

CITATION AND MEMORIAL FOR DR. WILLIAM F. BRADLEY

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More than a year ago, the Council of the Society unanimously nominated William F. Bradley to be the next recipient of the Distinguished Member Award. After the tragic car accident of 16 January 1973, in which he was fatally injured, the Council unanimously agreed, and I know the membership of the Society will likewise endorse, that we should proceed with the original intention even though we must do so posthumously. What was planned originally to be a citation becomes now also a memorial to a distinguished scientist and a fine personality.

Bill or Brad, as he was affectionately known to every member of the Society, played a leading role in the development of our Society and of the Annual Clay Minerals Conferences. At the time of his death, he was President of the Society, and also of the A.I.P.E.A. (International Association for the Study of Clays). He had attended every Clay Minerals Conference, served as Editor of *Clays and Clay Minerals*, 1963–1966, and was a member of council for many years. He was a member of many societies including the American Chemical Society, Geological Society of America, Mineralogical Society of America, the Mineralogical Society (London), American Crystallographic Association, Geochemical Society, and the Society of Economic Paleontologists and Mineralogists. He was President of the Mineralogical Society of America, 1970, and was Editor of the *A.C.A. Transactions* (1966).

During his scientific career, Dr. Bradley held two principal appointments. From 1934–1961, he was a chemist with the Illinois State Geological Survey, and from 1961 to the time of his death he was Professor of Chemical Engineering in the University of Texas, at Austin, Texas. For almost 20 yr he was a consultant with the Shell Development Company in Houston, Texas. In all three activities, Bill was concerned principally with the study of clays and layer silicates. It was a fortunate circumstance which brought R. E. Grim and W. F. Bradley together in Urbana, Illinois, for a period of almost 30 yr and their joint publications, sometimes with a third author, show what a valuable cooperation developed between these outstanding members of our Society. It is very fitting that both

names should be enrolled on our list of Distinguished Members. During his association with the Shell Development Company, Bill collaborated actively with many well-known clay mineralogists associated with the company at that time, including J. F. Burst, R. A. Rowland, H. van Olphen, Hugo Steinfink and C. E. Weaver; all who are familiar with the characteristics of Bill's expressive way of writing will recognize his role in the numerous joint publications.

Bill contributed to many aspects of the mineralogy and technology of clays. His published papers with single or joint authorship number around 60, and many of these have been of major importance in the development of the subject. Bill is especially well-known for his studies of the crystal structures of attapulgite, sepiolite, rectorite and other mixed-layer minerals. He was joint author with Grim and Bray in 1937 of the well-known study of clay-grade micas in which the term illite was first proposed. Less well-known to clay mineralogists are his studies of other mineral structures; he co-authored papers on the carbonate minerals, particularly huntite $Mg_3Ca(CO_3)_4$ and dolomite, on alunite, on some rare earth borates, on lanthanum telluride, on K_3SiF_7 , and on colloidal hydrous ferric oxide.

One of the most frequently quoted papers in the field of clay mineralogy is Bradley's 1945 paper on "Molecular Associations between Montmorillonite and Some Polyfunctional Organic Liquids", in which he established the broad outlines of the swelling of montmorillonites by polar organic liquids. In his characteristically modest way, he described the Fourier syntheses derived from 00l intensities as 'Fourier sketches', emphasizing, perhaps unduly, the limitations of the results, which nevertheless showed the packing of the organic molecules in sheets between the silicate layers. As an off-shoot of this work, he established what is now the universal practice of identifying montmorillonite by its characteristic swelling in ethylene glycol.

Another major contribution, which appeared in joint publications with J. M. Serratosa in 1958, was the determination of the OH bond axes in layer silicates

by i.r. absorption measurements. In fairness to an earlier investigator, we must not forget that Professor M. Tsuboi, in 1950, was probably the first to apply i.r. measurements to this problem in the mineral muscovite. However, Serratos and Bradley recognized the broad importance of this method for supplementing X-ray structure analyses, and the results have been unexpectedly far-reaching. In particular they showed that useful results could be obtained with well-oriented layers of micro-crystalline layer silicates, i.e. clay minerals.

Bradley made many studies relating to the technology of clays. His work illuminated the reactions which occur when clay minerals are heated to high temperatures. The ordered nature of many of these reactions, which we now call 'topotaxy', was recognized clearly in a paper with R. E. Grim in 1951. His study of the mullitization of kaolinite, with J. E. Comeforo and R. B. Fischer, in 1948 was an important landmark in the evaluation of the kaolinite-mullite reaction series.

Over the years, Bradley, often in collaboration with R. E. Grim, participated in a variety of geologically oriented clay studies. We remember particularly a paper on the sediments off the California Coast and the Gulf of California (1949), a study of the chloritic material in sediments (1954), and a general discussion of diagenesis in sediments (1964).

Since this is a Memorial of an outstanding man as well as a Citation of his scientific achievements, it is proper to mention those characteristics which endeared him to colleagues and collaborators throughout his life. Bill was a very modest person in speech and in writing. He was often slow in speaking, weighing each word carefully, and on one occasion was heard to say: "I can't think and talk at the same time". If anything, he tended to underestimate his own achievements. It was entirely characteristic that he called his early Fourier syntheses 'sketches' and 25 yr later his presidential address to the Mineralogical Society of America, 'Low-Key Crystallography'. Those who were close to Bill in scientific work insist that he was ready at all times to help others and to ask nothing for himself. One correspondent tells me: "I am convinced that he has contributed *substantially* to many papers, although his name is not in the publications".

I was not privileged to know Bill away from scientific affairs, but others tell me of his capabilities in many directions. One writes: "Bill always was anxious to work with students. . . . I am sure that all feel that they profited greatly from this association", and another says: "As a teacher he willingly spent many hours tutoring students who asked for help. Many students whose native language was not English have not

forgotten his help". Others tell me of Bill's prowess at bridge and his interest in snipe hunting. Another describes his ability to do great cartwheels and handstands, and to participate in a 'push-up contest' at a cocktail party. All write or speak with much affection for Bill.

Bill is survived by his wife Ruth, who also suffered injuries in the car accident which was fatal for Bill, his daughter, Mrs. John H. Nabors, Jr. of Dallas, and his son, Dr. William C. Bradley of Boston.

Mme President, I regard it as an honor to be permitted to offer this citation in support of the proposal that the name of *William F. Bradley* be inscribed posthumously as a Distinguished Member of our Society, and I present to you Mary Bradley Nabors, his daughter, to receive the Distinguished Member Award Certificate. It is also with pleasure that I present to her the gift customarily given by the Society to the President at the termination of his period of office.

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