thickness of atmosphere, Earth circumference, 15” transducer, jet stream shear, stratosphere circulations, troposphere temperature inversion, Earth rotation drag, space debris re-entry, asphalt friction, reindeer hoof impacts, soil conduction, shoe-to-heel transmission, shock-wave reverberation, impact engineering, iron ore mining, calving arctic glaciers, TNT, WWI gun-sound ranging, Icelandic volcanoes, chemical explosions, nuclear proliferation, CTBT nuclear-test-ban monitoring, long-range communication, XLR signal cables, speaker cables, 240 V power cable, 24 V signal-multiplication circuit, 400 Watt amplifier, power phase inverter, 1200 Watt power supply, 4.5 kW diesel generator, thunder, jet engines, meteor explosions, supersonic flight, Krakatau, Kirkenes Airport, Luftwaffe’s Arctic front, impeller acoustics, 1440 rpm rotor transducer, 2.4 GHz laptop computer, 5000 year old *brummers* (Scandinavian bullroarer), 500 sec waveforms, 4 AM snow crystals, 24-hour recording from Bardufoss’ IS37 array 12 September 2014.

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Trying to Understand Things that are Bigger than Yourself

Interview with Mario de Vega

Carsten Seiffarth