

## 11. The music of Gaia

### Notes from the Earthquakes

“THE MUSIC OF GAIA”, “the sounds of Earth”, may sound strange; however, it is a reality. Of course no mention is made here to songs, pop music groups or albums with the titles ‘Gaia’ or ‘Earthquake’. As stated above, this “restless” and “unquiet” planet generates micro-earthquakes every day ...every month ...every year. The longitudinal waves, also called primary waves (P-waves), when reaching earth’s surface (an interface between two media with different density and different wave propagation velocities according to the definitions of Physics) from the interior of earth’s crust refract and propagate in the atmosphere in the form of acoustic waves, that means, in frequencies perceptible to the human ear. On the contrary, as already mentioned, the transverse waves, also called secondary waves (S-waves), can not propagate through liquid media and do not enter into the atmosphere.

In many cases, there are witnesses of a hollow sound attaining the earthquake, a terrible rumble which is heard during the seismic tremor, in particular upon arrival of the first “painless” seismic waves. In fact, many of these sounds are produced by the movement of faults, the upheaval of the surface rocks, the falling rocks and the objects in our houses, all of them being the result of vibration. The hollow sound that attains the earthquake is perceived by man as a terrible chthonic groan. Be that as it may, this sound is a loud scream of Earth, which results from a normal seismic process of the planet. The second waves (S-waves), the catastrophic ones, are not accompanied by any sound effect.

Nevertheless, each earthquake has its own particularity, its own personality. No earthquake is similar to another one, not even to another earthquake of the same seismic source, focus or fault. According to seismologists, a seismogram is a record of the seismic wave that travels in Earth’s body, or better to say a record of various waves of different frequencies. The same is with the “strong ground motion”, where the acceleration seismogram records the whole wave spectrum of an earthquake.

But, how can we hear the earthquakes? When we listen to music, we are receiving a wide spectrum of acoustic frequencies (notes) from a loudspeaker that causes vibrations in the atmospheric air. Similar is the case with an earthquake: the soil shakes, the air vibrates and we feel the earthquake by receiving again a wide spectrum of wave frequencies. The only difference in this latter case is that the single units of the waves, namely the “earthquake’s notes”, are not well discernible.

The sudden, unpleasant feelings and the shock we get from a seismic tremor are due to the high frequencies, while the “dizziness” and the oscillation are due to the low ones. Still, not all people perceive a seismic tremor in the same way. What one exactly perceives as a seismic tremor depends on the size and orientation of the seismic source, on his distance from the earthquake’s epicenter, on the kind of rocks that exist between him and the seismic source, on the space around him and finally on his temperament and psychological condition. Many animal species perceive also in a different way the seismic waves and react differently than man. We all have heard or read about many animals’ reaction to the seismic waves, which occurs either during or

even before the earthquake, as well as the fact that some animals remain indifferent and many of them calm during an earthquake.

The kind of signals that animals receive ahead of an earthquake is a totally different thing. Although this is an often noticed phenomenon, there is no scientific explanation as of today. But, is it possible for us to hear the earthquakes by reading their seismograms as if they were sound signals? The answer is yes!

The size of earthquakes varies from zero or a bit more – hundreds of millions of earthquakes of this size occur every day- to 9-9.6, which is the size of earthquakes occurring two to three times per century. Earthquakes are sudden and unexpected slip phenomena that occur on geologic faults. Energy is released from these faults and is being transmitted throughout the body of Earth. Most earthquakes of small size transmit their waves in short distances, whereas earthquakes of big size send their waves to the whole world, which they run across many times. These high energy vibrations energize the whole planet and make it oscillate like a bell, for many minutes or even hours after their generation. The earth's vibration is similar to the tremor of a big and heavy bell after its clapper has ceased to strike it.

However, earthquakes rarely occur in a single fault. Quite always, earthquakes are generated in particularly complex fault networks, small or big ones. These many cracks enrich the seismic waves with many and different frequencies - low or high ones, bass or prima ones – like a band with sounds from drums, trumpets, contrabasses and clarinets. For the same earthquake size, a small fault produces high frequencies, whereas a big fault produces low ones. There is an additional reason why the earthquakes' acoustic frequencies change: while the seismic waves travel in the air at the same time with those traveling on the ground, they lose energy; so, the closer to the earthquake's source we are, the more we feel it. Nevertheless, as we already know from Physics, the high frequency waves lose faster energy while traveling than the low frequency waves. Thus, the further we are from a band, the better we hear the bass sounds. The same is with an earthquake: high frequencies are prevalent around the epicenter and low frequencies in further distances.

Finally, another factor that influences the frequencies of a seismic wave is the type of rock it travels through. Thus, e.g., the granite permits the waves to travel through with lowest energy loss. The opposite is the case in loose materials: seismic waves lose more energy and mainly their high frequencies.

Seismologists with a talent in music or with the assistance of musicians tried to compose music by analyzing the frequencies of different seismograms, and they did it! What comes out as a result is real music; yet, this is not the result of a talented, high intelligent and sensitive creature's inspiration, namely the man's, but music from the sounds produced by the Earth when it shakes, or from the analysis of the "cryptographic messages" resulting from the seismogram analysis. Of course, after the electronic analysis of the seismic waves for their conversion into notes, man, with his intelligence and sensitivities, comes in between.

The 1992 Landers Earthquake in California, an earthquake-landmark in the science for many reasons, was the first earthquake to be converted into a two minute piece of music. Whoever is curious to hear the earthquakes' sounds can try to download a

music piece from the USGS (U.S. Geological Survey) website. Anyhow, the music of the Landers Earthquake sounds like rock (take notice of the original meaning of the word!)

Our earth produces sounds; among others from the earthquakes. This is a scientific fact today. The music sounds produced by the massive motion of the grains of sand under the influence of the air are also familiar. Certain notes have been detected, recorded and studied as a result of another geological procedure, the *aeolian erosion*, that is, the motion of air with grains of sand. We can convert these sounds with our computers into music. Of course, we do not know whether all these sounds constitute Gaia's language, as we did not know anything about the dolphins' and the whales' language some years ago. From now on, we can use the "poetic license" to travel with our fantasy in the world of Gaia's whispers, screams and music.