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by Simone Vitale © February 2017

A device that translates electrical signals into sound opens up exciting paths of communication between plants and humans.

That Ringing in My Ears

Rome, September 2007 — I was taking part in an holistic wellbeing fair. While spending time at my stand and promoting sound healing and Tibetan singing bowls, I kept hearing this ringing, jingling sound in the background, not really giving it too much attention but still noticing its persistent presence.

During one of my walks around the place, I finally identified the source of that sound: the stand of the Damanhur Federation of Communities, a thriving spiritual eco-community located in the northwest of Italy. The young woman at the stand was explaining to a group of intrigued people that the music they could hear was coming from a device connected to the plant they could

see before their eyes, and that the plant itself was actually "playing" the music.

Totally fascinated, I patiently waited for the group to move somewhere else and then started a conversation with her. She introduced me to the basic principles of the Music of the Plants. We ended up becoming friends, and a few months later we were performing together on stage at a festival called La Città Olistica (The Holistic City) in Rome: two women doing contact improvisation, the plant with the U1 device, and myself on piano.

That's how it all started for me.

During the rehearsal of the performance, I had my chance to overcome my scepticism about the idea that plants can create music intentionally. I had found the



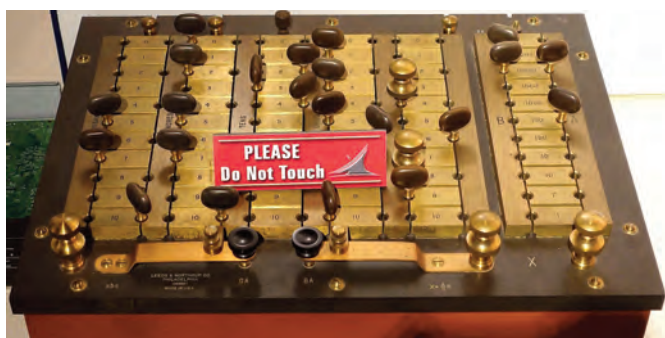
Citizens of the Damanhur Federation of Communities, photographed in 2011. (Photo: Flickr.com)

concept and the technical process of transducing electrical signals from the plants into a MIDI (Musical Instrument Digital Interface) signal ingenious and clever. But it was difficult to assimilate that in the end the music was not just a random outcome of this electrical connection; rather, a sort of "awareness" of the plant was also involved. This is what the Damanhur researchers (the developers of the U1 device for the Music of the Plants) discovered in their 40 years of investigation: that after some time of being exposed to their own sounds, plants seem to become aware that the sound is coming from them and they start modulating it intentionally.

A Musical Instrument for Plants

The U1 device is based on a variation of the Wheatstone bridge, where one or more fixed resistances and a variable one are used to measure variations of impedance (electrical resistance). In the case of the U1, what is being measured is the electrical resistance in the living tissues of plants. These variations can then be translated into a variety of different signals, including MIDI for digital musical instruments such as synthesisers.

Fluctuations in the electrical potential of tissues can be measured in every living being. In animals and humans,



This example of a Wheatstone bridge is from the Leeds & Northrup Company, Philadelphia, c. late 1800s. (Photo: National Electronics Museum, Maryland, USA)

these can also be related to different emotional states.

The Music of the Plants project aims at investigating, in an artistic way, the reactivity of plants to their environment and their ability to communicate and learn.

This research has not yet entered mainstream scientific investigation, so all the information available is offered by communities and individuals that, like myself, can see the meaning in terms of ethical, ecological and spiritual awareness. We can improve our relationship with our environment by understanding the presence of something we can call "consciousness" in plants.

In preparing for that first performance in Rome, I found myself spending hours playing piano together with a plant, and I was witnessing the slow development of the process. The subtle changes in the plant's music in response to the sound of the piano and its own sound were becoming more and more evident to me.

After the performance, I borrowed the U1 device from my friend to use for some time. At home I kept it connected to an *Anthurium andraeanum* for hours, listening to its music and how it changed during the day. This whole experience sparked an interest in me to understand a little more the mysterious world of plants' perception and inner life.

I have never been the kind of person who sees plants as unconscious beings (I believe that consciousness is present in everything: stones, water, soil, etc.). At the same time, I was not aware of how much knowledge is already available on the perception of and even communication with plants. I am talking here about scientific knowledge.

Of course, communication with plants has been part of the life of gifted people and shamans since the dawn of time, as well as a completely ordinary fact for plant lovers and people with a green thumb. These people know at an intuitive level that you should always talk and sing to plants and they will respond positively.

Do Plants Hear?

Plants have their own senses. Some of these can be compared to all five human senses. In addition to these, plants have some 15 other senses that are unique to the vegetal world, e.g., plants can "sense gravity and magnetic fields (which influence their growth), and can recognize and measure numerous chemical gradients in the air or in the ground".¹

The idea that plants' way of playing music changes over time when they are exposed to the sounds they are making through the U1 device may make sense from a scientific point of view. In fact, it has been suggested that plants have their own way of perceiving sound vibrations.

Studies indicate the following findings:

"There is a strong relationship between sound waves and plant growth. Sound waves with specific frequencies and intensities have been shown to have significant effects on a variety of biological, biochemical, and physiological activities including gene expression in plants. However, sound waves with high frequency and intensity can be harmful to the proper growth and development of plants."²

"The contents of soluble sugar, protein, and the amylase activity in chrysanthemum increased significantly in response to sound waves with certain intensities (100 dB) and frequencies (1,000 Hz) which indicated that sound stimulation could enhance the metabolism of roots and the growth of *Chrysanthemum* (Yi, 2003b)."³

"The effects of music to improve crop yield and quality have been reported in tomato plants, barley and other vegetables (Hou and Mooneyham, 1999; Spillane, 1991; Xiao, 1990). Weinberger and Measures (1979) reported the effects of intensity in audible sound on the growth and development of Rideau winter wheat.

The authors concluded that the vegetative growth response of winter wheat to audible sound was mainly dependent upon both frequency and intensity."⁴

Plants seem to react to vibrations coming from insects and other plants:

"The ability of plants to increase their defenses in response to micrometer-scale vibrations lends support to recent hypotheses that plants can detect and respond to low-amplitude vibrations produced by neighboring plants (Gagliano et al. 2012a, b, Gagliano and Renton 2013)."⁵

"A vibration signaling pathway would complement the known signaling pathways that rely on phloem-borne signals, airborne volatiles, or electrical signals (Wu and Baldwin 2009; Mousavi et al. 2013)."⁶

The roots of the plants seem to be sensitive to a

broader range of frequencies than the parts above the ground. They also produce a "clicking" sound, most probably as a by-product of their growth. Putting together the facts that the roots of a plant both produce and perceive sound, we unveil a whole new scenario in our understanding of the communication network that exists underground. Sounds seem to be definitely within the range of plants' communication skills.

Can We Talk about "Plant Consciousness"?

If we consider "intelligence" as the ability to solve problems and learn from experience, then plants are definitely intelligent. But are they "conscious" in the way they respond to the environment?

From a scientific point of view, even the word "response" sounds heretical when applied to plants. In 1901, following the presentation of one of his works, the brilliant Indian scientist Sir Jagadis Chandra Bose (who produced an incredible amount of forward-thinking research and inventions) was put down by Sir John



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Burdon-Sanderson, the authority on electrophysiology at that time. The point was that Bose, a physicist, had used the words "Electrical Response in..." in the title. Burdon-Sanderson wanted him to change those words to "Certain Physical Reactions in...", simply because the word "Response" pertains to the domain of physiology rather than physics. For this reason, the Royal Society did not follow up on its intention to publish Bose's work.⁷

In 2005, more than a century later, the Society for Plant Neurobiology was founded following The First Symposium on Plant Neurobiology. This new field aims to "understand how plants perceive, recall and process experience, coordinating behavioural responses via integrated information networks that include molecular, chemical and electrical levels of signalling".⁸ The Society's choice of the term "neurobiology" in relation



Plants form bonds with the people who take care of them.

to plants was so controversial as to cause strong reaction in the official scientific world—so much so that it changed its name to the Society of Plant Signaling and Behavior.

This is exactly the shortcoming of our modern knowledge: everything is separated into different fields, each one with its terminologies and each one with its dogmas. We are able to reach high peaks sometimes in one field or another, but we often miss what that means in the big picture. However, we are currently witnessing the re-awakening of that holistic thinking typical of the ancient wisdom. The separate paths of science and spirituality are now joining again, a reconciliation that will bring about a much-needed leap in our thinking process.

As Paco Calvo, Professor of the Philosophy of Science at the University of Murcia, Spain, states in "The Philosophy of Plant Neurobiology: A Manifesto":

"Plant neurobiology has taught us that plants have an internal system for organizing sets of behaviors that is functionally similar to the animal nervous system. We can, therefore, approach plant behavior and neurobiology from the point of view of ecological psychology, and analyze the plant-environment system as a whole whose behavior emerges and self-organizes at a particular scale of interaction, the one mandated by ecology. (This may be one reason why plant intelligence has been neglected for so long, but time-lapse photography has evidenced the contrary.) Consistent with this approach, plants may well perceive opportunities for behavioral interaction in the form of affordances."⁹

The classic book *The Secret Life of Plants* is a good source of information on unusual and fascinating experiments and research on the consciousness of plants.¹⁰ In a time frame spanning from the mid-1950s to the late 1970s, there was a booming interest in the understanding of plant consciousness. Unfortunately, our scientific investigation modality shows all its primitiveness when the only thing that people can come up with is to threaten or hurt living beings to observe their reactions.

In the mid-1960s, polygraph examiner Cleve Backster first observed the astounding reactions of different plants

when subjected to threatening intentions and behaviours. The plants would "pass out", showing no sign of the electrical activity that was being detected by instruments made of a galvanometer used in conjunction with a Wheatstone bridge and very similar to the polygraph used in lie detection. Using this system, Backster was able to observe behaviour in plants, such as detecting the intentions of people in the room, reacting to threatening intentions or behaviour and even reacting with shock when another life form was hurt in their vicinity. Luckily, not all his experiments involved violence. He also researched how plants are connected to their carers at a distance. Plants seem to create a sort of bond with the persons who take care of them, a connection that goes beyond physical distance, as some of Backster's experiments seem to prove.

From the mid-1950s, research chemist Marcel Vogel experimented more in the direction of psychic energy. He was able to observe how plants react to the projection of negative and positive thoughts towards them.

Electronics specialist Pierre Paul Sauvin conducted an even more peculiar experiment. He used a toy train to create a mechanism that would give him a considerable electric shock at the end of the train's course. He then connected a plant to a switch by which the train direction could be reversed. After receiving a first shock, Sauvin ran the train again, this time anticipating the pain of the electric shock. He reported that the plant was able to detect his anxiety and reacted by switching the direction of the train.

In Japan, Dr Ken Hashimoto, an expert in lie detection, was a pioneer in transducing these electrical signals that the polygraph can read from a plant into sounds. He and his wife reportedly created a connection with some of



Not only do plants learn, memorise and communicate, they also make decisions and solve complex problems.

their plants, in particular a cactus that they were able to teach to count numbers. I believe that this last instance has more to do with a deep connection between the minds of the Hashimotos and the plant, rather than with an awareness of numbers by the plant.

Whatever this all means in terms of scientific research, it is obvious that plants are highly intelligent beings. Having no brain, in the animal sense, they work on a modular basis, being able to lose about 90 per cent of their bodies and still survive. They have been able to transform the surface of the Earth, making it suitable to host millions of other life forms (including us humans) through a process that, although perfectly explainable on a dry scientific level, actually is closer to magic and miracle than anything else I can think of. They make more than 90 per cent of the biomass of the planet, a fact that should earn them the title of "dominating species" on the Earth (which, in fact, they are).

Plants have senses that resemble those of animals. In fact, plants can "see", "feel", "smell" and "taste" and, as we have seen, it is not outrageous to think that they can "hear" as well. Plants even present what in psychology is called "procedural memory", the kind of memory that allows us to perform automatic actions without thinking about all the single operations involved in the process. As of yet, there is no practical evidence of "semantic" and "episodic" memory in plants, but it is not possible to say what future research may discover.

When attacked by an insect, they are able to summon the enemy of that insect as a reinforcement.

As Professor Calvo writes:

"The list of plant competencies has been growing at a considerable pace in recent years. Plants can, not only learn and memorize, but also make decisions and solve complex problems. They can sample and integrate in real time many different biotic and abiotic parameters, such as humidity, light, gravity, temperature, nutrient patches and microorganisms in the soil, and many more, courtesy of a highly sophisticated sensorimotor system (Hodge, 2009; Trewavas, 2009; Baluška and Mancuso, 2013) that includes proprioception (Bastien et al., 2013; Dumais, 2013), with sensory information being transduced via a number of modalities. Furthermore, plants can anticipate competition for resources, growing differentially depending upon the future acquisition of minerals and water (Novoplansky, 2015). Plants also exhibit self-recognition and territoriality (Schenk et al., 1999), being able to tell apart own from alien, directing their movements towards their targets of interest (Gruntman & Novoplansky, 2004). Plants can communicate aurally (via released volatile organic



Chemical signals released by plants under attack by predators warn other plants to be alert to danger.

compounds—VOCs—Dicke et al., 2003; Baldwin et al., 2006) with members of their own kind and with members of other species. They can even communicate bioacoustically, making and perceiving 'clicking' noises (Gagliano et al., 2012). Some plants can tell vibrations caused by predators apart from innocuous ones (wind or the chirps of insects), eliciting chemical defenses selectively (Appel and Cocroft, 2014). In a sense, plants can see, smell, hear, and feel (Chamovitz, 2012)."¹¹

One of the most obvious differences between the behaviour of plants and that of animals and insects is the time scale. The plant world moves at a much slower pace. Since the invention of time-lapse cameras, we have been able to observe plant life at a more comprehensible speed for us. This has allowed us to realise that they act pretty much like animals in their search for food. Their roots roam the under soil quickly and largely until they find nutrients, to then stop there for some time, as animals do.

Interspecies Communication

It is a matter of fact that plants communicate with their environment. Plants such as tobacco, corn, tomato and lima bean (to name just a few) can communicate with other species as well. When attacked by an insect, they are able to summon the enemy of that insect as a reinforcement. Plants are able to understand when contact with another organism needs to be met with defence and counterattack or when it represents an opportunity for symbiosis.

They are able to understand when contact with another organism needs to be met with defence and counterattack or when it represents an opportunity for symbiosis. For instance, a tree that is attacked by

caterpillars releases airborne chemicals that can be detected by neighbouring trees which will then start producing chemicals toxic to the caterpillars.

The presence of neurotransmitters such as serotonin, dopamine and glutamate has been observed in plants, although their function is not yet clear. Lactose and myosin, molecules that allow animal muscle cells to move, have been found in an area close to the tip of the roots, which is considered the "brain" of plants. The roots also show a high level of electrical activity. According to Stefano Mancuso and Alessandra Viola in *Brilliant Green: The Surprising History and Science of Plant Intelligence*:

"Darwin was the first to notice that the root tip is a sophisticated sense organ capable of registering and reacting to different parameters... Thus, Darwin formulated what a century later would become known as the 'root-brain hypothesis'..."¹²

"Darwin wrote and affirmed several times that he considered plants to be the most extraordinary living things he had ever encountered..."¹³

The Music of the Plants provides a fascinating new field of exploration and research around the topic of plant consciousness. On the one hand, hearing sounds produced by a plant offers a direct feedback of the state of the plant in its environment, something that anyone who has a beloved plant can enjoy. On the other hand, it allows musicians and music lovers to deepen their ability to listen. When one engages in a musical dialogue with a plant, one enters a different level of awareness—or, I should say, "one should enter" for the dialogue even to take place.

I have improvised music countless times in my life, alone and with other musicians. I am far too used to the human response to a call or to respond in a human way



Simone Vitale, playing the anantar (koto-tampura), makes music with a *Crassula ovata* (jade) plant connected to his U1 device.

to a call. But when I sit close to a plant with one of my instruments, my experience in this regard is not really useful. With a plant, I need to allow myself to slow down, first of all in my mind, and sink deeper, tuning to a different time scale.

When I am sitting there, I need to open a different space to allow myself to perceive the interaction. And when the signal comes, it often comes in a different way than I expected. If I am not fully present and attentive, I will miss it. I will miss the opportunity to learn more about communication, more about life. And when I do catch that moment, then I feel very grateful for everything I can learn in that glimpse of deeper connection.

As journalist-activist Professor Michael Pollan puts it in the foreword of Mancuso and Viola's *Brilliant Green*:

"Most people who bother to think about plants at all tend to regard them as the mute, immobile furniture of our world—useful enough, and generally attractive, but obviously second-class citizens in the republic of life on Earth. It takes a leap of imagination over the high fence of our self-regard to recognize not only our utter dependence on plants, but also the fact that they are considerably less passive than they appear, and in fact are wily protagonists in the drama of their own lives—and ours."¹⁴ ∞

About the Author:

Simone Vitale is a visionary musician, composer and sound healer. His work is dedicated to promoting an ecology of sound and music where kindness and mindfulness are the keys to a deeper connection with ourselves and each other.

In his project The Sound of Golden Light, Vitale is following the call for a more ethical approach to Art. His deep understanding of the effects of sound and music on the body, mind and soul is offered for the higher

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An *Ocimum tenuiflorum* (tulsi) plant is hooked up during one of Simone Vitale's recording sessions.

Music of the Plants

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purpose of contributing to a reconnection with Nature at a time when this is urgently needed. His project presents a transformational, uplifting and heart-opening musical experience grounded in a well-researched and competent use of frequencies and harmonies.

Originally from Rome, Italy, Vitale is currently based in Auckland, New Zealand, after spending four years in Berlin, Germany. He has been sharing his work since 2012 in India (Kerala, Tamil Nadu), Germany, Estonia, Finland and New Zealand. His article "432 Hz: Towards a New Standard Concert Pitch" was published in NEXUS vol. 23, no. 6 (October–November 2016).

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