A high-profile researcher, Alan received a number of fellowships from the Royal Society, Nuffield Foundation and the British Council, as well as a Senior Gledden Fellowship. A new Fe, Nb sulphide mineral was named 'Edgarite' in his honour and has been accepted by the IMA Commission on New Mineral Names. He was a Fellow of both the Mineralogical Society of America and the Geological Association of Canada, and had been Member of the Mineralogical Society of Great Britain & Ireland since 1962.

Alan's research record speaks for itself. Less-widely appreciated perhaps was his unassuming courage and persistence in the face of chronic ill health. A diabetic from his youth, he suffered increasingly from those complications that accompany the illness long-term, including serious deterioration of vision. He made no concessions to his health, nor expected others to make any. Knowing how much his work meant to him, there is some consolation in the fact that death from heart failure intervened before he became unable to meet his own high standards. In January 1998 he died at his home in London, Ontario, with his family at his side.

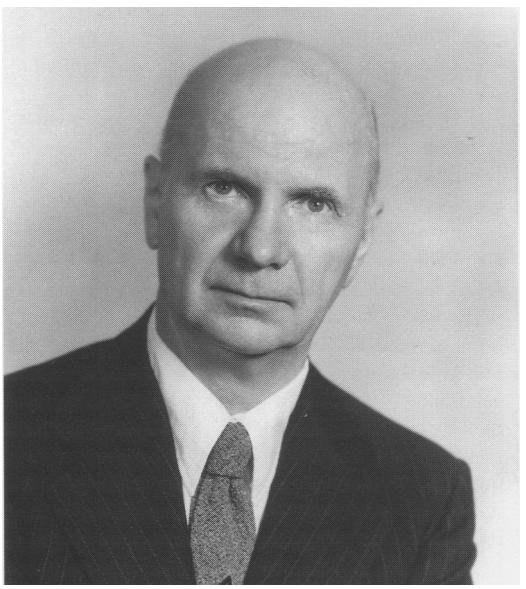
Those of us who work in the engaging field of potash-rich mafic volcanics will sorely miss his participation, but he leaves us a legacy of enthusiasm and will to persist as well as a valuable deposit of experimental knowledge.

FELICITY E. LLOYD
PRIS,
Reading University

Prof. G. Tunell (1900–1996)

George Tunell died on July 4, 1996 in his retirement community at Montecito, California. His wife Ruth had preceded him in death by four years; they had no children. His long and eminent career produced major advances in the X-ray crystallography, physical chemistry, and thermodynamic analysis of minerals, particularly of mettallic ores. His outstanding achievements were recognized by the Mineralogical Society of America by electing him President of the Society (1950) and by awarding him the Roebling Medal, its highest honour, in 1973. He also served as President of the Geochemical Society (1962–1963). His many publications and his training of a generation of earth scientists at the University of California stand as an enduring legacy.

George Gerard Tunell, Jr. was born in Chicago, Illinois on April 4, 1900. His father was a prominent railway engineer who served on local and national planning commissions and as an adjunct faculty member of the University of Chicago. His mother died when George was seven years old. As a consequence, young George travelled extensively with his father on the Santa Fe Railroad, and acquired a lifelong love of trains. While on a visit to Arizona, a miner gave George a small collection of minerals and ores. In so doing, the kindly man stimulated a distinguished career in mineralogy. In following years, George spent many afternoons in the Geology Department of the Field Museum of Natural History in Chicago, where the scientific staff



Prof. G. Tunell

https://doi.org/10.1180/minmag.1999.063.2.18 Published online by Cambridge University Press

further nurtured George's intense interest in minerals. In 1918 George entered Harvard University as a student of mining geology. Four years later he graduated and began post-graduate studies in the same institution. By this time his interest in economic mineralogy had expanded into a major career motivation.

In 1925 George began research work at the Geophysical Laboratory of the Carnegie Institution of Washington, concentrating on the genesis of metallic ores. His experimental work carried out there was accepted for a PhD thesis at Harvard in 1930. Research progressed on three fronts: X-ray crystallography, petrography, and experimental petrology. These were the early days of X-ray crystallography, and Tunell produced some of the first structure determinations of minerals, as well as pioneering contributions to the theory and practice of X-ray crystallography. A notable accomplishment was the demonstration of square coordination of divalent Cu in the black oxide tenorite. Early in his career, George anticipated that both alkaline and acid sulphur-bearing solutions would turn out to be important fluids in the formation of metallic ore deposits. With E.W. Posnjak he measured the solubility of CuO in acid solutions in the system Fe_2O_3-CuO-SO_3-H_2O; the measurements yielded important implications for the supergene zones of the great copper ore deposits. These pioneering experiments were among the first of their kind in the experimental petrology of ore minerals. Tunell's ideas about fluid transport of metallic sulphides were to bear additional fruit many years later in his collaboration on mercury ores with his students and long-term colleagues Frank Dickson and Bob Learned. Tunell and his co-workers observed present-day cinnabar deposition in northern California from alkaline mercury sulphide solutions. Experimental work by Dickson and Learned revealed a major effect of silica saturation in decreasing the solubility of HgS in such solutions. The clear implication is that silica-poor mercury sulphide solutions, upon encountering quartzose rocks, would quantitatively precipitate mercury ores, thus explaining the conspicuous emplacement of cinnabar in quartzite, as in the famous occurrence at Almaden, Spain. Gunnar Kullerud, in his presentation of George Tunell for the Roebling Medal, cited Tunell as the leading authority on the formation of mercury ore deposits.

George married Ruth Phillips, a science teacher, in 1931. In 1947, George and Ruth left Washington for health reasons. George spent two years at the California Institute of Technology before accepting a faculty position with the University of California, which appointment he held for the rest of his career, for 16 years at Los Angeles, and then at the Riverside campus until his retirement in 1967. After retirement, he was Professor Emeritus recalled to active duty at Santa Barbara until his death. The rigorous nature of his teaching remains a U.C. legend. Although a wonderfully kind man, Prof. Tunell was never lenient with students: he expected them to observe the uncompromising standards that he exacted of himself (for some of us this was a dreadful discipline!).

Tunell's researches in the physical chemistry of metallic ore-forming solutions led him into a study of the foundations of the theory of chemical thermodynamics, as formulated in the 1860s by J. Willard Gibbs. In his monumental exposition, Gibbs was sometimes quite terse, giving only scant commentary on the derivations of some of his most important equations. As Prof. Tunell constantly impressed upon his students, a common lack of understanding of the logical details in the development of these equations has led to widespread misuse of some of the most basic equations. In a 1985 lecture at the University of Chicago, subsequently published as the keynote article of the Springer-Verlag book series "Advances in Physical Geochemistry", Tunell outlined rigorously and with elegant simplicity the logical foundations of Gibbs' Equation 12, which is the fundamental equation of chemical thermodynamics. A lengthy monograph on the equally important Gibbs Equation 98 was published by the Carnegie Institution in 1979. These and many other works on classical thermodynamics established George Tunell as one of the most respected modern commentators on J. Willard Gibbs.

George Tunell profoundly influenced a large number of students and associates over his long career. Many of those who had this good fortune have been professionally involved with crystallography and thermodynamics. It is impossible for us to forget Prof. Tunell's oft-repeated admonition: "Think it through again. Don't leave out any steps this time, and understand every step".

ROBERT C. NEWTON
Department of Earth and Space Sciences,
University of California at Los Angeles

https://doi.org/10.1180/minmag.1999.063.2.18 Published online by Cambridge University Press