Biographical Encyclopedia of Astronomers

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Bates, David Robert

Born Omagh, Northern Ireland, 10 November 1916

Died Belfast, Northern Ireland, 5 January 1994

Sir David Bates carried out innovative research in atomic, molecular, and optical physics, which he applied to problems of aeronomy and astronomy. He was educated at the Royal Belfast Academic Institution in Belfast, after which he entered the faculty of science of the Queen's University of Belfast. He graduated in 1937 with B.Sc. degrees in experimental physics and mathematical physics, obtaining first-class honors in both. In 1938, Bates was awarded the M.Sc. degree. He married Barbara Morris in 1956, and they had two children, Kathryn Maud and Adam David

After wartime research and before departing for Belfast in 1951, Bates was a lecturer in the Department of Mathematics and then a reader in the Department of Physics at University College London. He was professor and head of the Department of Applied Mathematics at Queen's University Belfast from 1951 to 1973, and then held a special research chair until 1982, when he became professor emeritus. During his tenure in the Department of Applied Mathematics (later the Department of Applied Mathematics and Theoretical Physics), Bates built a research school in atomic, molecular, and optical physics that became world-renowned

With graduate students and postdoctoral fellows, Bates forged deep connections between atomic, molecular, and optical physics and astronomy. In his studies, Bates combined physical insight with mathematical formulations constructed to enable quantitative comparisons of theory and measurement. He investigated a diverse range of processes and made significant contributions to the accurate description of photoionization, photodetachment, collisional excitation, ionization and charge transfer, chemical reactions, mutual neutralization, radiative association, dissociative recombination, dielectronic recombination, collisional-radiative recombination, and ion-ion recombination. He profoundly influenced and inspired generations of graduate students

Bates' applications to the terrestrial atmosphere established the foundation and fundamental concepts for later studies of the physics and chemistry of planetary atmospheres and astrophysical plasmas. His approach, first employed in studies of the terrestrial ionosphere, has become standard. In it, he identified the detailed microscopic processes that produced the free electrons and the recombination processes that removed them, made estimates of their rates, and evaluated their consequences.

The original analysis of ionospheric structure with Sir Harrie Massey led to the recognition that the process they called dissociative recombination is the dominant recombination process in molecular plasmas, and Bates demonstrated that it plays a decisive role in determining the luminosity and chemistry of many atmospheric and astrophysical environments and laboratory plasmas. Working with Marcel Nicolet, Bates identified the chemical source of the infrared hydroxyl bands in the airglow of the atmosphere and pointed to the importance of methane and water vapor in the chemistry of ozone With Agnes Witherspoon and Paul Hays, he demonstrated the profound effects of minor constituents in atmospheric chemistry and the role of industrial and microbiological sources and sinks. This research is fundamental to studies of global change and the effects of pollution.

Bates made substantial contributions to astrophysics, perhaps none more enduring than his work with Lyman Spitzer on the formation and destruction of molecules in interstellar clouds. From 1962 to 1993, Bates was editor of *Planetary and Space Science*, and for 28 years he was a co-editor of *Advances in Atomic, Molecular and Optical Physics*

Bates received many honors including election to the Royal Irish Academy in 1952, the Royal Society of London in 1958, the International Academy of Astronautics in 1961, the American Academy of Arts and Sciences in 1974, the Académie royale de Belgique in 1979, the United States National Academy of Sciences in 1984, and the International Academy of Quantum Molecular Science in 1985. He received honorary degrees from seven universities He was awarded the Hughes Medal of the Royal Society in 1970, the Chree Medal of the United Kingdom Institute of Physics in 1978, the Gold Medal of the Royal Astronomical Society in 1979, and the Fleming Medal of the American Geophysical Union in 1987. For his services to science and education, Bates was knighted in 1978. Two medals were created in his honor: the Sir David Bates Medal of the European Geophysical Society and the Sir David Bates Medal of the UK Institute of Physics.

Alex Dalgarno

Selected References

Bates, David R. (1983). "Scientific Reminiscences." In *Proceedings of the International Symposium on Atomic, Molecular and Solid-State Theory, Collision Phenomena, and Computational Quantum Chemistry*, edited by Per-Olov Löwden, pp. 5-32. International Journal of Quantum Chemistry, Quantum Chemistry Symposium, no. 17. New York: John Wiley and Sons.

Burke, P. G. and D. S. F. Crothers (1996). "Professor Sir David Bates, FRS." *Comments on Atomic and Molecular Physics* 32: 127-130.

Dalgarno, Alexander (1997). "Sir David Robert Bates." *Biographical Memoirs of Fellows of the Royal Society* 43: 47-71