

Memorial to Charles Alfred Anderson

1902-1990

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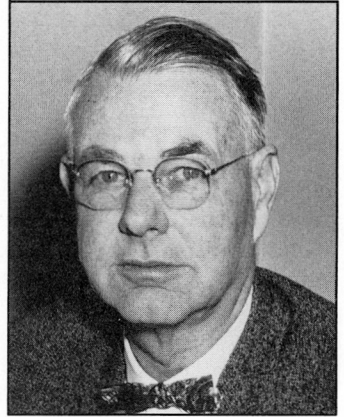
Charles Alfred Anderson—"Andy" to his colleagues and indeed to virtually all of his co-workers regardless of rank—was born June 6, 1902, in the small farming community of Bloomington in southern California, the son of Amel Andrew Anderson (christened Emil Anders Andersson in Sweden), a farm worker who had come to the United States at age 11, and Mary Eliza Anderson (nee Lyman, born in Utah and a granddaughter of one of the 12 apostles of the Mormon Church).

Andy came up the hard way. From about age 12 and for many years thereafter he worked weekends and summers as a field hand on the various farms in the area, picking fruit, weeding, plowing, irrigating, activities for which he had no great liking and which generated in him a determination to find some better way to spend his life.

In this he was strongly encouraged by his mother, an avid reader, who kept him well supplied with books and supported him in his efforts toward obtaining an education.

A small rural school in the Bloomington area provided Andy with a solid elementary-school background. He went on to high school in the nearby city of Riverside, and after graduation, continued on for another two years in the affiliated Riverside Junior College. From the beginning, he was inclined toward the sciences and probably would have majored in chemistry but for the odd chance (odd for the day and circumstance) that this small junior college would have on its staff a geologist, Julius Eggleston, educated at Amherst and Harvard. Andy took the proffered course in mineralogy and, under Eggleston's guidance, became familiar with the nearby famous mineral-collecting locality, the Crestmore quarry of Riverside County. Here the contact-metamorphosed limestone contained a fabulous assemblage of rare and unusual minerals, and Andy became a keen observer and collector. Eggleston also was acquainted with A. O. Woodford, then at the beginning of what was to be a long and illustrious career as a teacher at Pomona College, in Claremont, California, and Eggleston urged Andy to continue a geological education there. In 1922 Andy applied for and was admitted to Pomona with a tuition scholarship; his other expenses were covered in a variety of ways—waiting tables at the College Inn, continued summer work in the citrus groves, and odd jobs such as the typing of Woodford's Ph.D. thesis, yet to be accepted at Berkeley.

After graduation in 1924 from Pomona with a bachelor's degree in geology, Andy headed for graduate school at the University of California at Berkeley, where, now with Woodford's sponsorship, he became a laboratory assistant to the mineralogist A. S. Eakle. His view of geology soon broadened. The geology department at Berkeley was a lively place at the time, with a faculty that included A. C. Lawson, Joseph LeConte, G. D. Louderback, N.E.A. Hines, and C. D. Hulin. Lawson, a transported Scot who had established his reputation working on the Precambrian strata of the Canadian Shield, was by all odds the dominant personality, feared (with reason) by all of the graduate students. His seminar, apparently a required course, involved classroom analysis of many important published papers. A dozen or so students were seated in a



row facing Lawson, who then demanded a critical analysis of the reading, generally, according to Andy, focusing on the student at the right-hand end of the line. (As Francis Pettijohn recalls in his memorable *Memoirs of an Unrepentant Field Geologist*, published in 1984 by the University of Chicago Press, the end chair on the left was in equal jeopardy, which led to an early rush for center seating.) Andy (and Francis) survived, but the experience was never to be forgotten by either.

Andy's first work at a professional level was a study of the mineral voltaite, working with samples from Jerome, Arizona—by curious coincidence the area that would be the locus of much of his work later in his career. His doctoral study, however, was on the copper deposits of Plumas County, California. Andy's conclusions as to the origin of the deposits apparently were received with some doubts by the Berkeley faculty but soon were to be backed up by Adolph Knopf (of Yale and the U.S. Geological Survey), and the thesis was accepted. The Ph.D. was granted in 1928, after which Andy was invited to join the staff as an instructor. Over the next decade or so he rose steadily in the academic structure, and by 1942 he held the rank of associate professor, also serving as an assistant dean of the College of Letters and Science.

Most of Andy's field research during his early years at Berkeley concerned the young volcanic rocks of northern California. The most important—or at least most referenced—of his publications on this topic probably was his 1933 paper on the Tuscan formation, a paper that contained a general review of the volcanic breccia problem. In other studies, he was able to show that the quartz in basalt of Cinder Cone of Mt. Lassen was of exotic origin, out of equilibrium with the olivine-bearing matrix, whereas at Glass Mountain in the Medicine Lake Highlands there had been actual mixing of magmas of differing compositions.

In the late 1930s Andy ventured farther east, joining his friend C. W. Merriam in structural and stratigraphic mapping to define thrust faults in the Roberts Mountains of central Nevada, and in 1940 he took a half-year sabbatical to participate in the E. W. Scripps cruise to the Gulf of California.

The entry of the United States into World War II in 1941 brought worrisome problems to Andy, as it did to many in the academic world. Student enrollment dropped, and there was concern about the proper way to contribute to the war effort. As it happened, in Andy's case, the solution was at hand. At that time, the U.S. Geological Survey was engaged in a Strategic Minerals Program, an extensive effort designed to provide the government with advice on the occurrence and availability of key metals, such as manganese, chrome, molybdenum, tungsten, vanadium, and mercury. A visit to Berkeley in 1942 by Edwin B. Eckel, commodity geologist in charge of mercury investigations (and a most amiable and persuasive man), convinced Andy that this program was where his talents could best be used in wartime. Accordingly, in September of 1942, he began what was to be a 30-year career with the Survey. In 1945, at the end of the war, he was invited to return to Berkeley but by then he was deeply committed to further work with the Survey.

Andy's first assignment was a year-long general survey of molybdenum deposits in the western states, providing advice to the War Production Board, after which he settled in to more detailed mapping of the molybdenum-bearing porphyry copper deposit at Bagdad, Arizona, assisted by E. A. Scholz and J. D. Strobell, Jr. The result, published as USGS Professional Paper 278, was most satisfactory (“...in many ways the best geologic study that I made”), and it provided much of the basis for later appraisals of porphyry copper deposits, such as that in the 1968 Graton-Sales volume.

From Bagdad, Andy turned to study of a copper deposit of an entirely different type—the massive sulfide deposits of Jerome, Arizona, with S. C. Creasey as his close associate. This project, gradually expanded to a general synthesis of the Precambrian geology of the region, was to continue for many years and, although interrupted by tours of administrative duty, would indeed be the highlight of Andy's career as a working geologist. By dint of careful geologic

mapping, plus geochronologic work by L. T. Silver and Thomas W. Stern, the sequence of events involved in the formation of the Yavapai Series, a greenstone belt with an age of about 1700–1800 m.y., was gradually unraveled. The origin of the massive sulfide deposits contained in that greenstone belt, however, remained for many years a controversial issue. In USGS Professional Paper 308, published in 1958, Andy and his colleague S. C. Creasey concluded that these were replacement deposits, introduced long after formation of the host rocks. But a competing view—that the deposits were syngenetic, formed essentially contemporaneously with the enclosing volcanic strata—was gradually gaining supporters internationally. Andy, encouraged perhaps by Donald E. White in Menlo Park, rather reluctantly began to give the concept some credence, particularly after a 1970 visit to the famous “kuroko” massive sulfide deposits of Japan, contained in unmetamorphosed volcanic strata of Miocene age. Upon return from the Japan field excursion, Andy enlisted the aid of J. T. Nash, another Survey colleague in Menlo Park, for a reexamination of the Jerome deposits; in a joint paper published in 1972 they concluded that a syngenetic origin was probable. Andy’s conversion was complete.

In 1952 Andy accepted an administrative assignment in Washington, D.C., as assistant chief of the Mineral Deposits Branch, and a year later took over as chief of that branch. It was a large group—more than 300 geologists—and although Andy would repeatedly complain that the branch was “too damn big,” there is little doubt but that he enjoyed his five-year tenure as Branch Chief. The position gave him ample opportunity to visit the many field projects, expanding his knowledge of the geology and mineral resources of the country and bringing him into personal contact with the working geologists.

After completing his tour as branch chief in 1958, Andy turned once again to his Arizona project. But the respite from administrative work was to be brief. In 1959 he was asked to take charge of the Geologic Division of the Survey on the retirement of W. H. Bradley from that position. Andy reluctantly agreed, but with the understanding that his term would be limited to five years and that he would have at least a brief field season in Arizona each year.

Andy was a firm believer in rotation of administrative positions, and he was remarkably adept at persuading able (and often reluctant) geologists to lay aside their own interests and to accept administrative assignments for specified periods. His success at doing this can perhaps best be illustrated simply by listing those who, in 1960, he recruited to serve as assistant chief geologists: Walter S. White, S. Warren Hobbs, James R. Balsley, Jr., and Vincent E. McKelvey—all men of established reputation in their individual fields. The redoubtable Samuel S. Goldich was induced to leave the University of Minnesota to head up the new Branch of Isotope Geology, and within remarkably few years, the Survey’s geochronology group would be of recognized world-class status.

Not all of Andy’s time of service as the Survey’s chief geologist was as rewarding, but beginnings were made of a program in marine geology and, under Eugene M. Shoemaker, the Survey was to have a significant role in lunar research. But there were trying times too, so it probably was with something of a sigh of relief that he completed his five-year tour in 1964. He and Helen then moved from Washington to the active center of Survey activities in Menlo Park, California, where Andy could resume his Arizona research and join a new group of bird watchers. At age 70, all responsibilities discharged, he retired and moved to Santa Cruz to accept appointment as research associate at the University of California. Later, in 1979, Helen and Andy would move to Pomona, California, to be closer to family.

Andy and Helen (Argull) were married in 1927 when Andy was still a graduate student at Berkeley, and they remained happily married throughout the many changes of locale and association that occurred over the next 60 or more years. They had one child, Robert Argull Anderson, now deceased. Andy is survived by his wife Helen, three grandchildren, and two great-grandchildren.

Andy was member or Fellow of a number of geological societies and was elected to the Council of the Geological Society of America (1946–1949). He was particularly active in the affairs of the Society of Economic Geologists, serving as vice president (1959) and president (1968); in 1974 he was awarded the Society's prestigious Penrose Medal. In 1956 he was elected to the American Academy of Arts and Sciences and in 1957 to the National Academy of Sciences. Pomona College, where Andy had been elected to Phi Beta Kappa in 1924, awarded Andy an honorary doctorate in 1960. In Washington, D.C., he was a member of the Cosmos Club. The mineral andersonite, a sodium-calcium uranyl carbonate first found at Jerome, Arizona, was named in his honor.

Andy died January 9, 1990, of Alzheimer's disease, following a long and productive career as a teacher, geologist, and administrator. He was a fine man and a good friend to many of us; he will be remembered with affection and respect.

SELECTED BIBLIOGRAPHY OF C. A. ANDERSON

- 1927 Voltaite from Jerome, Arizona: *American Mineralogist*, v. 12, p. 287–290.
- 1930 (with Finch, R. H.) The quartz basalt eruptions of Cinder Cone, Lassen Volcanic National Park, California: University of California Publications, Department of Geological Sciences Bulletin, v. 19, p. 245–273.
- (with Knopf, Adolph) The Engels copper deposits, California: *Economic Geology*, v. 25, p. 14–35.
- 1931 The geology of the Engels and Superior mines, Plumas County, California, with a note on the ore deposits of the Superior mine: University of California Publications, Department of Geological Sciences Bulletin, v. 20, p. 293–330.
- 1933 Volcanic history of Glass Mountain, northern California: *American Journal of Science*, v. 26, p. 485–506.
- The Tuscan formation of northern California, with a discussion concerning the origin of volcanic breccias: University of California Publications, Department of Geological Sciences Bulletin, v. 27, no. 7, p. 215–276.
- 1935 Alteration of the lavas surrounding the hot springs in Lassen Volcanic National Park: *American Mineralogist*, v. 20, p. 240–252.
- 1936 Volcanic history of the Clear Lake area, California: *Geological Society of America Bulletin*, v. 47, p. 629–644.
- 1938 (with Clark, B. L.) Wheatland formation and its relation to early Tertiary andesites in the Sierra Nevada: *Geological Society of America Bulletin*, v. 49, p. 931–955.
- 1939 (and Russell, R. D.) Tertiary formations of northern Sacramento Valley, California: *California Journal of Mines and Geology*, v. 35, no. 3, p. 219–253.
- 1940 Hat Creek lava flow: *American Journal of Science*, v. 238, p. 477–492.
- 1941 Volcanoes of the Medicine Lake Highland, California: University of California Publications, Department of Geological Sciences Bulletin, v. 25, p. 347–407.
- (with Merriam, C. W.) Reconnaissance survey of the Roberts Mountains, Nevada: *Geological Society of America Bulletin*, v. 52, p. 1675–1727.
- 1948 Structural control of copper mineralization, Bagdad, Arizona: *American Institute of Mining Engineers Transactions*, v. 178, p. 170–180.
- 1950 Alteration and metallization in the Bagdad porphyry copper deposit, Arizona: *Economic Geology*, v. 45, p. 609–628.
- 1955 Oxidation of copper sulfides and secondary sulfide enrichment: *Economic Geology 50th Anniversary Volume*, p. 324–340.
- (and Scholz, E. A., and Strobell, J. D., Jr.) Geology and ore deposits of the Bagdad area, Yavapai County, Arizona: U.S. Geological Survey Professional Paper 278, 103 p.

- 1958 (and Creasey, S. C.) Geology and ore deposits of the Jerome area, Yavapai County, Arizona: U.S. Geological Survey Professional Paper 308, 185 p.
- 1963 Simplicity in structural geology, *in* Albritton, C. C., ed., *The fabric of geology*: Reading, Massachusetts, Addison-Wesley, p. 175–183.
- 1967 Precambrian wrench fault in central Arizona: U.S. Geological Survey Professional Paper 575C, p. C60–C65.
- 1968 Arizona and adjacent New Mexico, *in* *Ore Deposits of the United States 1933–1967* (Graton-Sales volume 2), American Institute of Mining, Metallurgical and Petroleum Engineering, p. 1163–1190.
- Metamorphosed Precambrian silicic rocks in central Arizona, *in* *Studies in volcanology*: Geological Society of America Memoir 116, p. 9–44.
- 1969 Massive sulfide deposits and volcanism: *Economic Geology*, v. 64, p. 129–146.
- 1971 (and Blacet, P. M., Silver, L. T., and Stern, T. W.) Revision of Precambrian stratigraphy in the Prescott-Jerome area, Yavapai County, Arizona: U.S. Geological Survey Bulletin 1324-C, p. C1–C16.
- 1972 Precambrian rocks in the Cordes area, Yavapai County, Arizona: U.S. Geological Survey Bulletin 1345, 36 p.
- (and Blacet, P. M.) Precambrian geology of the northern Bradshaw Mountains, Yavapai County, Arizona: U.S. Geological Survey Bulletin 1336, 82 p.
- (and Nash, J. T.) Geology of the massive sulfide deposits at Jerome, Arizona: A reinterpretation: *Economic Geology*, v. 67, p. 845–863.