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PACO CALVO – NATALIE LAWRENCE
PLANTA SAPIENS: UNMASKING PLANT INTELLIGENCE

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BOOK REVIEW

Paco Calvo is a logic and philosophy of science professor at the Department of Philosophy, University of Murcia, Spain. He also works in Minimal Intelligence Lab (MINT) and is a leading personality in plant behaviour and signalisation. He connects philosophy with biology, neuroscience, cognitive science and psychology in his research.

In *Planta Sapiens*, Calvo describes his research in plant intelligence and behaviour. Besides the research results and biological and philosophical ideas, there are also narrative parts describing his journeys. Thanks to them, the text is readable and quite light-hearted. The book is divided into three parts, each containing three chapters.

In the introduction, Calvo describes one of his experiments during which he tries "to put a plant to sleep" with anaesthetics. For his experiment, he chooses a wildly growing specimen of *mimosa pudica*, a plant which folds its leaves when touched. He closes it under a glass lid along with a cotton swab soaked with anaesthetics, and in an hour, he can demonstrate that the *mimosa* has lost its natural ability to fold its leaves. He then repeats a similar experiment with the carnivorous *dionaea muscipula*.

Through the experiment, the author introduces his intention, which is noticeable throughout the whole book, to motivate the reader to reconsider his thinking about plants as passive organisms. Based on the experiment, Calvo argues that if it is possible to put plants to sleep, to put them in a state of not doing their usual activity, that activity can be therefore understood as their normal behaviour. Does that mean they are awake? The author points out the possibility that plants could have some form of subjective experience, that is, they could be aware. The text is thus supposed to offer a view of plants as active agents of the biosphere, as organisms with complex behaviour and specific form of intelligence.

In the first part of the book, Calvo describes different behavioural manifestations of plants and draws attention to the mistakes we make when trying to understand them. He mentions the problem of zoocentrism, i.e., our biological establishment in the animal kingdom, based on which we tend to see plants as a passive green background of the world. We cannot really perceive plant movement, and our intuitions about the meaning of plants are limited. Calvo finds another example of such misunderstanding in our historical notions of the structure of nature, such as *scala naturae*, where plants are just a rank above inanimate nature.

Besides zoocentrism, Calvo mentions anthropocentrism, for both manifest themselves in our concept of intelligence. One of the central presuppositions of intelligence is often considered to be the ability to move. However, since the movement of a plant is practically invisible to us, we do not see plants as intelligent. The author states Patricia Churchland's claims as an example of such thinking. However, according to Calvo, plants move by reacting to their surroundings by the way they grow and change their physical structure. While doing that, a plant needs to perceive, respond and anticipate, which requires intelligence. Calvo considers the roots to be the centre of plant intelligence.

Throughout the text, there are recurrent references to Charles Darwin's works. Following his example, Calvo emphasises the importance of carefully observing plant behaviour. Thanks to resourcefulness and technology, we are now able to make plant movement visible to us, for example, by time-lapse records of plant growth. They reveal how plants systematically explore their environment. However, as Calvo warns, it is again important not to slip hastily into anthropocentric or zoocentric interpretations.

Plant behaviour is way too complex to be explainable as simple evolutionary adaptation. Based on his observation, he states that it results from ingenious cognitive processes. Plant behaviour is cognitive because it is anticipative, flexible and purposeful. A plant does not just passively receive stimuli from its environment but actively reacts, anticipates future events, and is even able to learn.

In the second part of the book, Calvo deals with specific biological and cognitive processes. Although plants do not have brains and nervous systems, he says we can identify a similar system in which electrical signals are transmitted through the vascular system. Due to the nature of plant life, the reactions are slow, though functionally, it is very similar to the nervous system. We can find evidence of this similarity in essential chemicals of the animal nervous system, which can also be found in plants.

After describing the physiology of plant cognition, Calvo focuses on philosophy. Based on Andy Clark's thesis about predictive processing, which states that our brains do not just passively process information but also anticipate the coming events, Calvo thinks about the proactive generation of experiences and simulations of the environment in plants. Another theory he considers is the computational theory of mind, i.e., plant intelligence as a consequence of fixed rules, although he does not find it sufficient. Yet he suggests studying plant cognition as a relation between the rules and the environment. As he states, such an approach is typical for ecological psychology.

The third part of the book offers further reflections on the ideas from previous chapters. Calvo returns to the thoughts about how challenging it is for us to try to understand plants because they belong to another realm of nature. It is then even more difficult than Thomas Nagel's struggle to understand what it is like to be a bat. We can examine cognition only as an interaction between a plant and its environment. The result is always unique for every individual plant. This approach is developed by biosemiotics and the concept of *umwelt* – a unique world created by each organism, its existence in its environment.

Calvo offers us a view of plants as unique personalities with subjective experience. From the questions of cognition, he proceeds to the questions of consciousness and subjective experience, which are very unusual topics when discussing plants. The author mentions two types of arguments against such ideas. The first is based on a difference between processing information for adaptive behaviour and subjective awareness of the environment, for which a nervous system is needed. The second type states that the evolution of consciousness would be useless for plants, for an innate adaptation is sufficient. Calvo just briefly responds that we have no

evidence that subjective experience cannot be situated in a different physiological foundation. He also emphasises that plant behaviour is too purposeful and flexible to be grounded in a genetic adaptation.

However, Calvo does not have any better arguments to support his thesis about plant consciousness, not even for the most basic definition of consciousness as the presence of feelings, subjective states, awareness of an environment and internal states. Nevertheless, he believes plants have internal states that help them deal with challenging environments using coordinated physiological activity.

Calvo realises, though, that we need to think about plant consciousness differently than we think about the consciousness of a human being. He, therefore, comes with the view of consciousness as a form of awareness. He works with the theory of the cognitive psychologist Arthur Reber, according to whom consciousness is a precondition of any life and its interactions with the environment. It is, therefore, present even in the simplest of organisms. Although Reber is more restrained regarding the consciousness of plants, he suggests examining it through genetic methods. If consciousness is universal, it should be coded in the DNA. Calvo then writes about another method based on integrated information theory. According to it, subjective experience consists of inextricably linked properties. The measure of consciousness is thus the integration of information and can be tested using electromagnetic impulses. However, any considerations about the consciousness of plants and other organisms raise several ethical questions, which Calvo deals with only briefly.

At the end of the book, the author thinks about ways to use the study of plants to our advantage. He describes the possibilities of their use in space exploration, for example, as inspiration for planetary machines acquiring samples and data. Understanding plants is also very important for solving the current environmental crisis. According to Calvo, the way out of environmental problems is through a change in our approach to plants – from passive oxygen-fixing entities to active agents of the ecosphere.



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