Preface

It has long been known that plants are regarded by the public as still life. While it is accepted that plants do germinate, grow and flower, it is not immediately obvious to us that they do much else. However we ourselves are animals and we impose specific animal requirements on everything else biological. Our requirement to detect movement, for example, is limited by the nature of our visual process. The retinal image lasts about a tenth of a second and numerous, vibratory movements of the eye (usually unperceived) are necessary to prevent retinal adaptation. If the movement is much slower than these visual limitations the description of still life is obvious – but from our perspective. Some bamboos grow a metre a day but at less than a mm/minute, it is still not obviously visible. The consequence is that whereas animal behaviour is easily seen and deductions made about both its instigation and likely consequences, plant behaviour has always had to rely on experimental circumstances with appropriate measuring devices to establish that plants do really behave. And even then the half below ground remains largely invisible. Only with the onset of time lapse can many plants now be easily seen to be doing something; to behave. And to a much wider public. While Jane Goodall could record chimpanzee behaviour with merely a pencil and notepad, only with special cameras or other complex experimental apparatus could plant behaviour in wild circumstances be recorded. Much of real plant behaviour in wild conditions still remains unreported.

Plants are among the only groups of organisms that use an external source of energy; the sun. The consequence is that they are the basis of all food chains and predation of one kind or another, threatening survival, was inevitable from the time some two billion years ago when plants first separated from their protozoan ancestors. The evolutionary solution

has been the construction of a plant body composed of repetitive elements, leaves plus subtended buds above ground and branch roots below. Inevitable loss of some simply leads to replacement by others. Growth takes place in embryogenic meristems in shoot and root tips. Furthermore predation and disease were tackled by the acquired ability to synthesize what is termed natural pesticides; substances that often flavour our food but do not kill us, because we are so much larger than any insect. The movement of plants to land some 500–700 million years ago subjected plants to additional environmental hazards. These are specifically sensed too and result in selective changes of the phenotype, often called plasticity. These changes are adaptive, designed specifically to potentially help survival, to continue growth of a kind and as far as possible reproduce. Plants are more sensitive to a much greater number of environmental signals that require adaptive change than the common roaming animal. Plants know about their environment because they respond to it; they are cognitive. Individuals control their own behaviour as cognitive agents to counter the hazards they perceive. Virtually all plant tissues are plastic. Plasticity is used to construct a phenotype with improved chances of survival, to fight over space and resources and construct a dynamic niche underground.

Biological intelligence is quite simply adaptive behaviour, improving survival probabilities as Dobzhansky indicated some 70 years ago. Easy to see when a zebra runs away from

a marauding lion or chooses to continue movement to find un-grazed food. Plants approach similar goals when they synthesize a chemical to kill off marauding insects or choose to search new soil by root proliferation when phosphate deficiency is sensed. Animals move, plants change structure and physiology; the goal is identical. For those that like simple analogies; there are two kinds of cars on European roads, those run by electricity and those using petrol. But the goal, transport of people or goods is the same despite the entirely different mechanisms.

However the choice of words to describe plant behaviour, intelligence, agency, cognition, consciousness (or better awareness) and incorrectly believed by some to require nervous systems, creates controversy. This book by a young Belgian philosopher of science deals with many of these issues. Intelligence, memory, learning, consciousness are discussed in the first part. The second part concentrates on biosemiotics, how meaning is created from the perceived signs and signals that plants experience and it creates a plant ethology. There is an ongoing debate among plant scientists that will continue until plant physiologists doff their white coats and decide to understand how plants do behave in the real world. A place of environmental uncertainty, extreme competition, battles over space and resources, disease, invasion, common death and real predation in the many ecosystems of the planet. This book should interest and educate any open-minded scientist who wants to understand better the current controversy and the increasing understanding of how complex, plant behaviour actually is.

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