work has identified the toxic material and shown it to be identical to the poison of the Japanese puffer fish, tetrodotoxin, a neurotoxin that is also a useful tool for the study of conduction in nerve fibers.

Embryological work on newts in the laboratory led to questions about species and to experiments on cross fertilization in vitro. It was not initially possible to raise the hybrids to maturity in the laboratory, so it was decided to let nature do the job. A "newt ranch" was opened near Pepperwood Creek in Sonoma County, California, and in this admirable setting it has been possible to study the homing behavior, longevity, and breeding habits of the newts. The first mature hybrid was not caught for six years, and, perhaps justifiably, the student who found it was "insufferable for days."

The book includes descriptions of social interludes such as one in a Berlin night spot where "well endowed young women in their full epidermal glory" were observed. The whole book is written in an entertaining manner, and at the same time the author's research is well set out, with conclusions clearly summarized at the end of each section. There is a bibliography of over 100 references.

Of Scientists and Salamanders reminds us that science should be enjoyable. As "big" science and the "monkeys and typewriters" approach to research become more prevalent, the potential pleasures of a more personal approach tend to be forgotten. I would therefore especially recommend the book to young people contemplating careers in science in the hope that they may learn to expect fun from their work.

[As this goes to press, word has been received of Dr. Twitty's death.]

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Autobiography of a Mexican Physiologist

Desde un Alto en el Camino. Visión y Examen Retrospectivos. J. JOAQUÍN IZQUIERDO. Ediciones Ciencia, Mexcio, D.F., 1966. 542 pp., illus. $10.

José Joaquín Izquierdo, now emeritus professor of physiology at the great national university of Mexico, has, in spite of political and other obstacles, been instrumental in establishing a high standard for physiology and biomedical science in Mexico, and indeed has influenced the development of these sciences throughout Latin America. With his wide international friendship among physiologists and scientific leaders, he presents, in his richly illustrated and documented autobiography, an admirable picture of the development of the life sciences not only in his own country but throughout the world.

Izquierdo was born in 1893 of a distinguished family in Puebla. It is astonishing that he describes in detail the 93 texts which comprised his collegiate training there. This documentation well illustrates the relatively high quality of collegiate training in provincial Mexico at the time. Izquierdo received his medical training at Puebla and in Mexico City. Again, he gives a careful account of his training, and his illustration from the 80 required texts he used shows the breadth of his studies. Greatly moved by the ideals of the Mexican Revolution, Izquierdo determined to devote himself to the improvement of medical training in his country. He began his career with a report on studies of malaria in Puebla and, with an excellent library at his disposal, he cautiously began laboratory experimentation. In 1918 he undertook his first physiological demonstrations in Mexico City, finally, in 1923, winning approval from the Mexican National Academy of Medicine for conventional physiological investigation.

He came to the United States under the auspices of Richard Pearce of the Rockefeller Institute, studying there as well as at the Cornell Medical School, the University of Pennsylvania, the Johns Hopkins University, and Harvard. In 1925 he became an assistant to Walter B. Cannon, and this association influenced his entire subsequent career. From Harvard he went to England, where he worked with Joseph Barcroft and Lord Adrian. He became acquainted with all the leading British physiologists and through them met Pavlov, as well as the leading physiologists in Belgium, France, Germany, and Spain. The influence of Corneille Heymans was promptly reflected by Izquierdo's publication of several papers on carotid sinus reflexes.

On his return to Mexico he prepared, with the help of Walter Cannon, a laboratory course in physiology which gradually developed into an outstanding teaching program. He was active in promoting an appreciation of the importance of a scientific background for the health professions. Meanwhile, Izquierdo's historical interests were aroused, and he published a series of accounts of the early development of medicine in Mexico. In order to acquaint his students with the classics of physiology he translated Harvey's *De motu cordis* and published it together with an inspiring account of Harvey's career. He also issued an outstanding appreciation of Claude Bernard, whom he regarded as the founder of scientific medicine. During World War II, Izquierdo was increasingly visited by outstanding physiologists from all over the world. For the benefit of his students he gathered, at his own expense, a large, first-class library in physiology and in the history of philosophy and medicine. He adorned his laboratory with pictures and bronzes of medical greats. A patron of the arts, he has also written wisely and well on many of the artistic treasures associated with medical history.

It is clear that Izquierdo has really enjoyed his busy and brilliant career. His 18 books and dozens of technical papers testify to his intellectual leadership. He is, moreover, a delightfully friendly person. He has continually emphasized the high ideals of the health professions, and in his own career he has certainly pushed close to their attainment.

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Mathematical Physics

The Analytic S-Matrix. R. J. EDEN, P. V. LANDSHOFF, D. I. OLIVE, and J. C. POLKINGHORNE. Cambridge University Press, New York, 1966. 295 pp., illus. $14.

For about the past dozen years, theoretical physicists concerned with high energy phenomena and elementary particle physics have been carrying on a torrid love affair with complex variable theory. It all began innocently enough when it was found that a generalization of the well-known classical relation between real and imaginary parts of the index of refraction of an optical medium led to interesting results in the quantum theory of scattering. Specifically, it was noticed that the real part of the amplitude describing the scattering of light by a target (an atom, a nucleus, a proton) evaluated in the forward direction (scattering through zero degrees) could be expressed as an integral over the imaginary part of the amplitude. The latter, in turn, is directly related to the total probability (called the cross-section) for removal of the light from a beam, an experimentally measured quantity. This relation between real and imaginary parts of a function is well known in mathematics as a Hilbert transform and exists whenever one is dealing with an analytic function with certain boundedness properties; hence the initial enchantment with complex variable theory of a rather elementary kind.

It was soon found that these relations, known in the trade as dispersion relations, could be generalized to describe not only light scattering but also scattering of particles with mass, such as pi-mesons and nucleons. They provided presumably exact conditions on scattering amplitudes and were directly related to experimentally measured quantities. There were several reasons for the popularity of dispersion theory: First, the quantum field theory from which it was derived has proved so resistant to explicit quantitative calculations in the regime of strongly interacting particles (mesons and nucleons) that it was gratifying to prove general consequences of the theory without being able to solve it explicitly. Second, dispersion relations, dealing as they do with measurable quantities, lend themselves to useful ways of thinking about theoretical questions and suggest reasonable approximations and relations between various processes in a phenomenological sense. Third, from the very beginning there appeared the possibility that the whole of relativistic quantum mechanics could be studied independent of quantum field theory, some of its diseases and complications being thereby avoided.

It is this third aspect that forms the basis of the present book. If one imagines a giant matrix, called S, with the rows and columns labeled by all possible particles in all possible configurations (momenta, spin, and so on), then the probability of a reaction column label → row label is proportional, essentially, to the absolute square of the corresponding element of the matrix. One hopes to study these matrix elements regarding them as analytic functions of the variables describing a given process. For example, in a two-particle scattering process these variables might be the total energy of the system and the momentum transferred from the projectile to the target.

The authors of this book make no pretense at a presentation of an axiomatic S-matrix theory. They utilize fully the laboratory of the perturbation expansion of quantum field theory as a guide to the sort of analytic behavior that can be rationally expected in order to eventually develop axioms. This type of "experimental physics" is a highly developed mathematical art and is very clearly presented. One is concerned here with the analytic properties of multiple integrals as a function of several complex variables, and one is led to questions frequently studied by very sophisticated mathematics (topology, homology theory), although the methods used here are well within the grasp of most theoretical physicists. A very complete analysis of the singularity structure of S-matrix elements in perturbation theory is given.

The high-energy behavior of scattering amplitudes is studied by means of the analysis of perturbation theory just described, and the connection to singularities in the complex angular momentum plane is brought out.

The final portion of the book is concerned with an exposition of the analytic structure of S-matrix elements that can be deduced from some simple assumptions (based on the knowledge gained from perturbation theory) and the exploitation of the so-called connectedness structure of the theory and the principle of unitarity, a consequence of probability conservation. This portion of the book is too technical to describe here. It deals with rather deep questions such as the role of unstable particles and the concept of causality in an S-matrix theory.

This book, although intended for a rather specialized audience, is well and carefully written and should be very useful to serious mathematical physicists.

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Nonmetals

The Chemistry of the Non-Metals. William L. Jolly. Prentice-Hall, Englewood Cliffs, N.J., 1966. 159 pp., illus. Cloth, $5.50; paper, $2.50.

This book is written for use with beginning students. As the author writes in the preface, it is "an introduction to, and a compendium of, the chemical compounds of the non-metals," by which the author means hydrogen, boron, carbon, silicon, germanium, nitrogen, phosphorus, arsenic, antimony, the chalcogens, the halogens, and the noble gases, 24 elements in all. The most striking feature of the book is its success in the inclusion of a "compendium" in such a small number of pages. This success is due in no small part to the author's emphasis on the most recent (post-World-War-II) chemistry of the elements, to the virtual neglect of the more classical chemical properties. One can almost hear the groans of industrial chemists reading this book and assuming, erroneously, that this is all that their successors will know about the nonmetals. For example, the only mention of the ability of hydrogen to reduce metal oxides is as a means for analytical determination of hydrogen gas by weighing the water produced by its reaction with copper(II) oxide. As a second example, the chapter on boron devotes ten pages to hydrides and derivatives, covering the remainder of boron chemistry in four pages.

For those who entertain the idea of using the book with beginning students, one small obstacle should be mentioned. The author presumes a familiarity with the language of chemists which is not universally achieved by students at the end of their third year of chemistry. Understanding of hydrogen bonding, of Gillespie's delightful electron-pair repulsion theory for predicting stereochemistry, of the significance of nuclear equations—${}_3Li^6(n, \alpha)_1T^3$, for example—and of how to use oxidation potential diagrams are all prerequisites for the use of this book. The student is obviously presumed to have had a fairly sophisticated introduction to "the chemical bond" prior to using this book. Thus for beginning students of sophisticated background, this book is certainly to be recommended highly.

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