Chris Nunn

Mind–Matter Research: Frontiers and Directions

Wilbad Kreuth, Bavaria, July 3rd–7th, 2006

First a confession: your reporter did not attend every session of this fascinating workshop. It was held in a vast centre, vaguely reminiscent of the Potsdam palace, set in an Alpine valley and a favourite venue for conferences. Inside, labyrinthine corridors — both literal and metaphorical; outside, glorious mountains, deep forests, a sparkling lake, some of the prettiest villages in the world. You get the picture, and can appreciate the temptation! So this report is no doubt unbalanced to some extent, and is very much a personal view of the proceedings.

A witty introduction by **Avshalom Elitzur**, co-organiser of the conference with **Harald Atmanspacher**, took what is at present the conventional stance in relation to consciousness studies. Proceeding from Leibnitz to David Chalmers, he emphasized the hardness of the hard problem. Indeed he claimed to have out-Chalmered Chalmers with a theorem showing that any complete physical explanation of consciousness has to involve new physics that we don't know anything about. As he is one of the world's most creative theoretical physicists, and has previously made incisive contributions to consciousness debates, **Elitzur**'s view merits respect. All the same, I wondered, isn't the 'hard problem' something of an idol with feet of clay that are beginning to show? Zombie and Chinese Room arguments, on which it partly stands, are looking ever more shaky these days. Maybe the kindest view to take is that, in the very long term, it will be seen to have had heuristic value analogous to that of Zeno of Elea's motion paradoxes; a misguided stance which nevertheless

Correspondence: *cmhnunn@btinternet.com*

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eventually stimulated constructive thinking. In the short term of course, Zeno could have been nothing but a hindrance to any Elean athlete wanting to catch a tortoise or overtake a competitor. And the intellectual athletes at this workshop were in a similar position. Luckily, most of them paid only lip service to the idol while a few brave souls explicitly rejected it. **Carsten Allefeld**, for example, later told us his reasons for preferring Merleau-Ponty's conceptual approach to that of Chalmers.

Next **Max Velmans** spelled out his 'reflexive monism' picture of conscious experience, emphasizing that it simply represents the best empirical means of describing the phenomena. A number of subsequent speakers felt that it could helpfully be incorporated into their pictures. Then **Hans Primas** offered a profound and remarkable analysis of the fundamentals, showing that the physical is *not* causally closed because physical laws do not in general set the initial conditions. He pointed out that individual experiments can be described in terms of Boolean, either/or logic, sets of experiments require 'Boolean manifolds' for their description, while Boolean logic is entirely inapplicable to wholes. Quantum entanglements are examples of such 'wholes'. He also presented a slide which read:

'Material world <——> Tenseless domain

Mental world <——> Tensed domain'

('Tense' as in past/future, not elastic band or anxiety!)

Some of the subsequent talks could be seen as footnotes to this slide, as philosophy has been described as a series of footnotes to Plato. So ended the first morning. I shall try to describe the rest of the proceedings more in terms of themes than named speakers.

Models

Most contributions were wholly or partly about constructing models capable of comprehending both mentality and the physical world. The procedure adopted was often to take everyday concepts and standard theories, then translate them into some mathematical or other language of the speaker's choice. Building on Whitehead's 'process philosophy', or ideas reminiscent of the Bohmian unfolding of an explicate order from an implicate order, were two popular procedures. It was not necessarily clear in every case, however, that the model arrived at added genuine explanatory or predictive power to the ingredients going into it. Indeed **Eliano Pessa** expounded, with great verve, a complicated argument which led, via a (currently non-

existent) Bohmian field theory, to the conclusion that some neural networks probably already embody all the characteristics of his quantum model, which may therefore be superfluous for practical purposes. This was a clever way of showing what might be required of a satisfactory neural net model.

Speakers generally, however, anticipated more from their models. One example that particularly interested me because it was unfamiliar (unlike the models of **Henry Stapp** or **Giuseppe Vitiello** for instance) was **Tito Arecchi's** well-developed proposal based on the dynamics of chaotic attractors, a crucial feature of which involved 'information replacement'. Apparently this allows computation 'beyond the Turing machine' — meaning much the same as Penrose's 'non-computational' cognition — plus a prediction that locusts are not conscious, while rabbits are.

Like live models in a beauty contest, all had plenty of aesthetic appeal — whatever one's doubts about their capability in relation to washing up, mowing the lawn or other mundane tasks. But beauty is of course in the eye of the beholder. If forced to choose, I would have awarded the *palme d'or* to **Paavo Pylkkänen's** interweaving of ideas about the holographic bases of mentality and the physical world with Bohmian process. However, the word 'hologram' apparently constituted an unacceptable blemish for some participants, most notably **Walter Freeman**. Which was a pity, I thought, as his picture of brain attractor dynamics (on which more later) is by no means obviously incompatible with an holographic one. After all, interference fringes must inevitably occur in it. Therefore holography might well have a role of some sort. At least I can report that all contributions provoked lively interest and debate, though agreement was in short supply.

Time

Here **William Seager** showed us that all current ideas about the fundamental nature of time run into problems and paradoxes, though some at least of the paradoxes appeared more semantic than 'deep'. Many speakers seemed to feel that any adequate concept of time would be linked to a proper understanding of the mind/matter problem, or vice versa. There was general agreement about the special status and importance of 'now', plus a feeling that time is inherently 'tensed' in some ill-understood way. Both of the latter conclusions, of course, were no great surprise given that the vast majority of participants were quantum theorists or psychologists. One suspects that a

meeting of relativity theorists and theologians might have reached opposite views on these matters.

Emergence

An implicit theme of many talks, only two were explicitly on this topic. **Peter beim Graben** gave a rigorous definition of 'contextual emergence', which is the most relevant type, followed by a discussion of how (classical) partitioning determines the nature of the emergence. Then **Scott Jordan** painted a nice picture of consciousness as 'aboutness', emerging over the course of evolution in the context of available ecologies. He had developed it independently, he told me, of Nicholas Humphrey's rather similar notion. My guess is that his theory complements Humphrey's in a constructive way.

Neural networks

A topic that played an important, sometimes central, role in many of the more specific models — naturally enough since the brain is by definition a neural network. **Amos Arieli** emphasized in his talk that real brains don't behave much like artificial neural networks, for the 'ongoing activity is made up of ephemeral ensembles of hundreds to millions of cortical neurons organizing dynamically into instantaneous states …'.

Empirical studies

I'll revert to describing individual contributions here because they were so disparate. **Dieter Vaitl** showed us some of the findings from IGPP Freiburg (the sponsor of the workshop). They have an ongoing programme of research into the neurophysiological and psychological correlates of altered states of consciousness (trance states, etc.). They certainly seem to be laying down sound foundations on which to build in the future.

Jiri Wackermann discussed studies of time estimations in the tens of seconds range and showed that these are best modelled by supposing that the relevant brain clock is like a pair of water clocks, not like a pendulum instrument.

Marlan Scully discussed some fascinating experiments on 'quantum erasure'. As is well known, interference fringes disappear if information is gathered about which slit a particle is going through in a two-slit experiment. What's less well known is that the interference fringes reappear if information about 'which slit' is then erased before the particle reaches the screen. It's one of those mind-boggling results

that the quantum world throws out in profusion. Explaining it requires giving up ordinary ideas of either reality or locality. **Scully** himself preferred to lose reality, while **Elitzur** wanted to keep that and lose locality.

Walter Freeman gave a masterly account of his EEG studies of the neurology of sensation, using arrays of 64 electrodes applied to the brain surface. Most of these studies were of olfaction in tiger salamanders or rabbits, but a few related to other types of sensation in other species. The findings suggest a rapidly shifting 'landscape' of attractors manifesting in patterns of phase and amplitude modulation, particularly in the beta frequencies (the current orthodoxy is that gamma frequencies underpin 'perceptual binding'). Individual attractors appear to embody discreet percepts. The associated wave fronts can spread ten times as fast as axonal conduction rates in the neurons involved. Remarkably, studies in which he looked at all sensory areas simultaneously showed global dissemination of patterns in the beta range, suggesting that information from any particular sensory modality is available to all modalities. He's tried to model his results with systems of differential equations, he told us, but doing so requires thousands and is totally unwieldy. He was hoping that the mathematics of quantum field theory might offer a way out and **Giuseppe Vitiello** appeared to share his hope.

To add another personal comment here, Freeman's approach surely deserves to be regarded as one of the hottest topics in consciousness research today, difficult though it is to apply to systems as complex as the vision of monkeys and cats (where confirmatory findings would carry most weight). That it has had less appeal to the neuroscience community than might have been expected is surely down to the fact that their favourite research methods (fMRI and recordings from individual neurons), which have indeed generated a profusion of fascinating and important findings, are simply unable to 'see' the Freeman phenomena due to inadequate temporal resolution in the case of fMRI and a 'can't see the wood for the trees' difficulty in the case of single neuron recordings. Maybe the new technique involving dyes that change colour with neuron activity will eventually offer a forward, for its temporal resolution is as good as EEG and its spatial resolution better than fMRI. Unfortunately it can only be used in anaesthetized animals at present, but perhaps a way round this limitation will be found.

Conclusions

I left the workshop more convinced than ever that matter has mind-like properties of some sort and that the project to understand what these are and how they relate to human consciousness is in good shape, albeit at an early stage. In the course of his coruscating talk, **Arkady Plotnitsky** quoted Niels Bohr as having said 'The goal of science is to convert deep truth into banal truth.' Appropriately enough for a Bohr statement, the complementary opposite of his remark is also true. This conference clearly showed that the goal of science is to enable us to see and understand deep truths that have long been hidden in banalities.