Memorial to Arthur Francis Buddington 1890–1980

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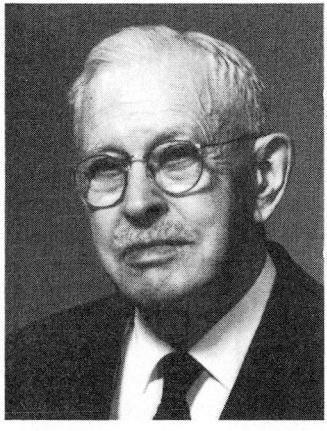

Arthur Francis Buddington was born in Wilmington, Delaware, on November 29, 1890, the son of Osmer G. Buddington and Mary S. (Wheeler) Buddington. His forebears came from England and their name was originally spelled "Boddington." The first "Boddington" moved to Groton, Connecticut, in 1669; the first Wheeler ancestor is recorded at Lynn, Massachusetts, in 1635. Both of his parents were raised on farms in Connecticut. His father, a Baptist minister, served for over 20 years at the Bethany Baptist Church in Wilmington, Delaware, before returning to the Poquonnock Bridge Baptist Church in Connecticut. His father was also an amateur naturalist, and it was through him, during summer vacations spent at Allen Point on Fishers Island Sound, Connecticut, that Arthur developed an enthusiasm for the outdoor life which was to become part of his profession.

After graduating from Mystic (Connecticut) High School in 1907, and from Westerly (Rhode Island) High School in 1908, he entered Brown University, where he majored (Ph.B.) in chemistry with minors in geology and botany. He undertook graduate study in geology at Brown, and despite a growing interest in hard-rock geology, completed his master's thesis on a study of Carboniferous flora.

Awarded a graduate fellowship at Princeton in 1913, he immediately joined a field party in Newfoundland under Prof. Gilbert Van Ingen, initiating his doctoral dissertation study (Ph.D., 1916) of Precambrian rocks around Conception Bay. His first publication growing out of this work was on the origin of the pyrophyllite deposits at Manuels, Newfoundland.

In collaboration with Prof. F. C. Smyth, while on a postdoctoral fellowship at Princeton for the year 1916–17, he undertook mapping of the Lake Bonaparte quadrangle in the Adirondacks. This initiated an involvement in that area which was to continue, intermittently, throughout the rest of his career.

In 1917 he became an instructor in the geology department at Brown University. In April 1918 he enlisted in the United States Signal Corps. At the end of the war, after his discharge in December 1918, he returned to Brown as an instructor. He remained for a semester before accepting an appointment as petrologist at the Carnegie Geophysical Laboratory in Washington, D.C. Here he undertook an investigation of the melilite mineral group involving synthesis and study of the phase relations. He remained in Washington for only a year before accepting an appointment at Princeton as assistant professor. During this time, however, he worked in association with such eminent scientists as N. L. Bowen, C. N. Fenner, H. E. Merwin, and H. S. Washington, and emerged with a lasting appreciation of the great importance to petrology of quantitative experimental physicochemical studies.

In 1924 he married Jene Elizabeth Muntz of Garrison, Nebraska, whom he met while working in Washington. Theirs was an especially happy partnership, and they had one daughter, Elizabeth Jene. Apart from many other official responsibilities as hostess while Dr. Bud was chairman of the department (1936–1950), Jene had to chauffeur him all over the Adirondacks during his field work, as he never drove. Even after his retirement as chairman, the Buddingtons made it a point to welcome all incoming graduate students and new faculty members either at a party at their home or by unannounced visits for tea on Sunday afternoon. All treasure memories of such occasions.

With the support of Prof. Smyth, Buddington actively promoted the transformation of the Princeton Geology Department from one overwhelmingly emphasizing soft rock (vertebrate paleontology in particular) to one more evenly balanced in respect to staff, and indeed best known thereafter for its research in mineralogy, hard-rock petrology, and economic geology. Some 51 out of 88 Ph.D. degrees in geology awarded between 1922 and 1945 were in these classical hard-rock fields, and Buddington was associated with most of them. His promotion of the graduate program in geology at Princeton saw the enrollment grow from 4 in 1920 to 30 upon his retirement in 1959. The total number of Ph.D. degrees in geology awarded before 1920 was 12; 174 were awarded between 1920 and 1959. Of his contribution to this growth and expansion, Buddington was justly proud.

For years Dr. Bud taught the undergraduate petrology course at Princeton, but his particular enthusiasm, as always, was with graduate students. For them he offered three separate courses: chemical geology, structural petrology, and petrogeny. Petrogeny concentrated on the properties of rock-forming minerals or mineral groups that could be used to derive genetic information about the rocks in which they occurred. All who took this "phase petrology" course found it to be immensely stimulating and useful.

Buddington always thought of himself as a field geologist, and more specifically, a field petrologist and economic geologist. Always keeping abreast of the literature, he maintained a keen sense of the importance of the fundamental theoretical and experimental researches on the physical chemistry of mineral systems to the interpretation of the origins of rocks as seen in the field. When conclusions derived from theory or experiment conflicted with conclusions based on field work, however, he always favored the latter. I recall his plotting a historical graph showing the steady decline in T and P of the experimentally determined alumino-silicate triple point. He pointed out how it was slowly approaching the lower temperatures and pressures that had long been qualitatively inferred from the distribution of these phases in the field.

His field experience between 1912 and 1960 was prodigious, amounting in all to about 44 summer seasons. Of these, 6 were spent in Newfoundland, 5 in southeastern Alaska (with the U.S. Geological Survey), and a total of 23 in the Adirondacks, where he personally mapped more than thirteen 15-minute quadrangle sheets. In the course of this work, he estimated that he walked 35,000 miles and sailed 5,500 miles to study 50,000 outcrops.

In 1927 Buddington reported the existence in the Coast Range batholith in southeast Alaska of a west to east succession characterized predominantly by quartz diorite, granodiorite, and quartz monzonite. Such findings were to form the foundation in the 1960s for inferences from igneous rock chemistry regarding the depth to the Benioff zone.

In 1935 he interpreted the diversity and distribution of the rocks in the syenitic and

granitic Diana Complex of the Northwest Adirondacks in terms of gravity stratification in an originally flat magma sheet. The operation of this process in such felsic magmas had not been demonstrated before.

In 1939 his classic Memoir 7 *Adirondack Igneous Rocks and Their Metamorphism* was published by the Geological Society of America. To this day this volume continues as the most immediate reference that comes to mind when the occurrence and location of any particular rock type in the Adirondacks is sought. His arguments for the origin of massif-type anorthosites (of which the Adirondacks must be the type example) by crystallization from a magma of gabbroic anorthosite composition were first presented in this volume. He separated the anorthosite suite from the syenite-mangerite-charnockite rocks with which they were invariably associated. The alternative hypotheses that these rocks were all derived by fractional crystallization of ordinary (low-alumina) basalt or calc-alkaline andesite magmas have yielded slowly in the face of the accumulating rare-earth-element data which show that Buddington was correct.

His paper on review and synthesis of data pertaining to the characteristics of granitic magmas emplaced at deep, moderate, and shallow depths (1959) was highly valued and provoked, as he remarked, a greater demand for reprints than any of his other papers. It was even published in Russian.

As a petrologist, Buddington was always sensitive to the potential occurrence of ores—as veins, accessories, or differentiates. His productive view of ore deposits in their full petrologic context rather than as isolated entities has been much appreciated in recent years.

In collaboration with J. R. Balsley, he thoroughly enjoyed aeromagnetic prospecting for iron ores in the Adirondacks during World War II. His interpretation of the positive and negative anomalies recorded in terms of the accessory Fe-Ti oxides initiated both his interest in rock magnetism and the possible use of these coexisting phases as geothermometers. This culminated in the publication in 1964 of the classic paper "Iron Titanium Oxide Minerals and Synthetic Equivalents" by Buddington and D. H. Lindsley, a former undergraduate student of his. Dr. Bud always felt undeserving of first authorship on this "field and experiment" paper. Such feelings doubtless contributed to his claim: "Take good care of students, for they may be your salvation later."

In his distinguished career, Buddington received many awards and honors: president (1940) and Roebling medalist of the Mineralogical Society of America; vice-president and Penrose medalist of the Geological Society of America; Dumont medalist and Honorary Fellow of the Geological Society of Belgium; Honorary Fellow of the Mineralogical Society of Great Britain; Fellow of the American Academy of Arts and Sciences (Boston), American Philosophical Society (Philadelphia), and the National Academy of Sciences; honorary degrees from Brown University, Franklin and Marshall College, and the University of Liege (Belgium). He also received the Distinguished Services Award from the U.S. Geological Survey.

After his wife's death in 1975, Dr. Bud moved to Cohasset, Massachusetts, to live with his daughter, Elizabeth (Mrs. Lyle Branagan), her husband, and four grandchildren.

Dr. Bud was modest, friendly, staunch, and immensely inspiring to all who knew and worked with him. Without doubt he was one of the giants among developers of North American geology. We all are grateful to him and for him.

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