# Memorial to David Tressel Griggs
# 1911–1974

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David Tressel Griggs died suddenly of a heart attack while skiing with friends at Snowmass, Colorado, on December 31, 1974. With his unexpected death, Earth science lost one of its most able and distinguished research scholars and teachers.

David Griggs was born in Columbus, Ohio, on October 6, 1911, the son of Robert Fiske and Laura Tressel Griggs. While a student of physics at Ohio State University, he participated in a scientific expedition led by his father, a distinguished professor of botany and a conservationist, to Mount Katmai and the Valley of Ten Thousand Smokes in Alaska. This exposure to the spectacular relics of a large explosive volcanic eruption left a profound impression and stimulated his lifelong interest in applying physics to the study of dynamic processes in the earth.

After completing his A.B. (1932) and A.M. (1933) degrees at Ohio State University, he was appointed to the Society of Junior Fellows at Harvard. Under the guidance of Nobel laureate Percy Bridgman, he began his pioneering systematic studies of the mechanical properties of rocks at high temperatures and pressures and of the physics of deformation in the earth. About a dozen important papers published by Griggs between 1934 and 1941 established the relevance of experimental rock deformation and scale model studies in geology and geophysics. Most notable among these were his papers on the creep of rocks, which provided a remarkably modern insight into the physics of slow deformations, and experimental studies of the effect of such variables as confining pressure, stress, time, temperature, and the presence of solutions on the solid-state flow of mineral crystals and rocks. In 1939, Griggs argued, in his "Theory of Mountain-Building," that thermal convection in the solid but deformable rocks of the Earth's mantle ("substratum") was responsible for orogenic deformation in the crust. Although this was an extremely controversial and unpopular idea at the time, the concept and model experiments have been presented in every textbook published in the last three decades. The development of the unifying theory of plate tectonics in the last decade has shown that Griggs's visionary model was well conceived in principle, if not in detail, and has certainly vindicated his position in the controversy with advocates of a "strong" Earth.

David Griggs's academic pursuits were interrupted by the outbreak of World War II when he left Harvard, in 1941, to become a research associate at the Radiation Laboratory of the Massachusetts Institute of Technology. His first assignment was to assist in the testing of the newly developed ground-based radar tracking systems, followed by participation in the development of air-to-air radar systems, in which he acted as program manager. His originality and special talents in making things work under operational conditions were quickly recognized, and these talents were utilized in a wide variety of situations in the post of special assistant for scientific matters to the secretary of war.

In this capacity he acted as a scientific liaison officer with the military commands in both the European and Pacific theaters. These assignments are described in some detail by his friends and former colleagues, W. W. Rubey and I. A. Getting, in the foreword to the Griggs Volume (1972),[1] a Festschrift volume dedicated to Professor Griggs on the occasion of his sixtieth birthday.

After the war Griggs became a section chief in the "Rand" project at Douglas Aircraft Company and subsequently played an important role in founding the Rand Corporation, where he served as the first head of its physics department.

During the postwar period, efforts were made by a number of scientists, notably by Dr. E. B. Knopf and Professor F. J. Turner, to persuade Griggs to resume his experimental studies of the mechanical properties of rocks. In 1948, he was induced by Professor Louis B. Slichter, director of the Institute of Geophysics at the University of California, Los Angeles, to accept an appointment as professor of geophysics in the institute, a position which he held, except for relatively short leaves of absence, until his death.

At UCLA David Griggs established a new laboratory for experimental deformation of rocks that has been steadily productive in terms of both scientific papers and well-trained scientists. The application of the experimental data to the interpretation of geological processes was at least as important to him as the acquisition of the data. One of his major interests was the extrapolation of the laboratory results to the conditions and time spans of deformation in the Earth's crust and mantle and application of the data in modelling of dynamical processes by experiment and with the computer. His research had great scope and originality, encompassing fracture and seismicity, flow of rocks in mountain-building, the global motions of the lithospheric plates and, at the opposite extreme of the scale, the submicroscopic dislocation processes that are fundamentally responsible for the solid-state flow of rocks. In recent years he worked extensively on problems of earthquake mechanisms and played a significant role in establishing programs to investigate prediction and possible control of earthquakes.

Griggs's ability as an experimentalist was unique and deserves special mention. What he called his "gift for gadgets" was in fact an extraordinary genius for design and successful operation of apparatus of all kinds. In the difficult and sometimes dangerous field of deformation at high temperatures and pressures, his inventions have had tremendous impact. The greatest range of experimental conditions consistent with safe operation of the equipment and the best attainable precision in measurement of stress and strain were the goals that he aimed for and consistently achieved. The several generations of apparatus of his design that employed gaseous confining media have provided much of the basic mechanical data on the weaker rock types. Recent developments and improvements rely generally on the availability of superior engineering materials and improved ancillary instrumentation. In 1956, Griggs's introduction (with G. C. Kennedy) of the "simple squeezer" provided an extremely versatile exploration tool for both phase equilibrium and deformation studies over an extended range of experimental conditions and portended the development of a variety of modern anvil devices. In an effort to attain pressures and temperatures high enough to induce plasticity in the strongest silicates, Griggs designed (about 1960) the first "cubic apparatus" based on the principles of the tetrahedral presses then in operation and employing weak solids as confining media. This equipment achieved pressures up to 50 kilobars and temperatures up to the

[1] Flow and Fracture of Rocks, the Griggs Volume, Heard, H. C., Borg, I. Y., Carter, N. L., and Raleigh C. B., eds.: Am. Geophys. Union Geophys. Mon., 1972, no. 16.

melting points of silicates, and its geometry permitted controlled deformation of prismatic samples. Extensive plastic flow of quartz crystals and many silicates were first obtained in this apparatus. Encouraged by the potential of this equipment for providing much-needed data on the flow laws of important crustal and mantle rocks, Griggs then developed devices with cylindrical geometry, also with solid confining media. They provided more reliable and continuous data on the temperatures and flow parameters of the samples over long periods of time (the longest tests have lasted up to nine months). These devices, the DT apparatus and its somewhat larger successor, the GB apparatus, have also provided much of the information currrently available on the flow mechanisms and flow laws of minerals and rocks.

As a teacher Dave Griggs was tremendously effective. He was intellectual father to a long line of students and implanted in them his high intellectual standards, scientific insight, and curiousity. He was impatient with incompetence and more so with carelessness or negligence, and his students quickly became aware of these traits. He had an uncanny insight and a critical ability that enabled him to detect flaws in a scientific argument or theory with ease; students and colleagues alike have seen their theories devastated under his critical examination. But this critical ability and insight were more frequently employed constructively with students in getting to the heart of a problem and suggesting a solution. Dave's relationship with his students was permeated by warmth, good humor, and mutual respect, and he always showed a deep concern for their personal and scientific welfare. Many of his students have made important contributions to geology and geophysics and are now in positions of professional eminence.

Although Dave loved an argument, his objective was seldom simply to be contentious. He was less concerned with the argument as an arena to exercise his agile mind (as his voluminous memory, rich experience, and intellectual brilliance generally assured a victory) than as a court for the judicial examination of every aspect of a problem. He also realized that the urgency of a competitive situation could produce flashes of insight and innovative ideas in the competitors. This was an essential part of his success as a scientist and especially as a teacher. Colleagues and students alike frequently turned to Dave Griggs for advice and guidance, which were always generously given. His warmth, humor, and ready wit were always evident and won the deepest admiration, respect, and affection of all who knew him.

David Griggs's scientific work has received well-deserved recognition and acclaim. He was a member of the National Academy of Sciences and the American Academy of Arts and Sciences. He was awarded the Walter H. Bucher Medal of the American Geophysical Union in 1970 and the Arthur L. Day Medal of the Geological Society of America in 1973. For outstanding civilian service to the nation during World War II, Griggs received the President's Medal of Merit. Twice he was the recipient of Air Force Exceptional Service Awards, first in 1953 and again in 1972.

Professor Griggs is survived by his wife, Helen, whom he married in 1946, and a son Stephen.

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