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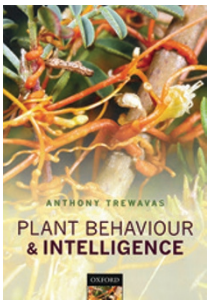
Smarty plants



Plant Behaviour & Intelligence

By Anthony Trewavas

OXFORD UNIV. PRESS, 2014. 304PP. £55

Most of us view plants as static, passive elements of the landscape. In this book Trewavas manages to shake this common belief. To his eyes plants are actively engaged with their environment, it is just that their behaviour consists of morphological changes that are generally too slow for us to notice. He gives a few anecdotal examples of more easily observed movements, like the sensitive plant *Mimosa pudica* folding its leaves when touched or a carnivorous plant closing its death trap, but his compelling case for plant behaviour comes when describing the astonishing activities of root systems.

Because the distribution of mineral nutrients in the soil is very patchy and water availability varies over time, plant roots have to keep exploring their environment. They act as a constantly evolving underground network of fractal, wriggling probes, sniffing and swallowing scattered resources. No wonder this aspect of plant behaviour is easily missed: not only is it slow, it is also hidden from our eyes. The ability of game theory to interpret the competitive manoeuvres of roots in soil space is presented as a sign of intelligent behaviour. By digging up forgotten experimental results and associating them with present-day research, Trewavas deeply challenges our conceptions of plants, questioning our definition of an intelligent life form and teaching us to appreciate something to which we cannot easily relate.

Trewavas outlines his work as following up on Barbara McClintock's Nobel speech assertion[1]: "A goal for the future would be to determine the extent of knowledge the cell has of itself, and how it utilizes this knowledge in a 'thoughtful' manner when challenged." His primary aim is to convince us that plants do behave and that intelligence does not require a brain. Trewavas defines intelligence as a capacity to solve problems and applies that definition in the context of plants to mean successful adaptation to variable environmental conditions. He considers the ability of plants to assess their environment, and use that information to make optimal biological choices, to be a decision-making process with a role equivalent to our thought.

In the 1970s, Christopher Bird and Peter Tompkins first published *The Secret Life of Plants*[2], in which they claimed, among other things, that plants were sentient and could sense the thoughts of humans. Since then, many biologists associate plant intelligence with the mystical ramblings described in Bird and Tompkins's book. Anthony Trewavas is, however, no New Age theorist. He is a now retired professor from the University of Edinburgh and a Fellow of the Royal Society whose work on calcium signalling has been published in journals of the highest quality. But he is also known as an advocate of 'plant neurobiology'.

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The creation of this field about ten years ago triggered a knee-jerk reaction in the plant research community, amply demonstrated by the refreshingly scornful comment of one of my colleagues: "Real scientists do not call plants intelligent!" More polite opponents call it "a provocative idea", and believe it to be "founded on superficial analogies and questionable extrapolations"[3]. One purpose of this book, though never clearly stated, is to detail some of the ideas behind plant neurobiology. Trewavas wants to fight the conception that plant behaviour is a sum of "dumb reflex". He convincingly argues that given the complexity of wild environments, there is no way that the response to all possible combinations of conditions can be genetically programmed. He demonstrates that plants make use of memory and learning, and can integrate multiple types of information to adapt to their specific environment.

When Trewavas applies systems biology concepts to the subject of plant behaviour, he nails a critical limitation in current research, namely to consider the plant as the entire system. The behaviour of a plant is intimately linked to its environment, and so the system of study must comprise both elements. When researchers sever the plant from its environment, they provoke its passivity. As he nicely puts it: in laboratories, "plants are made to perform to order by the experimenter, just as animals are made to perform in a circus ring." Natural environments, not laboratories, show the real range of plant behaviour.

This is a book that requires patience, although the author's enthusiasm for the complexity of life is evident. While Trewavas warns us that he wrote a "book for dipping into, rather than reading through", a kind of memoir, it is too long, and in attempting to convey his ideas, makes no concession to the reader. Indeed, we even have to wait six chapters for a definition of behaviour. Despite these shortcomings, the book succeeds in reshaping our perception of plants. A few chapters are enough to uncover the hidden diversity of plant ingenuity and show how oblivious we are of what is different from us. The evidence for plant resourcefulness and the elaborate metaphors that confer unexpected meaning to these findings also give us a better grasp on the complexity of plants.

Is that enough to prove that plants are intelligent? That comes down to simple semantics. In my opinion, the scope of the word 'intelligence' allows its extension to all kingdoms of life. But what matters more than defining intelligence is that thinking differently about plants, which Trewavas forces us to do, affects the way we will study them. The greater lesson to be learned from this book is not about plant intelligence but human intelligence: as smart as we like to believe we are, we should not let comfortable preconceptions constrain our ideas and hinder our exploration of the complexity of nature. ❐

References

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