have been wiser to integrate this material with that in the first section. Indeed, some of the notation employed in earlier sections is only defined in the final chapters.

Because of the conceptual and pedagogical lapses described above, *Liquids and Solutions*, by itself, is probably not an entirely satisfactory introduction to the liquid state. Nevertheless, the author's experimental approach to the field may make the book a useful supplementary text. Donald A. McQuarrie's *Statistical Mechanics* or Friedrick Kohler's *The Liquid State* are suitable alternatives for this audience. For a more sophisticated treatment, the reader is urged to consider *The Theory of Simple Liquids* by Jean-Pierre Hansen and Ian R. McDonald.

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Neurophysics

A. C. Scott
340 pp. Wiley-Interscience, New York, 1977. $24.95

Sir Isaac Newton, in Book 3 of his *Opticks*, proposed some queries, "in order to a farther search to be made by others." The 24th of these asks, "Is not Animal Motion perform'd by the Vibrations of [the ether], excited in the Brain by the power of the Will, and propagated from thence through the Capillamenta of the Nerves into the Muscles, for contracting and dilating them?" Here is an enthusiastic book for physicists who would make such a "farther search." *Neurophysics* is written from a far-reaching perspective, extending from the membrane level to fiber, neuron, nerve net, and even to the human mind itself. The bulk of the book is a review of mathematical models of nerves, closely following Alwyn C. Scott's article of April 1975 in *Reviews of Modern Physics*.

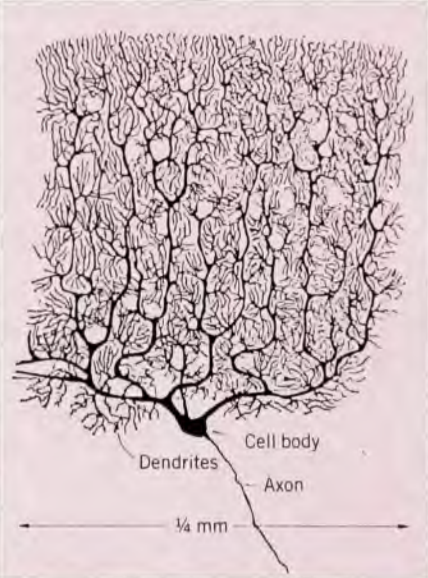
Scott, a professor in the Department of Electrical and Computer Engineering at the University of Wisconsin at Madison and author of *Active and Nonlinear Wave Propagation* (Wiley-Interscience, New York, 1970), writes in the preface that the book evolved from notes for a course attended by students of computer science, mathematics, physiology, physics and zoology, as well as engineering. He feels that it is entirely appropriate that physical scientists play only a minor role in the study of the living brain, but "we still have contributions of value to make."

Neurophysics begins with physical principles—Maxwell's equations—and in the first chapter gives a sophisticated derivation of the nonlinear diffusion equation. The material in this chapter traces its historical origins to Lord Kelvin's cable equations.

The emphasis on mathematical analysis as opposed to biological observations tends to make the book difficult to follow. For example, in chapter 3, "The Active Nerve Membrane," which begins on page 28, the reader only learns of such important experimental facts as the resting potential on page 41 and the ion-concentration ratios on page 42 (the absolute concentrations of sodium and potassium inside and outside the membrane are not given at all). It appears to me that readers not familiar with the subject would do well first to study Alan Hodgkin's readable little volume, *The Conduction of the Nervous Impulse* (Thomas, Springfield, Ill., 1964).

The book introduces the Nernst–Planck equation (although only for sodium ions) implicitly, in terms of the chemical potential. The analysis that follows deals with steady-state sodium currents, although only transient sodium currents are observed in squid axon (potassium ions carry steady curents); perhaps the motivation for this approach should be stated explicitly. On page 36 the constant-field approximation is mistakenly equated with electroneutrality; these are distinct simplifying replacements for Gauss's law and (when used in conjunction with the Nernst–Planck equation) yield different solutions. This material should be supplemented by Tobias Schwartz's review in *Biophysics and Physiology of Excitable Membranes*, edited by William J. Adelman Jr (Van Nostrand Reinhold, 1971).

The usual voltage-dependent conductance is defined and, after presenting a set of voltage-clamp data, Scott proceeds to the Hodgkin–Huxley phenomenological expressions. Despite Scott's remark about "an inevitable (and regrettable) tendency to consider [these equations] as 'graven on a stone tablet,' " the dependence on these, and more generally on voltage-dependent membrane conductances, remains heavy in the book.



A Purkinje cell of the human cerebellum, about ¼ mm across, drawn by Ramon y Cajal. A single nerve cell may communicate with 80 000 other neurons. Reproduced from *Neurophysics*, by A. Scott, reviewed here.

The next chapter begins stimulatingly with mention of the Kolmogoroff–Petrovsky–Piscounoff equation, which despite its origin in genetic diffusion has the form of the nonlinear diffusion equation derived for membranes, with the current density taken as a given function of membrane voltage. This equation was shown to evolve from a steplike initial condition to a solitary wave with constant speed, quite analogous to excitation of a nerve impulse. Scott points out that the equation, $P = uE$, which relates the power P and energy density E to the propagation velocity u, applies as well to the conduction process as to the burning of incense or a candle. He then analyzes the Hodgkin–Huxley equations, in which the constant-velocity propagation condition is assumed rather than derived. He deals with computational difficulties, propagation of the leading edge of the action potential and two simplifications: the FitzHugh–Nagumo equation and the Markin–Chizmadzhev model. There is also material on the myelinated axon, fibers with changing diameter and the decremental conduction of narcotized fibers, the latter leading to an interesting variational approach by the author. The book describes an electronic nerve analog: the neuristor, a superconductive niobium device.

Scott discusses the important questions of stability of solutions and the threshold of excitation, as well as interactions within a single neuron, the dendritic tree of which may accept as many as 80 000 inputs from neighboring nerve cells. After briefly discussing the transmission of information from one nerve to another at synapses, Scott proceeds to the branching of dendrites and axons, which in a drastic simplification may be treated by a Boolean algebra. The assumptions of an all-or-none process, latent addition at synapses and time delays produce the McCulloch–Pitts neuron, which makes a suitable element for neural nets. These nets have become embodied in machines, both conceptual and actual, known as "Perceptrons."

The last chapter deals with the human mind, a subject that appears to be far too broad to be discussed in a meaningful way on the basis of the earlier topics. It asks, and answers in the negative, whether mental characteristics might emerge from the nets of model neurons discussed. The conclusion, bolstered by trendy and mystical quotations, casts doubt on the viability of the scientific enterprise in the area of the mind. Scott makes it clear that he disagrees with B. F. Skinner's view that "Man is much more than a dog, but like a dog he is within range of scientific analysis."

Overall, this book, with its detailed analyses and nearly fifty pages of references, is recommended to students and others interested in the field, but it should be read together with a book that gives a greater appreciation of the experimental findings and that discusses membrane approaches other than that of voltage-dependent conductances—in other words, with K. S. Cole's *Membranes, Ions and Impulses* (University of California, Berkeley, 1968).

H. RICHARD LEUCHTAG

H. Richard Leuchtag, who is associate editor of PHYSICS TODAY, has done both experimental and theoretical work on the biophysics of the nervous system. His work on the application of electrodiffusion theory to nerve membranes has appeared in the Biophysical Journal.

Numerical Methods in Fluid Dynamics

M. Holt
253 pp. Springer-Verlag, New York, 1977. $31.70

The advent of high-speed computers has encouraged the numerical solution of many physical problems of basic and practical interest and of such complexity that would previously be considered untractable. As a result, the subject of computational fluid dynamics has aroused a widespread interest for instruction and research.

Maurice Holt is an aerodynamicist of impeccable credentials, and his new monograph is the outgrowth of his teaching and research of the subject matter at Berkeley and the University of Paris in recent years. It is a welcome addition to the available books in the field, particularly as the only one in the English language that broadly surveys, with adequate depth, the various methods of attack developed in the USSR. Most of these methods, however, are motivated by technical problems in rocketry and high-speed flight, and thus deal with partial differential equations of the hyperbolic or mixed type, which must allow discontinuous solutions to represent the presence of physical shock waves. Consequently, Holt's book is rather more specialized than the title suggests.

The emphasis is on the solution of hyperbolic systems by the finite-difference procedure, although the boundary-layer problem governed by parabolic differential equation is also touched upon. The basic concepts in numerical analysis are briefly reviewed in chapter 1, which is only 27 pages long, half of which is de-