Allan Talbott Gwathmey - Scientist, Scholar, Gentleman

July 29, 1903 — May 12, 1963

The United States has provided many giants in the field of corrosion to the scientific community. It was my privilege to be a student and long-time friend of a man -- Allan Talbott Gwathmey -- who developed the metal single crystal as a tool for understanding the surface properties of metals. Although he himself was not foremost a corrosion scientist, his work was corrosion related as indicated by the fact that four of his students served as chairmen of the Gordon Conference on Corrosion over a 15 year period. In the following paragraphs I will attempt to give a picture of the man who inspired many people and who was admired by many more for his loyalty, his spirit, his selflessness, his principles, his gentleness, and his breadth of interests. In the description he will be referred to in a formal way because it reads much better. To me and to other close friends he was known as "Pete", an address not used widely among his colleagues at other institutions.

Allan Gwathmey was born in Richmond, Virginia on July 29, 1903. He attended preparatory school in Richmond and received his B.S. degree from Virginia Military Institute in 1923. Following several years of employment as an engineer, he continued his schooling and obtained a B.S. in Electrochemical Engineering from Massachusetts Institute of Technology in 1928. After several years of industrial research, Allan Gwathmey entered the Graduate School at the University of Virginia during the severe depression years of the early 1930’s and earned the Ph.D. degree in Chemistry in 1938. He chose to do his thesis research in low voltage electron diffraction, a field which later became popularly known as LEED. He did all his own glass blowing, all the fabrication of electronic components, the growing and surfacing of the single crystals used, and the nulling of spurious fields influencing the paths of the electrons. He received no substantive technical support from his advisor and it was truly a "do-it-yourself" thesis. During this work it was noted that a spherical single crystal of copper exhibited a pattern of interference colors when it was heated. This observation captured his fancy in such a way that an understanding of the anisotropic surface properties of metals became the focal point for his research efforts during the next 25 years. He continued at the University of Virginia as a research associate until his appointment as a member of the Chemistry Department faculty in about 1947 and remained a member of the faculty until his death.

His interests at the University of Virginia were campus-wide. He lived for many years in the Colonnade Club on the Lawn, that beautiful terraced green lined with grand trees that connects Cabell Hall with the building that symbolizes the University, the Rotunda. He fought in many ways to retain the dignity and charm of the Colonnade Club to the end that it was the focal point for faculty social life. He served on the

University Senate and did what he could to encourage de-emphasis of intercollegiate athletics. His viewpoints in this regard were different from those of many of his friends, associates, and students, but these views did not inhibit his friendships. He was called on by the President of the University many times to serve as host for distinguished visitors. He was particularly talented in hosting female visitors: I remember particularly seeing his talent in action while charming and entertaining Lady Astor. He was a constant thorn in the sides of the deans and presidents, when they were not aggressively seeking to build excellence into departments. He interested his sister, Mrs. Robert M. Jeffress, in providing funds to restore some of the small gardens within the serpentine walls. He played important roles in encouraging wealthy alumni to support their university. His intellectual interests were wide. He taught a course in aesthetics in the Department of Philosophy and he was writing a book - never completed - on economics.

Prof. Gwathmey treated his graduate students as one big family. They were welcome to confide in him and to seek his advice on technical as well as non-technical matters. His office door was always open and be would interrupt whatever he was doing to talk to students. Since he married late in life and had no children of his own, his students filled a void in his life. When things did not go well in the laboratory or when the demands of the experiment were greater than the available resources, his favorite expression was "The toughening discipline of a complex experiment". Years later when his students communicated among themselves by letters, wire, or telephone, it was not unusual to have a post script which read TTDOACE.

Allen Powell was the first Ph.D. student to work closely with Dr. Gwathmey and I was the second. Neither of us had him officially as our thesis advisor, however, since he did not have faculty status at the time we carried out doctoral programs. My research goal was to determine the range of the anisotropic surface behavior of single crystals of many different metals including copper, gold, nickel, cobalt, silver, iron, lead, tin, bismuth, zinc, cadmium, and magnesium in such diverse processes as aqueous corrosion, catalysis, electrodeposition, friction, wear, wetting, recrystallization, and oxidation.

The groundwork in preparation of the crystals, their conversion to flats and spheres, the surfacing procedures and the means for accurate determination of orientation were developed, but the major refinements in techniques were made by students who followed me. G.P. Smith and L. Dyer studied the behavior of single crystals in friction and wear; J.B. Wagner and R. Cunningham emphasized behavior in catalytic reactions; F.W. Young and J. Cathcart studied rates of oxidation of crystals of known orientation using ellipsometry as a tool. J. Kruger and L.B. Johnson studied adsorption and wetting of single crystals; K. Lawless and L. Garmon studied the structure of electrodeposits on known crystal faces; P. Sherry and G. Link used emission

microscopy and field ion microscopy to study very small single crystals. Other students who worked on various aspects of the surface properties of single crystals included M. Wasserman, Edwin Cox, Jr., Virgil Straughan, Helen Grenga, Thomas Gibson, Thomas Swank, J.M. Bailey, R. Meelheim.

Some of his better known publications related to corrosion include:

"Some Experiments Showing the Directional Reactivities of Single Crystals of Copper," A.T. Gwathmey and A.F. Benton, Trans. Electrochem. Soc. 77, 211 (1939).

"The Growth, Orientation and Preparation of the Surface of Single Crystals of Copper," A.T. Gwathmey and A.F. Benton, J. Phys. Chem. 44, 35 (1940).

"Influence of Crystal Face on the Electrochemical Properties of a Single Crystal of Copper," H. Leidheiser, Jr., and A.T. Gwathmey, Trans. Electrochem. Soc. 91, 95 (1947).

"The Selective Deposition of Carbon on the (111) Face of a Nickel Crystal in the Catalytic Decomposition of Carbon Monoxide," H. Leidheiser, Jr., and A.T. Gwathmey, J. Am. Chem. Soc. 70, 1206 (1948).

"The Effect of Added Atoms on the Catalytic Properties and on the Superficial Structure of Certain Faces of a Single Copper Crystal," A.T. Gwathmey and R.E. Cunningham, J. Chem. Phys. 51, 497 (1954).

"Rates of Oxidation of Several Faces of a Single Crystal of Copper as Determined with Elliptically Polarized Light," F.W. Young, Jr., J.V. Cathcart, and A.T. Gwathmey, Acta Met. 4, 145 (1956).

"Structure of Oxide Films on Different Faces of a Single Crystal of Copper," K.B. Lawless and A.T. Gwathmey, Acta Met. 4, 153 (1956).

When Professor Gwathmey was installed as President of the Virginia Academy of Science In 1953, he declared: "I recommend the pursuit of basic knowledge to any young man as a life’s work. In spite of its hardships it is a source of never-ending gratification and astonishment..... No matter how scarce some materials may be, there is no shortage of undiscovered knowledge." These comments reflected a way of life that inspired many of his students to remain in basic research or in academic work. The names of many of his students are familiar names in journals concerned with some aspects of materials science. Those who continued research in the field of corrosion include:

John Cathcart, Oak Ridge National Laboratory, known for his explanation of the anistotropic oxidation of metals and the oxidation of columbium and tantalum.

Lewis B. Johnson, University of Virginia, known for his research on the corrosion of dental amalgams.

Jerome Kruger, National Bureau of Standards, known for his interesting applications of ellipsometry to problems in corrosion.

Kenneth Lawless, University of Virginia, known for his research using electron diffraction and high voltage electron microscopy.

G. Pedro Smith, University of Tennessee, known for his work on fused salts.

J. Bruce Wagner, Jr., Northwestern University, known for his work in the thermodynamics of oxide corrosion products.

Frederick W. Young, Oak Ridge National Laboratory, known for work on imperfections in single crystals and their relation to etching behavior.

Professor Gwathmey did not make the accumulation of material things as a goal of his life. His widowed mother had means, his married sister was very wealthy, and he had no other family members he had to be concerned with, at least until he married in 1953. He did not serve as a consultant to make extra money, although he did assist several close friends who were senior officials of major companies in technical matters in a non-remunerative way. Honoraria received from lectureships were either returned to the sender to use in advancing a charitable cause or were donated to non-profit organizations in which he was interested. He drove an old car and the expensive pieces of clothing he often wore were gifts.

He loved his native state with a passion. The beauty of the Lawn at the University, the Spirit of VMI and his admiration for Thomas Jefferson were often subjects for comment or discussion among his friends and almost always crept into his public lectures. The loss of William Barton Rogers to Massachusetts and his founding of MIT In the north rather than at William and Mary bothered him enormously. He prevailed upon the Virginia Academy of Science to found an institute devoted to basic research. They did in 1948 and a small grant allowed Prof. Strickland at the University of Richmond to carry out a research program on the blue green algae. The Commonwealth of Virginia in 1949 provided a grant of $20,000 plus free rental of an old building in a park in Richmond and the Virginia Institute for Scientific Research came into being. Virgil Straughan and I were the first full-time employees and the hardships endured in pulling an institution up by its bootstraps were only bearable

because of the enthusiasm and inspiration of Allan Gwathmey. This institution grew to a staff of approximately 40 and sufficient funds were raised to build a modern laboratory on 20 acres of ground in the beautiful west end of Richmond. The building was dedicated in July 1963 and was named the Allan Talbott Gwathmey Laboratory. He lived to see it completed and occupied. The Institute is now part of the University of Richmond.

Dr. Gwathmey was among the first to recognize the importance of metal single crystals as a research tool in studying many surface phenomena. The development of the semiconductor industry and the need to understand the solid state behavior of single crystals of silicon and germanium ran parallel to the research at the University of Virginia on metal crystals. When Nicolas Cabrerra and John Mitchell joined the Physics Department, Dr. Gwathmey was quick to take advantage of their presence on campus. These two men, with their intimate understanding of crystal growth and defects in solids, enabled students quickly to understand the defect solid state and adapt the principles to their own work. It was an exciting time for students of science in the 1950's.

The beauty of single crystals, particularly those that were oxidized in the form of spheres or were etched in various ways, satisfied him in the same way that an outstanding experimental result did. He maintained an exhibit of the prettiest crystals in a large glass—topped display case in his office. I remember such well known scientists as W.A. Noyes, Jr., H.H. Storch, N.F. Mott, H. Eyring and C.J. Davisson leaning over the case and listening intently as Dr. Gwathmey described the significance of each crystal. An exhibit of the more beautiful crystals was held at the Valentine Museum in Richmond, Virginia, and others were furnished for use in industrial displays. General Motors used crystals studied by one of his students, L. Dyer, in an exhibit at the New York World's Fair.

He considered all actions of the utmost importance. Letters were drafted, rewritten, put aside, and revised before being worthy of mailing. Lectures and slides were prepared with the greatest care. Manuscripts were revised many times before submittal for publication and experiments had to be repeated many times before they were considered correct. Social events were planned carefully and strategy was the keyword when he plotted a confrontation on an emotional issue. His special foes at Gordon Conferences were those who devoted all their experimental skills to the obtaining and analysis of data on samples of unknown surface structure and composition.

Who were his ideals? For sheer intellectual capacity, a zest for life, and a broad scope of interests, it was Thomas Jefferson. On the local scene, it was Professor Jesse Beams, a member of the National Academy of Sciences and President of the Physical

Society. In his home town of Richmond he had deep bonds of friendship with Langbourne Williams, Chairman of the Board of Freeport Sulfur Co.; Edwin Cox, Vice President of Virginia—Carolina Chemical Co.; and Robert Kean, an MIT graduate and a descendent of Thomas Jefferson. On the distaff side he idolized the Dean of Women, Roberta Hollingsworth, who later became his wife when they both had passed the age of 50. His sister, Elizabeth Jeffress, was often in his conversation and he sought her advice on many issues.

Allan Gwathmey was not blessed with good health and was a rather frail child. His father died while Allan was young and this event made him aware of the importance of good health. In the early 1950's it was recognized that he had a severe case of diabetes and he soon became a "brittle diabetic". His pockets always contained sugar, candy, or fruit so that he could titrate the injected insulin as his body advised him. Blackouts were not uncommon in the early days of his treatment and one of them resulted in a broken knee. In 1961 he began to experience impairment in the muscles that control breathing, swallowing and talking. Chemotherapy was of some help, but a creeping paralysis began that culminated in his death on May 12, 1963. The last few months of his life were difficult beyond expression but he never lost his optimism and his interest in the activities of his students and of the Virginia Institute for Scientific Research. It was an unpleasant experience to see one you admire conquered by a mysterious ailment one is hopeless to fight.

An excellent summary of Professor Gwathmey's character is contained in a memorial statement prepared by his friends and presented before the faculty of the University of Virginia after his death: "In the University, he will be remembered for his ideals, for the depth of his convictions and for his dignified presentation of them. When called upon to defend his position, he was always polite but never yielded where principles were involved. He could preserve outward calm under great stress and his earnestness and carefully reasoned arguments seldom failed to command respect even from those who could not agree with him. In the course of time, many of his proposals have come to be accepted and adopted but the spirit which compelled him to fight for principles and causes and for academic excellence and efficiency within the University could never rest. For others, he fought many battles in an entirely selfless way with an intensity and courage which will not soon be forgotten".

Henry Leidheiser, Jr.

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