A memorial Tribute to

Gerhard Herzberg

11 May 1999

Dr. Arthur Carty

Welcome

Dr. Boris Stoicheff

Dr. Bill Schneider

Musical Interlude
« avant de Quitter », from Faust by Gounod
G. Herzberg, accompanied by Christopher Longuet-Higgins

Dr. Don Ramsay

Dr. Takeshi Oka

Musical Interlude
The Sentry Song, from Iolanthe by Gilbert and Sullivan
G. Herzberg, accompanied by Christopher Longuet-Higgins

Dr. Henry Mantsch

Dr. Agnes Herzberg

Dr. Arthur Carty
Announcement of Herzberg Distinguished
Research Fellowship

Reception in the Library, Second Floor

DR. ARTHUR J. CARTY

Welcoming and Bridging Remarks

J'aimerais souhaiter la bienvenue à la famille et à tous les amis du regretté Gerhard Herzberg. Welcome to the family, and the many friends and colleagues of the late Gerhard Herzberg.

We have called this gathering a "Memorial Tribute", but it is in reality a celebration of the life of a great man, one of the true pioneers and giants of scientific research in this country. As the President of the National Research Council, it would be impossible for me to overstate the contribution Dr. Herzberg made to NRC and to Canada. He was, as we all know, a brilliant and dedicated scientist whose work defined an entire field of research. But more than that, he set a standard for excellence and humanity, to which we can all aspire.

I think that John Polanyi, another Nobel Laureat who unfortunately could not be with us, has said it so well in describing Gerhard Herzberg on his passing.

"He was the foremost Canadian scientist alive. He was a brilliant experimentalist, vastly patient and ingenious, and as a person, gentle and generous – a role model for the rest of us. He was a gentleman of science."

We will be hearing today some personal thoughts from some of Dr. Herzberg's many colleagues, students and friends.

And I will be sharing with you some of the many written tributes that we have received at NRC since his death.

I would like to start with a message from his Excellency, the Governor General Romeo LeBlanc:

"Dr. Gerhard Herzberg was a leading figure in 20th century science and the Canadian and international scientific community mourns his passing. He was a chemist, astronomer and physicist who devoted his life to research. Some of his discoveries have had worldwide significance... This great scientist will be remembered as a man wholeheartedly devoted to research, who made an important contribution to the advancement of the pure sciences in Canada and abroad."

"Dr. Herzberg worked at the National Research Council for almost half a century. He was a source of inspiration for the generations of researchers and scientists who were fortunate enough to work with him over the course of his long career and to whom he has bequeathed his passion for research and knowledge. I am sure the staff of the National Research Council and the Canadian scientific community will always remember him."

And from the Prime Minister, the Right Honourable Jean Chrétien :

"On behalf of all Canadians, it is a great honour to join in the tribute to the late Dr. Gerhard Herzberg.

With his passing, Canadians have lost a scientist of extraordinary talent whose distinguished accomplishments .. have earned him a place amongst the world's most outstanding scientists.

Les nombreuses distinctions qui ont couronné sa carrière montrent que Dr. Herzberg laissera le souvenir d'un esprit scientifique de la plus grandes envergure.

That he is no longer among us is a matter of universal regret, yet he leaves behind an incredible legacy that will live on in his work, enriching and inspiring generation after generation of Canadians."

On behalf of the Royal Society of Canada, Jean-Pierre Wallot, the current President of Academy III, wrote:

"The Royal Society was fortunate to have counted Dr. Gerhard Herzberg among its ranks, and to have benefited from his extraordinary contributions to Canadian science. We must cherish his memory and be inspired by his example."

And from the Chemical Institute of Canada, Dr. Terrance Rummery, Chair of the Board of CIC, writes:

"The work of a multitude of chemists over many years has been made easier, or perhaps possible, because of the tools that Dr. Herzberg's fundamental research provided.

The legacy of his many outstanding contributions to several fields of science provides a lasting memorial to a truly great scientist."

I also want to say a few words about the international impact of Gerhard Herzberg's work. GH sent more than brilliant ideas and key measurements off into the scientific community, he sent out hundreds of inspired and passionate students who served as disciples for spectroscopy around the world.

The tributes we have received have come from many countries – Russia, Taiwan, the UK, Germany, the US, and Japan.

Tadao and Fumiko Shimizu from Tokyo in speaking of their time in Herzberg's lab at NRC wrote:

"A very international research group consisting of about 20 people came from almost the same number of countries. Very high level research activities were going on in the group. We felt every one was respected and we loved the leader, "GH". We loved to stay in this good atmosphere."

And Yuan-Tseh Lee, the President of the Academia Sinica in Taiwan has written:

"Just like everyone who became a physical chemist in the second half of the 20th century, I was not only educated, but also greatly influenced by his work on spectroscopy. He will live in my mind forever."

As Sir Harry Kroto, another Nobel Laureat writes:

"GH created a laboratory at NRC in Ottawa where many of the key experimental advances in the field were made and also where many of the world's leading molecular spectroscopists were trained. Researchers from all over the world flocked to NRC to spend time there as postdocs (as I did) or as working visitors. Almost every spectroscopist seems, at one time or another, to have passed through Ottawa."

Or as Wolfgang Ketterle from MIT wrote:

"As a postdoc, I visited him in Ottawa – it was for me like a pilgrimage to the temple of spectroscopy!"

And finally, let me share one last tribute with you that provides another insight on the character of this truly great man.

From Israel Halperin from University of Toronto and Secretary of the Campaign for Human Rights:

"Gerhard Herzberg should be remembered as a great scientist. But he should also be remembered as an outstanding participant in the struggle against inhumanity. When asked to support some humanitarian action, his response was quick and generous, with his characteristic reply "I'm all for it"."

DR. BORIS STOICHEFF

It is fitting for us, the Greater Family Herzberg, to meet in this lovely building and especially in this auditorium to pay tribute to our good friend Gerhard Herzberg, one of Canada's National Treasures. It was in this hall that for 50 years he attracted the great scholars and scientists of the world and introduced them to us. We were fortunate to have such a person among us, to encourage and support us, and to treat us as equals in his natural and humane way. There is no doubt that he touched each of us in a special way.

I first met Dr. Herzberg 50 years ago when he came to Toronto to give a seminar in the Physics Department. I was just completing my Ph.D. thesis under the supervision of his friend Harry Welsh. I was planning on post-doctoral studies in Amsterdam, but after hearing Herzberg's outstanding lecture on the quadrupole spectrum of hydrogen and how it could be used to detect hydrogen in the planets and the interstellar medium, I began to wonder, "Why should I go to Amsterdam when we have such a person here in Canada?" So in time, I received a Fellowship to work in the Spectroscopy Lab in Ottawa. I came in '51 and soon realized how extremely lucky I was to be able to join this group of Alec Douglas, Don Ramsay, Hin Lew, and Cec Costain, with a boss who had a resounding laugh and we affectionately came to know as GH.

Speaking about luck, I am sure that most of you, just as I, often heard GH talking about his good luck, not about difficulties and concerns, but about his good luck. Perhaps this started when he was born on Christmas Day, even though he missed out on extra parties and gifts. At the Gymnasium in Hamburg, he had two close friends Alfred Schulz and Hans-Werner Doering, and a superb teacher Professor Hillers, who gave extra classes on the new ideas in atomic physics. When it came time to go to university, Alfred's father suggested that Gerhard should write to Mr. Stinnes, a wealthy shipping merchant for support, and although he thought this a brash thing to do, in desperation he wrote to Stinnes and in this way he managed to receive funding to start university. His professor at the Technical University in Darmstadt, Hans Rau, was an amazing man, cherished by Herzberg throughout his life, because he encouraged students to think and to work independently. Also, he sent Gerhard off to Freiburg to listen to Schroedinger lecture, and with a letter of introduction to meet him.

As Herzberg said many times, it was his good fortune to start scientific work just as the new quantum theory was developing with applications to atomic and molecular problems. Moreover, he was at the right place at the right time, namely in Göttingen, the world-centre of Mathematics and Physics, where all of these exciting developments were taking place. There he worked in the Institutes of Max Born and James Franck, and had the opportunity to meet the greatest minds as they came from all parts of the world on visits to this shrine. Even luckier, he met Luise Oettinger, a physics student, and they married in December of 1929. His interest in molecular-orbital theory led to an inviation to spend a year in Bristol, and he couldn't have known how this experience to learn English would be so crucial within a few years. It was in Bristol that he became accustomed to afternoon tea as a venue for meeting with colleagues and friends and to carry on discussions of science or world affairs. Afternoon tea became a habit in the lab and at home to the last of his days.

An opportunity came his way in late 1930 to build a spectroscopy lab in Darmstadt. There, he supervised the research of several students, post-doctoral fellows and visitors, one of the latter being John Spinks who came from the faraway University of Saskatchewan in 1934. Because of the severe economic conditions caused by years of poor crops, the bachelors of the university were given $500 to go away for a year. Spinks chose to go to Herzberg's lab to learn spectroscopy, and they succeeded in studying many spectra together, and became close friends. With the Nazis in power, conditions in Germany deteriorated rapidly and severely, and because of Luise's Jewish ancestry, the Herzbergs were forced to leave their native land. So at 30 years of age and recognized as one of the pioneers of molecular physics, Herzberg searched in vain for a research position on all six continents. But good luck came his way again. The Carnegie Corporation announced that it would give Guest Professorships for two years to universities in the Dominions and Colonies provided the application was made by the President and there was a need for someone with that special expertise.

And here Spinks played a major role. He let the President of the University of Saskatchewan, Walter Murray, know of Herzberg and his situation, and Murray with his great foresight felt that here was a wonderful opportunity for Canada to get an internationally known scientist. So he wrote to the Presidents of the University of Toronto and of NRC about Herzberg, noting that if they did not have positions to offer, he would, even though his university did not have funds or equipment. But he wrote, "a man of his ability can do much with very little." How right he was. The Herzbergs arrived in mid-

September, were met by Spinks at the station, and within two weeks Herzberg was lecturing.

He found that this small university had very high standards, and the students worked hard, and much was accomplished. Gerhard and Luise quickly fell in love with Canada and decided that Canada was their home. Within three months he had tenure, and within two years landed-immigrant status, and Paul and Agnes were born and raised in Saskatoon. All very, very lucky as he kept reminding me, to have ten happy years there, and he was forever grateful to John Spinks, Walter Murray, and Saskatoon.

He took the opportunity to work at his first love, astronomy, when he was offered a post at Yerkes Observatory of the University of Chicago, and there he found a new life-long friend the theorist Subrahmanyan Chandrasekhar (Chandra for short). In spite of scientific success, the Herzbergs were homesick for Canada. Spinks came into the picture again. He wrote: "We want to get you back here by fair means or foul," and he let C.J. Mackenzie and E.W.R. Steacie know. This immediately set the wheels in motion resulting in Herzberg coming to the NRC in August of 1948, with the encouragement and support of the President, to set-up a major laboratory in the Physics Division.

Herzberg was ever thankful for this most welcome outcome and he made the most of it. He was particularly lucky he said to have excellent young collaborators in Alec Douglas, Don Ramsay, Hin Lew, and Cec Costain. And together they established the Spectroscopy Laboratory which became a Mecca for those working in the field of atomic and molecular structure. They came from all over the world to cross its threshold. He was fortunate too in his technical assistants Jack Shoosmith in the lab and Lila Howe and Izabel Dabrowski in analysis and computing, and Marjorie Thompson as his secretary. Of all his achievements, he was particularly proud of the Spectroscopy Lab, and grateful to Canada for giving him this unique opportunity.

When Herzberg reached the age of 65, the NRC established the rank of Distinguished Research Scientist in order to keep him on staff. Two years later he was awarded the Nobel Prize to world acclaim.

But this accolade came without his wife and science partner Luise, who had died six months earlier. As luck would have it, Gerhard's school chum Alfred Schulz who had cared for his sister and her daughter Monika Tenthof during the war years in Hamburg, indroduced Gerhard and Monika. They married and were a devoted and constant couple for the past 27 years. In 1974, the Herzberg Institute of Astrophysics was named in his honour. Imagine the irony, 50 years before, as a youth advised that he should not study astronomy unless he had private means, now had an institute of astrophysics named after him.

After lunch at the Herzberg's home about five years ago, I began to think that the life of GH and of science in Canada are not well known by Canadians, and that I should perhaps try to write the story even though I am not a historian. Gerhard told me of the huge correspondence available and gave me permission to read it. I am still at it, and I have found many gems in this material. Let me mention a few that are fitting for this special tribute, as they tell us how much his friendship meant to his colleagues the world over.

When Herzberg invited Walter Heither (with whom he collaborated in Göttingen when both were 24 years of age) to join the Physics Division, he replied: "I have no doubt that the atmosphere in Canada would be very nice indeed, and it would be delightful to be with you. In fact there is hardly anyone I would desire more as a colleague."

And in a touching letter from Ertle Harrington, who was Head of the Physics Department while Herzberg was in Saskatoon, on the death of his wife Olive: "I only wish you were close enough to talk things over with me, for you were amongst our closest, and in all respects our best friends."

And to close, in words that are as appropriate today as they were when written 50 years ago by his friend Chandra after the Herzbergs had left Yerkes: "We have been long enough in this country to appreciate kindliness and to value friendship when it rarely comes. It is most certain that I have valued the friendship you generously gave us more than any other personal experience during our twelve years here.

And now that we are again left alone, I am beginning to wonder, what I had not for the three years you were here, whether it is worth giving up all things personal for the abstraction of science. I am afraid this sounds dangerously close to self-pity: but there is always an ingredient of self-pity in any feeling of personal loss: and your leaving has been one – deeply."

Indeed, we were fortunate to have Gerhard Herzberg living among us.

Boris Stoicheff
May 11, 1999

BILL SCHNEIDER
The Saskatoon Years (1935 – 1945)

Gerhard and Louise Herzberg arrived in Saskatoon in the summer of 1935. At that time I was a student enrolled in an Honours Chemistry Program at the University. I had heard of a new appointment in the Physics Department. The Physics building was located next door to the Chemistry building.

At that time, I had as my roommate Henry Taube. We lived in a local boarding house about a mile from the campus. I had known Henry previously when we attended the same high school in Regina, but he was one year ahead of me. The year of Herzberg's arrival, Henry had started a Master's program with Professor John Spinks and was encouraged to take Herzberg's course on Atomic Spectra and Atomic Structure. Once he was into it he told me one day, "Bill, you've got to take that course – it's really great"!

And, so the next year I did just that – I registered in the course. It was a unique experience and as university lectures go, this was a breath of fresh air. He was a masterful lecturer and with his infectious enthusiasm made the subject come alive. Subsequently, I took two other courses of his, one was Nuclear Physics, the other Molecular Spectra and Molecular Structure. For this course we used the German version of his text. The English edition was not yet available. These courses were taken generally by physics and chemistry students. One of my classmates at this time was Alex Douglas who was registered in the Honours Physics Program.

I left Saskatoon in 1939 after completing the Masters degree, and I did not meet the Herzbergs again until after the war in 1948 when Gerhard joined the staff of NRC.

In retrospect, the initial apprehensions the Herzbergs had about moving from Darmstadt to Saskatoon were quite understandable. Without first-hand knowledge, moving overseas to a small university on the Canadian prairies was certainly a big gamble, which required a lot of courage and self-confidence. And moreover it was not the most favourable time for such a move.

At that time, Saskatchewan was in the midst of a devastating drought and depression and its economy was in shambles. At the university student enrolment, which had been around 1400, was dropping. Students, including myself, became delinquent in paying tuition fees. But, Dr. Walter Murray, the University President, a kindly man much loved by everyone, insisted all students must nevertheless be allowed to complete their year. At the end of the year the administration went to great lengths to find summer jobs, usually maintenance jobs around the University, so that unpaid fees could be recovered. As an example, one summer I spent quite a few weeks helping to paint a barn belonging to the University's Department of Agriculture.

When Gerhard arrived in Saskatoon the University had no Ph.D. programs. Consequently research equipment and specialised research facilities were very limited. At that time only McGill and Toronto offered doctoral programs in Canada.

But on the other hand, there were also some positives:

1. The University of Saskatchewan had an excellent reputation in undergraduate science teaching. M.Sc. graduates were sought out by Toronto and McGill and the larger American Universities. For example, my roommate, Henry Taube, ended-up at the University of California in Berkley, and later as a Professor at Stanford, was awarded the Nobel Prize in Chemistry in 1983.

2. Another positive and by a happy coincidence, the year Gerhard arrived in Saskatoon, Professor Alty, a senior professor in Physics, resigned to take a post in the United States. This made it possible to appoint Gerhard to a full faculty position.

3. The third and most important positive was that, above all, the Herzbergs were extremely grateful to have found in Saskatoon the personal freedom and security which had been denied them in Nazi Germany. They became extremely fond of Saskatchewan and the University and seized every opportunity in later years to revisit the city and their many friends they left behind.

It was also in Saskatoon they started their family with the births of Paul and Agnes. I recall clearly seeing Louise on sunny afternoons walking across the open campus towards the Physics building with a perambulator containing either Paul or Agnes. She would then work with Gerhard until about six o'clock when they would walk home together. Passers-by would stop to chat, and needless to say the incumbent of the perambulator was much admired.

In spite of the limited research opportunities, Gerhard was scientifically very productive during his years in Saskatoon. To get started he needed a high-resolution spectrograph. He managed to bring some key parts with him from Germany. Eventually with a grant from an U.S. Foundation he was able to order other parts, including a state of the art diffraction grating. During the inevitable delays in completing the spectrograph, he worked on his books with the expert assistance of Louise. His first two books had been published in German. New English editions of both were then under preparation. Professor John Spinks assisted in some of the translations.

On the experimental side, Alex Douglas had enrolled as a Master's Degree student with Gerhard, and assisted in the construction and assembly of their first high-resolution spectrograph. Eventually it produced excellent spectra and so began a series of important research publications as well as an important scientific alliance. And no doubt some of the ideas Gerhard generated during his early years in Saskatoon, he was able later to bring to fruition in Ottawa when his spectroscopy laboratory was established here.

Gerhard Herzberg has had a major impact on science in Canada. He was a highly visible role model, and the high standards he set in his work inspired younger scientists to greater achievement. He was an outstanding teacher and lecturer. He was also a man of genuine warmth, humour, generosity and modesty. His scientific insights, his disciplined focus and hard work brought him the highest accomplishments as a scientist. He leaves a monumental legacy to us and to future generations.

As we celebrate his life and cherish his memory, the memories of two scientific colleagues are also interwoven. They are of Dr. Louise Herzberg and of Dr. Alex Douglas. During their lifetime both provided expert scientific assistance, as well as personal and moral support. Their memories too are enshrined in our hearts and minds.

Finally, may I express to the Herzberg family, Monica, Paul and Agnes, our deep sympathy, and we hope you will find solace and comfort knowing that we share your great loss, and that Gerhard's Memory shall live in all our hearts and minds with pride and admiration.

W.G. Schneider
May 11, 1999

A.J. CARTY
Introduction to Musical Interlude

One of the other aspects of Gerhard Herzberg of which many of have spoken was his love of music – not only as a listener, but also as a talented performer.

We have an opportunity today to listen to Gerhard in full voice in tapes that were made many years ago. For the two selections we will be hearing today, he is accompanied by Christopher Longuet-Higgins, now a Royal Society Research Professor (retired) at the University of Sussex. Dr. Longuet-Higgins wrote to us saying

"He was one of my heroes, as a scientist, as a musician and as a person. The world is richer for what he gave to it".

The first selection is "Avant de Quitter" from Faust by Gounod. While we listen, we will be scrolling on the centre screen, the names of many co-authors who published with Gerhard Herzberg over his long career (see Annex).

Not all of Gerhard Herzberg's musical selections were serious. I understand he delighted in what some would describe as the rather irreverent works of Gilbert and Sullivan. We have a tape today of one of the most irreverent of all such tunes, "The Sentry Song" from Iolanthe by Gilbert and Sullivan. Apologies in advance to any politicians who might be in the audience (see Annex).

While we are listening this time, we will be scrolling the names of all those who worked in the Spectroscopy Group during his long career at NRC.

D.A. RAMSAY

That beautiful musical interlude reminds me of a story. On two occasions Dr. Herzberg came to sing at our church. I was the organist at that time. On the second occasion I wondered what we could give him in acknowledgement of his contribution. I suddenly realised that we had a man in our congregation, a Walter Cameron, who was a retired blacksmith and a wood-carver. He was very well known in the Perth area and busloads of people used to visit his forge. I asked Walter if he would carve something of his choosing and we would reimburse him for his efforts. I also suggested that he should present it to Dr. Herzberg after the morning service. "Oh No", said Walter. "It is not appropriate for a blacksmith to make a presentation to a Nobel Laureate". I said, "Walter, Dr. Herzberg is a very approachable person and I will be there to support you." So the presentation was made. Walter had carved an interlocking chain with a wooden ball inside it. Dr. Herzberg was admiring it when Walter said, "You know, I woke up at FIVE o'clock one morning and I suddenly had an idea how I could carve this out of one piece of wood". Dr. Herzberg said "That's interesting, I sometimes wake up at THREE o'clock in the morning and I get an idea and have to go to the lab to try it out".

Then there was a slight pause in the conversation. Dr. Herzberg said, "I do not have TV, I think it is a waste of time." Walter replied "I do not have a TV either. I prefer to spend my evenings whittling wood." Then Dr. Herzberg said, "But I have been on TV FIFTEEN times", to which Walter replied, "Oh, I have been on TV NINETEEN times!"

Dr. Herzberg had a wonderful sense of humour and enjoyed a joke, even if occasionally it was on him. But now I come to the more serious part of my presentation. I first met Dr. Herzberg at Columbus, Ohio in June 1948. It was the occasion of the Annual Meeting of spectroscopists. He had just presented a paper to a packed audience and one could feel the excitement in the room. He had described experiments carried out at Yerkes Observatory near Chicago in which he had constructed an absorption tube, 22 meters in length. The tube was equipped with mirrors at each end so that light could be reflected back and forth through the tube as many as 200 times. Absorption path lengths of some kilometres could be obtained in this way. By filling the tube with hydrogen at a few atmospheres pressure he was able to obtain an absorption spectrum of hydrogen in the visible region of the spectrum.

This spectrum, which was the first electric quadrupole spectrum to be observed, is a very, very weak spectrum. However, it is also very important, since hydrogen is the most abundant molecule in the universe, and the spectrum is useful for detecting and monitoring hydrogen in various heavenly bodies.

I joined Dr. Herzberg's group in the Physics Division of NRC in July 1949. Dr. Alex Douglas had arrived before me and was busy building spectrographs and spectrometers for the visible, ultraviolet and infrared regions of the spectrum. I was assigned the task of building a flash photolysis apparatus for studying the spectra of short-lived species known as free radicals. Dr. Hin Lew arrived in September 1949 and set about building an atomic beam laboratory.
Dr. Cec Costain, who was radar officer in the Pacific in WW II, joined the group a little later and was responsible for setting up a microwave laboratory. So, by the early 1950's a laboratory was equipped for studying the spectra of atoms and molecules in any spectral region from the microwave through the infrared and visible regions to the ultraviolet.

Post-doctoral Fellows began to arrive from many different countries around the world and, together with visiting scientists, made a vigorous and stimulating group. Dudley Herschbach and John Polanyi were among the early workers and later shared a Nobel Prize in 1986 (with Y.T. Lee). Harry Kroto was a Post-doctoral Fellow from 1964-1966 and Bob Curl was a visiting scientist for an extended period. They too shared a Nobel Prize in 1996 (with R. E. Smalley). Many other Nobel Laureates and distinguished spectroscopists visited the group from time to time. It was generally recognised that under Dr. Herzberg's leadership, Ottawa had become the Mecca for spectroscopists. All spectroscopists of note visited the group at one time or another. There was one notable exception. I visited him once in Florence and asked why he had not been to Ottawa. His reply was that everyone comes to Florence!

Dr. Herzberg always showed tremendous enthusiasm for his work and fortunately this is a quality that is contagious. He was always ready to encourage others but never to dictate what they should do. He believed strongly in the creativity of the individual. His lectures were always exciting and one never found anyone asleep on these occasions. His books are monumental expositions on the subject of atomic and molecular spectroscopy and have a timeless quality.

It was most fitting that he was awarded the Nobel Prize in Chemistry in 1971 "for his contributions to the knowledge of electronic structure and geometry of molecules, particularly free radicals". The preamble to the citation is of special interest and I will quote it in its entirety. "This year's Noble 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 undisputed centre for such research. It is quite exceptional, in the field of science, that a single individual, however distinguished, in this way can be a leader of a whole area of research of general importance. A noted English chemist has also said that the only institutions that have played such a role were the Cavendish Laboratory in Cambridge and Bohr's institute in Copenhagen."

Dr. Herzberg's group has produced five Nobel Laureates and eight Fellows of the Royal Society of London. Most of us would be willing to agree that such honours would have been more difficult to achieve without the inspiration of Dr. Herzberg. This record is comparable to that achieved in recent years by the Laboratory of Molecular Biology in Cambridge.

I think that it is a tribute to the genius of Drs. C.J. Mackenzie and E.W.R. Steacie that they persuaded Dr. Herzberg to come to Ottawa in 1948 and gave him the opportunity to set-up a laboratory and the freedom to work on any subject of his choice as long as he was able to do so. Such foresight produced wonderful results.

D.A. Ramsay
May 11, 1999

TAKESHI OKA

Throughout his life Dr. Herzberg worked on molecular spectroscopy with great enthusiasm and sincerity. He produced a succession of important results and he systematized the subject by writing the classic textbooks. The books are the "bible" for us in the field, and he is aptly called the founding father of molecular spectroscopy.

In addition to this, a man of his caliber also leaves an enormous amount of treasures for the next generation to succeed and develop. Here I wish to talk on how I inherited a beautiful jewel from him.

Since hydrogen is the most fundamental and most abundant atom in the Universe, Herzberg worked on hydrogenic species throughout his life. In his 1967 presidential address at the Royal Society of Canada, he talked about the great role the hydrogen atom played in the "Development of Our Understanding of the Structure of Matter and of the Universe" and discussed similar roles played by the hydrogen molecule, the hydrogen atomic anion H^-, and the hydrogen molecular cation H_2^+. Twelve years later he was to discover the Rydberg spectrum of H_3, but in 1967 even a man of his prescience did not anticipate it. Herzberg was always very free to admit that he could not foresee the future. At the end of the address he talked about H_3^+, the jewel which I later inherited from him. He writes... "It is likely that H_3^+ is present in the interstellar medium.... However, the possibility of detecting H_3^+ in interstellar space depends on the discovery of a spectrum of this molecule in the laboratory." This was one year before the discovery of polyatomic molecules in interstellar space by Charlie Townes and his colleagues. He then discussed his on-going attempt with John Johns to find the laboratory spectrum.

Our section had a weekly group meeting in which we reported our progress in the lab. I have fond memories of Dr. Herzberg giving his report as a member of the Group when it was his turn. A list I have of the topics of Herzberg's reports in the meetings around 1967 clearly shows how persistently he thought about and made an effort to find the spectrum of H_3^+. At that time I was not ready to accept those ideas and most of his valuable discussions went above my head, pearls before swine so to speak.

I hadn't even remembered those group talks until recently when, in writing a letter to Dr. Herzberg, I looked up my old note books. However, I am sure that his talks at the Group Meeting were ingrained somewhere in my subconscious memory which led me to my work later. Herzberg was extremely shy and reticent in formally

suggesting a problem to us but he shared his ideas freely for any of us to work on them.

It took me ten full years to realize how precious this jewel was. In 1975, I decided to drop everything I was doing at that time and concentrate on a laboratory search for the H_3^+ spectrum. The first thing I did was to go to Alec Douglas, our section head, to ask for the budget to build a new laser spectrometer needed for the search. His answer on that day was an almost flat 'no', and I left his office asking him to reconsider. When I went to discuss the matter with him a week later, Alec immediately approved my proposal. I was quite surprised. Not only was our section budget on decline at that time and my proposal would consume a major portion of it, but it was also quite clear that I did not know much about molecular ions whose spectroscopy was notorious among specialists to be extremely difficult. Moreover, Herzberg himself was looking for the spectrum and he was convinced that, if there is any chance of discovering the spectrum, it had to be through its emission rather than its absorption as I proposed. It was extremely generous and courageous of them to let me try. It would have been very difficult to have my proposal approved by formal funding agencies. Anyhow, that one week in 1975 finalized the direction of my subsequent research up until today. I feel I am extremely lucky to have passed my most vigorous years at this Research Institution with those two great scientists and human beings.

After four and a half years, the laboratory spectrum was observed in 1980 in a room that is next to this auditorium. My attempt to search for interstellar H_3^+ was immediately started. Eight years later H_3^+ was found in Jupiter quite unexpectedly in emission and identified by Jim Watson. In pictures of Jupiter's image taken by using H_3^+ emission, the brightening at the polar region of Jupiter is all due to H_3^+ in its ionosphere. By now the H_3^+ spectrum has become a general tool for astronomers and geophysicists to study the morphology and temporary variations of planetary plasmas.

Another eight years later H_3^+ was finally observed in interstellar space as predicted by Herzberg thirty years before. I was very happy when I was able to report this to him at his home. The observation has given the most direct observational evidence supporting the ion-neutral reaction scheme of interstellar chemistry in which H_3^+ plays the pivotal role. Subsequently the spectrum of H_3^+ has also revealed a novel and surprising aspect of the chemistry of the diffuse interstellar medium. Now H_3^+ is found everywhere in the interstellar medium. Dr. Herzberg followed these developments with enthusiasm, never

once claiming that his idea and enthusiasm initiated these inspiring developments.

Finally, in the remaining few minutes I would like to say something which is opposite to what I have said so far, that is, how poorly we appreciate his treasures. Contrary to the popular view we seldom really understand what has been worked out by our predecessors. Just to give an example, many people tend to believe that we completely understand Newton's classical mechanics. Four years ago, Chandrasekhar, who was a close friend of Dr. Herzberg, published a book on Newton's Principia and showed us what fantastic fundamental and radical ideas Newton had and how many of them had been lost from modern textbooks. We can use classical mechanics but some of the overall understanding of the subject which Newton had has been lost. Likewise, we can perhaps understand individual items so comprehensively assembled in Herzberg's textbooks, but the overall understanding of molecular spectroscopy, expecially of electronic spectroscopy, will be lost from us forever.

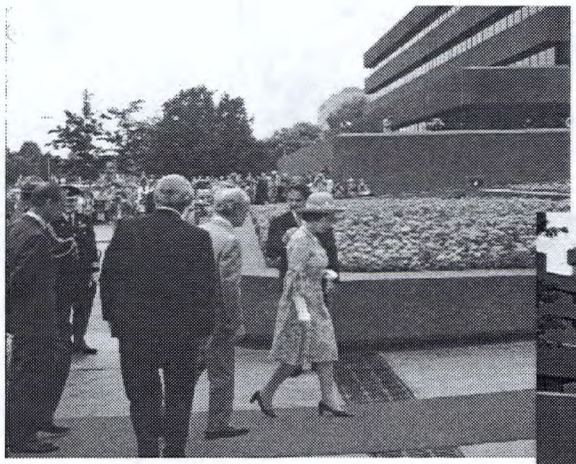
Takeshi Oka
May 11, 1999

G. H. - it seems like only "yesterday"

Personal recollections of Henry H. Mantsch

December 1994, celebrating G.H.'s 90th birthday

Her Majesty the Queen
officially opens the
Lester Pearson Bldg.
across from NRC on Sussex
July 1973



G. H. *and*
"the Chinese connection"

letter from Prof. Wu Hsueh-Chou

April 1979

中国科学院长春应用化学研究所

CHANGCHUN INSTITUTE OF APPLIED CHEMISTRY
CHINESE ACADEMY OF SCIENCES
CHANGCHUN, JILIN, PEOPLE'S REPUBLIC OF CHINA

April 10, 1979

20|4

fessor G. Herzberg
zberg Institute of Astrophysics
ional Research Council Canada
awa, Canada K1A 0R6

r Professor Herzberg:

I am very glad to receive your letter dated March 5,
9. I delayed replying you as I have been in Peking on
iness, and it took a few days for the letter to be for-
ded to Peking. First of all, allow me to congratulate
for your discovery of the triatomic hydrogen, and plea-
accept my belated congratulations on the Nobel Prize!

Since Liberation I have not written you as well as all
friends abroad owing to political reasons, but I always

Then came the Cultural Revolution.... As a result of
the interference and sabotage by the "gang of four" and
other extremists - leftists, the already narrowed gap be-
tween China and the advanced world was widened again. I
myself was badly hurt both physically and mentally ....

I would like to tell you that I am going to send my st
dent Mr. Hsi Jhi-Chuan to your Research Council to work un
der the guidance of Dr. Mantsch. Mr. Hsi's application ha
been approved by the Chinese Academy of Sciences, but he i
still waiting for the visa from Canada. He will tell you
about my situation after his arrival in Canada.

Sincerely yours,

Wu Hsueh-Chou

with G.H. at the
Chinese Embassy in Ottawa

"Mr. Hsi Shi-Chuan had arrived"
1980

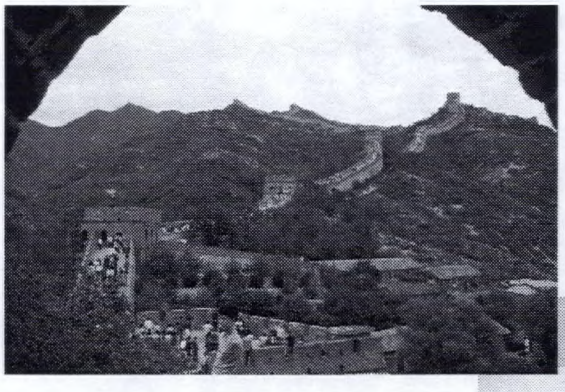
with G.H. in China

"working out of the Friendship hotel"

Beijing, 1981

G. H. ***learns to master chop sticks***

G. H. ***taking in the "sights"***



taking off for Changchun ("Eternal Spring" in Chinese) in Manchuria

"At long last" G.H. and Wu meet after 50 years

Wu posing with the Management team of his Institute for Applied Chemistry in Changchun

special honor for G.H.
"dinner at Wu's (tiny) apartment"

Wu showing off his grandchildren

posing in Wu's library "a fresh red rose every day"

G.H. *"a social butterfly"* ??

G. H. with Norman & Magda Jones
and Jeanette Grasselli
chairman of the Int. FT-IR Conference
Picnic in the Gatineau Hills
1985

G. H. "riding the bus home
from the picnic with the
FT-IR crowd" 1985

G. H. gives a dinner party at his home for Andy Cole from Perth, Australia 1985

G. H. with Prof. Wu Zhen-Kai head of a visiting Chinese delegation 1987

G. H. "the victim" or "a good listener"

G. H. guest of honor at NRC scientists wives 40th anniversary meeting Ottawa, 1989

G. H. helping celebrate Bill Schneider's 75th birthday at I.C.P.'s home 1990

I.C.P. Smith
"May I help with your coat?"

G. H.
"Certainly not!"

Dr. Kim (postdoc from Korea)
and his Japanese wife Makiko
dream of hosting a dinner for G.H.

"the Herzbergs grant them the wish"

February 1989
G.H. meets Sakharov in Ottawa

"a dream come true"

G. H. being picked up at
Lakeway Drive en route to work

"HHM on duty"

G. H. *"and the outdoors"*

having tea at the Herzberg cottage in Quebec near Val-des-Monts

Fall 1985
arriving at the cottage we are met by a neighbor

"Dr. Herzberg, your deck is caving in"

Gisbert Winnewisser:
"I built a radiotelescope up in the Alps, I should be able to fix a deck"

the deck got fixed

Spring 1986
first visit to the lake after winter

"time to clear the trail
around the lake"

Easter 1986
egg hunting at the cottage

G. H. "I found one"

Summer 1989
exploring Herzberg Lake
by canoe

Thank you Gerhard and good bye

"We shall always remember you"

DR. AGNES M. HERZBERG

On behalf of Paul, Monika and myself, I would like to thank everyone for coming, the previous speakers and all those who have been involved in the planning and organization of this celebration of the life of my father, known by many of you as G.H.

I want to thank also Mr. Peter Milliken, the Deputy-Speaker and Member of Parliament for Kingston and the Islands, for taking time from his busy schedule to be here today, and Mrs. Marlene Catterall, Deputy-Government Whip and Member of Parliament for Ottawa West-Nepean, who presented a beautiful tribute to my father in the House of Commons two days after he passed away. Both Mr. Milliken and Mrs. Catterall have been advocates and champions of the support of science from the public purse and in particular the support of the National Research Council of Canada. My father went to see Mrs. Catterall in 1989 or 1990 with Dr. Mantsch. After that whenever her name was mentioned, he would say "Oh, Mrs. Catterall, she knows everything." There were not many he said that about, certainly not his children.

Everyone here will have different memories of G.H. as we all interact in different ways with others. Except for Dr. Schneider, Paul and I have probably known G.H. the longest. Even if Dr. Schneider knew him longer, unlike G.H.'s children he probably was not swung up in the air on G.H.'s shoulders, read to by G.H. at bedtime or when he was sick.

Memories are highly personal and I shall share with you some of mine. These may bring back some that you yourself cherish.

When my parents first got married, father wondered if they could ever afford children. He also hoped he would earn enough money to always be able to have a box of chocolates in the house. Of course, when he could afford that, we were all worried about getting too fat.

Imagine how it was in 1935, sixty-four years ago, when my parents left Germany and came to Canada. Imagine too the changes my father saw over ninety-four years both in society, in the way one lived and in the laboratory. He predicted that in perhaps twenty years from now, the world would be too crowded and hot and would not be such a nice place to live.

The situation in Germany had become impossible, but still my parents must have had some anxiety when they set out for a place called Saskatoon in Saskatchewan in Canada! G.H. considered that Saskatoon was his Canadian birthplace and where he spent, what he told me very many times, the best ten years of his life.

G.H. acclimatized well to the cold weather because, as he said, "I was young then." In Saskatoon, Paul and I were born. G.H. was very happy and loved and admired Dr. Murray, the President of the University of Saskatchewan, and respected his sound judgement and sure acumen.

G.H. worked at his office at the university on Sunday mornings and Paul and I would go to the university to take him home for lunch. We would throw pebbles at this window so he would know we were there. Sometimes we would visit the university farm afterwards. In the course of these visits, we learned, perhaps father taught us, how to make the sound of a pig. (It is not oink, oink as some are led to believe.) (As I prepared this talk I discovered I could still make the sound, after some practice, but be assured I shall not do it here.)

When I was a student at the University of Saskatchewan, I met Bishop Steer who said he remembered meeting G.H. thirty years before as they were both walking to their respective places of work Sunday mornings. The bishop told me he did not have the heart to tell Dad he was going in the wrong direction, that he should be going to church and not to his laboratory.

Because of his positive experience at the University of Saskatchewan where he taught a coterie of students of exceptional quality, some of whom later became his colleagues and friends in Ottawa, thus giving him roots from Saskatchewan in Canada, my father felt since 1935 that he was a Canadian.

In 1945, just after the war ended, we moved to Williams Bay, Wisconsin, where the Yerkes Observatory is situated. It was a great place for children, but my parents felt among other things very isolated. There father taught us to ride bicycles, to make and fly kites and we all learned to play croquet. We all listened together on Sunday evenings to Edgar Bergen and Charlie McCarthy. G.H. liked in particular Mortimer Snerd!

In 1948, we moved to Ottawa. There, one had to be up early on Sundays if one wanted to start the day with G.H. in the garden. Mr. Shoosmith helped him plant hedges, shrubs, etc. Mr. Shoosmith, who came from England, told G.H. that in England good lawns were cut twice a week. Thus I mowed the lawn twice a week. Then I went to England to study and when I would see a particularly good lawn, I would say to the owner, "I know how you have such a good lawn, you mow it twice a week." They always said, "No."

I liked to help father in the garden, but G.H. always got to do the things that were the most fun, digging the holes, planting the bushes, etc. while I fetched and carried. I finally complained to mother who must have talked to him about it. Things changed after that. He would stand back from the hole and say, "I wonder what I need now!"

G.H. claimed he did not have a good memory, but he must have had it for physics. When we would ask him to bring something home from the office or pick something up on his way, he would always say, "Phone and remind me." Whether he did not want to have the responsibility of remembering or cluttering his mind with it, who knows? Or perhaps, he even liked to speak to us during the day. Unlike Churchill, he did not seem to mind his family disturbing him at the office or at home.

G.H. usually forgot the punch line of any joke he tried to tell. But, one of his favourite stories was the following: G.H. went to Oxford (sic) to visit Professor Norrish. It was a Sunday and Professor Norrish met him at the Oxford (sic) train station, and took him immediately to the pub. After G.H. had his tea and Professor Norrish had his pint, Mrs. Norrish arrived in a fury as the lunch was being ruined as they were late. Why had they not come directly to the house? Professor Norrish said: "Herzberg needed a drink!"

To me, my parents had no accents. When G.H. spoke in German on the German Radio in 1955 when Einstein died, his brother said, "You sound like an Englishman who speaks German very well." To the family, the only two words G.H. had trouble pronouncing were "coin" which he called "cohen" but eventually got it right and the word "gaffer" meaning an old man or the boss. He always said "goffer".

While growing up, I did not realize my father was famous. He seemed to know famous people, but that does not make one famous. When Professor P.A.M. Dirac visited in Ottawa in 1955, we went on long walks in the Gatineau Hills; for hour after hour, nobody said a word. Then when we came back and sat in the darkness of the living room, no one said a word either. Maybe this is how science is done, I thought.

Early on, G.H. wore three-piece suits; when he went to Belgium for a stay of a few months in 1960 on the Queen Mary, he bought his first sports jacket. At the National Research Council he wore a lab coat which protected and saved his clothes. A new suit was first for "good"; then it became his office suit, then his Saturday suit, then gardening suit and finally his painting suit. Once I overheard my mother speaking to my father as they were cleaning out his clothes cupboard in Ottawa. "But how many painting suits do you need?" G.H. had not really done any serious painting since we left Saskatoon!

On re-reading last weekend some of my father's letters to me from Belgium, I found the following: "The boat trip was quite nice. But one spends far too much time eating. I just barely got my lecture done." (January 10, 1960). In the same letter in answer to what must have been my worrying about some exams he said, "Do not worry.... According to old [sic] Goethe worry is one of the greatest enemies of man." I wonder if G.H. ever worried about unimportant things!

In replying a few weeks later to a letter of mine in which I must have told him about Robert Oppenheimer's lectures at Queen's University (February 4, 1960). [Mail was very quick then; the lectures were January 25, 26 and 28 and G.H. replied on February 4!] "It is always a great experience to hear in person a really great man even if one does not understand everything he says (that also applies to Prof. Dirac). I am sure I would not have understood all that Oppenheimer said."

G.H.'s principles and his strong sense of duty, his scientific accomplishments, his love of music and nature will always be there. His life and the way he lived could perhaps be considered to be an upper bound to what is possible.

I once asked G.H. how he did it all: the physics, the bringing up of a family, building a house, the garden, etc. All he said was "Don't ask." We and the world should and will never forget G.H.

Another thing that G.H. taught us by example is that he never said anything bad about others nor worried about other's ethics and morals. There was never any gossip. The implication was that one should not worry about other's standards, only one's own. One should mind one's own business.

G.H. received very many honours. But as Aristotle stated: "Dignity does not consist of getting honours, but in deserving them." It goes without saying that G.H. deserved his very many honours.

In about 1994, I came up from Kingston to have lunch with my father. As usual we went to the cafeteria across the street at External Affairs. This practice not only gave G.H. a short walk at noon which he sometimes made longer but perhaps it was also that he thought the NRC cafeteria was not the same since Mrs. Carson's reign. I understand all the directors used to line up to give Mrs. Carson a kiss at Christmas time; her pies were legendary. When we went back to NRC, the elevator had a sign on it that it was being repaired. But the Commissionaire
managed to get it anyway. (In the last few years, G.H. did not like to walk up the stairs after a meal.) The elevator came and the repairman was in it. I asked him why my father got such service? "Well," said the repairman, "he owns the building!"

G.H. spent his life in the pursuit of science and the arts; he searched for openness, honesty and objectivity. He did not care to have the flashiest car on the street nor was he ostentatious about his accomplishments. He did not like to attract attention. He listened and weighed the evidence.

Once father and I shared an eye appointment at Dr. H.T.J. Mount's. Dr. Mount asked why he did not believe in God. G.H. said that he had not seen enough data.

G.H. had his idols too. These were Dr. Chandrasekhar, Dr. Douglas, Dr. Murray and Dr. Steacie; he respected them very much, but they were also his friends.

When Sir Ralph Richardson, the actor, passed away some years ago, Sir Lawrence Olivier wrote an article about him. In it, Sir Lawrence said that if it were true when one died and went to heaven, one sat on a cloud for eternity, then he, Sir Lawrence, would like to sit on a cloud with Sir Ralph Richardson since Sir Ralph was such good company. If this is true, but G.H. would have said, we need to see more data, I am sure G.H. and the quartet of names I have just

mentioned would have a wonderful time on the same cloud. There would be a lot of stimulating talk about science and the arts and lots of laughter. It would be good to be what- ever is the equivalent of the proverbial fly on the wall in this situation.

When asked what he could pass on to the younger generation, Winston Churchill said, "Out of a life of long and varied experience, the most valuable piece of advice I could hand on to you is to know how to command the moment to remain!" Our memories of G.H., including his advice, his science, his working for dissidents, and the fun, we shall always be able to command to remain.

I would like to close with a quotation and some excerpts of a poem, which I think, describe G.H. and our thoughts about him very well.

The quotation was written by Sir George Trevelyan, in speaking of a friend.

> "He was an outstanding example of a type that has always specially attracted me: the specialist who has a wide outlook, broad knowledge, and warm enthusiasms outside his own subject as well as in it, and, more particularly, a man he was, whose mind has been trained in the splendid discipline of a science, but whose heart and eyes take also delight in the triumphs of art, in the history of man, in the beauties of nature. Such a man is about the best thing that our modern civilization can produce."

The poem is by Stephen Spender entitled *The Truly Great.*

> I think continually of those who are truly great.
> ...
> What is precious, is never to forget...
> The names of those who in their lives fought for life,
> Who wore at their hearts the fire's centre.
> Born of the sun, they travelled a short while toward the sun
> And left the vivid air signed with their honour.
>
> [Stephen Spender, *Collected Poems* 1928-1985]

If you let me make one last quotation, this is by Leo Rosten who wrote *The Education of Hyman Kaplan.*

This quotation is from an essay about his father.

"He was a simple man, without a shred of affectation. His tastes were innocent, his desires easily satisfied. He was unfailingly agreeable. He made no demands on anyone. He disapproved of gossip and simply did not know the meaning of rancour or envy. He was entirely without self-righteousness. He never pried or probed or stuck his nose into anyone else's affairs. I rarely heard him complain, and though he was far from prudish I never heard him use profanity. And not once in over fifty years, can I remember his uttering a mean or malicious or spiteful thought."

...

"He was a dear, kind, gentle man, and I loved him."

[L. Rosten, *People I Have Loved, Known or Admired*, p.21.]

Agnes M. Herzberg
May 11, 1999

DR. ARTHUR J. CARTY

Closing Remarks

Before we leave here today, I have one last pleasurable duty. That is to announce the creation by NRC of a new Herzberg Prize and Fellowship. The Herzberg Memorial Prize and Fellowship will be a prestigious and highly selective distinction made to an established and internationally renowned researcher and will be open to applicants from Canada and around the world. The recipient will receive a prize of $25,000 and a Fellowship of up to $100,000 for a stay of up to one year at one of NRC's many research laboratories.

We hope in this small way to help to keep Dr. Herzberg's memory and his love and passion for science alive.

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Per Jensen
J.P. Jesson
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R.C. Johnson
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Wojtek Mejewski
N. Marmet
Paul Marmet
Mark Marshall
Liola Mason
Massicotte
C.W. Mathews
C.L. McEwen
Lorna McEwen
A.J. McHugh
A. Robert W. McKellar
C.J. McLarnon
D.B. McLay
Meerts
H. Meinel
Anthony Merer
E. Miescher
Ian Mills
E.R.V. Milton
Nasser Moazzen-Ahmadi
C.K. Mohler
A.G.V. Monfils
H.R. Moore
Y. Morino
D. Morris
B.A. Morrow
John Morton
R.E. Moss
T. Nakanaga
R. Nanes
N.A. Narasimham
W.S. (Bill) Neil
L.S. Nelson
Laszlo Nemes
G.W. Nichols
J.P. Noad

Mario Noel
Caroline Nowlan
T. Ogata
J.F. Ogilvie
Takeshi Oka
Markus K. Oldani
Brian Orr
G.A. Osborne
S. Osborne
Irving Ozier
S. Paddy Reddy
Joseph Paldus
C. Pallett
D.D. Pant
James E. Parkin
B. Pascat
V. Paski
Faye Pealow
A.S. Pearl
E.R. Peck
J.R.D. Peers
M.L. Perrier
Jan Petersen
Eugene Pfitzer
D.H. Phelps
J.G. Phillips
R.A. Phillips
Pierre Plessis
Joseph Pliva
S.R. Polo
R.F. Porter
James Potter
Oleg L. Polyansky
N.M. Pozdeev
A. Predoi
S.H. Priddle
M. Proulx
Donald Ramsay
K. Suryanarayana Rao
K.N. Rao
J.W. Raymonda
Grote Reber
C. Reid
John Reid
J. Retallack
Nathan H. Rich
Mike Riggin
U. Ringstrom
R.K. Ritchie
G.J. Ritter
C. Roche
J.D. Roger
M. Romheld
Jean-Yves Roncin
B. Rosen
I.G. Ross
Stephen Ross
Joelle Rostas
P.M. Roulty
A. Roytburg
Dmitri Sadovskii
Shuji Saito
B.D. Saksena
M.M. Sanz
Kamil Sarka
Peter Sarre
Hiroyuki Sasada
K.V. L.N. Sastry
Flavio Scappini
R. Scullman
R.T. Schieder
F. Schreier
R.H. Schwendeman
Trevor Sears
J.P. (Jerry) Sebesta
L. Sedgewick
M. Selwood
D. Setser
D. Sharma
I. Sharma
N. Sheppard
Midori Shimauchi

Fumiko Shimizu
Tadao Shimizu
Jack Shoosmith
K.C. Shotton
H.F. ShurvellBenoît Simard
N.L. Singh
S. Singh
D.S. Smith
Vlada Spirko
G.P. Srivastava
J. G. Stamper
Boris Stoicheff
John M. R. Stone
I.K.M. Strathy
P. Sutherland
P.J. Sutherland
J.D. Swalen
Victor Szalay
G. Szamosi
Amin Taleb-Bendiab
D.R. Tayler
E. Thiessen
P. Thistlethwaite
D. Thompson
B.A. Thrush
P. Thurnauer
T. Tiedje
Susan M. Till
Y. Ting
R.S. Title
Dennis Tokaryk
Jonathan Towle
K. Tran
D.N. Travis
A. Trombetti
Frank Tudron
C.P. Turner
R. Turner
W.J.R. Tyerman
J.K. Tyler
J. Tyrrell
W. Ulrich
J. Vandenbelt
Jean Vander Auwera
P.M. Veillette
R. Velasco
R. Velasco-Ferro
R. Velasco-Ferre
P. Venkateswarlu
R.D. Verma
Michel Verdoet
Beulah Wadsworth
S. Wallin
Ding-Chang Wang
Hugh E. Warner
P.A. Warsop
L. Watmann
James K.G. Watson
T. Weber
Erwin Weinberger
D. Weitz
G. Wessel

Gerhard Herzberg

Medals, Awards

Médaille de l'Université de Liège	1950
Henry Marshall Tory Medal, Royal Society of Canada	1953
Joy Kissen Mookerjee Gold Medal, Indian Association for the Cultivation of Science	1954
Gold Medal, Canadian Association of Physicists	1957
Medal of the Society for Applied Spectroscopy	1959
Médaille de l'Université de Liége (silver)	1960
Médaille de l'Université de Bruxelles	1960
Pittsburgh Spectroscopy Award, Spectroscopy Society of Pittsburgh	1962
Frederic Ives Medal, Optical Society of America	1964
Willard Gibbs Medal, American Chemical Society	1969
Gold Medal, Professional Institute of the Public Service of Canada	1969
Faraday Medal, Chemical Society of London	1970
Royal Medal, Royal Society of London	1971
Linus Pauling Medal, American Chemical Society	1971
Nobel Prize in Chemistry, Swedish Royal Academy of Sciences	1971
Chemical Institute of Canada Medal	1972
Madison Marshall Award, American Chemical Society (North Alabama Section)	1974
Earle K. Plyler Prize, American Physical Society	1985
Jan Marcus Marci Memorial Medal, Czechoslovak Spectroscopy Society	1987
Minor Planet 3316=1984 CN1 officially named "Herzberg"	1987
Appointed to the Queen's Privy Council for Canada	1992

Gerhard Herzberg

Honorary Degrees

L.L.D,	University of Saskatchewan	1953
D.Sc.	McMaster University, Hamilton	1954
D.Sc.	National University of Ireland, Dublin	1956
LL.D.	University of Toronto	1958
LL.D.	Dalhousie University	1960
D.Sc.	Oxford University	1960
LL.D.	University of Alberta,	1961
D.Sc.	University of British Columbia	1964
D.Sc.	Queen's University, Kingston	1965
D.Sc.	University of New Brunswick	1966
Fil.Hed.Dr.	University of Stockholm	1966
D.Sc.	University of Chicago	1967
D.Sc.	Carleton University, Ottawa	1967
Dr.rer.nat.	University of Göttingen	1968
D.Sc.	Memorial University, Newfoundland	1968
D.Sc.	York University, Toronto	1969
D.Sc.	University of Windsor	1970
D.Sc.	Royal Military College of Canada	1971
D.Sc.	Drexel University, Philadelphia	1972
LL.D.	St. Francis Xavier University	1972
D.Sc.	University of Montreal	1972
LL.D.	Simon Fraser University	1972
D.Sc.	Université de Sherbrooke	1972
D.Sc.	Cambridge University	1972
D.Sc.	McGill University	1972
D.Sc.	University of Manitoba	1973
Dr.rer.nat.	University of Hamburg	1974
D.Sc.	University of Bristol	1975
D.Sc.	Andhra University	1975
D.Sc.	Osmania University	1976
D.Sc.	University of Delhi	1976
D.Phil.	Weizmann Institute of Science	1976
D.Sc.	University of Western Ontario	1976
D.Sc.	Laval University	1979
Dr.phil.nat.	University of Frankfurt	1983
Ph.D. (hon)	University of Toledo	1984
D.Sc. (hon)	St. Mary's University	1991