John Gerald Taylor: Comrade, Polymath, and Consummate Neuroscientist.

Reminiscences of life together under the aegis of INNS

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I first came to know John well in 1993 when as President-Elect I helped persuade him to become the first International President of INNS by running for election as President-Elect. He was already President of the European Neural Network Society, so his election was assured. When we took office in January 1994 I invited Judy Dayhoff to serve as Treasurer, and she graciously accepted. We got off to a busy start when it became clear that the INNS was teetering on the edge of bankruptcy. John and Judy showed their true mettle. While I recruited a new Management team and Judy reorganized our finances, he took over as Program Chair in mid-stream and fielded a first-class, profitable summer meeting in San Diego. Both went on to become President of INNS, assuring the stability and financial security of INNS through a period of continuing fall in membership. Notably with his remarkable vision of the future he instituted the present cooperation of IJCNN instead of separate meetings in head-to-head competition with IEEE. Knowing the importance long term of an outstanding publication, he also became European Editor-in-Chief of the INNS journal Neural Networks, a post he filled with distinction to the time of his death.

A beneficial outcome of our experiences together was the life-long friendship between John and me, which soon came to include our wives. With passing years I became more fully aware of the remarkable range and complexity of his interests and activities. He was a published poet and an accomplished amateur actor with voice training, which explained the deep, mellifluous baritone by which he delivered his lectures and opinions. A listing of titles of his published books illustrates and illuminates his intellectual evolution from mathematical physicist to visionary futurist, philosopher, neurodynamicist and brain modeler.

He published several standard reference books on quantum mechanics (1970), black holes (1973), special relativity (1975), and neural networks (1993; 2002), demonstrating his scholarly command of the foundations of mathematical physics and neural networks. What surprised and intrigued me were his futuristic speculations in “The Shape of Minds to Come” (1971; 1974). He let his imagination...
soar, boosted as by rockets by his scientific knowledge and acumen. In contrast to the foreboding visions of George Orwell in “1984” Aldous Huxley in “Brave New World” and Kurt Vonnegut in “Sirens of Titan”, John’s predictions of the impact of neurotechnology on the quality of human life were buoyantly optimistic. He expressed hope that by chemical and electromagnetic intervention, such as by fetal implants and brain grafts, memory drugs, implanted electrodes, transcranial stimulation, and controlled diets mankind would ameliorate disease, stupidity, criminality, and fatigue. He suggested that electrodes implanted in the ‘pleasure centers’ would enhance sexual pleasure, and that after work people could retire to recreational facilities such as ‘sex rooms’, ‘danger rooms’, and ‘meditation rooms’ as to the local pub. What a vivid imagination!

Among some strong praises the strongest adverse comments that critics made were that his “book is dedicated to blurring the fast-fading distinction between science fiction and fact” (Kirkus Reviews), and “...each chapter can be seen as an article in the style of Scientific American or Psychology Today. But, like such articles, the generalizations go well beyond the findings of the experiments, and technical problems that limit the procedures are rarely presented.” (Stanley C. Ratner). To this and similar comments in other reviews John replied, “I, as a mechanist, can deliberate, this occurring through my making as conscious as possible my subconscious needs and motives, and also evaluating the various outcomes of my possible choices of action ... and, in particular I hope to do this so as to allow people to cast off many of the shackles of older and worn out ways of thought. I may even hope for some credit in doing this if I am successful, but then I am only human!” In forthcoming books he displayed audacity in his willingness to entertain far out hypotheses, tempered by his insistence on experimental testing and confirmation. For example, he thoroughly tested his speculations in parapsychology and concluded that claims of clairvoyance, telekinesis, and so forth were due either to fraud or to self-deception.

When John retired from King’s College he continued to serve as Emeritus Professor and Director of the Centre for Neural Networks at King’s College London. The focus of his scientific activities was the consciousness, which he had studied for the previous quarter of a century. He pursued this goal with tenacity as Guest Scientist of the Research Centre at the Institute of Medicine in Jülich, Germany, where by immersion in experimental data he learned what he needed in clinical neurology and brain imaging to formulate his hypotheses. In 2001 he summarized his mature overview of the field in “The Race for Consciousness” including his own and others’ models, likening the world-wide search to the competitions he had witnessed in mathematics and physics for solutions to major problems such as Fermat’s last theorem.

The book displayed John’s mind at its best. He set forth his goal post to be striven toward: “One very difficult and basic problem exists whose scientific solution would correspond to winning the race: the crucial ingredient in the neural activity of the brain that sparks consciousness into life. It is this so-called hard problem – to
discover that added value that guarantees the presence of consciousness – that is the final winning post we seek. Once that feature has been discovered, we are there! (p. 10).” He then systematically constructed the metaphysics of his model, giving definitions of mind, the experimental tools needed and available, and “the real work” in which he formulated the “active components involving higher cognitive processes … from which the self can emerge”, which gave “…a glimpse of a special form of neural activity — “bubbles” — supported by particular areas in the cortex.” In voluminous detail he treated “... the varieties of conscious experience and how they an be explained using relational ideas ... “ with “a final chapter indicating the relevance of it all to society and our future... which ... leads to tasks for the third millennium: the creation and direction of conscious machines (p. 12).”

John and I often debated the nature and mechanisms of consciousness for the 20 years we were privileged to know each other. Being both iconoclast we enjoyed exploring and challenging both old and novel ideas. There was sufficient overlap in our scientific backgrounds that we found broad areas of agreement. His conception of “the relational mind” was fundamentally comparable to my conception of “the intentional stance”. In both systems we agreed that perception was based in the synthesis of fresh sensory input with the recall of memories, which was triggered by sensory inputs that were selected and filtered by the sensory cortices. The constructions were discontinuous. His cortical “bubbles” were comparable to my “wave packets”. His “attentional blink” was imposed by the transient shutdown imposed by my “phase transition” in my cinematographic neurodynamics. His CODAM model (COrollary Discharge of Attention Movement) was based on the conviction we shared that perception required the prior specification by the brain of what sensory input was being sought, and that focused attention was an action of control deriving from motor systems.

The control was first conceived and reported over a century ago by renowned physicist and army surgeon Hermann von Helmholtz (1879). It was first modeled in engineering terms by Von Holst and Mittelstädt (1950) using control systems theory, showing how execution of an intentional movement was facilitated by transmission of an “efference copy” of a motor command to the sensory cortices to predict the new sensory input, so that an error message would be computed by comparison of the expected signal and the received signal. The term “corollary discharge” was used by Roger Sperry (1950) to model similarly the control of the eyes in optokinetic reflexes. We used the term “preaference” (Kay and Freeman, 1998) to describe the process of predicting sensory input by establishing in each sensory cortex a landscape of attractors that expressed the Bayesian prior probabilities of a set of expected future inputs prior to each act of observation.

Despite these broad areas of understanding and agreement enthused by good will, we seldom if ever cited each other’s work. It is instructive to ask: why not? The reason was that in Thomas Kuhn’s (1962) phrases we were working in different paradigms. We were reasoning from differing data sets (he with statistical averages from clinical recordings in patients, I with one-trial, high-density, intracranial
recordings from rabbits – Freeman and Quian Quiroga, 2013); different classical experiments (he from clinical observations, I from classical Pavlovian reinforcement learning); and differing rules of evidence (he localizing functions to brain parts – amygdala, posterior cortex, and so on – I localizing patterns to sites in dynamical brain state space – my K-sets). We each had a self-consistent model expressed in mathematical form for which the other’s experimental data were not conflicting but were irrelevant. The basic ideas were pervasive, but the exploration of the implications in detailed neural mechanisms provided rich fodder for interminable discussions without closure.

Perhaps where we differed crucially was in our respective backgrounds. As a neurobiologist I disagreed with his localization of consciousness to specific parts of the brain or areas of cortex. As a theoretical physicist he perhaps found wanting my applications of nonlinear dynamics and far-from-equilibrium thermodynamics to cortical populations. Ultimately we both remained speechless before what John called “... the sort of inner experience that we do ourselves, as shown by introspection. Such an aspect could never, however, be proved scientifically. It has to be accepted that science cannot enter into the inner life.” He really strongly believed that consciousness is the prime scientific problem, and that David Chalmer’s “hard problem” could be solved, if not by him then by other scientists. I believe equally strongly that, since scientists have no measure by which to confirm the presence of consciousness, the prime question with an answer is “how do brains create an intentional stance, from which consciousness emerges as a form of predictive control?” The further question, what enables this 1.5 kg lump of matter to be aware?, is best left to philosophers, along with questions like “how did the Universe come to exist?”, and “why is there something rather than nothing?” John boldly took shots at those questions, too, with answers that were always informative and entertaining (Taylor, 1993) – and debatable. We miss him.

Titles of books by John Gerald Taylor:

New worlds in physics (1974) Faber UK
Special Relativity (Oxford Physics) (1975) Oxford UP
The Promise of Neural Networks (Perspectives in Neural Computing) (1993)
London: Springer-Verlag
Neural Networks and the Financial Markets Predicting, Combining, and Portfolio

References
Freeman WJ, Quian Quiroga R (2013) Imaging Brain Function with EEG: Advanced
Temporal and Spatial Imaging of Electroencephalographic Signals. New York:
Springer. http://dx.doi.org/10.1007/978-1-4614-4984-3
Helmholtz H von (1879/1925) Treatise on Physiological Optics: Vol. 3. The
1925).
Holst E von, Mittelstädt H (1950) Das Reafferenzprinzip. Wechselwirkung zwischen
during olfactory behavior. Behavioral Neuroscience 112: 541-553.
Kuhn T (1962) The Structure of Scientific Revolutions. Chicago IL: Chicago UP.
Sperry RW (1950) Neural basis of the spontaneous optokinetic response. Journal of
Comparative Physiology 43: 482-489.