

Nobel Prize in Chemistry 1971



Gerhard Herzberg

The Nobel Prize in Chemistry 1971 was awarded to Gerhard Herzberg *"for his contributions to the knowledge of electronic structure and geometry of molecules, particularly free radicals"*.

RESEARCH INFORMATION:

This year's Nobel Prize winner in Chemistry, Dr. Gerhard Herzberg, is generally considered to be the world's foremost molecular spectroscopist and his large institute in Ottawa is the indisputed center for such research. It is quite exceptional, in the field of science, that a single individual, however distinguished, in this way can be the leader of a whole area of research of general importance. A noted English chemist has also said that the only institutions that have previously played such a role were the Cavendish laboratory in Cambridge and Bohr's institute in Copenhagen.

Herzberg began as a physicist and his first contributions to molecular spectroscopy were published at the end of the 1920's. In such investigations one measures how molecules absorb light-energy - also outside the visible region - i.e. in the ultraviolet and infrared. Since light-energy is packaged as quanta, these measurements can provide accurate information about energy contents in molecules. From this information their size,

shape and other properties can be derived. Such calculations must be based on the description of matter given by quantum mechanics. The development of this subject during the 1920's and 30's is regarded as one of the most exciting periods in the history of physical science. Herzberg's elegant experimental investigations combined with his theoretical insight into their interpretation contributed to the progress of quantum mechanics while being decisive for the rapid development of molecular spectroscopy.

One may now ask why Herzberg - originally a physicist and even famous as an astrophysicist - finally was awarded the Nobel Prize in chemistry.

The explanation is that around 1950 molecular spectroscopy had progressed so far that one could begin to study even complicated systems of great chemical interest. This is brilliantly demonstrated by Herzberg's pioneering investigations of free radicals. Knowledge of their properties is of fundamental importance to our understanding of how chemical reactions proceed.

For a chemical reaction to occur the original molecules must in some way break up into fragments which rearrange to form the new molecules. These fragments, or intermediates, are called free radicals.

Free radicals are very difficult to study due to their short life-times - measured in millionth's of a second. Herzberg therefore had ample opportunity to repeatedly demonstrate his exceptional experimental skill when the necessary spectroscopic technique was worked out.

Herzberg has so far performed extensive precision determinations of the properties of over thirty free radicals among which are to be found the radicals methyl and methylene - well known from organic chemistry. Among his exciting discoveries may be mentioned that radicals drastically change their shape with increasing energy. For example, methylene is linear in its ground state but bent in states of higher energy. Many of the most important results were only achieved after several years' work and some of the most exciting as late as at the end of the 1960's. One can therefore note that this year's prize is truly an award for contributions of great current interest.



International Journal of Science Innovations and Discoveries

ISSN:2249-5347

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