Physics via France

Time Reversal. An Autobiography. ANATOLE ABRAGAM. Clarendon (Oxford University Press), New York, 1989. viii, 373 pp. + plates. $39.95. Translated from the French edition.

In the fall of 1945 Edward Purcell, Robert Pound, and Henry Torrey detected the nuclear magnetic resonance response of protons in paraffin at Harvard and, essentially simultaneously, Felix Bloch, William Hansen, and Martin Packard registered those of protons in water at Stanford. Since then advances in NMR spectroscopy have revolutionized chemical and biochemical analysis and, more recently, medical diagnostics. The instrumental developments stemmed principally from the availability of ever stronger and stabler magnetic fields through the use of superconducting materials; from the significant lowering (to the millikelvin range) of the working temperatures available in the laboratory; from improvements in electronics; and, perhaps most important, from advances in computing. The interpretation of the data obtained from the newer high-resolution NMR instruments was made possible by the continuing refinement of the theory. Anatole Abragam and the laboratory he directed at Saclay near Paris were important contributors to both the experimental and the theoretical advances in the field. Abragam's *Principles of Nuclear Magnetism*, first published in 1961, has become a classic. It helped unify the field and has trained several generations of NMR investigators.

Abragam's work in physics combines Gallic elegance with Anglo-Saxon practicality. As *Time Reversal*, his autobiography, makes clear, he is in part a product of both these cultures. Born in Russia, he emigrated to France when ten years old. Being bright and competitive, he did well in the French school system and initially opted for a career in medicine; but this was at the expense of following a track that would have led to one of the Grandes Ecoles, something he has regretted ever since. The lectures he had to listen to in chemistry and physiology quickly changed his mind about medicine. He shifted gears and went to the Sorbonne to attend uninspiring lectures in physics and mathematics, drifting in and out of several physics laboratories because of lack of guidance. Abragam paints a dismal but undoubtedly accurate picture of the state of French physics before the war. After the war, a scholarship at the Ecole Supérieure d'Electricité (Supelec) and a position at the newly created French Commissariat à l'Energie Atomique (CEA) gave him a second start in physics. In 1947 he went to the Clarendon Laboratory in Oxford, where he earned his doctorate working with Maurice Pryce and Brebis Bleany on problems in the theory of paragmagnetic electron spin resonance. These two years in Oxford were the happiest of his life: he proved himself a first-rate theorist and gained the approval and self-confidence that had eluded him earlier. A fellowship at Harvard in 1952–53 brought him in contact with Purcell, Pound, and John Van Vleck and introduced him to NMR. He went on to solve important problems in the theory of perturbed angular correlations, ESR, and NMR. His assuming the directorship of a newly created NMR laboratory at the CEA in Saclay in 1955 allowed him to combine his expertise as a theorist with his considerable talents as an experimentalist. The contributions of Abragam and his collaborators to elucidating dynamic nuclear polarization in liquids and solids and nuclear pseudomagnetism, to proving nuclear antiferromagnetism, and in making polarized targets for high-energy experiments established his laboratory as one of the outstanding NMR centers in the world. These accomplishments earned him the respect and acclaim of his disciplinary colleagues and paved the way to a professorship at the prestigious Collège de France, to the directorship of physics at the CEA, and to his election to the Académie des Sciences as well as numerous foreign honors.

Time Reversal (though its title in French is *De la Physique avant Toute Chose*) is not a history of NMR, nor does it pretend to be. Nonetheless, it presents many thoughtful insights into this history. Similarly, it offers intriguing glimpses of the workings of the French higher educational system, the French atomic energy establishment, the Collège de France, and the Académie; interesting assessments of some of the physicists Abragam has come in contact with (among them Lew Kowarski, Francis Perrin, Louis de Broglie, and Claude Bloch, as well as those mentioned above); and comments on big and little science, fundamental research, and the relation between experimental and theoretical physics. (Some of these last topics are treated more succinctly in Abragam's *Reflections of a Physicist* [Oxford University Press, 1986].)

The importance of the book would have been enhanced by a fuller and more thoughtful description of Abragam's management of the CEA physics. One also would have welcomed more about what it meant seemingly always to be an outsider: first as a Jew in Russia, then as a Russian and a Jew in France, then as a graduate of Supelec and as an Oxonian Ph.D. in enterprises dominated by Normaliens and Polytechniciens (the CEA and the Collège). Abragam is much more revealing and introspective when he writes about his Russian upbringing and its legacy and when he discusses the influence of Pushkin and other Russian poets on his aesthetic life. The book has a different tone when he talks of his visits to Russia and Russian culture.

The most interesting part of *Time Reversal* is Abragam's description of his life before going to England and his seeming lack of accomplishment until he was well into his 30s. The fortuitous way he got to work with Pryce and into magnetism is astonishing. The story of late blooming is most refreshing. But the autobiography suffers from the fact that Abragam does not succeed in linking its various parts into a coherent whole. The last part of the biography is cluttered with irrelevant anecdotes about famous scientists.

Abragam admits that his various chapters are not "overflowing with the milk of human kindness" (p. 290). In places the book leaves one somewhat uncomfortable and reveals an apparent obsession with Nobel prizes, status, and hierarchies that is not unusual with eminent scientists but is not often expressed so openly in autobiographies. More important, one is left frustrated because important questions that Abragam could help answer are not addressed: What was the relationship between Abragam's work and what came before and after? What accounts for the success and impressive productivity of the postwar French scientific establishment, given its fragmented and impoverished prewar condition?

ALFRED REDFIELD
Department of Biochemistry and Physics, Brandeis University, Waltham, MA 02154
SILVAN SCHWEBER
Department of Physics, Brandeis University, Waltham, MA 02154

Water and Global Warming

Climate Change and U.S. Water Resources. PAUL E. WAGGONER, Ed. Wiley-Interscience, New York, 1990. xvi, 496 pp., illus. $69. Wiley Series in Climate and the Biosphere.

Uncertainty makes all planners, managers, and engineers uneasy. To their credit, water resource professionals have, more than some, faced up to uncertainty. They have devised rules of thumb and statistical criteria that make it possible for them to deal with it systematically as they go about planning and building water supply systems, flood control projects, navigational waterway improvements, and so on. By using historical records in conjunction with such concepts as maximum probable flood, drought return period, safe yield, mass curves, and extreme event, the uncertainty inherent in natural phenomena like the hydrologic cycle can be quantified and handled in a consistent fashion. The uncertainty is not reduced, but neither is it ignored.

Climate Change and U.S. Water Resources is intended to capture the attention of the water resource community by calling into question not the concepts of uncertainty assessment but the reliance in their application on the assumption that the past is prologue. Its theme is that the future is not what it used to be and that climate change must be anticipated if water resource systems are to be managed effectively and planned wisely.

The book, the product of a panel of the Committee on Climate of the AAAS, takes as its starting point the consensus that warming will follow the continuing increase in the concentration of carbon dioxide and other heat-trapping gases. Specifically, the panel begins with the assumption that a doubling of carbon dioxide is likely to lead to an increase in the average global temperature of 2° to 5°C, an increase of 7 to 15 percent in precipitation, and a rise of 10 to 100 centimeters in sea level.

The first three papers set the stage. The initial paper reviews current and projected water use, assuming no climate change. The second reminds us of the limits of climate change predictions, and the third discusses problems of decision-making with imperfect information. For those concerned with policy, the most important observations are that previous water demand forecasts have been notoriously poor, even when not blurred by the prospect of climate change (Waggoner and Schefter); that a schism exists between atmospheric scientists who prefer to avoid making detailed forecasts and policy analysts who insist on high levels of resolution on a regional scale (Schneider *et al.*); and that the uncertainty associated with