

The Dignity of the Lima Bean

Julia Kospach, Viennese journalist and author of several books on gardening, interviewed Florianne Koechlin in early 2009.

“Do plants have rights?” asks the Swiss biologist and chemist Florianne Koechlin, and concludes that: yes, they do. And they have dignity too. A conversation about the newest research on plants that suggests we must revise our picture of plants as living machines. For plants communicate, interpret, learn from experience and remember (their roots can distinguish between themselves and others).

Do plants have dignity, Ms Koechlin?

“Dignity” seems so religious and human-oriented. But it can also just be a sign that other living beings – animal or plant – have a value for which they must be respected.

Is that what is most important to you?

That is the main theme of my new book „PflanzenPalaver“ (“Plant Chat”). I observed that people and partly also animals have escaped from the mechanistic trap, and are no longer considered as living machines that react in a predetermined way to inputs and environmental influences. And it is also true for plants, that they’re active, have a ‘self,’ can adapt, interpret and plan.

Where does this information come from?

Above all from molecular and cell biology. In the past 20 years people have discovered an incredible amount and see that plants, animals and we people are much more similar than we thought before. That is probably not so surprising, if we think about evolution. Plants, animals and people have the same single-celled protozoa as our ancestors, which developed over three billion years. Compared to that, plants and animals that have existed since 300 to 400 million years seem relatively young.

Giving us so to speak the same cellular ancestry on the cellular level?

At the cell level there are surprisingly many similarities. No one expected that. We find in plant cells the same neurotransmitters and the same potential for action in passing information as in animal cells. Plants have an immune system, and plant roots can differentiate between themselves and others; something that is normally considered to be a sign of brain activity.

How does that work?

Science isn’t very sure about that either. There are some experiments, for example with pea plants. There you can see that the roots of a pea plant don’t compete with each other. They search in different directions, as they are from the same plant and are all looking for the same plant nutrients.

That’s fine, but do they compete with the roots of other plants?

Exactly. If this pea plant is split into two halves that are genetically the same, then after a fairly short time the roots of one half grow into the areas of the other half – as if the plant knew quickly that it is not ,herself’ anymore, but an other. That’s where we are, and scientists also think that this identification process functions too quickly to be simply genetically determined.

The communication genius in the plant world seems to be the lima bean.

Probably other plants communicate as much and as variably through scents as the lima bean. In any case this bean has been well researched.

Over what and with whom do they communicate then?

The lima bean not only knows that she has been attacked by a harmful insect, but also by which one. She tastes it in its spit. If she is attacked by spider mites she produces a scent that lures predatory mites. For caterpillar attacks, she produces a slightly different one, which attracts parasitic wasps that eventually kill the caterpillars. She basically calls on the appropriate bodyguard – according to what's eating her. Isn't that fantastic?

Critics would say that the lima bean doesn't know the difference between the caterpillar and the mite. Their reaction is a reflex to a chemical procedure.

When I say she „knows,“ I mean it of course as a metaphor. But the big question is still: are plants just exchanging information based on reflexes, or are they really communicating, are they taking action? I've talked about these questions with the Salzburg scientist Günther Witzany, who is active in the field of biosemiotics. He has spent a lot of time on this question and says that the plants really do communicate.

An example?

If a tomato is attacked by caterpillars, she produces toxins, but also scents, namely methyl jasmonate, which warns the other parts of the plant and neighboring plants that danger is approaching. The neighbors then begin producing toxins too.

So the art of communication between plants lies less in the defensive reaction than in informing other plant parts and neighbors?

Both are needed. The neighbor of the tomato under attack always lives in a cloud of many different scent molecules. Now these methyl jasmonate ones are there too. First she must recognize them. Then she must interpret, that in this situation these molecules mean danger, and finally she must react, by producing toxins. She must become active. That goes far beyond the simple signal exchange – it is true communication.

In addition, the researcher in Jena, Wilhelm Boland, told me that methyl jasmonate can have completely different effects and meanings in different locations and contexts – and even in the same plant.

However the main opposing argument is still that despite their highly developed reflexes, these all take place below the state of consciousness.

I don't claim that plants have a consciousness. We don't know that. However there are different levels in capacities to learn, to remember, to perceive or to be conscious, and how much is present in plants remains a puzzle.

And what does consciousness mean anyway? Meanwhile, nobody questions anymore that chimpanzees are conscious. The boundaries are melting away on all levels.

And the boundaries between animal and plant worlds are also fluid. You give the example of a jellyfish, which doesn't have a brain.

Generally it is said: animals have a brain and plants don't. But there are transitional life forms that lie somewhere in the middle. Jellyfish, for example, have a kind of nervous system, but no central brain. So it's like they have a diffuse command region. I visited the scientists Frantisek Baluska and Dieter Volkmann at the University of Bonn. They say: Maybe plants have structures that can be compared to a

nervous system. Plants communicate with electrical signals – so-called action potentials – like our nerve cells. So maybe plants have structures analogous to our nerves, but do not need nerve cells. Their tissue is – unlike tissue from humans or animals – regularly structured. You find cell tubes that are on top of each other, either vertical or horizontal, so the electrical signals can be conducted along these tubes. We humans need extra nerve cells, because we have such a muddle of cells.

They suppose that plants have a kind of decentralized command region which can perceive signals from outside and answer them accordingly. That way they can face new and unpredictable situations, which is absolutely essential for success in survival and evolution. This command region could be in the tips of the roots.

What would change if people suddenly were sure that plants have some kind of a nervous system, even if in a different way?

The picture of plants would be turned completely upside down. It makes a big difference if I consider plants to be living machines that only react through reflexes, or as beings with something similar to a nervous system and brain, that are perhaps even capable of perceiving sensation – or feeling.

So what do you think?

I think that right now it is just as speculative to say that plants have no ability to perceive as to say the opposite. We just don't know. There are so many indications from modern biology, that plants are subjective individuals. There are also examples of plants that learn. For instance, young plants were raised in a lightly saline nutrient solution. Later these plants could survive in a saline environment, in which other plants had long since died. This means that the experience of the young plants was transferred from the roots to the whole plant. And the older plants had, so to speak, remembered their youth.

And that also works, as you have written, from one generation to another.

That is then at the level of genetics and is a very exciting area – epigenetic inheritance. Molecular biologist Barbara Hohn from Basel showed this effect, known in animals and people, for the first time in plants. She exposed *Arabidopsis thaliana* plants to ultraviolet rays and the chemical substance Flagellin, simulating a bacterial attack. She then observed that there were genetic changes in the stressed plants. That in itself is not exciting. We know that. But this experience of stress was inherited further – to the 5th generation – although the next generations were not exposed to any stress. So it's as if the genes of the 5th generation remembered the experiences of their ancestors! Barbara Hohn told me that previously no one had looked at this process because people considered this to be an esoteric area.

Where does this attitude come from?

It goes back to a very old argument around Lamarck, Darwin and Mendel. Lamarck said that inheritance takes place by passing on modes of behaviour to the next generation. His most famous example was this funny mammal that always stretched out his neck to eat the highest leaves of a tree, and that over time became a giraffe. According to Mendel and Darwin, that's of course impossible. According to them there was once a simple chance mutation of a mammal with a longer neck, which then succeeded because of its better chances for survival. When I was a student, Lamarck was a major example of a mistaken theorist. Today we discover that he wasn't so wrong after all and that both – genetics and Lamarckian effects – play a role. The fact that environmental influences have a direct effect on genetic make-up and that these influences can be transmitted further, is gaining ground. That is sensational!

And the fear of being ,esoteric'? Do you and all the scientists who work on these subjects live in fear of applause from the 'wrong side'?

Yes, sure. That is the big nightmare. And yet 'esoteric' is such a vague concept, long something like a pool where many different currents meet. A book called "The Secret Life of Plants" came out in 1973. It was a wild mix of science and esoteric and really scared the scientific world. Whole areas of research, for example the electrophysiological research on plants, were simply stopped, for fear of being put in the esoteric corner. It was a barren landscape – until a few years ago.

Why is it getting better now?

It isn't really. People like Frantisek Baluska and Dieter Volkmann are still considered esoteric. But things are changing slowly, and part of the scientific community is going further. The mechanistic picture of plants isn't enough any more. In the last few years there have been so many new discoveries that cannot be understood with the normal concepts that new ideas are needed.

A few decades ago it would have been unimaginable to consider that animals had a soul or a recognized consciousness. At least as far as the great apes go, people are now clear about that. Do you think it is possible that in a few decades it may be as matter of fact to talk about plants' souls and consciousness?

I'm convinced that this discussion will happen. Before it was, for example, unthinkable that plants had hormones. So scientists used the term phytohormone. In the meantime, many hormones found in animals and people have also been found in plants. They are still called phytohormones, but that can be explained historically. People couldn't imagine that plants and animals are so close to each other, that there isn't such a big wall between them. And over the last ten years this wall has crumbled ever more.

What does all that mean for how we will handle plants?

Two years ago some critical experts from different disciplines and I started a project we call the „Rheinauer Theses on the Rights of Plants.“ In this we formulated a number of rights that plants should have. One of these rights is the right to reproduce. The 'terminator technology,' for example violates this right, as it would make plants sterile through genetic engineering for purely economic reasons. We also formulated the right to independence. In my view it is necessary to discuss specifically what is going on with the hors-sol tomatoes. These tomatoes are raised in greenhouses on artificial soil. They can be up to eight meters long, and every drop of water and fertilizer they get is allocated by computer. They do not have the least bit of leeway to lead any kind of independent life.

Where else are the rights of plants harmed?

For us the patenting of plants clearly exceeds the limit. You can patent a microwave oven, but not a plant. No one discovered a plant and no one can reproduce it. Thus I oppose patenting of plants, also on socioeconomic grounds, but above all because of the plant herself.

What about pruning, cutting or grafting?

These are no problem. It is not that plants shouldn't be eaten or used in other ways. That was also never the case with animals, that they should be taken out of the food chain.

Then what's the goal?

There should also be limits to a complete instrumentalization of plants. But it is hard to find these limits. Because plants let everything happen to them and they don't scream if one goes too far. They don't give a sign when the limits are exceeded. We have to find these ourselves.

Is – or was – this so different in animals?

I remember that when I was a girl visiting a farm I would watch the cows in their stall for hours. They were chained the entire winter. But they looked very peaceful. Today, at least in Switzerland, we have binding regulations about keeping farm animals. Cows, for example, have to be let outside a few times also in winter. It took first the perception that animals have dignity and aren't 'things', and then required observation of freely roaming cows to see that they needed to move, before there could be such regulations. Maybe it is similar with plants. Many things I describe in my book „PflanzenPalaver“ (“Plant Chat”) were first discovered when researchers switched from the lab to nature, went outside and saw how plants communicate, react and interact. Maybe such field observations can also shed light on the boundaries that should not be trespassed with plants.

The Swiss approach to the subject seems to be especially progressive. Article 120 of the Swiss Constitution says that the dignity of creatures has to be respected. So in 2004 the Swiss Executive Federal Council directed the “Federal Ethics Committee on Non-Human Biotechnology,” of which you are a member, to investigate what the dignity of creatures could mean for plants.

We developed a paper on basic principles that was given to the press in the spring of 2008.

You were really jeered, as in ‘does a lettuce really have dignity?’

Oh yes, of course. That could be expected. But it was not different with animals in the beginning. We had a press conference that was widely reported – partly seriously, sometimes not. For me the most important picture was a poster at a newspaper kiosk from one of the biggest Swiss daily papers. There in big letters: “Plants have Dignity.” That was terrific. For most people that is such a provocative and unusual thought that it is great if it just stands somewhere and is up for discussion.

Plants react to being stroked, you write.

Twenty years ago scientists found out that stems thicken if they are stroked. That was laughed at as esoteric. Then the molecular biologists discovered that different genes related to direct contact, the so-called “Touch Genes,” are activated when plants are stroked, and lead to a whole cascade of changes in growth. Suddenly it's not esoteric anymore. It's like that with a lot of things. The same is true for hearing...

Will plants thrive more when Bach or Mozart are played to them?

Hearing means that plants are probably aware of sound waves that reach the extremely sensitive membranes of their cells. Naturally they don't discern Bach as Bach or Mozart as Mozart. But there is research that shows that particular tone frequencies promote growth, and others rather slow it down. Explained like that it is actually a rather mechanistic thing. But we're at the very beginning on this. At the moment we discover more than we can understand. Therefore we are still working a lot with metaphors, which help us grasp a completely new picture of the plant.

You have said in an interview that in the past you always used to say „no, no, no“ to all the results of agro-genetic engineering, while your opponents had visions. In which ways have your views changed?

The risk argument is still important, but we can't talk for 20 years only about potential risks. There also have to be opposing concepts and alternatives for a modern future. But we don't have the 'silver bullet' solution proclaimed by agrobiotech. We have a whole bouquet of different solutions.

Away from monocultures to a diversified agriculture?

Absolutely. Diversity is central. Ecological agriculture. Away from chemicals and monocultures and

towards diversity, because diversity is not only pretty and useful, but also greatly increases productivity – over monocultures – as plants cooperate with each other and because niches can be used, where it comes to interactions. These dimensions have until now fallen off the research radar screen, because diverse agriculture is mostly carried out in very small areas.

Do you talk to your plants?

Yes, but sometimes I have the feeling that I'm just talking to myself. And I really don't have a green thumb. I can get closer to plants much better through painting.

Swiss biologist and chemist Florianne Koechlin, born in 1948, is well known as a critic of genetic engineering and for her various books and articles. She is Managing Director of the Blueridge-Institute and for years has worked on alternatives and options to the current all too one-sided scientific understanding – especially in relationship to plants. She is on the boards of the Foundation for Future Farming and Swissaid, and is a member of the “Federal Ethics Committee on Non-Human Biotechnology.” Her most recent books are „Zellgeflüster“ („Cell Whispers“, 2005) and „PflanzenPalaver. Belauschte Geheimnisse der botanischen Welt“ („Plant Chat. Overheard Secrets from the Botanical World”) (256 pages with color photos; in German, 2008 Lenos Verlag, € 19.90).

Rheinauer Theses on the Rights of Plants:

http://www.gmo-free-regions.org/fileadmin/files/gmo-free-regions/Food_and_Democracy/Rheinauer_Theses_englisch.pdf