

Vibrations and natural phenomena in ancient sites affecting the brain activity

How to study the mind in the archaeological sites

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Abstract — From a number of research studies and our own experience it was observed that some ancient “sacred” sites have a specific affect on brain waves during rites. The frequencies of resonance found at these sites were tested on a group of volunteers in the laboratory of our university. Audiometric tests at the Otorhinolaryngology Clinic were used and the response was measured by EEG. Similar tests on the same group were repeated in an ancient hypogeum in Italy. We found there was a prevalence of frontal areas or occipital (posterior) areas with no predominance of one cerebral hemisphere (left of right) over the other whilst the frequencies were played. Throughout the experiment some brain areas had also a split of waves, but only in those volunteers who regularly practiced meditation or prayers. Each volunteer had a different sensitivity to all the tones without one tone prevailing, with each exhibiting a strong response to a subjective and personal tone. In the same hypogeum we applied some innovative methods of research to better understand this altered state of mind induced from the vibrations present in that location with very interesting results.

Keywords: *archaeoacoustics, ultrasounds; infrasounds; low sound frequency.*

I. INTRODUCTION

Archaeoacoustics is a well known complementary discipline to archaeology that involves the study of ancient site using an interdisciplinary approach. So we also used medical-anthropologic approach that extends archaeoacoustic analysis to include the relationship between the human body and archaeological sites using new forensic methodologies. Following this path we carried out a research in collaboration with the Head and Neck Department and the Clinical Neurophysiological Unit at the University of Trieste (Italy) to assess the effects of resonance phenomena on the human body^[5,9]. The idea of the connection between brain and ancient “sacred” sites were proposed in international literature by Princeton Engineering Anomalies Research Group (PEAR), University of Princeton, NY under the directorship of Robert

Jahn. In 1996 PEAR published a paper titled “Acoustical Resonances of Assorted Ancient Structures”^[10]. In it they found at six different Neolithic temples in England and Ireland an acoustic resonance of around 110Hz, frequencies that commonly fall within the male vocal range. They also found that the dominant standing-wave patterns at such frequencies are the principle of radial or longitudinal harmonics with little azimuthal or vertical variations. PEAR’s conclusion showed that the ancient structures possessed resonant acoustical properties that may have contributed to their functional purposes.

On the basis of PEAR’s findings, a research group from UCLA (USA) directed by Cook, published a paper in 2008 analyzing ancient architectural acoustic resonance patterns and regional brain activity^[11]. In it the authors looked at the effect and correlation of the frequencies found by PEAR at English and Irish temples on brain activity using electroencephalography (EEG). In their pilot project, 30 healthy adults listened to tones of 90, 100, 110, 120, and 130 Hz whilst brain activity was monitored using EEG. In particular they found that the pattern of asymmetric activity over the prefrontal cortex shifted from one of higher activation on the left side at most frequencies to right-sided dominance at 110 Hz. These findings are compatible with relative deactivation of language centres along with a shift in prefrontal activity that may be related to emotional processing. These results suggested that the acoustic properties of ancient structures may influence human brain function and that a wider study of these interactions should be undertaken. From these results Cook hypothesised that the resonance of the chamber cavities might have been intended to support human ritual chanting. There was the possibility that tones at these frequencies might specifically affect regional brain activity^[11].

So our research group tried to repeat this experiment on a group of 10 volunteers who underwent examination by EEG while listening to tones between 90Hz and 120Hz^[5,10], similar to the resonant sounds found at some Neolithic structures in Europe (England, Ireland, Italy, Malta, Turkey) as in the study by Ian Cook at the University of California (UCLA, 2008).



Fig. 1 – The adsorbing sound room and the devices during EEG research.

In second instance we searched another approach to volunteers by an imaging system able to value the emotional state of subjects during tones based on information on the integral parameters of head mobility obtained using a video analysis called TRV (Variable Resonance Imaging Camera) technology, which provides quantitative information of the periodic movements of any part of the body of imaged volunteer^[3,6].

The TRV image analyzer system is used to monitor vibrations in normal or altered physiological states. In a little square on the computer screen the image of the subject is shown using a spectrum of false colours, with a graph corresponding to the initial position. Any emotional state of examined subject produce a different vibration of the body not visible to a naked eye, but visible to TRV camera. The coordination of human movement depends on the emotional and physiological state of mind affected by various factors increasing or decreasing his stress conditions.

This system was developed by the secret services to test the emotional state of terrorist suspects under police interrogation. Furthermore this special technology is used by airport security staff to evaluate the emotional/stress condition

of passengers. Any subject planning a terrorist attack who is in a stressful condition, can be immediately identified by the red/orange colour painted on computer monitor by dedicated software around the subject taken by security video camera. We are the first research group who used this new technology for other purpose than security^[9].

This last method of research is at work but we have preliminary results which confirm EEG results.

II. EEG RESEARCH RESULTS

All of our 10 volunteers, 4 male and 6 female, were subjected to a "comfortable" volume of sound whilst in the absorbing sound room (see Fig. 1). This is used for audiometric tests at the Otorhinolaryngology Clinic and has been modified with suitable software and hardware. This type of room was also protected by a Faraday cage to shield from any possible external electromagnetic interference that could affect the results. After two minutes of silence to evaluate the resting brain rhythm, the volunteers were subjected to the tones of 90, 95, 100, 105, 110, 115, 120Hz arranged in a random way for one minute each. At the end of every cycle they listened to a mantra of the same frequency for a period of two minutes. Skilled technicians examined the EEGs to verify the data collected. They found there was a prevalence of frontal areas or occipital (posterior) areas with no predominance of one cerebral hemisphere (left of right) over the other during playing. Each volunteer had a different sensitivity to all the tones without one tone prevailing (i.e. 110Hz), with each exhibiting a strong response to a subjective and personal tone (i.e. 90Hz or 105Hz or 120Hz)^[5].

In the results obtained by Cook, Pajot and Leuchter the activity in the left temporal region was found to be significantly lower, closer to 110 Hz than other frequencies. Additionally, the pattern of asymmetric activity over the prefrontal cortex shifted from one of higher activity on the left at most frequencies to right-sided dominance at 110 Hz^[1].

Our results showed that each volunteer has their own individual frequency of activation that can be significantly different from 110Hz, but always between range of 90-120Hz.

Further those volunteers with a frontal lobe prevalence during the toning received ideas and thoughts similar to what happens during meditation, whilst those with an occipital lobe prevalence during the toning visualized images.

This could explain why in some ancient sites there are different chambers tuned to different resonant frequencies instead of 110Hz only. We think because also other frequencies are capable of activating emotional processing. Achieving this emotional state was an important component of ancient rites so that a real sense of mystical elevation. It is possible some areas of the brain are effected without the sound actually passing through the ear.

As a result of this study, the protocol has been modified introducing a series of questions for each volunteer following exposure to the tones (*Have you seen images? Have you*

interesting thoughts during the sounds? Did some frequencies disturb you?). Volunteers will also be invited to raise their arm if they received some sensations during a tone (left arm for images, right arm for thoughts) and a little pause (20 sec) will be inserted between each tone^[5].

During this investigation we observed that the exposure to these frequencies during meditation or prayer can create a brain activity response which differs depending on whether or not the volunteers are trained or not in meditation techniques. This lengthy research has yet to be concluded, but early results indicate that the aspect of brain waves measured by EEG are totally different^[9].

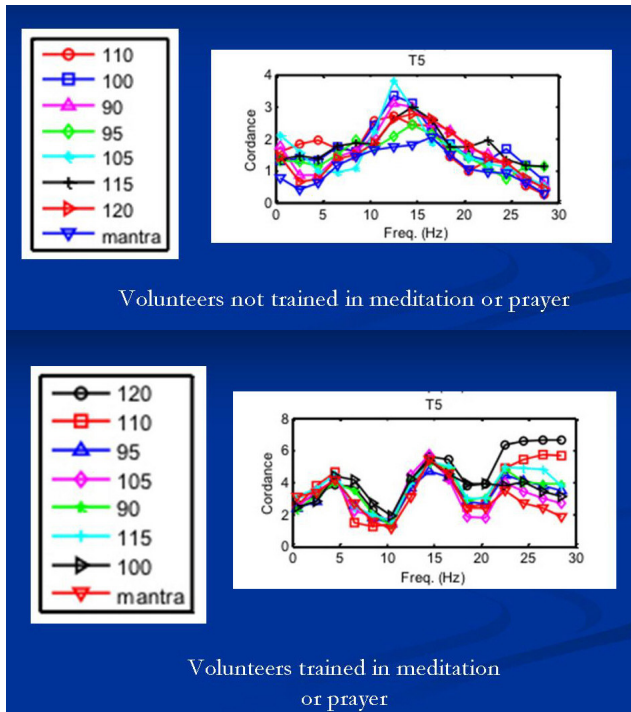


Fig. 2 – The EEG cordance aspect of different tones in the volunteers.

Above: the aspect in T5 electrode in a not trained volunteer in meditation or prayer. Below: the same electrode in a trained volunteer

In particular we can observe two or more peaks of brain wave frequency in some areas during the emission of tones between 70-140Hz, this is not usually possible under normal conditions. Usually, (but not with a pathology), such frequencies are found, i.e. during sleep, or another frequency, i.e. when we are awake, it is not ordinarily possible therefore for two frequencies to be experienced contemporary, (i.e. to be asleep and awake at the same time). However these results showed this is possible if the volunteer is trained in meditation or prayer techniques and is exposed to particular tones. This creates an oneiric experience (one of visions or ideas) with total consciousness but without the use of chemical substances^[9].

In the research at work we examined the same group of volunteers in the underground structure of Cividale del Friuli hypogeum, a very ancient structure connected with Great Mother's cult and located in North Italy, using a portable EEG

(see Fig.3). The volunteers were subjected to the resonance frequencies present, theoretically making a comparative assessment with our laboratory study. The structure were stimulated in the different chambers by a Irish (or shamanic) drum and recorded on EEG the brain behaviour. In Cividale del Friuli hypogeum there are for example two chambers with different resonant frequencies. The other 4 chambers have been modified over the centuries it is therefore not possible to say with any certainty if these too had different or a similar range of resonance. Also Jahn and his collaborators found different frequencies of resonance in different temples in England and Ireland, often in different chambers of the same temple^[10]. Such frequencies create strong emotions in people during rituals.



Fig 3 - The underground structure of Cividale del Friuli hypogeum during EEG research. The stimulation of the resonance was obtained by a shamanic drum.

III. TRV CAMERA RESULTS

TRV technology (Variable Resonance Imaging Camera) is something we have been working with over the last three years^[3,6]. The TRV system's camera has a common CCD backlit, with a three MegaPixel sensor. The protective anti-aliasing filter was removed to extend its vision beyond visible light into the infrared (IR) and ultraviolet (UV) range. It has a system of rotating LEDs from infrared to visible light which generates ultraviolet light and synchronises it to the lights rotation at will from 1 Hz to 10 KHz. The lens is a 25 mm quartz-fluorite with passband from 200nm to 1800nm. It is connected to a PC, but videos can also be saved to internal flash memory (see Fig. 4).

We utilised a TRV camera and software derived by Russian technology, the same used at Sochi Winter Olympic Games in 2014 (known as the Defender System X in Japan and Merlin Camera in Italy) which analysed almost 2,500,000 people before they entered the venues. It was deemed a real success, because no terrorist attack occurred.



Fig. 4 – The digital camera of TRV system used in Cividale del Friuli hypogeum.

The TRV cameras software makes clear immediately the emotional state of the volunteer, in fact human vibrations from 1Hz to 10Hz are pointed out by the colour and extension (Fig.5).

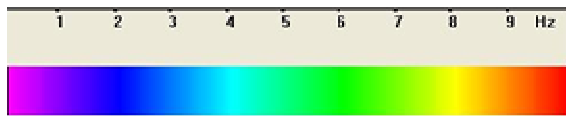


Fig. 5 - Images converted to a scale of pseudo colours in relation to the frequency in Hz of the human body.

We used this method in the archaeoacoustic field in Italy in the site of Alatri^[6] and in Cividale del Friuli hypogeum^[2,3,4]. In the second site we found a natural vibration of geological origin coming from subsoil affecting mind. We found this by traditional archaeoacoustic method (digital recorders and ultra-sensitive microphones). Normally low frequencies can affect mind because interfering with brain wave which have a low frequency of movement. We also must remember that brain activity is not only electric, but also magnetic, so also magnetic fields who very frequently match geological vibrations can modify the state of mind.

For example in Cividale del Friuli (Italy) hypogeum, the TRV system recorded perfectly the transition to an altered state of consciousness of the volunteer, which occurred when the entire chamber began to vibrate at the same frequency as the subjects during chanting. Initially this was captured by the camera and software as a transition to one color, until the image of the person in the foreground totally disappeared, indicative that the frequencies moved from a broad range to a narrower range^[6].

In Cividale del Friuli hypogeum this altered state of consciousness was achieved by simply repeating a mantra for approximately 8 minutes, as documented by an audio recording which taken at the same time. Ultimately the male voice or percussion instruments tuned on the right resonance

frequency confirm by TRV camera that a "mystical" state can be reached after a few minutes by those who are subjected to the resonance phenomenon inside the hypogeum chambers^[6].



Fig. 6 – A volunteer in Cividale del Friuli hypogeum. The blue band around the body indicates the very low frequency of the body which means a very deep state of relaxation of the mind (between 1-2Hz).



Fig. 7 – By TRV camera it is possible to value the stress condition of everyone. This child is on the top of Alatri acropolis and the vibrations coming from below make the subject relaxed. She looks a medium state of relaxation because not in meditation (4-5Hz).

Also this method confirmed that the sound at particularly frequencies, but in the range of 70-140Hz can change the state of mind moving the human brain in different level of consciousness. And also this method express the concept that only the people trained to meditation and prayer take advantage from the resonance of these temples.

IV. CONCLUSIONS

Our research demonstrates the real effect of resonance, found in ancient temples, on the human body.

Archaeoacoustics is an interesting method of analysing ancient sites to re-discover a forgotten technique that effects the emotional sphere of human consciousness.

In six years of research using new technologies we are along way from any definitive conclusions. Despite amazing results we need to study more deeply the relationship between ancient sites and people who spend some time inside them. We understood that ancient civilizations did not build everywhere their temples, but in particular locations where natural physical phenomena were able to modify the state of conscience of the people during a ritual. New technologies together well known methods, i.e. EEG, showed this in our studies. We can say through our technologies and methods ancient populations have a good knowledge human brain, empiric for sure, but effective.

But we have to underline that only trained people can take advantage from being in these temple in presence of right tones. Both methods evidenced this. So we can conclude that these temple were only for "initiated" people or priests, like the historical sources wrote.

However we also can conclude imaging technologies open new roads for better understanding this aspect by researchers in archaeoacoustic field. Archaeoacoustics should therefore not only consider analyzing the acoustic properties of the site, but also all the associated physical phenomena which is not perceived by the ears which could potentially influence a population and their perception of a particular site as being sacred. Using such technologies, we observed a change of emotional state in various volunteers after they remained for some time in sacred sites especially by vibration, audible (as a chant or a drum) in particular in connection with resonance phenomenon or not audible (natural infrasounds, ultrasounds). So it looks that mechanical vibrations are only one aspect of the possibility for affecting human mind, because also magnetic fields can affect human mind. So we can also say without studying the relationship between environment and human mind the study in archaeoacoustics appears somewhat limited. In our researches we demonstrated that some physical phenomena (vibrations, magnetic fields) present at such sites, can influence brain activity^[7]. To analyze altered states of consciousness at particular locations, we suggest to use musical instruments or the voice re-creating original ancient environmental situation for stimulating the resonance whilst volunteers were monitored using electroencephalography (EEG)^[5,9] and TRV camera^[3,6,9]. We also have to consider we cannot use both methods in the same moment, because one interferes with the other for electric and magnetic reason. But it

is also necessary a deep archaeological analysis of the site, because archaeoacoustics without an archaeological background is only acoustic.

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REFERENCES

- [1] Cook, I. A.; Pajot, S. K.; Leuchter, A. F., "Ancient Architectural Acoustic Resonance Patterns and Regional Brain Activity", *Time and Mind*, Volume 1, Number 1, March 2008, pp. 95-104 (10).
- [2] P. Debertolis, N. Bisconti: "Archaeoacoustics analysis and ceremonial customs in an ancient hypogeum", *Sociology Study*, Vol.3 no.10, October 2013, pp. 803-814.
- [3] P. Debertolis, Gullà D, Richeldi F, "Archaeoacoustic analysis of an ancient hypogeum using new TRV camera (Variable Resonance Camera) technology", *Proceedings of the "2nd International Virtual Conference on Advanced Scientific Results" (SCIECONF 2014)*, Žilina (Slovakia) June, 9 - 13, 2014, pp. 323-329.
- [4] P. Debertolis, N. Bisconti: "Archaeoacoustics analysis of an ancient hypogeum in Italy", *Proceedings of the Conference "Archaeoacoustics: The Archaeology of Sound"*, Malta, February 19-22, 2014, pp. 131-139.
- [5] P. Debertolis, G. Tirelli, F. Monti: "Systems of acoustic resonance in ancient sites and related brain activity". *Proceedings of Conference "Archaeoacoustics: The Archaeology of Sound"*, Malta, February 19-22, 2014, pp. 59-65.
- [6] P. Debertolis, D. Gullà: "Archaeoacoustic analysis of the ancient town of Alatri in Italy", *British Journal of Interdisciplinary science*, September, Vol. 2, (3), 2015, pp. 1-29.
- [7] P. Debertolis, M. Zivic: "Archaeoacoustic analysis of Cybele's temple, Roman Imperial Palace of Felix Romuliana, Serbia", *Journal of Anthropology and Archaeology*, Vol. 3 (2), 2015, pp. 1-19.
- [8] P. Debertolis, D. Gullà: "Anthropological analysis of human body emissions using new photographic technologies. A study confirming ancient perceptions in Art History", of the "3rd International Virtual Conference on Advanced Scientific Results" (SCIECONF 2015), Žilina (Slovakia) May, 25-29, 2015, pp. 162-168.
- [9] P. Debertolis, D. Gullà: "New Technologies of Analysis in Archaeoacoustics ", *Proceedings of Conference "Archaeoacoustics II: The Archaeology of Sound"*, Istanbul (Turkey), Oct 30-31 Nov 1, 2015, pp. 33-50.
- [10] R.G. Jahn, P. Devereux, M. Ibson: "Acoustical Resonances of Assorted Ancient Structures," *J. Acoust. Am Soc* Vol.99 No.2, February 1996 pp.649-658.

* Note. Super Brain Research Group (SBRG) is an international and interdisciplinary project team of research (Italian, Croatian and Finish members) on archaeo-acoustic of ancient sites and temple in Europe (Official web site: <http://www.sbresearchgoup.eu>).