A Vast Yet Limited Gift; Werner Loewenstein's New Book, Physics in Mind: A Quantum View of the Brain

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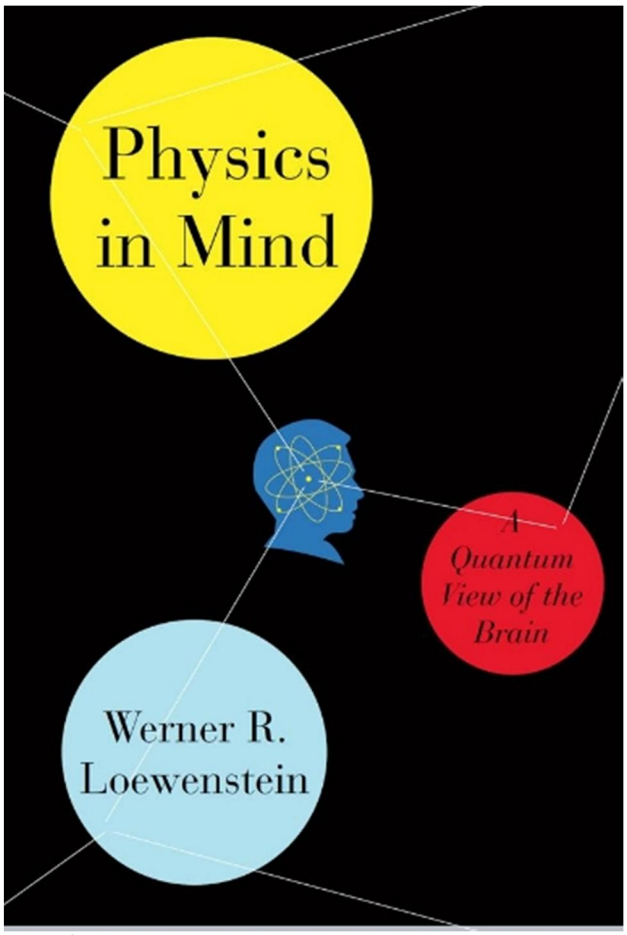
Werner Loewenstein's 2013 book, *Physics in Mind: A Quantum View of the Brain* (New York, Basic Books, 325 pp.), is a welcome and much needed addition to the existing literature on quantum neurodynamics. Professor Loewenstein's qualifications as a principle pioneering researcher into the nature of intercellular communication and as emeritus director of Columbia University's Cell Physics Laboratory lend mainstream gravitas to quantum perspectives on brain function.

In contrast to other authors' prior works concerning quantum physics and the sentient brain, Loewenstein's volume hews much more strictly to experimentally established facts about brain biophysics rather than positing radically new and empirically untested neural substrates for quantum aspects of neurocognition. Only at the end of his text does Loewenstein advance his own tentative hypotheses regarding quantum wetware at the core of mental processes; by the time he makes these suggestions, which are both limited in scope and firmly grounded in known physical chemistry, he has already built up for the reader a background of bedrock knowledge about widely accepted physical principles of neural function in evolutionary context.



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The masterful tour on which Loewenstein's book takes its readers initially encompasses most high points relevant to the classical thermodynamics and statistical mechanics of living systems in terms of evolutionary origins and neural outcomes; many of these matters had already been plumbed even more extensively, albeit with only passing discussion of quantum-related issues, in Loewenstein's 1999 volume The Touchstone of Life: Molecular Information, Cell Communication, and the Foundations of Life (Oxford, Oxford University Press, 366 pp.). Physics in Mind begins by broadly considering classical arrows of time; the book then surveys in particular the transduction of information from DNA in 1 dimensionally coded sequences to protein folding in 3 dimensions, biologically unique free energy economies of computational memory reset by biochemical instantiations of "Maxwell's demon," flows of biophysical power through high-energy phosphates and energy-boosted electrons, and rapid information transmission relevant to neuronal signal propagation via incarnations of Maxwell's demon within cell membrane ion channels. Physics in Mind goes on to present in rigorous fashion established aspects of known mainstream biophysics for which quantum phenomena play an intrinsic though not specifically or uniquely intracerebral role: single photon capture by chlorophyll in photosynthesis and by "tuned" rhodopsin in visual receptors, as well as transformation of quantum processes into molecular information by "G-demons." Finally, Physics in Mind discusses possible candidates for quantum substrates of neurocognition specifically within the central nervous system along with arguments both for and against their scientific plausibility; here both thermal decoherence, familiar from the objections of Tegmark (2000), and the intracellularly restricted location of microtubules are invoked by Loewenstein to argue against the orchestrated coherent tubulin wave function collapse proposed by Penrose and Hameroff (1996), while a dielectric interneuronal membrane lipid substrate supporting coherent states needed for intramolecularly programmable quantum computation is suggested by Loewenstein as a possible alternative to tubulin.

All the above aspects of Physics in Mind are potentially valuable gifts to the future of cognitive neuroscience. However, the virtues of those gifts also imply a significant caveat about their value. This proviso is related to Loewenstein's disciplined limitations on the scope of his own inquiry. He at least implicitly proposes to grapple in terms of neurophysics mainly with the forms of cognitive experience, *i.e.* with the "measurement of meaning" and with relative differences among qualia such as varieties of perceived color; nevertheless, he does not address the brute generic fact of subjective consciousness. Thus, in the end, while Loewenstein's book offers an important signpost of further possible progress in quantitative correlations between neurocomputational structures and qualitatively particular kinds of cognition, his work does little to address the nub of Chalmer's (1995) ever-refractory "Hard Problem." Perhaps philosophers rather than biophysicists are still needed in the ongoing struggle to bridge this "explanatory gap" (Levine 1993).

References

Chalmers D. Facing up to the problem of consciousness. Journal of Consciousness Studies 1995; 2(3): 200-219.

Hameroff S, Penrose R. Orchestrated reduction of quantum coherence in brain microtubules: a model for consciousness? In: S.R. Hameroff, A.W. Kaszniak, and A.C. Scott (Eds.) Toward a science of consciousness - the first Tucson discussions and debates, Cambridge: MIT Press, 1996; pp.507-54.

Levine J. On leaving out what it's like. In: M. Davies and G. Humphreys (Eds.) Consciousness: psychological and philosophical essays, Oxford: Blackwell, 1993.

Tegmark M. The importance of quantum decoherence in brain processes. Physical Review E 2000; 61:4194–206.