

carrying out the policy of industrialization. Stalin, on the other hand, favored unrealistic targets and brutal methods. Nor was Stalin willing to tolerate engineers' claims to autonomy. Palchinsky was arrested in April 1928 and shot in secret. He was accused of heading a conspiracy of engineers to overthrow the regime. A reign of terror against Soviet engineers followed.

Palchinsky's life underscores vividly the general argument that Graham makes about Soviet engineering projects. The Soviet leaders disregarded the principles that Palchinsky had advocated. Political and ideological imperatives overrode technical advice; vast projects were carried through without regard to human cost. Huge numbers of engineers were trained, but in very narrow specialisms, completely against the spirit of Palchinsky's conception of engineering.

Graham provides a series of brief case studies of Soviet large-scale technological projects—among them the White Sea Canal and Chernobyl. He ascribes the major technological failures of the Soviet period to the regime's rejection of Palchinsky's vision of a harmonious relationship between technology and society. The human costs imposed by the regime in its engineering projects contributed to its collapse.

This superb book distills in a vivid and moving way the results of Graham's many years of research on Soviet science and technology. It deserves to be read by all those interested in the relationship between technology and society.

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A Theory of Perception

Information, Sensation, and Perception.
KENNETH H. NORWICH. Academic Press,
San Diego, CA, 1993. xx, 326 pp., illus. \$59.95
or £46.

The 18th-century philosopher George Berkeley argued that knowledge of the external world is acquired indirectly, on the basis of information provided by the senses, and is therefore necessarily uncertain. In *Information, Sensation, and Perception*, Kenneth Norwich skillfully translates Berkeley's phenomenology into a mathematical theory that considers the process of perception in terms of the nervous system's attempt to maximize the verisimilitude of the sensory picture that it receives.

The theory offers an explanation of the

psychophysical transformations performed by the sensory neuron in response to an external stimulus. The empirical laws of psychophysics, such as those bearing the names of Weber, Fechner, and Stevens, are seen as alternative manifestations of the behavior of single neurons acting in parallel, which thereby provide redundant information to the brain about the nature of the stimulus.

The mathematics is that of information theory, but viewed through the lens of the physicist rather than that of the psychologist or computer scientist. It is assumed that the stimulus population being sampled by the receptor is approximated by a Gaussian distribution; hence the measures used to describe such distributions are developed for the continuous rather than the discrete case. This in no way hinders the model from generating explanations for the empirical channel capacities of sensory systems that have been tested by noting their response to discrete stimuli; nor does it deter the model from achieving the more lofty goal of providing a unified picture of human information processing and psychophysical laws. A single equation is used to derive estimates of empirical indices presumed to reflect perceptual sensitivity, such as the

Weber fraction for stimulus discrimination, the exponent of the power function between perceived and actual intensity, and the inverse relationship between reaction time and stimulus intensity.

Perceptual accuracy, according to Norwich, depends on the ability of the senses to reduce the uncertainty in a variable input and thereby gain information about the precursor to the ensemble of events that constitute the stimulus distribution. This process is relative because the stimulus distribution is always evaluated against an ongoing internal noise or reference distribution of neural events—which leads to some interesting conjectures about the existence of undetectable stimuli produced by the sense organs themselves, though the underlying neurophysiology is not part of the theory. For the broader theoretical structure, as well, Norwich intends to furnish guidelines, not strictures, concerning possible physiological mechanisms.

Norwich's approach is markedly different from that of most theoretical psychologists working in the fields of perception and psychophysics. The departure is most striking in the treatment of perceived magnitude, which is thought by Norwich to depend on the variance of the stimulus



Vignettes: The Science of Humans

Ordinary people, mere social actors, average citizens, believe that they are free and that they can modify their desires, their motives and their rational strategies at will. The arrow of their beliefs now goes from the Subject/Society pole to the Nature pole. But fortunately, social scientists are standing guard, and they denounce, and debunk and ridicule this naive belief in the freedom of the human subject and society. This time they use the nature of things—that is the indisputable results of the sciences—to show how it determines, informs and moulds the soft and pliable wills of the poor humans. "Naturalization" is no longer a bad word but the shibboleth that allows the social scientists to ally themselves with the natural sciences. All the sciences (natural and social) are now mobilized to turn the humans into so many puppets manipulated by objective forces—which only the natural or social scientists happen to know.

—Bruno Latour, in *We Have Never Been Modern* (Harvard University Press)

I think it must be admitted that our society has become a little more humane in a number of large ways, and in a myriad of details, because of inquiries and teachings of the social sciences which work to systematize compassion, to make human concern less sentimental, more effective. We are a little more efficient at counseling and consolation, we are a bit more regardful of the claims of mutual respect, sojace, support, and sympathy in companies, hospitals, schools, and courts of law, when we are told that this is a matter not only of religious or human commitment but simply of best practice, of appropriate technique, for which evidence can be adduced.

Charles W. Anderson, in *Prescribing the Life of the Mind: An Essay on the Purpose of the University, the Aims of Liberal Education, the Competence of Citizens, and the Cultivation of Practical Reason* (University of Wisconsin Press)

distribution rather than on its mean. More particularly, Norwich assumes variability at the receptor level to be a power function of mean intensity; thus, while it is understandable why psychophysical laws are expressed in terms of measures of central tendency, this practice is misleading, since it is the change in variance, not the change in mean, that drives the perception of magnitude. One light is perceived as brighter than another because of differences in their entropy or uncertainty: the variability engendered by the bright stimulus is greater than that engendered by the dim one.

Another distinctive feature of this book is the absence of any discussion of the role of contextual and cognitive variables. Through a bottom-up approach Norwich competently treats the physical half of psychophysics while leaving to others the task of addressing the well-known influence of psychological factors. Regardless of whether or not the theory incorporates all the key issues of perception, this book affords us clear insight into the style of reasoning required to see the empirical laws of perception as the natural outcomes of a common, unified theory. Berkeley would have liked it.

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“Organic Technology”

Molecular Nonlinear Optics. Materials, Physics, and Devices. JOSEPH ZYSS, Ed. Academic Press, San Diego, CA, 1993. xvi, 478 pp., illus. \$105 or £81. Quantum Electronics.

Nonlinear optics emerged as a field of study soon after the realization of the ruby laser. Most of its fundamental physical principles, which concern the propagation characteristics of high-intensity light beams, were established during the 1960s. It is now known that the electronic motion induced by electromagnetic fields of high amplitudes is not strictly proportional to these amplitudes. According to perturbation theory, quadratic and cubic nonlinear polarizations may be introduced which are, respectively, quadratic or cubic functions of the amplitudes of the prevailing light waves.

During the '70s, several prototype nonlinear optical devices were developed. Harmonic light generators provided coherent beams in the ultraviolet, optical parametric downconverters served as tunable infrared coherent oscillators, and great progress was made in the development of picosecond and femtosecond pulse generators. Micro-

wave electro-optic modulators and nonlinear propagation studies have contributed to the successful development of optical fiber communication systems. Further progress in all-optical switching techniques and in holographic memory storage and read-out devices will broaden the range of optoelectronic applications.

The field of nonlinear optics has always benefited from a close interaction between physicists and electronic engineers. During the '70s it was discovered that organic materials with long conjugated chains exhibited nonlinear susceptibilities of exceptionally large magnitude. Stimulated by the potential technological payoff, another category of scientists, the chemists, joined the nonlinear optical enterprise. Organic and polymeric materials hold considerable promise for nonlinear optical devices. They can be grown in single crystals or spin-coated to form optical waveguides, which may be integrated with semiconductor laser devices.

Joseph Zyss, coeditor of a 1987 book entitled *Nonlinear Optical Properties of Organic Molecules and Crystals*, has now compiled a new volume that reviews additional developments in the field during the past decade. *Molecular Nonlinear Optics* is intended for readers who are already familiar with the basics of nonlinear optics. It provides a fascinating overview of the large enterprise undertaken jointly by physicists, chemists, and optoelectronic engineers to develop organic and polymeric materials suitable for device applications, including harmonic up-conversion of the output of semiconductor lasers, microwave electro-optic modulators, and all-optical switching devices.

The book is divided into three parts: Fundamentals, Nonlinear Optics in Molecular Media, and Nonlinear Optics in Polymeric Media. “Fundamentals” may be a misleading title for the first part, which covers two special topics not specifically restricted to organic materials. One chapter treats theoretical advances in the nonlinearities of spatially extended excitons influenced by nonlocal many-body effects; the other describes advanced experimental techniques for time-resolved nonlinear spectroscopy.

The remaining chapters run the gamut from basic physical properties through the chemical design of polymeric materials to device configurations using crystalline or polymeric waveguiding films. Considerable attention is paid to poled polymers and their stability. Each chapter is self-contained and is followed by a comprehensive list of references.

Although all the chapters are clearly written, I found Shen's contribution on the orientation of organic molecules at an air-

water interface particularly enjoyable to read. The technique of second-harmonic generation is capable of providing detailed information about surface configurations. It is unfortunate that Shen was unable to include his more recent results based on sum-frequency generation of infrared and visible light beams; it is hoped that another review of the fertile topic of interface configurations will be forthcoming in the near future.

In the preface to this volume Zyss states, “While it may still be premature to predict the nature and extent of application breakthroughs in this field, the last decade has undoubtedly seen molecular nonlinear optics acquire full-fledged scientific status with recognition from both physicists and chemists. . . . This book will have fulfilled its dual goal when supplying state-of-the-art information to the benefit of currently committed scientists while helping renew the field by attracting needed future contributors.” I am confident that this goal will be reached. I recommend the book to active researchers in this branch of nonlinear optics as well as to anyone who is considering entering the field.

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Adverse Events Associated with Childhood Vaccines. Evidence Bearing on Causality. Kathleen R. Stratton, Cynthia J. Howe, and Richard B. Johnston, Jr., Eds. National Academy Press, Washington, DC, 1994. xvi, 464 pp. \$49.95.

Agriculture, Environment, and Health. Sustainable Development in the 21st Century. Vernon W. Ruttan, Ed. University of Minnesota Press, Minneapolis, 1994. viii, 401 pp., illus. \$44.95; paper, \$19.95. Based on a conference, Bellagio, Italy, Oct. 1991.

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