Memorial to Felix Chayes 1916–1993

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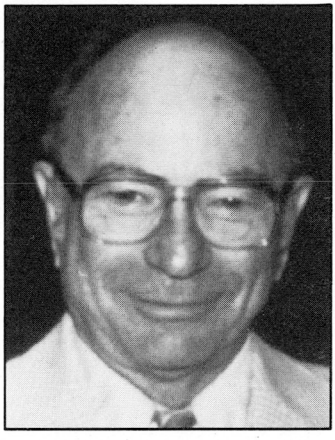

The fruitful scientific career of Felix Chayes ended with a car crash not far from his home in Kensington, Maryland, in January 1993. He died in the hospital the following month.

Felix was born in New York City on May 10, 1916, and went to New York University in 1932 to study law but changed to geology. He was elected to Sigma Xi and Phi Beta Kappa, and after receiving his B.A. in 1937 he went on to Columbia University for an M.A. degree, awarded in 1939. There he encountered Professor S. J. Shand, who became his mentor. He worked on the alkaline rocks of the Haliburton-Bancroft area of Ontario and received his doctorate in 1942. The combination of his own searching mind with Shand's wide and deep understanding of many igneous processes and how they should be interpreted in chemical and quantitative terms became the prime factor that molded Felix's career.

Felix's first job was as chemist for Gillis & Pawel Metal Company in Webster, North Carolina, in 1941. In the same year, he married Irene Hendry. Then with the demands of World War II increasing, he moved to Washington to take the post of mineral-economist with the War Production Board (1941–1942). Following that, he became chemist-petrographer with the U.S. Bureau of Mines at College Park Station in Maryland until 1946, and then spent a year as petrographer to the Manhattan Project at the Massachusetts Institute of Technology.

In 1947, he moved to the Geophysical Laboratory of the Carnegie Institution of Washington, after Dr. Adams, the laboratory's director, had been deeply impressed by a report Felix wrote on the application of statistical methods to petrological data. Thus began an association, lasting almost 40 years, that was to have a profound impact on all petrologists. During this era, Felix wrote two books and more than 100 papers. The articles he contributed to the *Annual Report of the Geophysical Laboratory* reveal the planning and incisive thinking that Felix put into every topic he tackled. His work attracted international acclaim; he lectured across the United States and abroad, and was honored with the ninth Krumbein Medal in 1984 from the International Association of Mathematical Geology. Almost single-handedly he had injected powerful shots of quantitative appraisal into a petrological community that was reluctant to delve into anything prefixed with a $\sum$, an equation in x and y, or in which the words "statistical covariance" appeared.

At the Geophysical Laboratory, he developed his two passions: granites and statistical analysis of petrological data. He collected New England granites with an enthusiasm for good grid sampling, even taking chips from the base of a local noteworthy's statue situated statistically correctly in the middle of town.

Felix's war work entailed estimating the proportions of minerals in rocks; thus, an integrating microscope stage was one of his first requirements on joining the Geophysical Laboratory. This led to his frequently cited 1949 paper, which, with its successors (e.g., 1951, 1956, and others not listed here) proved to petrologists that getting numbers from rocks could be simple and

most valuable, if treated properly. The difficulty of distinguishing K-feldspar from untwinned plagioclase during point counting engaged his chemical knowledge, and he developed the now widely used staining technique (1952).

The Geophysical Laboratory was proud of its new recruit and quickly confirmed him as a staff member. He delved deeper into the realms of statistical petrology, showing among other things the shortcomings of papers based on inadequate or biased sampling and exposing the "constant sum" problem of many Harker variation diagrams (1962). Few dared to join him in the mathematical approach to petrology; on the whole he was a lone pioneer, applauded from the sidelines.

At the same time and more in keeping with Geophysical Laboratory traditions, he studied the X-ray diffraction effects of short-range ordering in layered sequences. This arose from his observation that certain subsidiary reflections in the X-ray patterns of some intermediate plagioclases were proportional to the ordering of Al atoms in the lattice (1959).

He was interested in the New England granites, and his point-counting studies revealed the poor state of the classification of granites. Turning, as he always did, to study the literature, he found that one person's granite was another's adamellite, to the extent that two people talking might not realize they were both talking about the same thing. So he devised a more logical classification (1957), but his use of symbols rather than words for his classes and subclasses, as Shand had done, ensured that it fell foul of the conservative petrological world.

Few people realize that it was Felix who collected the standard granite sample G-1, which since 1949 has been used as the international interlaboratory geochemical standard. By 1959, when supplies were running short, he had to test and organize an alternative source nearby, because the original quarry is now smothered by houses.

In the mid-1960s, Felix began collecting chemical analyses of Cenozoic volcanic rocks, at first on punched cards, from which he later transferred them to magnetic tape. By 1971, the data set exceeded 10,000 rock analyses, and, realizing its potential for use by others for comparative as well as statistical use, he printed 200 copies of a user's manual for distribution to any petrologists interested. Its construction obliged him to consider the nomenclature and taxonomy to be used in it. He was appalled by the lax identification given to rocks so carefully and expensively analyzed. His known desire to codify rock names to correspond to measurable or observable features caused Albert Streckeisen to invite him in 1970 to join the newly formed International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks. There, besides putting forward his own points of view (all recorded in the subcommission's archives, held in the Mineralogy Department of the Natural History Museum, London), he played the valuable role for nearly 20 years of reducing the arguments presented by others to a logical line of simple facts. "Hey, hang on," he would say. "Do you mean ... ?"

As his publications show, during the latter half of the 1970s and throughout the 1980s, he was totally consumed with computer keyboard operations and with International Geological Correlation Program Project 163, Igneous Geochemical Data Base (IGBA), launched in 1977. He designed IGBA to be a databank built up from refereed published papers by national teams, to be stored at the World Data Center in Colorado, and to be retrievable by individuals working in the field. In the 1970s, the hard work of writing the software for IGBA fell to him. He had some assistance from José Brandle of Madrid (now the chairman in succession to Felix, IGBA having been embraced by IUGS in the mid-1980s as the Subcommission on Data Bases for Petrology). Felix worked tirelessly organizing the funding for annual conferences of international delegates, and he convinced us to be as enthusiastic as he was; we met in various parts of the world. Felix wrote circulars updating the software and procedures for capturing data from the literature, and newsletters to keep us going. In 1984, IGCP Project 163 was replaced by Project 239, and Joe Frizardo of Bowling Green State University, Ohio, joined in creating software.

Felix's next aim was to expand the use of microcomputer-based database management systems worldwide, to get it to countries where this was news. So he organized a workshop, raising funds from the National Science Foundation, and in 1987 held the workshop at Kuwait University. The university set up banks of microcomputers for the use of 50 scientists from 37 countries. The workshop was a personal triumph for Felix, and the university continued as a center of excellence, with the well-trained staff, but the Gulf War dispersed everything, including the computers. This was a sad blow for Felix, and Project 239 closed in 1990 after a year's extension.

Felix retired from the Geophysical Laboratory in 1986 and was given the title petrologist emeritus. But Felix was not the sort who stops working; he merely allowed himself more time for other activities. He obtained a research associate post in the Department of Mineral Sciences at the Smithsonian Institution; this allowed him the facilities he required, and he spent several days a week there. He continued spending a day or two each week at the Geophysical Laboratory, further developing programs for extracting petrological information from IGBA, and writing an unceasing stream of useful information sheets, which he posted, faxed, and E-mailed to his many IGBA colleagues and friends. IGBADAT, as it is now called, will be his lasting memorial. History will look back on him as a wise counselor and gentlemanly scholar who was one of the few to make major advances in mathematical petrology in this century.

Felix was a Fellow of the Geological Society of America, a Life Fellow, and in 1967 president of the Mineralogical Society of America, and a member of the American Geophysical Union.

Outside the laboratory, Felix was a witty conversationalist, and one of the pleasures of life was to have dinner with him after a day in the laboratory or conference room. He also played the recorder and was active in the American and Washington recorder societies.

He will be missed by many all round the world, but especially by his wife Irene.

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