

VISION AND CONSCIOUSNESS IN PLANTS
Some Thoughts on the Recent Studies of Plant Neurobiologists

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Our tight co-evolution and the reliance of humans on plants to provide food, medicines, and recreational drugs might raise the question of who actually domesticated whom. Baluska and Mancuso

When I was researching the book that my publisher ultimately titled *Plant Intelligence and the Imaginal Realm* (authors rarely get to title their books) I ran across the work of Frantisek Baluska and Anthony Trewavas who are leading lights in the field of plant neurobiology. They, in fact, focus much of their work on plant intelligence and are quite unremitting in their poignant gentlemanly attacks on those they term “brain chauvinists.” I found them and their work to be some of the most exciting research I have had the pleasure to read.

After my book came out, I received a warm email from Baluska about the book and how much he liked it. Recently he wrote again, sending me links to five newer articles he had cowritten with other plant neurobiologists and researchers. I want to mention the rather mind-bending material in one of them but first I will list all five that he sent me as I think them all worth a read, especially for the quite fascinating insights they contain.

The articles are: Baluska and Mancuso. Plants, climate, and humans (*Science and Society*, EMBO Reports 21:e50109, 2020); Trewavas, Baluska, Mancuso, Calvo. Consciousness facilitates plant behavior (*Trends in Plant Science* 2019, prepress, thus no month, volume or

number on my copy); Yokawa, Kagenishi, Baluska. Anesthetics, anesthesia, and plants (*Trends in Plant Science*, January 2019, vol 24, no. 1); Baluska and Reber, Sentience and consciousness in single cells: how the first minds emerged in unicellular species (*BioEssays* 2019, 41, 1800229); and the final one, which I will talk about a bit here, Baluska and Mancuso, Vision in Plants via Plant-Specific Ocelli (*Trends in Plant Science*, September 2016, vol 21, no. 9). Just a note: if you can't access these through google scholar, you can certainly find what is called the doi number, which is almost always listed on the abstracts of the articles and then you can access the article you want through sci-hub (google it). Just type in the doi number on that site and there you go.

The article on vision in plants is not long but it is rather exceptional. *Ocelli*, defined, are considered to be simple eyes or eye spots, which some life forms have instead of what we consider proper eyes to be, and which can perceive movement but nothing else. Baluska and Mancuso do a good job of bringing that simple belief into question, showing that in fact plants possess a rather remarkable capacity for vision in just the way we think of it, that in fact *ocelli* on the surface of plant leaves actually see the world in much the same way we do. (Which brings up the uncomfortable thought that when we eat plant leaves we are eating plant eyeballs.) They relate a rather remarkable story as an example.

The plant *Boquilla trifoliolata* is a climbing wood vine, sometimes referred to as the chameleon vine. When the plant climbs a tree, as the authors note, it modifies “the appearance of its leaves according to the host plant, perfectly mimicking the colours, shapes, sizes, orientations, and petiole lengths of the leaves.” That is, it changes its leaves to look *exactly* like the leaves on the plant it is using as a trellis – irrespective of what shape or color those leaves might have.

If the plant should send out three vines (from a common root) that climb three different species of tree, each vine will mimic the leaves on its particular tree. In fact, no matter what tree the plant climbs, the vine can mimic its leaves. As the authors then comment, this indicates “some kind of plant-specific vision (perception of body shapes of neighboring plants) via a specific sensory system capable not only of sensing but also of decoding projected images.” *B. trifoliolata* can also exactly mimic the leaves of trees it has not yet touched, clearly showing the capacity for utilizing visual inputs alone to alter form.

A great many reductionists fall back on statements like GENETICS! (similar to our ancestors saying the gods did it or that unbalanced humors caused the disease), e.g. Daniel Dennet’s (often mimicked) comments that such behaviors “are nothing more than the blind actions of genetic programs that spin themselves out without awareness or other internal subjective states.” (My initial response to that is “prove it.” But of course the proponents of this perspective cannot. These assertions are simply examples of a religious commitment to a stubborn belief in human superiority which of course does not have to be proved.)

A new generation of researchers, no longer wedded to outmoded 19th and early 20th century biases, have immersed themselves in the new field of plant neurobiology. They are extremely articulate and very clever writers (making them a joy to read) and continually irritate their more mechanical colleagues by accusing them of “brain chauvinism.” (Trewavas is particularly humorous.) In their typical understated manner, Baluska and Reber comment, “We find it interesting that evolutionary biologists, psychologists, philosophers are all comfortable with the notion that the bio-physical elements of life appeared just once but that, somehow, are uncomfortable with the notion that mental elements accompanied them.”

The inaccurate picture of the world that plant neurobiologists (and many others) are struggling to overcome came first out of christianist beliefs in the supremacy of human beings as the only extant life form that possessed a soul – specifically, it's the belief that people were of a different order than all other living beings on this planet. Scientists (one of the most powerful of the protestant sects) incorporated nearly all the underlying christianist beliefs, including the belief that *Homo sapiens* were superior to all other life forms. The former worships a monotheist God, the latter worships Science (another kind of monotheistic god) which focuses not on the soul (they could not find it during autopsies) but on consciousness and brain size and the ability to reason (I think therefore I am). Still . . . looking over the behavior of human beings through historical time, I am pretty sure that people are not exactly rational beings but rather rationalizing organisms. (I think therefore I rationalize.) Or perhaps, even better, semi-hairless primates with delusions of grandeur. (A sense of humor helps.)

Many of the difficulties we now face are in fact coming from an inaccurate view of the natural world (which includes both our exceptionalist and exemptionalist beliefs) rubbing up against reality, that is, the ecological truths, interactions, and limits that govern the behavior of all life on this planet. Sooner or later we are going to have to have the courage to face what Earth is telling us – a primary element of which is that all life on this planet is intelligent and has its place in the ecological fabric that supports the continued existence of life here. Otherwise we risk the rise of pathogens and Earth events far more dangerous than the current coronavirus

One of the great truths of life is that the Universe has a way of humbling arrogance. Most of us learn as we age – quite often through bitter experience – about the cosmic 2x4. The longer the humbling is put off – almost always through denial – the worse the blow when it comes.