PART 4.
Basic Molecular Processes

https://doi.org/10.1017/S0074180900164824 Published online by Cambridge University Press

Astrochemistry: From Molecular Clouds to Planetary Systems
IAU Symposium, Vol. 197, 2000
Y. C. Minh and E. F. van Dishoeck, eds.

Gerhard Herzberg 1905–1999

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Gerhard Herzberg died on March 3, 1999 at the age of 94. Most would regard him as the greatest molecular spectroscopist the world has ever seen. He had a monumental knowledge of molecular spectra, remarkable technical skills and boundless energy and enthusiasm. A new spectrum he had not seen before was to him a joyous discovery to which he would respond with excitement and an intense absorption as he immediately tried to identify the origin of the features it contained. His books dominated the field and were necessary reading and re-reading for both aspiring and experienced researchers. Gerhard was a natural leader and not only in the laboratory he directed.

Gerhard received the Nobel Prize in Chemistry in 1971. The statement reads "for his contributions to the knowledge of electronic structure and geometry of molecules, particularly free radicals." His contributions were actually much more extensive and many were relevant to astrophysics in which he had an abiding interest. His contributions to astrophysics, actually astrochemistry, were recognized by his adoptive country, Canada, by the creation of the Herzberg Institute for Astrophysics.

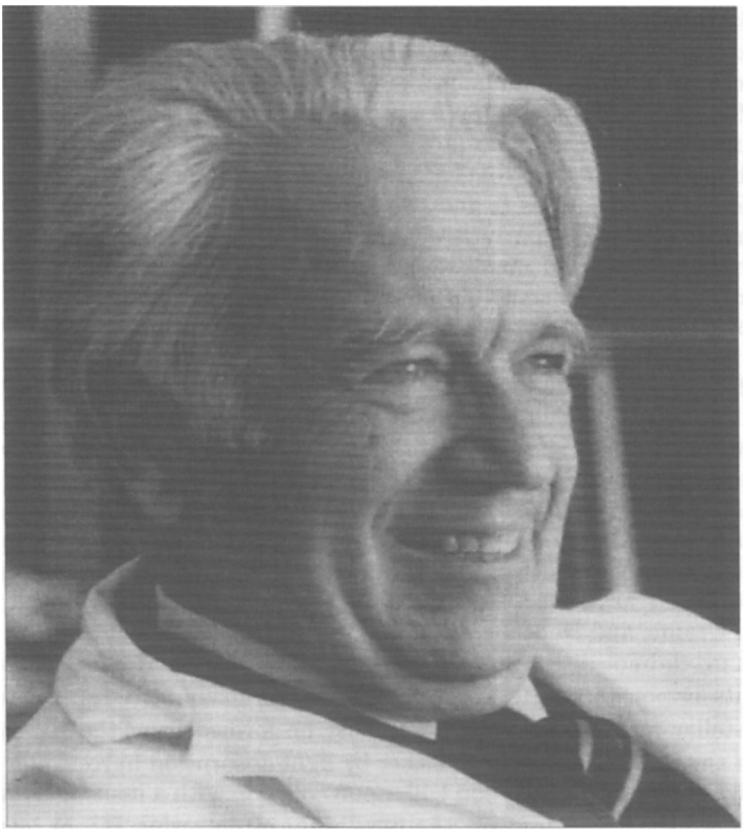
With Alex Douglas in 1941, Gerhard identified interstellar absorption lines as being due to CH^+. With the development of flash photolysis, Gerhard was able to study transient species, amongst which were the astrophysically important organic species CH_2 and CH_3. He pointed out that molecular hydrogen has a weak quadrupole spectrum that could be used to search for the molecule in distant objects and by comparing with measurements made with a long path length spectrometer, he discovered H_2 in the atmospheres of Uranus and Neptune. He would have been fascinated by the recent detection of the methyl radical in Uranus and Neptune.

Gerhard did not discover H_3^+ though he looked long and hard. He certainly knew of its importance. He wrote in 1967 "It is likely that H_3^+ is present in the interstellar medium since H_2^+ ions must be formed from the H_2 molecules present in the interstellar medium either by light absorption beyond 805 Å or by cosmic rays and since each H_2^+ ion will, upon collision with a neutral H_2 molecule immediately form H_3^+. However the possibility of detecting H_3^+ in interstellar space depends on the discovery of a spectrum of this molecule in the laboratory."

And that is how it did happen with the detection of H_3^+ by Oka, Geballe, McCall, & Hinkle. Gerhard found instead of H_3^+ the Rydberg spectrum of H_3 and, what is more, recognized it. Gerhard also obtained the continuous spectrum arising in the spontaneous decay of the excited states of H_2 into the vibrational continuum, of the ground state, the process shown by Solomon and Stecher & Williams to be responsible for the destruction of H_2 in interstellar space. The

diffuse interstellar bands were an absorbing interest and he would have been excited by the measurements of J-P Maier and his group on anion spectra. Gerhard thought originally that the features are due to solid state particles but he changed his mind and argued persuasively that gas-phase molecules are responsible.

This photograph is how he will be remembered–it is how he was–vibrant, energetic and involved, with a warm, encompassing friendliness that embraced everyone. His way of doing science is an inspiration to all of us.



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