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the analysis of many of the contrast details in the electron microscope, which are generated by strain fields of dislocations, relies heavily on Ewald's conceptual description of two-beam dynamical interactions, including anomalous absorption (the Borrmann effect). An offshoot, the Ewald sum procedure, was originally invented to calculate the electrostatic energy of an ionic crystal and is widely used, for instance, in modern band-structure calculations.

For 60 years Ewald was a prime mover in x-ray crystallography. His book *Kristalle und Röntgenstrahlen* (1923) gave the first comprehensive treatment of the subject, while *Fifty Years of X-Ray Diffraction* (1962) surveyed the mature field. Together with C. Hermann he founded *Strukturbericht* (first published in 1931), a collection of results on crystal structures, which, with its successor volumes *Structure Reports*, is the standard structure-data repository for industry and science. The *International Tables*, also conceived by him in the 1930s, set the uniform nomenclature, units and standards for the specification of these data. After World War II, Ewald initiated *Acta Crystallographica* and acted as one of its chief editors from 1948 to 1959. He was president of the American Crystallographic Association for 1951-52.

Ewald was very much concerned with the international character of his science. After World War II he was instrumental in reestablishing the International Union of Pure and Applied Physics, serving as its first secretary-general and later as vice-president. He was instrumental in founding a separate International Union of Crystallography, of which he served as president for some time.

The success of these diverse and wide-ranging science-policy initiatives rested largely on Ewald's personal qualities as a scientist of high vision and standards and as a diplomatic and convincing negotiator, but ultimately on his disarming honesty and modesty. To his students and colleagues he was not only a window into the larger world of science and the intellect, but also a model physicist in his scrupulous search for the physically correct and lucid formulation of ideas. He was equally demanding in his insistence, honed by long years as an editor, on the precise language in which these ideas were to be expressed. At the same time, he always enjoyed his science and was delighted when progress was made, either by himself or by others. He remained receptive to new ways of thinking and was ready to get them a fair hearing when normal processes for doing so broke down. Finally, there is no better testimony to his personal

qualities—harmoniously complemented by those of his wife, Ella—than their enormous international circle of friends, who made the Ewald residence, wherever it was, an eagerly sought-out stopover point for travelers from far and wide.

In 1979 Ewald received the first Gregori Aminoff Medal of the Royal Swedish Academy, in honor of his lifelong accomplishments. In 1985 IUC established the Ewald Prize, which will be awarded for the first time in 1987 (see page 81).

In his late eighties, Ewald told one of us that he would like to "finish his doctor's thesis" by finding a way to deduce the structure of a crystal directly from the intensities of the x-ray diffraction spots. He would have been delighted that the 1985 Nobel Prize in chemistry was awarded to Jerome Karle and Herbert Hauptman for finding a solution to this problem.

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Maurice A. Biot

Maurice A. Biot died peacefully at his home in Brussels on 12 September 1985. Biot was born in Belgium in 1905, and obtained degrees in electrical engineering, mining engineering and philosophy as well as a DSc (1931) at the University of Louvain. At Caltech, where he received a PhD in aeronautical sciences (1932), he was first a student and then a collaborator of Theodore von Kármán, with whom he wrote a classic textbook, *Mathematical Methods in Engineering*. He taught at Louvain, Harvard and Columbia. At the outbreak of World War II he enlisted in the US Navy, for which he did work on the theory of explosions and armor penetration. After the war he was briefly on the faculty of Brown University.

The largest and probably most significant portion of Biot's research dates from the years after 1950, when he became an independent consultant and worked for Shell Development, Cornell Aeronautical Labs, sundry government agencies and, most recently, Mobil Oil. He was elected to the US Academy of Engineering and the Royal Academy of Sciences of Belgium, and held several

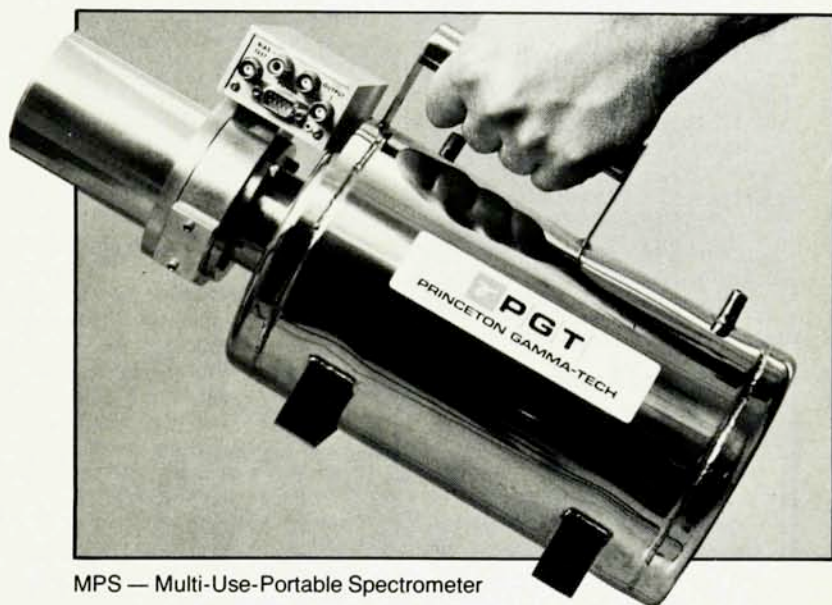
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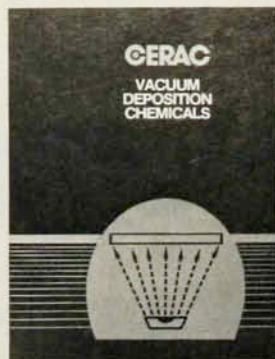
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Sam B. Treiman, Roman V. Jackiw, Bruno Zumino, and Edward Witten

Current algebra remains our most successful analysis of fundamental particle interactions. This collection of surveys on current algebra and anomalies is a successor volume to *Lectures on Current Algebra and Its Applications* (Princeton Series in Physics, 1972). The first two articles, "Current Algebra and PCAC" by Sam B. Treiman and "Field Theoretic Investigations in Current Algebra" by Roman V. Jackiw, were originally delivered as lectures at the Brookhaven Summer School in Theoretical Physics in 1970. The next two, "Topological Investigations of Quantized Gauge Theories" by Professor Jackiw and "Chiral Anomalies and Differential Geometry" by Bruno Zumino, have been revised from lectures at the 1983 Les Houches Summer School. The remainder of the work consists of research articles by William A. Bardeen, Professor Zumino, Edward Witten, and L. Alvarez-Gaume.

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BIOT

aeronautical patents.

As an applied mathematician and physicist, Biot was a master of variational techniques, operational methods and numerical approximations. He had the rare talent of taking seemingly complex problems, finding the essential concepts and coming up with invariably useful, and frequently brilliantly simple, theories. One thinks in particular of:

► His elegant work on elasticity and stability problems in prestressed elastic and viscoelastic media, begun in the 1930s and culminating in 1965 with a monograph entitled *Mechanics of Incremental Deformation*. This monograph gave, among other things, the details of a powerful and original method for treating the onset of folding in layered geologic structures.

► His theory of wave propagation in fluid-saturated porous elastic solids. Published almost 30 years ago in the *Journal of the Acoustical Society of America*, it has in the last ten years or so proved enormously valuable in describing quantitatively the damping of oceanic sound waves interacting with bottom sediments.

► His variational treatment of heat-transfer and irreversible-thermodynamics problems, which resulted in two recent monographs.

Biot published close to 200 research articles and books on elasticity theory, thermodynamics, applied mathematics, soil mechanics, wave propagation and scatter, wing flutter, geophysics and seismology. In these times of extreme specialization such breadth of competence is, to say the least, uncommon. Equally unusual was his ability to produce so much first-rate research while working outside the academic establishment, without students and essentially alone. His was a great and unique talent.

Biot's friends will long remember him as a brilliant conversationalist, an

amusing and articulate polemicist interested in all the great technical, social and political issues of our turbulent era. It was my great privilege to have been his friend for many years.

IVAN TOLSTOY

Knockvennie, Castle Douglas, SW Scotland

Frank Harold Spedding

Frank Harold Spedding, professor emeritus at Iowa State University and founder and director emeritus of the Ames Laboratory of the US Department of Energy, died on 15 December 1984 in Ames, Iowa, at the age of 82.

Spedding was born on 22 October 1902 in Hamilton, Ontario, Canada. He moved to the United States with his family a month later, and became a naturalized US citizen through his father. He received his MS from the University of Michigan in 1926 and his PhD in chemistry from the University of California at Berkeley in 1929. He remained at the University of California as an instructor of chemistry (1929-30 and 1932-34) and as a National Research Council fellow (1930-32). In 1935 he went to Cornell University as George Fisher Baker Assistant Professor. Spedding joined the Iowa State University faculty as associate professor of chemistry in 1937, advancing to professor of chemistry in 1941. He was additionally named professor of physics (1950), professor of metallurgy (1962, in what is now the department of materials science and engineering) and Distinguished Professor of Sciences and Humanities (1957). Spedding served as director both of the Iowa State atomic project (1942-47) and of the Institute for Atomic Research (1945-68). He was director of the Ames Laboratory of the US Atomic Energy Commission (now of DOE) from its inception in 1947 to his retirement from administrative duties in 1968. Spedding formally retired as a professor in 1973, becoming professor emeritus at that time.

Spedding was an internationally recognized expert on the rare-earth and related elements, initially pioneering crystal-field spectroscopy with these elements and eventually extending his contributions to all aspects of their chemistry, physics and metallurgy. His major accomplishments in this area included the separation of the pure rare earths on a large scale by displacement ion-exchange chromatography and the preparation of all of the pure rare-earth metals, also on a large scale. This led to a burgeoning worldwide use of these elements, both for research and for application, stimulated in many cases by ultrapure and excellently characterized samples furnished by Spedding's laboratory. Re-

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