

# **The Enchanting Subject Of Consciousness (Or Is It A Black Hole?)**

## **Review of *Enchanted Looms: Conscious Networks In Brains and Computers* By Rodney Cotterill**

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The subject of consciousness is proving to be almost like a black hole to those who draw close to it. Once seduced inside the event horizon, they appear lost to normal scientific activity but follow a trajectory towards an explanation of the phenomenon which others, standing well away from the fateful edge, shout out to them is impossible to follow scientifically or is of little interest to those in the scientific mainstream. Those already lost to the black hole hear the cries of their companions but cannot escape the fatal attraction exerted on them. And as more and more fall into the black hole it expands, so swallowing more and more into its ever roomier interior. Will information ever get out about what the intrepid explorers have discovered? Or will there just be a gradual separation into those who have disappeared and those who resolutely turn their eyes from the glorious sight of infalling colleagues.

The above is a bit of exaggeration, I grant, but is along the lines of comments I myself have received about my own interest in consciousness, both from colleagues and my nearest and dearest. Rodney Cotterill has also fallen into the black hole of consciousness,

but he has shown by his excellent book that information can be sent back from inside the event horizon. It may be just part of the radiation of heat from the surface (the so-called "Hawking radiation"), but it contains some important indications of the nature of the interior. It is also beautifully written. Indeed, the dedication at the beginning -- "for all who care for the mentally infirm" -- is apposite, indicating that the book has been written from the heart as well as the head.

Cotterill starts with a gentle introduction to the nature of and puzzles about conscious experience, including a very effective picture of the author drawn by portrait-drawing robot in Japan (in actuality by a line-extraction algorithm), and moves on to a description at a simple level of the anatomy and physiology of the brain. A good description of brain imaging and the difference between top-down and bottom-up processing then follows. A chapter on the living neuron and brain-type neural networks then leads to neural network learning rules and their relation to some of the learning processes in the brain, including associative memory nets, topographic maps and feedforward nets learning by the delta rule. The complexity of visual processing and the marvellously crystalline structure of the cerebellum are then described, including muscular and emotional control systems in the brain. Synchrony and the binding problem and attentional processing are then clearly considered, moving to eye movements and visual processing as a set of associated actions, and the involvement of working memory in higher-level processing. The results of Libet on the timing of consciousness in relation to spontaneous movements are briefly discussed, before a return to consciousness at page 293, in which there is emphasis on unconscious processing as prior to the emergence of consciousness.

We have now come to the longest (83 pages) and most important chapter of the book, entitled "Midwives of Reflection". It is in this chapter that the main intellectual meat of the book resides, the real message coming out of the "black hole" of consciousness research. It commences with a discussion of the problems associated with the definition of consciousness, and the beginnings of the deeper analysis of human conscious experience by a discussion of the phenomenon of "filling in", the gap in visual experience associated with the blind spot. Cotterill shows some excellent "hands-on" examples of this, and justifies the presence of some form of inner experience -- the controversial "qualia" -- which is missing in a blind person (so countering the argument of Dennett that qualia do not exist, since he claimed that there is no filling in for the blind spot, in contradiction to actuality). This leads to a vivid description of other sensory illusions, such as the cutaneous rabbit, and so to the body matrix of Melzack. It is the latter which is suggested as being involved in the process of filling in; it is an automatic process at an unconscious level. A discussion of Searle's features of unity of conscious experience, intentionality and focus versus periphery is then given, and Sommerhoff's Integrated Global Representation mentioned.

However, this still does not home in on consciousness in any precise way, as Cotterill admits. After some further remarks on top-down versus bottom-up, consciousness begins to emerge in the section "The theatre that never closed" as "a mechanism that enables us to relate to our personal space," which needs considerable unpacking, some of which is begun in that section. He claims that the key to consciousness is time: "And I believe that

the key factor is time. If the organism is to have the ability of responding to the temporal texture of its environment, on the time scale inherent in that texture, it will have to be able to retain a temporary record that spans a sufficient amount of that texture." An appeal to action-based perception and the active acquisition of information finally leads to a description of the suggested "core circuitry of consciousness". This involves a set of recurrent loops joining the posterior lobes to the frontal lobe of the brain. This is supported by some brain imaging results and developed in more detail in the following subsections. To get to the nub, qualia are proposed to arise from motor action and internal re-afference, suggested as arising from intrafusal fibre activity developed from independent gamma neurons; thus we arrive at "the idea that qualia are inextricably related to the body's musculature...", for which some evidence is presented. Further discussion ensues on volition, sleep, language, intelligence (in humans and other primates), concluding with the impressively entitled section "Consciousness will be seen in computers".

I have a number of cavils about small points, such as that the scan-path approach (p. 277) to visual processing has now been discarded by psychologists; only 250 milliseconds (p. 293) are needed for consciousness to be aroused in a replication of Libet's experiment on consciousness of spontaneous motor acts (Keller and Heckhausen, 1990). Moreover, the latter experimental duplication leads to a very different view of the way that consciousness is implicated: "...the time of feeling an urge to move necessarily coincides with the change of control from a lateral unconscious to a medial conscious process." In the process, it is attention to naturally occurring unconscious motor acts, asked for by the experimenter, which causes the acts to be driven into consciousness. There is no problem about "free will" from this point of view.

I have a deeper point to make about the nature of consciousness being presented in the book. At the end of the book Cotterill states "What, then, is my prescription for simulating consciousness in a computer? That is one of the things this entire book has been leading up to, because the only reliable way to achieve this goal would be to emulate the anatomy and physiology of the only structure we can be sure is conscious: the human brain." As he then admits, this is a bit of a cop-out since it will be a long time off before such a complex simulation will be done. However it is not clear to me that such a simulation would do the trick, since we know that it is being replicated in wetware every second by billions of examples here on earth. It would still leave unprobed the principles on which the emergence of conscious experience depends. It is that which this book was about. Why did Cotterill not follow up the issue of time that he emphasised for consciousness, as I noted earlier? There are numerous approaches using working memory modules as basic to this emergence (as discussed, for example, in Taylor, 1999). These systems handle time in a flexible and powerful manner and are closely related to attentional brain centres, as modern brain imaging experiments have now shown. The basing of consciousness on gamma afferent feedback is also dangerous, in the light of results on deafferented patients who have difficulties of movement but not apparently of consciousness (Cole and Paillard, 1995).

However, these comments are part of the controversial subject that is the study of consciousness. In all, this is a beautifully written book, and one of value to anyone wandering near the black hole of consciousness. It is one of an increasing number of messages now coming out from the event horizon, suggesting that the hole may not be so black as it seems.

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