



Inner Presence: Consciousness as a Biological Phenomenon. Antti Revonsuo. MIT Press, 55, Hayward Street, Cambridge, MA 02142. 2006. 473 + xxv pp. Price not stated.

In the last decade and a half, 'consciousness studies' has emerged from the nether world of scientific investigation. Consciousness is now seen by many scientists as the last great unsolved scientific problem. There are several reasons for this dramatic shift in the fortunes of consciousness studies, including the fact that neuroscience as a whole is occupying the scientific centre stage, but a lot of credit also goes to three pioneering books: Roger Penrose's *The Emperor's New Mind*, David Chalmer's *The Conscious Mind* and Francis Crick's *The Astonishing Hypothesis*, each representing a radically different perspective on consciousness. Crick's book was the most conservative of the three (despite its title) in which he claimed that consciousness is an entirely biological phenomenon which is identical to (as yet unknown) brain processes. Roger Penrose argued that the phenomenon of consciousness is tied to the foundations of physics in general and quantum mechanics in particular. David Chalmers went one step further, claiming that consciousness cannot be explained by *any known scientific theory* and that consciousness is a fundamental substance on par with electrons and quarks. Since then, the trickle of books on consciousness has turned into a flood. It almost seems as if the first thing a new Nobel Prize winner does these days is to write a treatise on consciousness. As a result, a new entrant to the marketplace of theories of consciousness is sorely tempted to announce his presence by making ever more radical claims about the nature of consciousness. The author of the book being reviewed here, Antti Revonsuo, has to be congratulated for not falling to this temp-

tation. Revonsuo has written a sober but ambitious book on consciousness that falls squarely within the Crick camp.

Revonsuo's book is sober because he agrees with most biologists and psychologists in thinking that consciousness is a phenomenon that can be identified with the workings of the brain and the brain only. At the same time, he is ambitious because he thinks that current biological explanations are inadequate. According to him, what we need is not yet another ad hoc hypothesis about consciousness but rather a whole research programme that systematically investigates the various dimensions of consciousness and then synthesizes them into a comprehensive explanation. Biologists on the whole should find this tactic compelling. After all, most biological phenomena resist neat explanations based on one or two hypotheses. If the investigation of consciousness is like that of protein structure, it will require many laboratories, the study of a range of molecules, many model organisms and a concerted research effort.

So what is Revonsuo's research programme? According to him, phenomenal consciousness is real, in that it has causal powers and is not to be dismissed as non-existent, like phlogiston or epicycles. At the same time, consciousness is not a primal substance, it is not caused by subatomic physical processes and it is not spread throughout the body and the environment.

The author focuses his study on phenomenal consciousness, by which one means those states for whom there is a subjective feeling of 'what it is like to be in such a state' like the taste of an ice cream cone on a hot summer day. Phenomenal consciousness is to be distinguished from other notions of consciousness such as access consciousness, in which one is aware of the contents of our experience (such as the fact that I *know* that I am eating an ice cream cone). It is this feeling of 'what it is like' that makes consciousness so important to us, for it is the reality of experience of pain and sadness, joy and beauty that gives our individual lives meaning and value. A zombie, i.e. a creature that has the same behavioural and adaptive features as we do but has no experience of its existence, would be able to forage for food but it would not experience its taste. Therefore, the zombie would not have the same sorrows as we do, and the notion of sorrow itself would have no meaning to such a

creature. To paraphrase Socrates, the unexperienced life would not be worth living.

Given the importance of subjective experience to us humans, there is no point in denying its reality. However, according to Revonsuo, the importance of conscious experience to us should not lead us to the extreme conclusion that it is a *sui generis* phenomenon, outside the ambit of biological explanation. Instead he proposes a research programme which can be described as follows:

(1) As a working hypothesis, assume that phenomenal consciousness is *solely* generated by the activity of neurons in the brain. In this, Revonsuo differs from other biologically motivated theorists such as the late Francisco Varela, who claim that the mind and consciousness are spread through the body and the environment (see Varela, Thompson and Rosch, *The Embodied Mind*).

(2) Dream consciousness is then postulated as a perfect model system for the study of consciousness, since dream experiences are generated in the absence of external stimuli, and therefore, can be easily studied in a laboratory. Note how the braincentric view of consciousness is crucial in the choice of dreams as a model system: if consciousness is generated in the brain, then it makes perfect sense to study consciousness using dreams where the brain is not bombarded by external stimuli.

(3) The study of dreams suggests that the best metaphor for consciousness is that of a virtual reality (VR) simulation. According to Revonsuo, the VR metaphor takes care of two key phenomenal aspects of consciousness: First, dreams as well as waking experiences are experiences of *coherent worlds* rather than of disorganized bunch of objects chaotically scattered here and there; Secondly, the fact that in both waking and dream experiences, I experience myself as participating in a spatio-temporally extended domain centred around the subject (the awake or dreaming *I*). Just as VR computers generate coherent worlds so does the brain. Note that VR worlds do not have to obey our normal physical laws and neither do dreams.

(4) Once we accept that consciousness is a VR simulation of the world, then an adaptive purpose emerges for consciousness. According to the author, the VR world generated by the brain allows us to simulate and predict dangerous as well as

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useful situations that might be encountered by human beings while exploring their environment.

I should add that while the book defends these four research strategies, it also covers alternative arguments (both philosophical and scientific) in great detail, so this book is not just a list of the author's own ideas, it also serves as an introduction to consciousness studies as a whole. I personally feel that the coverage of consciousness studies as a whole is a bit too much; the book would have been about half the length, and the main argument easier to understand, if the author had stuck to his own ideas. Then again, since one of the author's stated aims is to lay out a roadmap for the field as a whole, he is within his rights to point out the pitfalls along the way, while leading us via the one true path. The novice reader will quite possibly benefit from these digressions.

Like every other book on a topic as controversial as consciousness, this book also has some flaws. For one, the book does not address the hard problem of consciousness. Why is there anything like phenomenal experience at all? No known physical or biological processes can plausibly be the basis for a state for which there is a 'what is it like to be in that state'. VR simulations are no exception – the reason why we experience something in a VR environment is because *we* inhabit those environments and not because VR computers secrete conscious experience. Why should the brain be any different? Secondly, even if we set aside such metaphysical puzzles, even a biological realist can quibble about brain centrism. Here is an alternative – the brain itself is given to us as an object via our experiential contact with the world, just like flowers and trees and umbrellas. Indeed, one could *define* objects, including the brain, as (geometric and material) invariants of our experience. Objects are shapes that remain constant while we move around in this world. If we accept this 'invariant' reasoning, then from symmetry considerations we should not make a distinction between the brain and other objects, so why privilege the brain?

Keeping the shortcomings of the book aside for the moment, a field as wide open as consciousness studies needs several research programmes, some biological, others physical and yet others metaphysi-

cal. Our knowledge of consciousness is bound to increase when these programmes compete in the public domain. For these reasons, I commend Revonsuo for sticking his neck out and stating his views about the geography of consciousness.

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Handbook of Virology. Jawaid A. Khan and Jeanne Dijkstra (eds). The Haworth Press Inc., 10 Alice Street, Binghamton, NY 13904-1580, USA. 452 pp. Price: \$69.95.

This book is very handy and provides up-to-date information on different aspects of plant virology in a very concise form. The book includes selected topics in both basic and applied aspects in plant virus research that are written by experts in their own field of research. The book therefore can serve as a useful guide to students, teachers and researchers in plant virology.

Descriptions on symptomatology would have been clearer with more illustrations. The chapter on architecture of plant viruses is rather brief and the assembly pathways for TMV and bromoviruses could have been described in some more detail with illustrations. The replication and gene expression of both RNA and DNA viruses are described in detail. This is followed by a brief description of viroids. Transmission of plant viruses, which is a very important aspect of plant virus research in the management of the disease, is covered in three chapters. The chapters on serology, detection and identification of plant viruses provide up-to-date information on various methods of disease diagnosis and are very useful to researchers in the field. The book also deals with the more contemporary topics such as recombination in plant viruses, virus variability and evolution. The chapter on recombinant DNA technology could have been presented soon after the chapter on isolation and purification of viruses. This chapter seems to be out of place although it describes the various techniques. Resistance to viral infection and control strategies are described rather briefly.

The most useful information for researchers in the field is provided in the appendix, which describes each family of viruses. The book would be of use to both graduate and undergraduate students of plant pathology.

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Annual Review of Neuroscience. Steven E. Hyman *et al* (eds). Annual Reviews, 4139, El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. 2006. Vol. 29. 914 pp. Price not stated.

Although intuitively it would seem that reviewing a set of reviews, a meta-review of sorts, would appear not too demanding (which is probably the reason why I accepted the offer so quickly), perusing through the twenty reviews that comprised the 2006 edition of the *Annual Review of Neuroscience* made me quickly realize the challenge at hand. Because the editorial committee of the Annual Reviews mainly chooses the topics based on their current relevance, the annual reviews series are not thematically organized. Added to this, the reviewer's job is particularly exacerbated by the scope of modern neuroscience that encompasses varied technical and conceptual approaches, all well motivated and necessary, but nonetheless difficult to be digested by a single brain (at least mine). This confession notwithstanding, in putting this review together I have taken the liberty to re-organize the presentation of chapters, emphasizing functional links where possible. I hope this approach might be of greater value to a reader of this meta-review interested in getting a gist of the breadth of issues being examined in the 2006 edition, rather than just evaluate the reviews in their order of presentation in the book, or segregate the reviews into areas such as molecular, cellular, systems, behavioral/cognitive and computational neuroscience as is typically done in many neuroscience journals these days.