Moveo ergo sum

Enchanted Looms: Conscious Networks in Brains and Computers (2000) Rodney Cotterill, Cambridge International Science Publishing. $27.95. Hardback; ISBN 0-521-62435-5.

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What is it that makes us conscious? Which animal species display this phenomenon and which ones do not? Can computers ever express awareness? Cotterill courageously and intelligently addresses one of the most fascinating and challenging problems in neuroscience: consciousness. The author identifies several constraints that must be met for a system to display consciousness. Among them, he argues for the possibility of internal stimulation or imagination, the capability to handle simultaneous streams of information and a short-term memory system. There is no room in our current view of the brain for a *homunculus* that interprets the information from the retina, processes it and directs our movements.

It is dangerous to bias our scientific judgments based on intuitive widely held notions. Examples of this abound in the history of science. It is unclear at this point to what extent philosophical arguments per se can draw a definitive answer to the problem of consciousness. The author takes a reductionist approach and starts by explaining the inner workings of the cerebrum and brainstem. The book exquisitely describes the basic knowledge that has been accumulated so far regarding the functioning of the brain. For those new to the field of neuroscience and for those curious about how our minds work, no pre-requisite or previous knowledge is assumed. Everything, from the main techniques to the paradigm-shifting experiments, is clearly explained in a concise, clear and amusing manner. The author draws on examples and simple demonstrations from everyday experience with plenty of links and examples from other fields. For those already aficionados in the subject, some of the initial chapters may be déjà vu. Yet, the entertaining writing style, together with the insightful comments and anecdotes make it worth reading.

Perhaps one of the most difficult questions concerns the mechanisms of what the jargon denominates *qualia*. This is typically exemplified as the question of defining the redness of red, our feelings and subjective sensation upon observing the color red. It is particularly complicated by the fact that I fear we still do not know what the exact questions are that we should pose regarding this matter. Several influential thinkers have even proposed that we will not be able to tackle with this question at all in a scientific reductionistic approach. Cotterill argues that qualia are inextricably related to feedback from the body's musculature. With respect to the issue of which species display qualia, Cotterill ventures the idea that they will be found only in mammals based on the different structure of the motor command fibers. The importance of moving and sensing the surroundings leads the author to be tempted to change Descartes' dictum into *moveo ergo sum*. However, the existence of paralytic or locked-in patients that are still perfectly conscious, the astounding power of visual imagination in the absence of any motor output, and the richness of dreams where there is no interaction with the muscles, argue against this idea. Our conscious decisions need to be directly and efficiently conveyed to the motor centers of the brain. But it is not clear that the fundamental interactions between the brain and muscles constitute a necessary, let alone sufficient, condition for awareness. However, we cannot discard any of these alternatives at this point, and original and experimentally testable hypothesis such as this one should be welcome. Even if they do not represent the final answer, they will definitively help us guide towards it.

Towards the end, the author skillfully argues that it will be possible to simulate consciousness in computers. That our planet is not the center of the universe, that the building blocks of life are ordinary chemicals, that evolution follows Darwinian principles, has already been accepted by most scientists. If it turns out to be true that artificial systems can indeed display consciousness, it will probably represent a major shock. A multidisciplinary approach such as the one pursued by Cotterill to the study of consciousness seems essential and welcome. Philosophers, physiologists, psychologists and other scientists all have contributed to the momentum that has been generated in the field. While we should keep in mind that it is still quite unclear how to build computers that can understand and laugh at jokes, display feelings, or show the creativity of Einstein, Shakespeare, Chopin or Van Gogh, this fascinating book explains the concepts and suggests new ideas that should stimulate anyone interested in these questions.