



Gerhard Herzberg – An Illustrious Life in Science. Boris Stoiceff. NRC Research Press, National Research Council of Canada, Building M-55, Ottawa, Ontario, Canada K1A 0R6. 2002. 468 pp. Price: \$49.95.

100 Sussex Drive, Ottawa was an address all bright, young molecular spectroscopists coveted to be at, throughout the second half of the twentieth century. Those who were fortunate to get there, always carried one or more volumes of their Testament: *Molecular Spectra and Molecular Structure*, vols. I–III. Gerhard Herzberg, the author of these volumes, remains today, perhaps the only example of a full life dedicated to the development of a whole area of science, namely, spectroscopy. Nobel prizes are often given for a single, brilliant achievement. Seldom does it go to those who achieve distinction because of their overwhelming contribution over several years to a whole branch of science. Herzberg, the father of modern spectroscopy was awarded the Nobel Prize in Chemistry 'For his contribution to the knowledge of electronic structure and geometry of molecules, particularly free radicals'.

To write the biography of such a person, in whose long life any day was as eventful as any other day, is extremely difficult, since one has a multitude of events, people, occasions and periods which one would like to highlight, to convey the essence of the character. Boris Stoiceff has done this admirably. After reading the book, even those who are quite unfamiliar with the life and work of Herzberg, get to understand the illustrious life in science on a personal level. For many of us who knew Herzberg through intimate contact with his work, the book is a revelation on the quiet drama of the magnificent life he had.

The book begins with a prologue which is as suspenseful as the beginning of a classic thriller. The reader feels as if he is on the Moscow Express, on that 2

November afternoon, wondering about the delay of the train leaving Leningrad. Then comes the sight of the Secretary, Soviet Academy of Science who rushes over into the compartment to announce that Herzberg has been awarded the 1971 Nobel Prize in Physics. Like Herzberg, we are left a little confused, 'why physics?' The suspense continues until the train reaches Moscow, and we experience the delightful climax when Mandelstam and Sobel'man greet Herzberg and congratulate him on being awarded the Nobel Prize in Chemistry. The mood of the whole book is set by this prologue. Suspense, uncertainty, hesitation and thrill over new discoveries fill the pages, and it is difficult to put the book down till the end.

The book is divided into four parts: The early years, A safe haven in Canada, the golden years, and Later years.

Little known facts come out to wonder at. To be born on 25 December, and then grow up to be non-religious to the extent of almost being an atheist! The first chapter on family and childhood builds up through a suspenseful end of school years, leading to frantic attempts to get some financial assistance for university education. The almost last minute offer of scholarship from Stinnes Company leaves the reader (like Herzberg himself might have felt at that time) with a sigh of relief. (Just imagine appearing for the interview to hear that the person who wanted to interview you had died one week ago!).

Chapter 2 on 'University years', describes the lonely First Semester, the good luck of coming under the influence of a proper guide in Hans Rau, and the interactions with eminent scientists who visited the THD. One gets a picture of the future Nobel laureate as a hard-working researcher, completely immersed in his research, winning the outstanding THD graduand award, and the Doctor of Engineering Degree with 'sehr gut' in oral.

After his doctoral degree, Herzberg spent a year in Gottingen, where he met and interacted with almost all famous scientists of that time, as well as young scientists who were to become famous later. One is shocked to read that almost three years before the discovery of the neutron, Heitler and Herzberg came close to the concept in their work on the interpretation of the rotational Raman spectrum of N_2 , when they thought that the

nitrogen nuclei obey Bose statistics! (Possibly, if they had come to the correct concept of the neutron in the nucleus, Herzberg would have got the Nobel Prize at the age of 25!). In Gottingen, Herzberg met Louise Hedwig Oettinger whom he married on 30 December 1929.

It was Gottingen to Bristol and back to Darmstadt where the experimental spectroscopist in Herzberg bloomed. He built the 2 m far ultraviolet and 3 m infrared spectrometers, a 12.5 m long gas cell, and 'much was accomplished'. And then came the Nazi nightmare and darkness descended upon German science. The agony of those days, thoughts of leaving his beloved Germany, and troubles from tormentors who thought that Herzberg was a Jew (which he was not) – all these appear at the end of the first part.

Searching the world for an academic position, shattered dreams, knocking at every door and there was no ray of hope! The situation is admirably painted by the author in the last sentence in part one: 'Recognized internationally as one of the pioneers of molecular spectroscopy and molecular structure at the age of thirty, Herzberg had nowhere to turn'.

The second part of the book, describes the beginnings in Canada, at the University of Saskatchewan. Herzberg built up lasting friendships with many people, and he and Louise became proud parents of Paul and Agnes. Herzberg worked hard, published many papers, and was elected to the Fellowship of the Royal Society of Canada. *Molecular Spectra and Molecular Structure: Volume I – Spectra of Diatomic Molecules*, was then published. Life in Saskatoon flowed smoothly. Then came the interlude at Yerkes Observatory, and once again the reader is exposed to the turmoil that had gone on in Herzberg's mind about changes in the work environment. The good thing that happened at Yerkes was the friendship that developed between Herzberg and Chandrasekhar, which lasted throughout their lives.

Fortunately for Canada, Herzberg returned to NRC in 1948, and thus began the golden years. 100 Sussex Drive, Ottawa became the Mecca of all bright, young spectroscopists. One does not have to be a spectroscopist to enjoy reading about the activities, atmosphere, enthusiasm and the inspiring leadership. (One can learn even a little spectroscopy in these pages). World-famous scientists walked through the corridors, honours

came by the cartloads, and the pure joy of doing basic research overcame everything else.

Towards the end of the golden years, dark clouds hovered over the horizon. Science at NRC got into the hands of politicians. The Short Road Down came. Herzberg fiercely defended the freedom of the researcher by speaking out against political interference. According to Herzberg, 'Scientific research of the purest kind is an intellectual activity, which like art, music, literature, archaeology, and many other fields helps us to understand who we are'. How true, and one fervently wishes that this realization comes to everyone, especially science policy makers, everywhere.

The golden years ended with a great personal loss for Herzberg, the sudden death of his wife Louise Herzberg, in the summer of 1971.

Herzberg was awarded the Nobel Prize in Chemistry in 1971. The Swedish Academy's citation says it all. 'It is quite exceptional in the field of science, that a single individual, however distinguished... Can be a leader of a whole area of research'. Herzberg means spectroscopy, spectroscopy means Herzberg.

Herzberg as an illustrious scientist is known to thousands of researchers all over the world. But only the few who have been fortunate to be associated with him would have known Herzberg, the person. Stoicheff, in the many incidents he has brought out, has admirably succeeded to bring out this side of the magnificent personality that Herzberg was. We read about how Herzberg had kept in contact with all his friends and colleagues throughout, how he helped and encouraged the younger scientists (many of whom later became well-known spectroscopists in their own rights), and how he made enormous efforts to provide relief and reduce suffering in post-war Europe. One is particularly touched by the simple fact that such a great personality had music as his main hobby. In spite of all difficulties, troubles and problems he faced in life, Herzberg often talked about his good luck only.

Stoicheff has brought out this biography of Gerhard Herzberg, a giant among scientists of the twentieth century, for all of us to read and enjoy. He is successful in conveying to the reader the thrills, joyous moments and pure pleasures Herzberg must have felt while doing his research. I sincerely wish this book is

made 'a must read' for all students of science.

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Air Pollution: Development At What Cost? Yogesh T. Jasrai and Arun Arya (eds). Daya Publishing House, New Delhi 110 035. 2003. 231 pp. Price: Rs 550

Air pollution is a problem faced by both developing and developed countries alike. Rapid industrialization for economic development to meet the specific requirements of the ever-increasing population is proving to be extremely dangerous for human life, ecosystems and cultural assets. Air pollutants do not respect any national boundaries. The complex interplay of natural forces, industrial emissions and transportation is not easily quantifiable. Specific pollutants such as carbon monoxide, sulphur dioxide, nitrogen oxides, particulate matter, ozone and other organic gases and vapours at ppm and sub-ppm levels exhibit a fascinating chemistry and molecular dynamics in terms of their degradation products and ultimate fate in the presence of ever-changing meteorological conditions such as humidity, temperature, radiation and atmospheric transport phenomena which are poorly understood. Given such a scenario, it requires a congregation of fertile scientific minds to enumerate, evaluate and analyse the data to discern the trends. Several aspects of air pollution need to be addressed, including sources, monitoring, impact assessment, technological remedies, and effect on plant and human health. This is the aim of most symposia on air pollution, but at the end of it all, a nagging feeling of 'not done enough' still remains.

The book under review is an outcome of a national seminar organized by the Indian Association of Air Pollution Control on 16 October 1999 to discuss such issues related to 'pollution and development', as emphasized in the preface by

the editors. It is a collection of 29 scientific papers, each constituting a chapter. Of these, 19 are technical papers and the others are invited review papers. The editors have converted the whole proceedings into a book without weeding out some papers of poor quality. Neither has any effort been made in collating the papers into specific sections.

Section I begins with a chapter on air-pollution monitoring and does not contain any new information. Chapters 2, 7 and 8 are investigations on the air quality, soil quality and effect of particulates from cement kiln industries. The authors have measured SO_2 , NO_x and SPM in Nayagaon-Kohr, Sawa-Shambhura and Gotan areas. They have concluded that the pollutants concentrate around 1000 m radius rather than in the immediate vicinity, depending upon the season. Variations in the soil characteristics such as pH, conductivity, osmotic pressure and salinity percentage were studied. Black cotton soil and red laterite showed higher pH, whereas sandy soil at Gotan exhibited higher osmotic pressure. Chapter 8 is a detailed study of the epidermal features of dusted leaves. There was a general decrease in the number of epidermal features of dusted and control leaves. A decrease in the number of epidermal cells and stomatal frequency was observed but an increase in stomatal index and trichome frequency was also noticed. Probably, this is a defence mechanism and adaptation of the leaves to regulate transpiration as well to control the entry of harmful pollutants.

Chapters 3–5 refer to the ecological aspects of air pollution, namely biodegradation control, green-belt plant scavengers for air-pollution control and behaviour of wheat and weeds with respect of SO_2 toxicity. The authors used leaf extracts of eucalyptus oil, Godawaj powder, neem, lantana, lemon, pudina and Bel for *in vitro* control of fungi in museum objects. Among these, only Godawaj powder was found to be effective for all the test fungi. Chapter 4 lists some of the specific pollutant-tolerant plants and crops which need to be maintained around industrial green belts. The pollutants covered include SO_2 , NO_x , ozone and carbon monoxide.

Sulphur dioxide toxicity at 1310 mg/m^3 concentration to wheat varieties (*A. fatua*, *S. glauca* and *P. minor*) was measured by Kumawat and coworkers. The effect of pollutants on stomatal con-