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FRANCIS JOHN TURNER

1904—1985

A Biographical Memoir by
IRIS Y. BORG AND LIONEL E. WEISS

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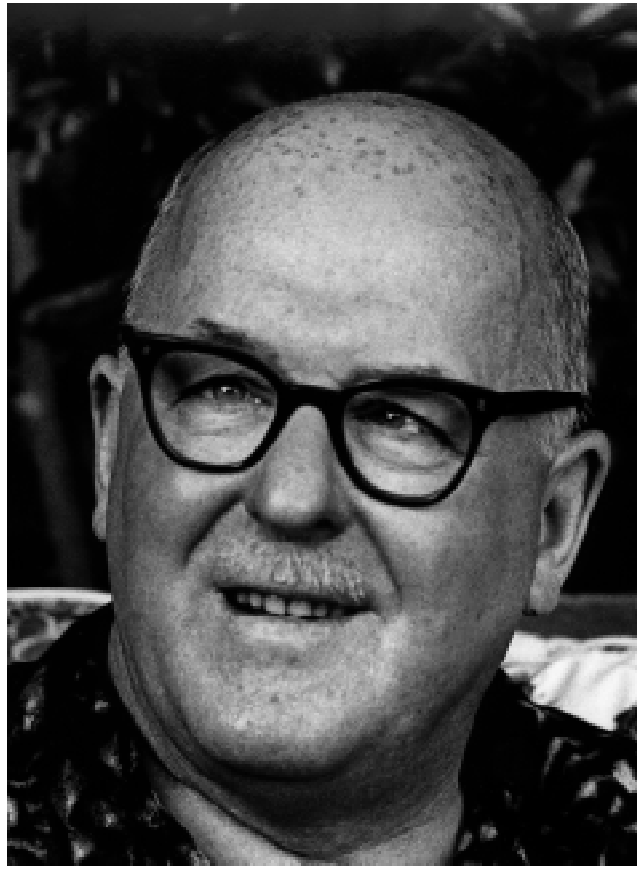

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Francis J. Turner

FRANCIS JOHN TURNER

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BY IRIS Y. BORG AND LIONEL E. WEISS

ON DECEMBER 21, 1985, the international geological community lost one of its most distinguished members—Francis J. Turner, professor emeritus of geology at the University of California, Berkeley. His departure affected all whose lives he had touched in various ways. Those who knew Turner only through his scientific work mourned the end of an era in the study of metamorphic and igneous rocks, a period in which he played a major role in transforming classical petrology into a modern science and through his writings, making then-current discoveries readily available to students and colleagues. Those who knew him personally, scientist and nonscientist alike, lost much more than a great geologist: they lost the company of a rare human being, unique in his warmth, generosity, and humanity. This brief memoir attempts to recall both aspects of the man—the eminent scientist and the unforgettable human being.

Francis John Turner was one of four boys born to a classics master at Auckland Grammar school in New Zealand. Turner spent more than half his life in that country. His father died young, and the children were brought up by their mother. All became successful if not distinguished pro-

fessionals, especially his older brother, a judge and president of the New Zealand Court of Appeals, who became Sir Alexander Turner. In 1930 Francis married Esme' Bentham, who together with their daughter Gillian, then Mrs. James McKercher, survived him on his death.

At the age of seventeen Frank, as he was called by family, friends, and close colleagues, matriculated at Auckland University College, winning a university senior scholarship in geology. At Auckland he earned a B.Sc. and an M.Sc. and won the von Haast Prize. His initial research interests were in the field of igneous petrology, resulting in publications coauthored with Professor J. A. Bartrum, his mentor at Auckland University. While finishing his M.Sc., Frank worked with the New Zealand Geological Survey until 1926, when he accepted a position as lecturer in the geology department at the University of Otago in Dunedin, headed by Professor W. N. Benson. It was Professor Benson who encouraged Frank to follow his own intense interest in the complex metamorphic rocks of New Zealand and who had a major influence on Frank's career. Subsequently, Frank spent many field seasons in the almost unexplored western part of the South Island of New Zealand traveling by foot, with pack horses or small boats, while doing reconnaissance mapping and sampling of the little-known metamorphic and ultrabasic rocks. Memories of those trips were the source of a lifetime of anecdotes that captivated his students and colleagues. Frank's love for the New Zealand wilderness stayed with him all his life. Throughout his long career, photographs of the fjord country of New Zealand adorned the walls of his office. His rock collections from the South Island provided the basis for many publications leading to his D.Sc., awarded in 1934 by the University of New Zealand and election to fellowship in the Royal Society of New Zealand in 1938.

In his desire to understand the genesis of the metamorphic rocks, Frank observed and collected in the field and poured over Professor Benson's metamorphic collection from the Highlands of Scotland, where mapping and interpretation of such rocks was relatively far advanced. He read prodigiously, particularly the works of the European metamorphic petrologists and was impressed with the unified approach to metamorphic processes proposed by the Finnish petrologist P. Eskola, which in the 1930s had yet to gain wide recognition. Using Eskola's notions of metamorphic facies, Frank not only explained the progressive metamorphism he saw in New Zealand, particularly in the Otago schist, but also further advanced them to allow their applicability to metamorphic belts everywhere. These studies formed the basis of Frank's first book, *Mineralogical and Structural Evolution of Metamorphic Rocks*, published some years later as a Geological Society of America memoir (1948), a book that established Frank's worldwide reputation and profoundly influenced a generation of young geologists.

Though mainly concerned with the mineralogical and chemical properties of metamorphic rocks, Frank became intrigued with the significant relation between the macroscopic structure and the corresponding microscopic rock fabrics. In pursuit of this aspect of metamorphism, he proposed to work with Dr. Eleanora Knopf, wife of Professor Adolph Knopf of Yale University, who was introducing the techniques of the European geologists, particularly those of Professors Walter Schmidt and Bruno Sander, to the study of the microscopic structure (nowadays termed fabric or texture) of metamorphic rocks. A Sterling fellowship in 1938 allowed Frank to travel to the United States and spend a year at Yale University. At Yale he became familiar with the universal stage for the petrologic polarizing microscope, an instrument rather like a goniometer that permitted the ac-

tual crystallographic orientation of individual mineral grains in a rock to be accurately determined with respect to external coordinates. When used in conjunction with a stereographic or similar projection, the stage allowed three-dimensional mapping of the microstructure of rocks, including intra- and intercrystalline phenomena and the preferred orientations of individual minerals. Ultimately, Frank became a master of this instrument and applied it to the study of both naturally and artificially deformed rocks and minerals.

His fellowship over, Frank returned to New Zealand and taught there throughout World War II. His teaching load at Otago was inhuman by modern standards, but it had the benefit of forcing him to read even more widely in every branch of geology and to learn to synthesize and condense vast amounts of information. He developed these skills to perfection, becoming an outstanding lecturer at every level—lucid, well organized, and witty, even when addressing subjects in which he was not expert. His curiosity led him far afield in geology. His graduate seminars tackled almost any subject, from chemical thermodynamics to the physics of wind-blown sand as expounded by R. A. Bagnold. In all of his lectures Frank passed on his insights and enthusiasm with amazing clarity.

Frank's year at Yale University eventually proved to be a turning point in his career. Although he had returned to New Zealand, the friendships made and the interests that were nurtured in New Haven set the stage for his return to the United States. In 1946, after being encouraged to apply for the vacant position of director of the New Zealand Geological Survey and failing to be appointed, he accepted an invitation from Chairman Howell Williams to join the faculty at the University of California in Berkeley as an associate professor. In 1948 David Griggs, whom Frank had met

through the Knopfs when Griggs was a graduate student at Harvard, was at the Institute of Geophysics at the University of California at Los Angeles (UCLA). The two men shared a keen interest in metamorphic structures and processes. AT UCLA Griggs was engaged in the laboratory deformation of rocks and minerals and was in need of petrographic assistance in interpreting the results. Thus, a friendship was renewed, and a technically rewarding research collaboration began, which lasted until Griggs died in late 1974.

At Berkeley, Frank found a conventional faculty teaching traditional geological subjects. Its most eminent member, Andrew C. Lawson, was professor emeritus and no longer actively pursuing research. The curriculum in the Department of Geology emphasized field work, and a degree in geology required among other courses a year of field geology in the Berkeley Hills, a summer field camp in the California coast ranges, or the foothills of the Sierra Nevada, as well as a semester course in surveying. Women were discouraged from majoring in geology if not actually excluded from the major, since they were persona non grata in the required summer field course. Under Turner's influence and later his guidance as chairman (1954-59), the department attracted students and scholars from all over the world, giving it a stimulating international character. While ever conscious of the importance of field work, Turner insisted that the course requirements for the bachelor's and higher degrees be altered to accommodate students who preferred to focus on the theoretical and experimental aspects of the field. He made sure that the curriculum was changed to remain current and to include new and promising approaches and discoveries in the fields of geochemistry and tectonics. Turner taught himself the principles of thermodynamics in order to better contribute to his own specialties within the

field of petrology and began his collaboration with Professor John Verhoogen in the writing of an advanced text on igneous and metamorphic petrology.

The post-World War II scientific expansion in the earth sciences stimulated a worldwide search for talent for the faculty at Berkeley in which Turner was pivotal. New members arrived from the United States, Belgium, Switzerland, England, Australia, and New Zealand. At one point, half the faculty members were foreign-born geologists and geophysicists, not one of whom had taken the Berkeley Hills field course but who were required to teach it. The department acquired the latest equipment for the study of every aspect of the earth sciences, from minerals to earthquakes. Turner was accessible to both students and faculty alike. He was never too busy to do whatever he thought appropriate to further the career of promising young geologists in the department or those he met in his travels abroad—Donald B. McIntyre, Ian S. E. Carmichael, W. S. Fyfe, R. N. Brothers, and M. S. Paterson, to name a few. Enthusiasm, excitement, and first-class research became the hallmarks of the department as its active young faculty gained international renown.

A large new building to accommodate the earth sciences became a reality. It replaced the cavernous Bacon Hall, a former library and the second oldest building on campus. Although it was a sentimental favorite, it was ill suited to house a modern science department. Along with his services to the department, Frank was always willing to serve the university as a whole. He sat on numerous administrative committees, including the Graduate Council, the Committee on Research, the Library Committee, and the Executive Committee of the College of Letters and Science.

Through all these efforts, Frank never lost passion for his own research. When queried as to what, in his opinion, was

his most significant research, he is on record as having answered "the deformation of Yule marble," his long collaborative research with David Griggs. Griggs and his students, notably John Handin and Hugh C. Heard, conducted laboratory deformations of cylindrical samples of marble in various orientations and at various temperatures, pressures, strains, and strain rates, while Turner and his students did the interpretative petrographic analysis. These experiments led to an understanding of the various mechanisms underlying the phenomenon of preferred orientation of minerals within rocks and hence the ability to reconstruct the stress fields that prevailed during the final stages of deformation. Although many different rocks and minerals, from quartz to pyroxene, were investigated, the most important results were obtained with calcite, either as a constituent of Yule marble or as single crystals. Turner and his students demonstrated the importance of slip, twinning, and stress-induced phase transformations (e.g., in enstatite-clinoenstatite) in effecting the preferred orientations observed in both naturally and laboratory-deformed rocks. Turner's geometric analysis of the telltale clues left after several of these processes had proceeded to completion showed incredible insight. Later development of dislocation models of intracrystalline deformation in minerals coupled with the use of X-ray texture analysis and the transmission electron microscope in the study of deformed rocks depended heavily on the early discoveries of Turner and Griggs.

Turner's written legacy includes eighty technical papers and six textbooks on metamorphic, igneous, and structural petrology. All but two of the books were written with colleagues, most often from Berkeley. All bear the stamp of Turner's gift for technical writing. His ability to synthesize succinctly the volume of detail associated with complex geological processes and present it clearly in fluent prose again

reflected his outstanding teaching skills. His constant familiarity with the latest developments in geology allowed him to provide additional insight into the interpretation of geological processes described in many historical monographs on special geological provinces that had been written before World War I (P. Eskola, P. Niggli, V. M. Goldschmidt, J. J. Sederholm, and H. Rosenbusch, among others). Integration of the new and the old into his texts was done in such a way as to remind readers that the best data and observations are not necessarily the most recent. His books were well received, especially abroad, much to his surprise; three of them went through second editions, which involved substantial updating, rewriting, and reorganization. These revisions occupied Turner after his retirement from the department in 1971.

Frank Turner received many honors during his long career. They are listed at the conclusion of this memoir. The last was the Roebling Medal, the highest honor of the Mineralogical Society of America, which was bestowed a few weeks before his death. He was not able to accept the medal personally because of his final illness, but he was deeply moved when several of his colleagues presented it to him in the hospital. His comment, as reported by H.-R. Wenk, was: "I did not do more than others, but I was always fascinated by discovering new problems along with recognizing that there are no final solutions in geology." In addition, Frank was invited to be a foreign correspondent of the Academia delle Scienze, Instituo di Bologna (1953), a corresponding member of the Geological Society of Edinburgh, a foreign member of the Geological Society of London, and a visiting fellow of Oxford University's Brasenose College (1972-73).

To a generation of geologists, his peers, colleagues, and students, Frank Turner was the most unforgettable person they ever met. He was brilliant, urbane, compassionate, and

thoroughly eccentric. He was a familiar figure at the University of California, Berkeley, campus, walking, stick in hand, from his nearby home to the Department of Geology and Geophysics. He never learned to drive, and he was almost 50 years old before his wife Esme' bought a car and entreated a student to teach her how to drive it and how to navigate the tortuous, narrow, steep streets of the city. A ride with Esme' was a never-to-be-forgotten—or hopefully repeated—experience. But Frank was nonplused by their expeditions and took them in stride. For some reason, he eschewed all credit cards, and his pocket usually bulged with a wad of cash. The Turners were similarly unconventional in being one of the last couples of their acquaintance to own a television set.

At first glance, Frank Turner appeared to be a formidable personage—a heavy-set, balding man with a small mustache and one wild eye. One soon learned he was kind to the core and had an acute sense of humor that endeared him to all. He and Esme' regularly invited colleagues, visitors, friends, and students to their house for cocktails. To students especially it was a treat to be invited to the small Turner house with its sloping floors and to meet many of the great intellectuals of the community and distinguished visitors. Conversation inevitably turned to the French Impressionist painters, chamber music, or fine wines, subjects dear to the Turners' hearts. Frank was a marvelous raconteur and with a martini in hand usually had his guests enthralled and in gales of laughter.

IN WRITING THIS MEMOIR we used information from the following sources:

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2. J. D. Clark and others. Frank John Turner, 1904-1985. *In Memorium, 1986*, pp. 307-309. Berkeley: University of California, 1986.

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HONORS

1938 Sterling Fellow, Yale University
1950 John Simon Guggenheim Foundation Fellow
1951 Hector Medal, Royal Society of New Zealand
1956 Member, National Academy of Sciences
Fulbright Fellow to Australia
1959 John Simon Guggenheim Foundation Fellow
1965 Honorary D.Sc., University of Auckland
1969 Lyell Medal, Geological Society of London
President, Mineralogical Society of America
1971 Berkeley Citation, University of California
Roebling Medal, Mineralogical Society of America

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