Boris P. Stoicheff: a Tribute on the Occasion of his 75th Birthday

By

H.M. van Driel and A.D. May

Department of Physics

University of Toronto

Toronto, Canada

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"….please give my regards to Boris."

Whenever we meet optical scientists at universities, conferences or anywhere else for that matter, and it becomes known that we're from the physics department of the University of Toronto we always hear the above remark. It seems that anyone who has ever worked with light knows Boris and is fond of this "charming gentleman". As a scientist and as a person, Boris has endeared himself to the optics community for more than half a century, a period during which he has become known as one of the world's finest optical spectroscopists. It is wholly fitting that we should honour this man who has contributed so much original research and service to the science community with this special Festschrift issue of the Canadian Journal of Physics on the occasion of his 75th

birthday. We are pleased to see that his friends, colleagues and former students share this sentiment and have written several outstanding research articles for this volume.

Boris Stoicheff was born in Bitol, Macedonia (then part of Yugoslavia) on June 1, 1924 and immigrated to Canada with his parents and sisters in 1931. Political instability in the Balkans, a situation unfortunately familiar to us again in 1999, led to the decision to emigrate. The family settled in Toronto where he played soccer, went on extensive bicycle tours with his friends and ran cross-country races (he was ranked 5th in the province of Ontario as a teenager and later in University ran the mile in under 5 minutes). However, with stimulation from teachers and friends at high school, he also developed a passion for mathematics. The lure of mathematics and a lifelong penchant for wanting to engage in the most intellectually challenging activities drove him to enroll in Engineering Physics, one of the top undergraduate programs at the University of Toronto. After obtaining his B.A.Sc in 1947 in the X-ray and Spectroscopy Option, he accepted what he hoped to be a permanent position with a local electronics firm. But the work proved to be too repetitive and boring for his inquisitive mind. Recalling the superb undergraduate physics labs, where he had received close attention from Harry Welsh and having been inspired by the excellent lectures of Malcolm Crawford, he enrolled for a one year M.A in theoretical physics.

With ever increasing respect for Professor Welsh, Boris decided to pursue a Ph.D. in experimental physics in 1948. The period just after World War II was an exciting time in science, with new instruments such as photomultiplier tubes and infrared detectors which had been developed for the war effort now becoming available for fundamental research. Welsh, assisted by Ted Paschler, was setting up a new spectroscopy laboratory

Photo #1: Boris at the outset of a 1200-mile bicycle tour in Ontario (1943).

to perform high pressure studies of gases and Boris began with Raman studies of CO_2. It was during this period too that he met Art Schawlow (Nobel Prize winner, 1981) who completed his Ph.D. with Crawford in 1949. Their lifelong friendship lasted until this year when Art unfortunately succumbed to leukemia.

Boris completed his Ph.D. in 1950 and with the aid of a Gilchrist fellowship stayed on for a year in Toronto to perform Raman scattering experiments at low pressures. One of his major successes was to obtain the first high resolution Raman spectrum of methane. To record the spectra, exposures of single photographic plates

sometimes took over 48 hours. To quote Boris: "I played a lot of chess while nurturing these experiments, but mostly got killed by my older colleagues." These experiments, made possible with the new high intensity Toronto lamps, formed the starting point of a fruitful research program for both Stoicheff and Welsh in the years to come. Then one day Boris attended a seminar by Gerhard Herzberg of the National Research Council on the quadrupole spectrum of hydrogen and its significance to the detection of this gas in planetary atmospheres. The material and the exciting way in which it was presented made such a profound impression on Boris that he cancelled plans to pursue studies in Europe and asked Welsh to help him obtain a postdoctoral appointment with Herzberg in Ottawa. Herzberg was only too happy to receive the enthusiastic young man.

At that time the NRC spectroscopy lab was run under the general direction of Dr. Herzberg but he gave complete freedom to his junior colleagues Alex Douglas, Cec Costain, Don Ramsey and Hin Lu, who were pursuing work in different subfields of spectroscopy. Boris proposed projects in Raman spectroscopy, which didn't fit into any of the existing areas; nonetheless he was allowed to establish his own experiments.

> "Dr. Herzberg, or 'G.H.' as we fondly called him, never told any of us what to research, never even added his name to our papers, but provided a stimulating atmosphere in which to work, while carrying out his own projects with a technician. Of course there was an atmosphere of friendly competition in the group, but we regularly met over lunch and afternoon tea to discuss each others' results. Herzberg also regularly invited the leading scientists in all areas of physics from around the world to come to NRC. During my 14 years at NRC I

probably had the opportunity to meet about 40 actual or potential Nobel Prize winners."

With his own technical innovations in the design of high power mercury lamps and multipass optical cells, Boris did some of the best high resolution Raman spectroscopy in the world. His patience was renowned. On one occasion in 1953, after he had just completed a two day experiment to obtain the high resolution Raman spectrum of benzene, Boris passed the exposed plate to the director. Herzberg shouted "By Jove, by Jove!!", his hands shaking with excitement. All the while Boris was praying that he didn't drop the plate. Within a week Boris was promoted to a permanent job with his own technician and postdoctoral assistants. During the 1950s Boris continued to astound the spectroscopy world with his marvelously detailed spectra and the derived molecular parameters of more than 20 nonpolar molecules, molecules that were not accessible by established infrared and microwave absorption techniques. His standards were high. In his own words he stated that a publication should not be superseded by one of higher precision or quality for at least 10 years. Looking back on his 30 odd publications in the field of High Resolution Raman Spectroscopy it is clear that he surpassed his own standards.

And of course the years in Ottawa proved significant in other ways as well, for it was there that he met his wife Joan (née Ambridge). Although Boris and his fellow (bachelor) colleagues loved to work day and night in the exciting research environment that Herzberg provided, there was one Saturday night in 1953 when, in response to an old high school chum's question "What are you doing Saturday night?" Boris answered

Photo #2: Peter, Boris and Joan Stoicheff (1957).

"nothing". This led to a blind date with Joan, who one year later became his wife. Their child Peter (now Professor of English, University of Saskatchewan) arrived in 1956.

In the late 1950s Boris developed an interest in Brillouin scattering, attempting to take advantage of his high power optical sources to observe some of the first Brillouin spectra in solids. When, in 1958, he learned of the famous Townes and Schawlow proposal for an "optical maser", he immediately grasped that such a source would be ideal for carrying out Brillouin spectroscopy. He and Gary Hanes moved quickly to develop a laser based on optical pumping of mercury. Although they appeared to reach threshold for stimulated emission, it was impossible to get beyond this to obtain net

positive gain. “If only we had thought about using Brewster windows or were smart enough to vary the diameter of the tube” he later recalled. Nonetheless, following the breakthrough announcement of a ruby laser by Ted Maiman in 1960, Boris constructed the first (ruby) laser in Canada and proceeded to characterize and use it.

The invention of the laser revolutionized optical physics and served as the basis for the second, and longer part of Stoicheff’s research career. Although he and his colleague Alex Szabo carried out original research on lasers, it quickly became apparent that competing with the major industrial labs in laser development was difficult since their resources were enormous. Boris therefore decided to focus on the use of lasers in spectrocopy. In 1963 he was encouraged by Herzberg to take a sabbatical year (even though NRC didn’t have an official sabbatical policy) and chose to work with Charles Townes at MIT. It turned out that “Charlie” himself had reached the same conclusion as Boris about using lasers in research rather than building new ones and, as it turned out, was also interested in Brillouin spectroscopy. When Boris also asked if he could bring his technician to MIT, Townes was originally taken aback, wondering what Boris must have thought of the research environment at MIT. However, as Boris explained, his technician only worked with him and therefore would have nothing to do if left in Ottawa. Overall the sojurn at MIT proved fruitful, especially since Boris was able to work with Townes’ brilliant graduate students Ray Chiao and Elsa Garmire on stimulated Raman and Brillouin scattering in solids and normal Brillouin spectra of liquids.

The stimulation of working with these bright young minds turned Stoicheff ‘s thoughts to the possibility of a University position. Increasing government intervention at the NRC and beckoning phone calls from Harry Welsh to come to Toronto caused

Boris to return to the University of Toronto as a full professor in 1964. These were heady days for the department since under Welsh it was in the midst of a major expansion. Boris was not disappointed with his decision to come to come back to the U of T. His first three graduate students, Archie McQuillan, George Stegeman and Bill Gornall approached research in laser spectroscopy with gusto and the lab in Toronto quickly flourished. Work on stimulated Raman scattering and Brillouin scattering in liquids and, later on, rare gas solids formed the basis of a productive research program. As was given to him years earlier, Boris gave his students considerable freedom in running their own experiments, almost to the point where his students wondered if Boris could actually deal with some of the minor technical issues in the lab. On one occasion, when a student excitedly came into his office and said "Professor Stoicheff, I'm getting really exciting data but the overhead water radiator is starting to leak. What'll I do?" Without batting an eyelash Boris quipped "Put a pail under the leak and keep taking data!". On another occasion when a student explained that he couldn't get an oscilloscope to trigger properly, Boris told him to use an outlet on another wall. Bewildered by this suggestion, but willing to humor his supervisor, the student reluctantly agreed. The trick worked. It turned out the outlets were on separate circuits.

Boris has always been prescient to recognize when to abandon research fields for more fruitful grounds, but only entered new areas if he felt he had enough new ideas to make an impact. In the late 1970s he moved from Brillouin spectroscopy of solids to Rydberg spectroscopy of alkali atoms using two photon spectroscopy techniques. This work laid the foundation for the more recent use of coherent spectroscopies to design wavepackets in atoms. In the early 1980s he began developing tunable VUV sources

(wavelengths as short as 80 nm) using 4-wave mixing in gases. This technique allowed him and his students to perform some of the best high precision spectrocopy in rare gas dimers. And even after his official retirement from the University in 1989, the intellectual wheels were still spinning as Boris, along with Kohzo Hakuta, observed enhanced second harmonic generation at the Lyman-α line of hydrogen with the aid of electromagnetic induced transparency.

Increasingly, starting in the 1960s, Boris' keen insight, analytical abilities and sound judgement led to his serving on many University, Canadian and international committees and to occupy senior executive positions in many organizations. Among these, he found time to serve a number of different societies such as the Canadian Association of Physicists and the Optical Society of America. His ability to get to the point quickly and make incisive suggestions not surprisingly led to his being appointed as President of both organizations, the former in 1983 and the latter in 1976. Boris was always attracted to working with the best and brightest minds, and in the case of the Optical Society was also attracted to the high degree of conviction he saw in the people who worked with this organization. As senior scientific advisor he played a role in the establishment of Lumonics, a Canadian laser company which at one point was the third largest in the world. And even two years before his retirement, when another person might have started to think of winding down his activities, Boris continued to serve his colleagues at the University of Toronto. He took on the onerous task of being the founding director of the Ontario Laser and Lightwave Research Centre, one of the new Centres of Excellence set up by the province of Ontario. For all these contributions it is not surprising that when we issued invitations to celebrate Boris's official retirement

from the University in 1989, more than one hundred people arrived, many of them from overseas.

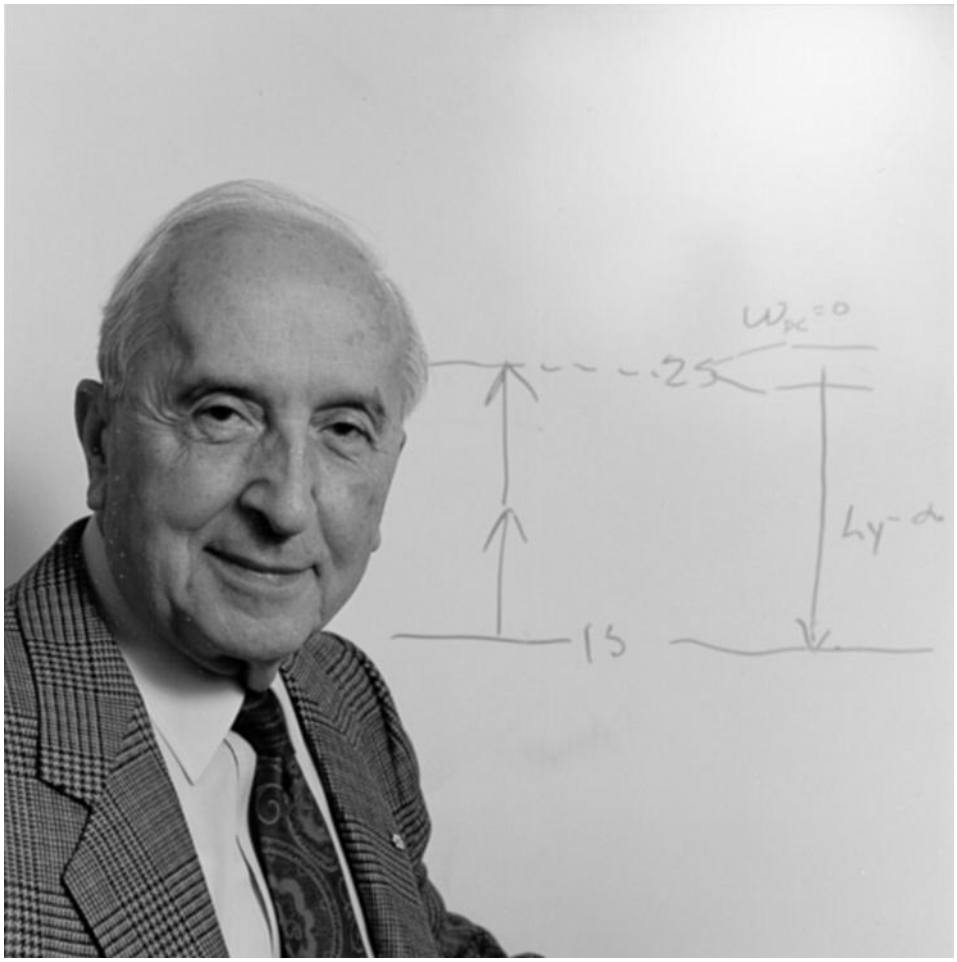

Photo #3: Boris P. Stoicheff (1999).

However anyone who knows him knows where his real pride lies. It is in the 25 graduate students who studied under him. The respect and warmth felt by these students, as well as the postdocs and visiting scientists is well known. Always a gentleman, Professor Stoicheff seemed to evoke the best from his coworkers by making physics fascinating and conveying his own love of the subject without sacrificing excellence, and leading by example, encouragement and support. Indeed he has often remarked that students are the main reasons for any success he has had over the years. Boris always

vigorously defended the experimental skills and research results of his students. A simple story illustrates this. Once in the early 1980s, Boris was giving an invited conference talk on excited state lifetimes of the rare gas dimers Ar_2, Kr_2, and Xe_2. At the end of the talk, when the Chair asked for questions from the floor, an individual stood up and pointed out that he had performed lifetime measurements on the same systems using a different method and that his times were longer by a factor of two. "And what do you have to say about that?", he pointedly asked. Without flinching, Boris's simple reply was "I guess you'll have to redo the experiment!" The roar from the audience ended the session.

Boris has received several honours for his research including fellowships in the Optical Society of America, the American Physical Society, the Royal Society of London, the Royal Society of Canada and honourary fellowship in the American Academy of Arts and Sciences, the Indian Academy of Science and the Macedonian Academy of Science and Arts. He was awarded the gold medal of the Canadian Association of Physicists for career achievement, the Henry Marshall Tory Medal of the Royal Society of Canada and the Meggers and Ives Medals of the Optical Society of America. He holds honourary degrees from four Universities and in 1982 was appointed an Officer of the Order of Canada. But Professor Stoicheff is known not only for the quality of his research. His enthusiasm for physics and his ability to communicate clearly and precisely to his audience has earned him a reputation as a superb speaker in both public and scientific forums. In 1977 he was named "University Professor" at the University of Toronto, that institution's highest honour, and has served as a "Distinguished Lecturer" at numerous Universities and Institutes.

Now, 10 years beyond his official retirement, we can observe that Boris has "slowed down" only slightly. He comes in later than he did in the past (now arriving shortly after 9 AM) and goes home a little earlier (leaving near 5 PM) but he still comes to his office nearly every weekend. His discussions now more easily revolve around his grandchildren, Alixandra and Christopher……their images peering up at him from his desk. His hobbies over the years involve travelling with his wife Joan and visiting the local art galleries. He has always been fascinated by the portrayal of light by eminent artists, starting with the Italian masters Caravaggio and daVinci. He has enthralled many a group of scientists and lay people alike with his slide collection of paintings, and his unique perspective on how light is understood and used by the artist. An avid reader, and as someone always interested in people, he also consumes biographies as a favorite way to pass the time at home. Over the last few years he has combined his love of biography with his lifelong respect for his mentor at NRC by working on a biography of Gerhard Herzberg, pointing out the role he played in establishing strong fundamental science research in Canada. If all goes according to plan the book might appear within a year.

And the future? With his mind never too far from science, Boris intends to turn his attention back to an old chestnut, one that has haunted him, Herzberg, Welsh and many others for several decades, namely, the origin of the diffuse interstellar bands. We hope that the stars remain in his eyes for many years to come!