Memorial to James Gilluly
1896–1980

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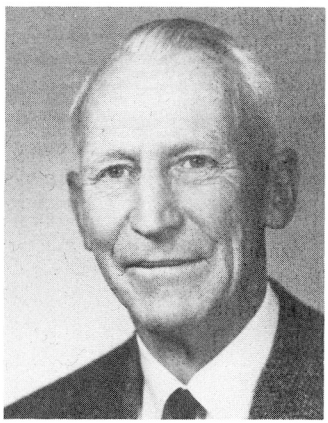

"The secrets held by the *everlasting hills* of an earth which Hutton claimed had *no vestige of a beginning, no prospect of an end*, are seriously undermined today by the vast flood of geological knowledge unleashed during the twentieth century. One who actively rode this flood from its very beginning—and who did not hesitate to change either horses or ideas in midstream—is James Gilluly: discoverer of new geological concepts, as well as avid investigator of deserts and mountains" (Aaron Waters, 1969, Earth Science Reviews Atlas, v. 5, p. A19–A27).

With the death of James Gilluly on December 29, 1980, at age 84, the geologic profession lost a powerful and imaginative protagonist whose contributions to science, and to the development of scientists, spanned well over half a century. Although Jim qualified as a specialist in many different disciplines at various stages in his career, and especially as a structural geologist, he was truly and proudly a general geologist. His enormous knowledge of scientific literature and his prodigious memory served him well in dealing productively with an exceptionally broad spectrum of geologic researches. A positive man who was always ready to accept or offer a challenge on subjects from geology to politics, Jim expressed his convictions strongly and with a quick wit. He was also a warm human being, a great believer in the rights of the individual, and a defender of the less fortunate. His knowledge was catholic, and he could recite an appropriate poem or a song from Gilbert and Sullivan as readily as he could recall an obscure scientific reference.

James Gilluly was born in Seattle, Washington, on June 24, 1896. All his education through his graduation from the University of Washington in 1920 was in Seattle. Economic circumstances forced Jim to work before entering college and between academic years to help finance his studies, and he served in the U.S. Navy for part of 1917 and 1918.

Immediately after leaving the university he was employed for a short time as a junior geologist with the National Refining Company in Montana. A long career with the U.S. Geological Survey began in 1921 when Jim became a Geologic Aide with Frank Reeves in eastern Montana. Another Survey newcomer on this party was M. N. Bramlette, with whom Jim developed a very close personal and professional friendship which lasted till Bramlette's death in 1977. Jim's second field assignment with the USGS was in northwestern Colorado with J. D. Sears' party (1922). Another newcomer on this project was W. H. Bradley, who also became Jim's close friend and colleague for many years. En route to the field area, the train carrying Gilluly and Bradley westward across the Rocky Mountains from Denver was stopped by snow drifts on the east side of Corona Pass. These two determined young geologists unloaded their field gear, carried it across the pass, and caught another train that had been blocked on the west side. After a field season

on the North Coast Naval Oil Reserve in Alaska as assistant to Sidney Paige (1923) and one in northeastern Colorado in Kirtley Mather's party (1924), Jim began his own independent studies, which continued during his ensuing years with the Survey.

Jim spent the academic years of 1922–1924 in graduate studies at Yale University with Adolph Knopf as his major professor, and his first independent USGS assignment, on the sedimentary rocks of the San Rafael Swell in Utah, was the basis of his doctoral dissertation in 1925 and was published as USGS Bulletin 806 with John B. Reeside and as Professional Paper 150.

Jim transferred to the Metals Section of the USGS in 1926 to study the Stockton and Fairfield quadrangles in Utah. He completed his fieldwork promptly (1927) and immediately prepared and published a monographic treatment (Professional Paper 173) of the stratigraphy and structure, the mechanics of igneous intrusion, contact metamorphism, development of extensive jasperoid rocks, and ore deposits that set a standard for excellence. His next assignment, a 1929 and 1930 field study of ore deposits in eastern Oregon, resulted in the publication of three USGS Bulletins (830, 846, and 879) and, more importantly, of topical reports on the albitization and partial silicification of a quartz diorite to produce the albite granite near Sparta, Oregon (Professional Paper 175-C). Reports based on these studies also developed a better understanding of the spilite problem and the origin of keratophyres.

While in Europe during the winter of 1932, Jim spent a month on concentrated study of the then-new subject of petrofabrics with Bruno Sander. Only one report, "Mineral orientation in some rocks of the Shuswap terrane as a clue to their metamorphism," was directly related to these studies, but Jim valued the training and treasured his association with Bruno Sander.

Back in the field again for partial seasons in 1932–1934, Jim mapped and studied the Ajo mining district, Arizona, and the final report (Professional Paper 209) is a definitive study of the general geology of the district and of the New Cornelia porphyry copper deposit. This report analyzes the metamorphic phases and orogenic history of the Precambrian(?) Cardigan Gneiss, interprets the structural history, describes the physiography, and delves into the origin of pediments.

From 1938 through 1950 Jim was a professor at the University of California at Los Angeles (UCLA), and throughout this period he retained a part-time status with the USGS and continued fieldwork started in 1936 in Cochise County, Arizona. During World War II, 1943–1945, he returned to the Survey first in connection with the strategic minerals program and then in 1944 and 1945 as a military geologist with the U.S. Army in the Southwest Pacific Command, where among other tasks he participated in the landings on Leyte. In spite of heavy duties connected with his university position, Jim completed the major reports on the stratigraphy and structure of Cochise County, Arizona (USGS Professional Papers 266 and 281), co-authored (with A. C. Waters and A. O. Woodford) the widely used textbook, *Principles of Geology*, studied (with U.S. Grant, 4th) subsidence in the Long Beach Harbor area, and prepared his important 1948 address on "Distribution of mountain building in geologic time" as retiring President of the Geological Society of America. The textbook has been revised through four editions, the last one being published in 1975. His success as a teacher of geology can be measured by the success of his students; many of these have held and still hold highly responsible positions in the petroleum and mining industries, on university faculties, and with the USGS, and it is their proud boast to have "studied with Gilluly at UCLA." Many an ex-student continued to be his close friend.

In 1950 Jim returned home to the USGS, where he remained until his retirement at age 70 in 1966. During those years his field studies in north-central Nevada led to reports on the northern Shoshone Range (with Olcott Gates), the Cortez quadrangle (with Harold Masursky), and the Winnemucca quadrangle. In addition, he was chief of the General Geology Branch of the Geologic Division, 1954–1957, chief of the Fuels Branch, 1957–1959, and an active and expert member of many USGS committees, including one that set standards for geologic mapping and maps. He was a USGS representative on the American Commission of Stratigraphic Nomenclature from 1952 to 1956 and one of the principal writers of the 1961 Stratigraphic Code. Both before and after his retirement, Jim was a particular inspiration to his younger colleagues, as he gave freely of his time to discuss and encourage their research and to critically review and help improve their reports.

Beginning with Jim's presidential address to the Geological Society and its subsequent publication (1949), the focus of many of his published papers was on more general and fundamental aspects of geology and particularly on mountain building and megatectonics. In the 1949 paper he questioned the ideas that orogenies are periodic, are of short duration, and are interspersed with long nonorogenic periods. This bold raid on established dogma was backed by compelling arguments, and had major impact on geologic thinking. Subsequent formal papers developed several original themes on subjects of continental scope and of relations between continents and ocean basins. Some questioned other aspects of conventional geologic thought and helped set the stage for the plate tectonic revolution fomented largely by others. He questioned, among other items: (1) then-accepted ideas on systematic connections among plutonism, volcanism, and tectonism; (2) the supposed universal association of orogeny and plutonism; and (3) the idea that radiometric ages of plutons also date the deformation of their wall rocks. He proposed that subcrustal flow or a transfer of subcrustal and basal crustal material is needed to meet the requirements of isostasy in changes like the uplift of the Colorado Plateaus province, and that other subcrustal flow was required to drag sialic material beneath the western continental margin of the United States to be available for remobilization into the overlying plutonic belt.

Concurrently, Jim became a leader in developing the quantitative approach to broad problems. By measuring from the geologic maps of North and South America, he showed how much the exposed areas of sedimentary, plutonic, and volcanic rocks decrease as the age of the rocks increases, and demonstrated more clearly than had been done previously how much more incomplete the geologic record becomes with age. He thus questioned the very basis for the ideas that orogeny had been speeding up through geologic time and that erosion rates are increasing. This quantitative approach also demonstrated the scarcity of identified Paleozoic plutons in the Western United States and emphasized the great flare-up of Mesozoic plutonic activity. Also, from map measurements of sediment volumes off the United States' coasts, Jim found a six-fold disparity in favor of the Atlantic Coast and concluded that it could be accounted for by westward drift of the continent and overrun of the Pacific sediments.

Jim liked to work out of field camps, particularly during his later projects in Nevada, and after-supper hours in these camps were famous for lively discussions of the finds of the day as well as of other matters both geological and nongeological. Many geologists passing through Nevada detoured to Jim's camp to partake of his hospitality and to participate in these stimulating discussions. Always the premier field man, Jim set a pace in the field that was difficult for many to match. Being light and wiry, he was able to do

strenuous fieldwork to an age when many of his contemporaries had assumed more sedentary roles. At the end of a field day it was common for him to bound down a steep slope ahead of the pack to be waiting in the Jeep chanting, "Let's have a beer." He was an extremely careful field worker who was totally intolerant of careless or sloppy work by others, but extravagant with praise for quality efforts.

Honors and awards bestowed upon Jim were many and well deserved. He was the Faculty Research Lecturer at UCLA in 1948, Bownocker Lecturer at Ohio State University in 1951, and the 17th William Smith Lecturer at the Geological Society of London in 1962 (published in 1963). He received the Penrose Medal, Geological Society of America, in 1958; the Distinguished Service Medal, the highest award of the U.S. Department of Interior, in 1959; the Walter Bucher Medal, American Geophysical Union, in 1969; and an honorary Doctorate of Science from Princeton University in 1959. The University of Washington, his undergraduate university, named him *Alumnus Summa Laude Dignatus* in 1963, a highly prestigious award in that the university bestows it upon only one alumnus each year. He was a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and an Honorary Member of the Geological Society of London. In 1962, he served as chairman, Division of Earth Sciences of the National Research Council. Jim also served on the U.S. National Committee on Geology and the Upper Mantle Committee of the International Union of Geodesy and Geophysics, and was a member of many professional societies. He became a Fellow of the Geological Society of America in 1927, was Vice-President in 1947, and was President in 1948.

Throughout most of his adult life, Jim had one preeminent helper. He and Enid Frazier were married in Pocatello, Idaho on June 30, 1925, an event Jim credited as the most important of his life. Her support, "pampering" as Jim called it, made his professional career possible and his personal life a pleasure. Together they enjoyed the good life of personal accomplishment and fulfillment, gracious hospitality, and family. Enid accompanied Jim on nearly all his field assignments whether their living quarters were in camp or town. Two daughters, Molly and Sally, were born to the Gillulys. Enid, the girls, and seven Gilluly grandchildren survive.

It seems fitting that one of Jim's last published papers was "American geology since 1910—a personal appraisal" (1977) in which he gave a brief autobiographical sketch and summarized his evaluations of developments in geology during his 55 years of association with the science. An apt closing to this memorial is a paragraph from a letter to the *Denver Post* (January 12, 1981) by W. R. Hansen: "One of the most respected and widely quoted of modern geologists, Dr. Gilluly perhaps will be remembered by his many friends for his towering mentality, biting wit, fiery temperament, colorful vocabulary, devotion to science and deep love of humanity."

SELECTED BIBLIOGRAPHY OF JAMES GILLULY

1923 (and Heald, K. C.) Stratigraphy of the Eldorado oil field, Arkansas, as determined by drill cuttings: U.S. Geological Survey Bulletin 736, p. 241–248.

1925 (with Page, Sidney, and Foran, W. T.) A reconnaissance of the Point Barrow region, Alaska: U.S. Geological Survey Bulletin 772, 33 p.

1927 Analcite diabase and related alkaline syenite from Utah: American Journal of Science, 5th ser., v 14, p. 199–211.

1928 (and Reeside, J. B., Jr.) Sedimentary rocks of the San Rafael Swell and some adjacent areas in eastern Utah: U.S. Geological Survey Professional Paper 150, p. 61–110.

—— (with Mather, K. F., and Lusk, R. G.) Geology and oil and gas prospects of northeastern Colorado: U.S. Geological Survey Bulletin 796, p. 65–124.
1929 Geology and oil and gas prospects of part of the San Rafael Swell, Utah: U.S. Geological Survey Bulletin 806, p. 69–103.
1931 Copper deposits near Keating, Oregon: U.S. Geological Survey Bulletin 830, 32 p.
1932 Geology and ore deposits of the Stockton and Fairfield quadrangles, Utah: U.S. Geological Survey Professional Paper 173, 171 p.
1933 Replacement origin of the albite granite near Sparta, Oregon: U.S. Geological Survey Professional Paper 175, p. 65–81.
—— (and Reed, J. C., and Park, C. F., Jr.) Some mining districts of eastern Oregon: U.S. Geological Survey Bulletin 846, 140 p.
1934 Mineral orientation in some rocks of the Shuswap terrane as a clue to their metamorphism: American Journal of Science, 5th ser., v. 28, no. 165, p. 182–201.
1935 Keratophyres of eastern Oregon and the spilite problem: American Journal of Science, 5th ser., v. 29, no. 171, p. 225–252, 336–352.
1937 The water content of magmas: American Journal of Science, 5th ser., v. 33, no. 198, p. 430–441.
—— Geology and mineral resources of the Baker quadrangle, Oregon: U.S. Geological Survey Bulletin 879, 119 p.
1942 The mineralization of the Ajo copper district, Arizona: Economic Geology, v. 37, p. 257–309.
1945 Emplacement of the Uncle Sam porphyry, Tombstone, Arizona: American Journal of Science, v. 243, p. 643–666.
1946 The Ajo mining district, Arizona: U.S. Geological Survey Professional Paper 209, 112 p.
1948 (chairman), Origin of granite: Geological Society of America Memoir 28, 139 p.
1949 (and Grant, U.S., 4th) Subsidence in the Long Beach Harbor area, California: Geological Society of American Bulletin, v. 60, p. 461–529.
—— Distribution of mountain building in geologic time (address of the retiring President): Geological Society of America Bulletin, v. 60, p. 561–590.
1950 Distribution of mountain building in geologic time; a reply to discussion by H. Stille: Geologisches Rundschau, Band 38, Heft 2, p. 103–107.
1951 (and Waters, A. C., and Woodford, A. O.) Principles of geology: San Francisco, W. H. Freeman & Company, 631 p., illus.
—— (and Cooper, J. R., and Williams, J. S.) Late Paleozoic stratigraphy of central Cochise County, Arizona: U.S. Geological Survey Professional Paper 266, 49 p.
1955 Geologic contrasts between continents and ocean basins, *in* Poldervaart, A., editor, Crust of the Earth—A symposium: Geological Society of America Special Paper 62, p. 7–18.
1956 General geology of central Cochise County, Arizona: U.S. Geological Survey Professional Paper 281, 169 p., with sections on age and correlation by A. R. Palmer, J. S. Williams, and J. B. Reeside, Jr.
1958 (with Roberts, R. J., Hotz, P. E., and Ferguson, H. S.) Paleozoic rocks of north-central Nevada: American Association of Petroleum Geologists Bulletin, v. 42, p. 2813–2857.
1963 The tectonic evolution of the western United States—17th William Smith Lecture: Quarterly Journal of the Geological Society of London, v. 119, p. 133–174.
—— The scientific philosophy of G. K. Gilbert, *in* C. C. Albritton, Jr., editor, The fabric of geology: Reading, Mass., Addison-Wesley Publishing Co., p. 218–224.

1964 Atlantic sediments, erosion rates, and the evolution of the continental shelf—Some speculations: Geological Society of America Bulletin, v. 75, p. 483–492.
1965 Volcanism, tectonism, and plutonism in the western United States: Geological Society of America Special Paper 80, 69 p.
—— (and Gates, Olcott) Tectonic and igneous geology of the northern Shoshone Range, Nevada: U.S. Geological Survey Professional Paper 465, 151 p.
—— (and Masursky, Harold) Geology of the Cortez quadrangle, Nevada: U.S. Geological Survey Bulletin 1175, 117 p.
1966 Orogeny and geochronology: American Journal of Science v. 264, p. 97–111.
1967 Chronology of tectonic movements in the western United States, *in* Symposium on the chronology of tectonic movements in the United States: American Journal of Science, v. 265, p. 306–331.
Geologic map of the Winnemucca quadrangle, Pershing and Humboldt Counties, Nevada: U.S. Geological Survey Geologic Quadrangle Map GQ-656, scale 1:62,500, sections.
1968 The role of geological concepts in man's intellectual development, *in* Limitations of the earth, a compelling focus for geology (University of Texas Bureau of Economic Geology)—A symposium held at the dedication of the new Geology Building, Austin, Texas, 1967: Proceedings of the Texas Quarterly, v. 11, no. 2, p. 11–23.
—— Geological perspective and the completeness of the geologic record: Geological Society of America Bulletin., v. 80, p. 2303–2311.
—— Oceanic sediment volumes and continental drift: Science, v. 166, p. 992–994.
1970 Crustal deformation in the western United States, [Chap. 4], *in* The megatectonics of continents and ocean basins (Johnson, Helgi and Smith, B. L., editors): New Brunswick, N. J., Rutgers University Press, p. 47–73.
—— (and Reed, J. C., Jr., and Cady, W. M.) Sedimentary volumes and their significance: Geological Society of America Bulletin, v. 81, p. 353–375.
1971 Plate tectonics and magmatic evolution: Geological Society of America Bulletin, v. 82, p. 2383–2396.
1972 Tectonics involved in the evolution of mountain ranges, *in* The Nature of the solid earth: New York, McGraw-Hill Book Co., p. 406–439.
1973 Steady plate motion and episodic orogeny and magmatism: Geological Society of America Bulletin, v. 84, p. 499–513.
—— Steady plate motion and episodic orogeny and magmatism—A correction: Geological Society of America Bulletin, v. 84, p. 3721–3722.
1977 American geology since 1910—A personal appraisal: Palo Alto, California, Annual Review of Earth and Planetary Science, v. 5, p. 1–12.

Printed in U.S.A. 11/81