Shammai Speiser

Chemistry and Beyond

1. Life in Haifa, 1941-1959

I was born in Haifa, on December 26, 1941, only child to my parents, Gina and Zvi, who emigrated in 1936 from Ternopol, then Poland now Ukraine, to Palestine.

My early childhood memories include curfew imposed by British soldiers in red barrettes, (nicknamed “KALANIYOT”, anemones in Hebrew) my kindergarten teacher and friends, my first day in school, the breakout of the War of Independence, and the liberation of Haifa in 1947, on Passover night. On September 1, 1947, I strated my first year at “Hugim” school. Hugim then was a comprehensive school, lasting 12 years of studies from elementary school, through junior high school all the way to high school. It had a very liberal and open- minded approach to education that encouraged free debate and students’ self-expression, I am sure that it had shaped my personality and my professional career. I have graduated from the mathematical-physical class (MEGAMA REALIT), emphasizing study of exact sciences, without, however, neglecting liberal arts and social sciences. My favorite teacher was Arie Rocker who taught chemistry in a very inspiring manner that convinced me to make it my lifelong subject. I still maintain strong contacts with many of my schoolmates, many of whom are very close friends.

Life out of school were very active, street games at my neibourhood, activities at the youth movement (Hashomer Hatsair), all kinds of sport activities, especially football (soccer), which became my favorite sport. I was a rather good football player, and made it later to the Technion's selection team.

With the Technion's football team, in the Hebrew university stadium, 1963

I liked painting, which I abandoned at the age of 14, resumed only later upon my retirement in 2010. I became enthusiastic about classical music at an early age, joining my father in listening to music radio broadcasting. I later acquired taste to jazz and to other music genres, it became a passion of mine ever since.

2. Student at the Technion, starting a family, 1959-1964, and army service, 1964-1967

After graduating from high school in 1959, I have started my army service in the Academic Reserve (ATUDA AKADEMIT) and started my studies, for the four years

B.Sc. program, at the Chemistry Department within the Faculty of Sciences at the Technion. My favorite subjects were many aspects of physical chemistry, taught by Professor Otto Schnepp, in particular spectroscopy and photochemistry. In the second semester of my third year, I have chosen a project in the advanced physical chemistry laboratory. The project, supervised by Professor Amitai Halevi, involved investigation of the mechanism of oxidation of iso-propanol utilizing kinetics methods and deuterium isotope effects. I was very impressed from Halevi's approach to the project, which for me was the first encounter with the methodology of scientific research. When I had to choose my final year graduate research work, Professor Halevi's laboratory was my obvious priority.

Amitai suggested that I would investigate the mechanism of N-nitration. This project followed the M. Sc. Work of Arza Ron[1] that showed that deuterium substitution increases the basicity of nitrogen bases as well decreasing the acidity of carboxylic acids due to a secondary isotope effect, thus suggesting using these effects as criteria of mechanism. My work proved, utilizing a combination of primary, secondary and solvent isotope effects that in the nitration of substituted anilines at the nitrogen atom, the rate-limiting step, in contrast to the established mechanism of aromatic nitration, can be shifted from attack by NO_2^+ to the subsequent proton abstraction.[1]

Being a soldier in the Academic Reserves required special training activities in the summer academic breaks of 1960 and of 1961. In the summer of 1961, I finished the officers' course, while in summer of 1962 we had a break from any army activity. After graduation, I should have started my army service in August 1963; this meant that I was unable to finish my research project. Amitai wrote a letter to the Army authorities requesting delaying my service for another year to allow completing my research and to write my M.Sc. thesis. Luckily enough the army approved my request so that by September 1964 I finished this stage of my academic chemistry education. My M. Sc. Thesis: “The mechanism of N-nitration”, was eventually published[2], my very first scientific publication.

It is important for me to mention that during all this period took place at the historic building of the Technion (now hosting the National Science Museum) and the surrounding sheds and buildings. Conditions for study and for research were poor and Spartan. For example, our student laboratory of organic chemistry was located, in Haifa Bay, in an industrial structure, not fitted for the task requiring long journey by bus. Yet working with Amitai was a very inspiring experience for me both scientifically and personally. I admired his sense of humor, his kindness and his being a true Renaissance scholar. We found many common fields of interests beyond the obvious chemical issues, such as history, literature, music, and football. Amitai was my first chemistry mentor also becoming my friend.

At the organic chemistry laboratory, in the industrial structure in Haifa Bay, 1961

In the summer break of 1962, I met Ruth Friede at a dance evening at the Technion's student club. Ruthie, who was then a soldier, also studied to become a teacher in the Army Teachers College. It eventually lead to our getting married on March 17, 1964.

In October that year, I started my army service in The Nuclear Research Center, "KAMAG" near Dimona. **Our son, Erez, was born on February 20, 1966**. I then transferred from KAMAG to serve at the Naval Officers Academy in Haifa.

During that year, I started planning to continue my chemistry education towards a Ph. D. degree (then D. Sc. Degree) at the Technion. During my fourth year at the Technion and in KAMAG, I liked my advanced courses in spectroscopy, photochemistry, quantum chemistry and statistical mechanics, and decided to do my doctoral research in these disciplines. I thought of joining the research group of Professor Otto Schnepp that was involved in molecular spectroscopy. Much to my disappointment, I discovered that Schnepp had left the Technion to take up a position in the US. I consulted with Amitai who told me that in addition to Arza Ron who took over Schnepp's group, two new Faculty members have just joined the Department (now the Faculty) of Chemistry, Professors Mordecai Rubin and Sol Kimel. I went on to see them. Rubin told me that his interests are mostly in synthetic organic photochemistry and much less in the physical chemistry aspects of it, which did not appeal to me. I then met with Sol Kimel, this actually started my academic career.

3. My Ph. D. work, 1967-1970

Sol outlined his scientific background and gave me a short review of his research on infrared spectroscopy of matrix-isolated molecules, done at the Weizmann Institute before joining the Faculty at the Technion. He went on to say that while he is still interested in some theoretical aspects of this subject, he intends to establish a laser-based spectroscopy research at the Technion. He was very frank in telling me that he has no experience in this field but is confident that it is the future field of research in molecular spectroscopy. He suggested that I would do some literature survey before I decide whether or not I would like to join his group as his first student. The laboratory main equipment was a newly purchased ruby laser. It was supposed to arrive at about the same time of my discharge from the army, in March 1967. The subject that I was supposed to explore was specific physical chemical aspects of the Stimulated Raman Effect. At that time there was not even one textbook about laser physics that I could have used to learn the basics of the field. It took me more than a month of intense reading of the literature to realize that this subject is being thoroughly investigated by leading groups (one was headed by Bloembergen that later was awarded the Nobel Prize in physics for his work on this subject) which did not leave much for us to contribute. However, my readings suggested other possibilities in the newly emerging discipline of nonlinear optics. One of the subjects of investigation in this field was two photon absorption processes that obey different selection rules, compared to conventional one photon processes. I came back to Sol telling him of my conclusion and suggested that I will investigate two photon induced photochemical processes that may lead to different reaction patterns due to these unique selection rules. Sol told me that he asked around about me and received enthusiastic recommendations about my academic performance, so much so that he trusts me with leading a research project as

I suggested. Our joint experience turned out to be highly rewarding, mainly due to Sol’s personality. It was an odd collaboration between a real educated European Gentleman, with a great sense of humor, and a rough going, opinionated Israeli born. I appreciated very much the freedom and independence given to me by Sol to conduct my research and enjoyed our daily scientific discussions and each other’s company. We soon found out that we had many common interests also in non- scientific subjects. Sol was my mentor and eventually became a very good friend.

I found out that iodoform undergoes photolysis, when excited at 350nm to yield, in a chain reaction, molecular iodine. One molecule of iodine is produced for each quantum absorbed by iodoform that has a broad absorption band at this excitation wavelength, which corresponds to excitation of two quanta at the ruby laser 694nm wavelength. This made iodoform an ideal candidate for quantitative determination of the ruby laser induced two-photon photolysis, by measuring the quantum yield of the produced iodine.

The six days war in June 1967 had delayed the arrival of our laser system. When it finally arrived in October, we had to learn the basics of setting up a laser spectroscopy laboratory. We got very useful advice from Professor Shaul Yatsiv and his coworkers from the Department of Physics at the Hebrew University in Jerusalem. They had already a lot of experience in laser physics and laser techniques, especially in the study of nonlinear optics of metal vapors and in particular the study of the Stimulated Raman Effect in potassium. By the end of November, we were ready for our first experiments after setting up our laboratory with the skillful assistance of our departmental mechanical and electronic services. We developed a methodology for measuring the photolysis yield as function of excitation laser intensity. We have established the two-photon characteristics of the laser induced photolysis of iodoform and were able to determine the **absolute** value of the two-photon absorption cross section, a first-time measurement of its kind. However, our most exciting discovery was a new kind of nonlinear optical solvent effect that increased the efficiency of the two-photon absorption due the effect of self-focusing of laser beams in solvents possessing a high optical Kerr constant, similar to the manifestation of this effect in enhancement of Stimulated Raman intensities. We finally went on to develop a novel chemical method for measuring the self-focusing length in a variety of solvents. I finished writing my D.Sc. thesis: “Photochemistry of molecules excited by ruby laser; two-photon photolysis of iodoform” and submitted it in December 1969. It was a real pioneering work in the very young field of laser-induced chemistry, the first done in Israel and one of the very few worldwide. Our publications of this work [2,3] were well received by the scientific community and are still quoted today.

At our laser laboratory, 1968

Earlier in 1969 Professor Adam Heller, then the head of laser research at the "Sylvania" group of "General Telephone and Electronics, (GT&E)", visited us. He told me that he likes our research and offered me to do my post-doctoral work with him, exploring his new idea of developing a novel kind of liquid lasers. I accepted his offer, when less than a month before my scheduled departure to the US, on August 1969, I received a cable informing me that GT&E had closed all its research activity in "Sylvania", meaning of course, that I needed to find a different place for doing my post-doctoral studies. Sol has suggested that I will delay submitting my thesis till December and then apply for a temporary position of a Research Fellow at the Technion, which will give more time for securing an alternative post-doctoral position. I followed his advice, and my application for that position was approved. Thus, I became a Research Fellow all through the academic year of 1970/71.

Our second son, Allon, was born on February 27, 1970, just 2 days before I defended my D. Sc. Thesis.

The year I spent as a Research Fellow proved to be rather fruitful. I collaborated with Sol and his new student, Oded Kafri, on number of projects. We extended our nonlinear photochemical studies on iodoform to consider theoretical aspects of multiphoton induced photochemistry[4-6]. Together with Itzhak Oref, we investigated the two-photon induced photolysis of gas phase azoethane.[7] Review of our work on nonlinear photochemistry, published in Nature, described it as a pioneering work and a breakthrough in this emerging field.[8] With Oded we also developed a novel theory for describing laser Q-switching by a rotating mirror, based on the Doppler Effect. [9]

In April 1971, Professor Jan Kommandeur from the University of Groningen, The Netherlands, visited our laboratory. Jan was Sols' acquaintance from their joint studies at the University of Amsterdam. We had a very intense discussion of my work and Jan came up with the suggestion that I will join him in Groningen as a Research Fellow. After consulting with Ruthie, I accepted this offer and in August 1971, we traveled to Groningen for a one year of post –doctoral studies that, eventually was extended to a second year.

4. post-Doctoral period in Groningen, 1971-1973

Traveling to Holland was our first trip ever abroad. We were assisted by Jan, members of his research group and above all by his wife, Lizzie, that made our adjustment to life in Groningen smooth and pleasant. We rented an apartment not far from the new campus of the university. Erez started to go to the kindergarten in our neighborhood and after some difficulties, including speaking fluent Dutch adjusted well to his new environment. Ruthie who stayed at home with Allon was excited in exploring Groningen that proved to be a pleasant, though a provincial quiet town. She soon got her way around spending time with some of our new friends, including two Israeli families also associated with the university. Overall, we liked being in Groningen, however, we never got used to Dutch weather, and I believe that most locals shared our sentiment.

I started working in the Laboratory for Physical Chemistry, which was in the center of Groningen and was about to be relocated in the new campus. I got used to riding my bikes to the laboratory and to the social interaction with laboratory members, both research students and Faculty. Jan first suggestion for a research project was to investigate radiationless transitions of the vibrational molecular manifold due to infrared excitation by a CO_2 laser. The idea was to build this laser utilizing the excellent technical skills of the Laboratory workshop. We consulted with Jan’s colleague in the Technical University in Enschede who had a lot of experience in building CO_2 lasers and realized that it will not be an easy task and may not be worth the effort, especially since the same process could be studied using optical excitation in the UV-visible spectral range. We only had a ruby laser system, like the setup that I have used at the Technion, which was not suited to the proposed project that needed a tunable laser source. Jan issued budget request from his funding agencies to purchase a dye laser pumped by nitrogen laser, which was the suitable system. While we were waiting for approval of this budget request and eventually to receiving the laser system, Jan suggested that I would get involved with the research program of his Ph.D. student, Gerard Makkes van der Deijl. Gerard was studying photoionization of biphenyl radical anion induced by ruby laser excitation. He observed a kind of saturation effect for the intensity dependence of the process. He varied the laser intensity by changing the pumping energy of the ruby rod. Based on my own experience and that of others I knew that this procedure results in uncontrolled changes in the temporal substructure of the laser pulse leading to uncontrolled laser intensities, not correlated with the pulse temporal envelope. Adopting my suggestion Gerard repeated his experiment, now changing the laser intensity by a series of neutral density filters, while keeping the flash pump energy fixed. The intensity dependence turned out to be linear, as it should for single photon excitation. Temperature dependence of the photoionization process indicated the existence of a higher excited state reached by consecutive two-photon absorption, however, the ultrafast non-radiative decay of this state, reduces the apparent quantum yield at higher excitation energies. This explained the two different laser dependencies that we observed.[10]

We soon realized that the pattern observed for the biphenyl photoionization is not limited just for this system and should affect any molecular excitation process of the first excited singlet state, where at higher laser excitation intensities, the fluorescence or the photochemical yield originated from this excitation will be quenched by further excitation to an upper singlet state. We called this general phenomenon "photoquenching". Together with Jan's Ph.D. student, Rennie van der Werf, we studied the various aspects of photoquenching and came up with a very useful expression in terms of a Stern-Volmer like intensity dependence of the observed quantum yield.[12] Together with Rennie I was involved in building up a new laser laboratory based on nitrogen laser-pumped dye laser system. It was part of a new project to study radiationless transitions in isolated molecules by monitoring their time resolved fluorescence decay. Unfortunately, we have finished building the laboratory just before my post-doctoral period ended.

During my second year in Groningen Sol took up a sabbatical leave at the University of Amsterdam. He was looking for a project that could make use of the laser flash spectroscopy set up that was available in Amsterdam. Together with a graduate student we studied the flash spectroscopy of iodoform and iodine and were able to prove that the primary process in iodoform photolysis is the formation of atomic iodine.[11]

During 1972, I applied for an academic position at various Israeli Universities. I have soon realized that in-breeding practice of favoring a local university graduate dictated the responses I received. Michael Ottolenghi from the Hebrew University told me that they secure their next appointment for Yehuda Haas that was about to go for his post-doctoral studies in California. At Tel Aviv University Danny Huppert was sent to the laboratory of Peter Rentzepis for a post-doctoral period in which he learned how to set up picosecond lase laboratory upon his return to Tel Aviv. In Weizmann Institute

Yehiam Prior that has just left for his post-doctoral period and was due to take up a position in the Chemical Physics Department.

I received nominations for a Lecturer position at Ben Gurion University and at the Technion. Some family considerations made me to favor the offer from the Technion. Thus, in August of 1973 we ended our stay in Groningen and returned to Haifa.

5. Faculty member at the Faculty of Chemistry at the Technion, 1973-1979

On September 1, 1973, I joined the Faculty of Chemistry to start my work as a Lecturer. The Dean, Professor Michael Cais greeted me. He told me not to expect any set up money to establish my research laboratory due to severe budget cuts taken by the Technion- “you will need to prove yourself without this” were his exact words. He went on to tell me that Sol offered to share his laser laboratory with me and have assigned a fourth-year undergraduate student, Hedva Zipin, to start my research group. While I felt at home coming back to my old laser laboratory and even to the same small office I had, I was frustrated that my research plans for setting-up a new laser laboratory based on tunable laser for time resolved photophysical studies of molecular systems, will have to wait until I would be able to secure the necessary funds. The breakup of the Yom Kippur war in October resulted in another delay of almost half a year before normal activities at the Technion have resumed’ with additional severe budget cuts. Our laboratory engineer, David Jacobs was killed in Sinai; it had shocked all of us and was a blow to our research capabilities.

This new situation forced me to change my research strategy. I had to rely on projects suited for ruby laser excitation, to initiate novel theoretical studies and to try and build a nitrogen laser based tunable laser system utilizing the Faculty machine shop and the Faculty electronic technicians capabilities.

Together with Sol and Arza Ron we studied the theoretical aspects of isotope separation utilizing stimulated Raman gain differences of isotopes[13]. Hedva Zipin studied the two-photon photolysis of the ferrioxalate actinometer system[15]. I have extended investigating photoquenching as a limiting factor for laser-pumped dye lasers[14,16], and initiated collaboration with Jacob Katriel to study the coherent aspects of multiphoton transition proababilities[17]. **On August 22, 1975, our 3rd son, Oren was born**, just when I received my first major research grant from the Israel Academy of Sciences.

Together with Eliezer Weiss, a fourth-year undergraduate student, we have investigated the prospects of utilizing energy transfer as means of extending dye lasers tunability and minimizing photoquenching effects[18].

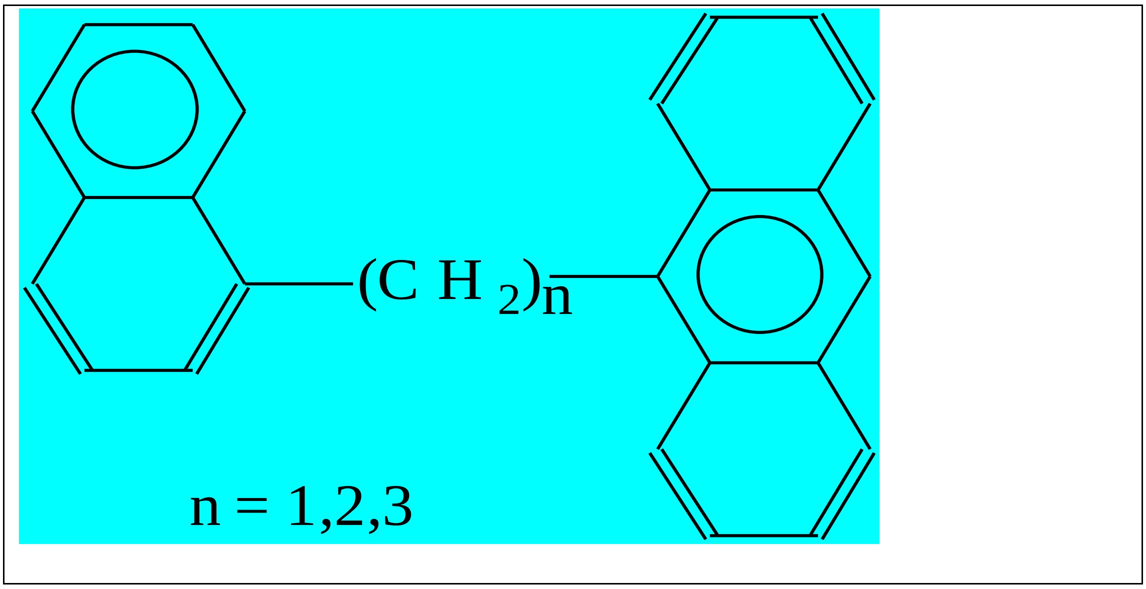
During the summer break of 1976, I stayed at the Physical Chemistry Laboratory in Groningen. Together with Rennie van der Werf we resumed our project of investigating radiationless transitions in small, isolated molecules. We soon observed what seemed to be quantum beats as expected from theory. However, to our great disappointment we realized that electronic noise interfering with our detection system was the main cause of our observation. Thus, the experiment had to be modified and required some work at the workshop. That meant that I was unable to finish the project during my brief stay. Professor Joshua Jortner from Tel Aviv University was also staying for the summer in Groningen. We had several scientific discussions about my research results where I have discovered a general, novel limiting 3/2 power law for multiphoton focused laser induced photochemical processes.[6] Joshua suggested a theoretical study to formulate a general explanation to this power law due to multiphoton absorption saturation effects at high laser excitation intensities. Our studies showed that indeed a 3/2 power law holds for multiphoton processes over broad laser intensity range, once above a critical intensity which is readily reached at the focal region of a focused laser beam.[19]

Upon returning to Haifa, Sol and I finished writing a comprehensive review on "Lasers and Chemistry" for Chemical Reviews. Its publication in 1977 was well received by the chemical community and was used for many years as a major reference source for researchers in laser chemistry.[20]

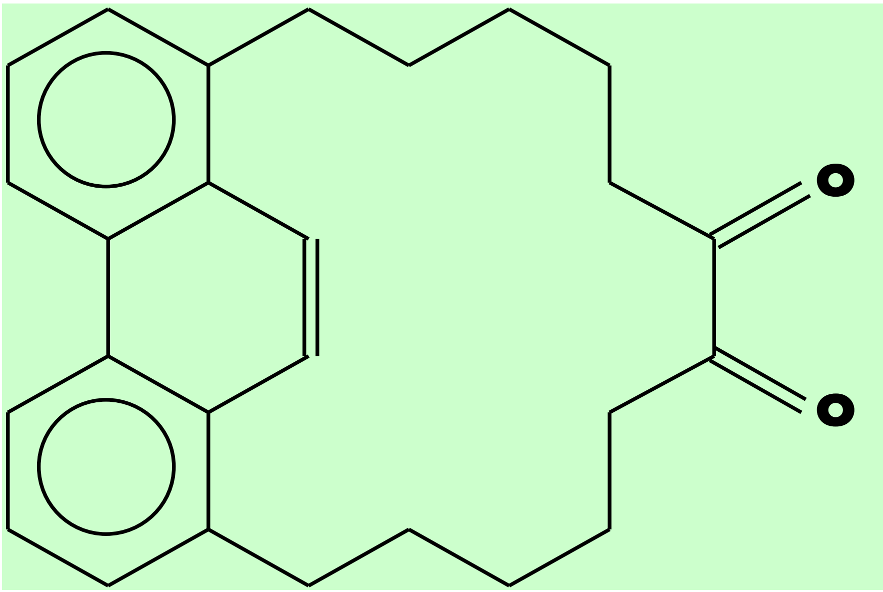
My first graduate student, Reuven Katraro, joined me in October 1976. My previous work on energy- transfer- dye- lasers (ETDL) convinced me that the field of electronic energy transfer (EET) is challenging. We soon have succeeded in establishing the unique temperature dependence of long-range electronic energy transfer observed in donor acceptor pairs in PMMMA matrix.[21,22] By the end of 1976 I received my tenure and was promoted to the rank of Senior Lecturer. Reuven became our laboratory engineer after finishing his M. Sc. Work. During that period we extended our studies of ETDL and other aspects of EET.[23-25] Our success enabled us to receive a NRF research grant which was mainly used to purchase nitrogen laser pumped dye lase system together with a data acquisition system. We were now able to study time resolved laser spectroscopy and photophysical prossseces.[26]

For a long time, I was interested in investigating the mechanism of intramolecular EET (Intra-EET). Schnepp and Levy did the pioneering work in this field. They investigated the bichromophoric molecule, **I**, where excitation of the naphthalene moiety resulted in fluorescence from the anthracene chromophore. Schnepp and Levy interpreted the observation as an efficient intra-EET process. However, given the experimental conditions they could not establish the process mechanism.

I



II



In the fall of 1978, I was asked by Professor Mordecai Rubin to help his Ph. D student, Shmuel Welner, to measure the fluorescence spectrum of the bichromophoric molecule**, II**, that Welner synthesized. I immediately recognized that this molecule will be ideal for investigating the mechanism of Intra-EET process. This was proved in a series of measurements that were rapidly published.[27] This study marked the beginning of more than 30 years of collaboration with Professor Rubin for studying all aspects of Intra-EET, becoming leaders in this field.[28]

In February 1979, Nasser Shakour joined our laboratory as our engineer, replacing Reuven Katraro.

6. Sabbatical Year, 1979-1980

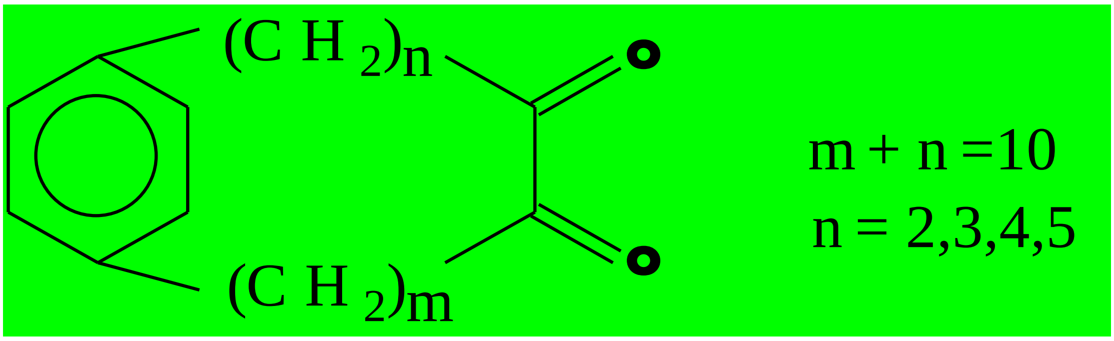
In August 1979, I took up a sabbatical year with Professor Ernest (Ernie) Grunwald at Brandeis University. Ernie was interested in infrared multiphoton induced photochemistry utilizing a pulsed CO_2 laser. I suggested investigating the excitation and photolysis of hexafluorobenzene (HFB) by following the temporal resolution of the excitation by monitoring the evolution of hot bands formation in the electronic spectrum of HFB. This eventually became the Ph.D. Project of Mike Duignan. We indeed were able to show just that[29], but, in addition, we noticed fluorescence emission in the visible spectral region. I suspected that this emission can be attributed to reverse radiationless transitions, as predicted by Jortner and co-workers giving rise to electronic excitation of the pumped molecule. Time resolved spectral analysis revealed a short-lived emission corresponding to the expected HFB fluorescence[30], accompanied by a broad structure-less emission band, spanning the entire visible region, with two distinct peaks corresponding to C_2 and C_3 fragments produced by the HFB photolysis. We showed that this broad band is characteristic of black body radiation for hot body at 3500K, attributed without mass spectrometry analysis to "highly carbonated" molecular fragment[31], that might have been superheated C_{60}, as shown, much later, by Kolodney, when C_{60} became a major researched molecule.

My father died in February 1980, which required my travel to Haifa during my stay at Brandeis.

7. Technion, 1980-1986

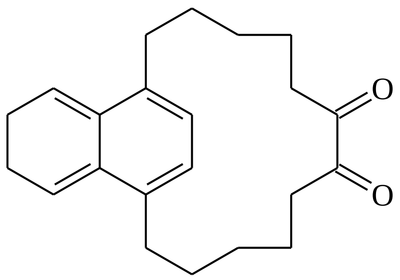
In 1981, I was promoted to the rank of Associate Professor. I continued my old project on photoquenching and on ETDL systems. We have measured photoquenching parameters that determine ETDL performance.[32,33] Our results were used in defining laser dyes properties in Kodak catalogue for laser dyes. Mordecai Rubin and I decided to launch a comprehensive research project for the elucidation of the mechanism of Intra-EET in solution. Our strategy was to synthesize a family of bichromophoric molecules with various lengths of the inter-chromophore bridge. The molecules chosen comprised of an aromatic molecular chromophore, such as benzene and naphthalene connected to a biacetyl moiety **III, IV** , similar to **I**.[34,35]

III

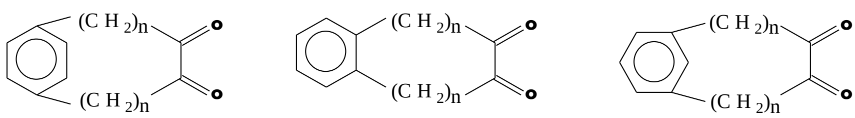


IV

1,4-Naph-5,5



P-n,n **O-n,n** **M-n,n**



n = 4,5,6 n = 2,3,4 n = 3,4

Scheme 2.

Together with Professor Colin Steel of Brandeis University we received our first US-Israel BFF grant for studies of Intra-EET. Our continued efforts in this field resulted finally in proving the essential role that Dexter type exchange interaction plays in singlet-singlet short range Intra-EET processes.[36-38]. My achievements received recognition by awarding me the Raymond and Miriam Klein Prize in 1984.

In addition, I continued to investigate molecular non-linear optical effects.[39] Together with Jacob Katriel and my Ph.D. student, Meir Orenstein, we have investigated optical bistability by developing a novel eikonal theory suitable for non-linear optical media in general and to molecular systems in particular.[40-42]

In summer of 1982, I began collaboration with George Atkinson, first at Syracuse University and in the following years at the University of Arizona in Tucson, on various aspects of spectroscopy and photochemistry of isolated molecules. This resulted in series of publications[43-45] and in receiving our next BSF grant with George.

In August 1983, while in Syracuse, my mother died, and I had to cut short my stay with George.

8. Sabbatical year, 1986-1987, Technion 1987-1991

In September 1986, I accepted the invitation by Dr. Jim Yardley, head of the photochemical research group of Allied Signal in New Jersey, to join his efforts in launching a project of molecular electro-optics. He was interested in our recent results on optical bistability and in our ideas on molecular electronics. We were successful in defining the experimental conditions for observing optical bistability in nonlineraly absorbing dyes and its implications to spatial light modulation. These efforts continued in 1987-1989 when I continued my association with Jim as a consultant to Allied Signal.[46-50].

During my sabbatical leave, I was promoted to the rank of Full Professor. Upon my return to the Technion, in September 1987 I resumed my research on Intra-EET and in molecular electro-optics and molecular electronics.[51-55] We were awarded a special grant to purchase a Nd-YAG laser coupled to a tunable dye laser allowing us to conduct laser induced spectroscopy and photochemistry in the 220-700 nm spectral range. We built a supersonic jet expansion valve that enabled us not only to study Intra-EET processes in solution,[56-59] but also to start a new project in investigating these processes under the conditions of super-cooled isolated molecules.[59]

In 1988, I became the Head of Technion's Division for Youth Activities, I resigned from this position after I was elected as the Dean of Faculty of Chemistry in October 1990.

9. Dean of Faculty, 1991-1994

I started my tenure as Dean when the academic standing of our Faculty at the Technion was in question. We had very few students, almost no new Faculty members and eight Faculty members that were about to retire within the next two years. The sentiment at the Technion management was that a major change involving even a possible shutdown of the Faculty of Chemistry, is needed. During the period in which I prepared myself to take office in January 1991, I have drafted a "white paper" that I have sent to the President, analyzing the situation and outlining a plan of action for reviving the Faculty. I stressed the need to replace all the positions that will become available due to the anticipated retirements by judiciously chosen young recruits that will receive significant start-up funds to ensure their academic success. To my pleasant surprise, President Tadmor accepted my white paper and instructed his administration to help us achieving the goals set by me. Over my four years as Dean we recruited nine new Faculty members, we initiated new courses and established collaborations with the Faculties of Materials Engineering and of Biology. In addition, the management accepted our demands to start rehabilitation of the deteriorating infrastructure of the Chemistry Building. This enormous project continues to this day.

In 1992, I became incumbent of the Freund Chair in Chemistry.

Despite dedicating much of my time to carry out my administrative duties, I managed to keep an active research. I established collaboration with Professor Don Levy from the University of Chicago (and Editor of Journal of Chemical Physics). Together we received new BSF grants, to work on our EET jet and solution studies.[61-66] We have also received an EEC grant to start a new project on photoquenching in laser dyes. [67] In addition, I have expanded my projects on molecular electronics[68-72] to the field of photoconductivity in polymers.[73-79] In 1993, I received The New England Academic Award, in recognition of my achievements in EET research.

Professor Gouda, on the left visiting the Faculty of Chemistry, together with the Senior Vice President, Professor Paul Singer, on the right, 1963

10. Sabbatical leave, 1994-1995

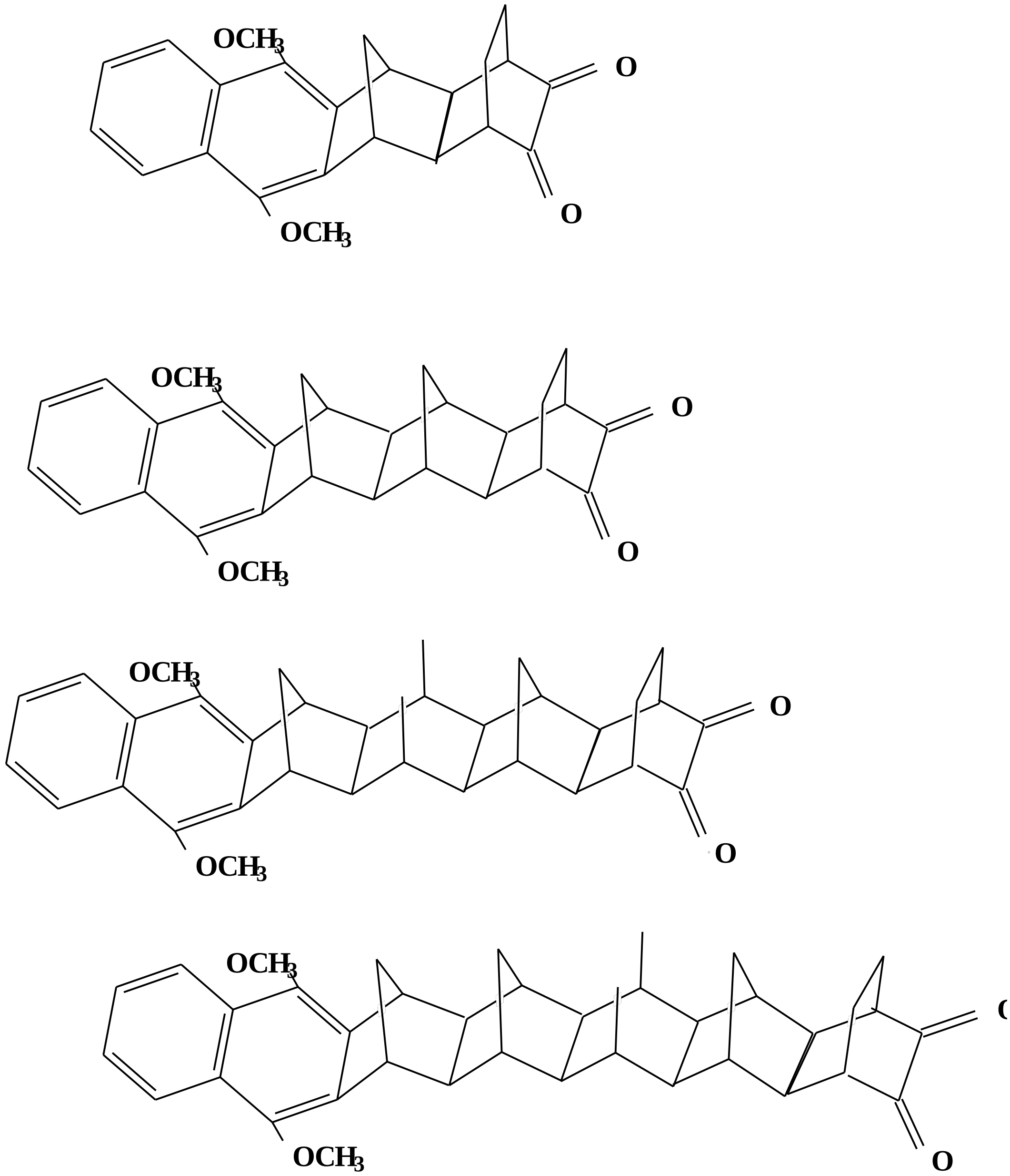
After finishing my tenure as the Dean of Faculty of Chemistry I took a sabbatical leave. I spent the first part of my sabbatical at the Laboratory of Physical Chemistry in

Groningen. I devoted that time to finish writing a few papers,[81,82] and an invited review on EET [82].

In February 1995, our first grandchild, Yotam, was born. Certainly, the most significant event of that year for me.

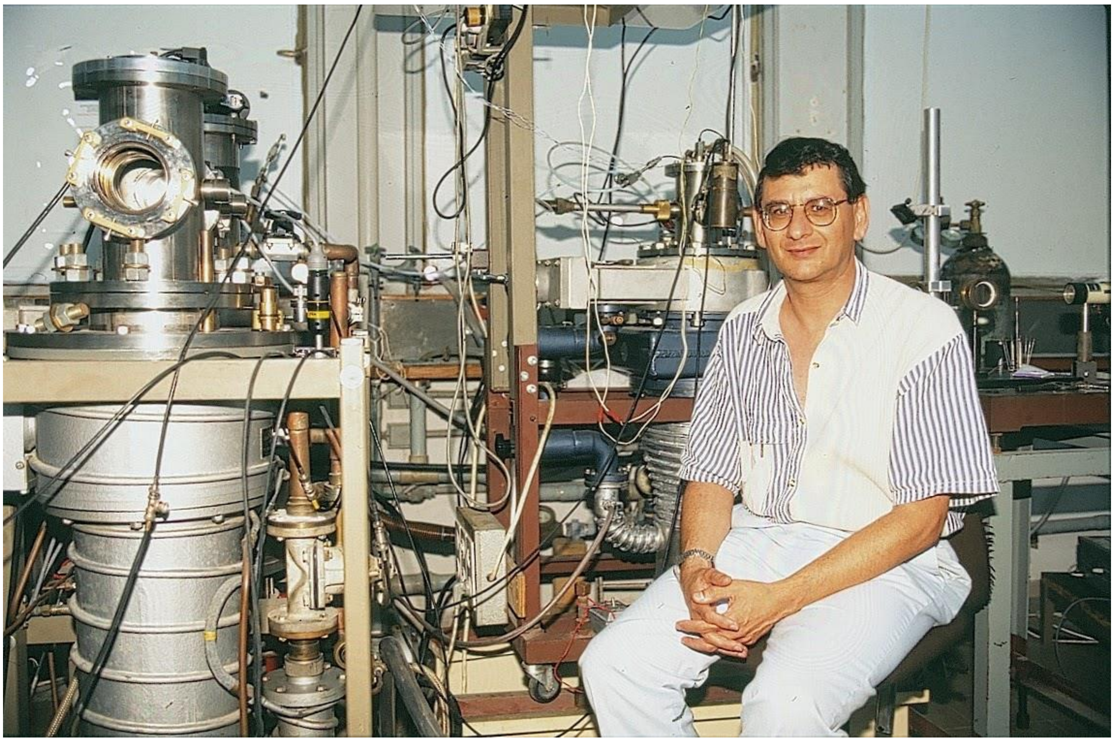
In the second part of my sabbatical leave, I stayed at the University of Melbourne Australia, collaborating with Professor Ken Ghiggino. I suggested studying the role played by the inter-chromophore bridge, in bichromophoric molecules, by comparing the rate of Intra-EET in rigid bridges and in flexible bridges. The work of Ghiggino on electron transfer suggested that rigid bridges are efficient due to through-bond interaction in enhancing the process. I suggested approaching Professor Paddon-Row from university of Sydney to synthesize for our project a series of molecules based on his previous work with Ken based on the rigid norbornene bridges. It took another year after I left Australia for him to finish the synthesis of the desired series of molecules, **V**. The results were spectacular, we showed that rigid bridges enhance Intra-EET by a factor of up to 10^5 compared to flexible structure such as **III** and **IV**.[90] This was considered as a major breakthrough in understanding the mechanism of Intra-EET.[91] It was also important to various aspects of intramolecular electron transfer processes' in chemistry and in biology.

V



11. Technion, 1995-2010

My research projects continued to involve Intra-EET in solution, supersonic jets and in stretched polymers films.[92-97]. Collaboration with Japanese groups yielded interesting results in revisiting the pioneering work on EET in the naphthalene-anthracene bichromophoric molecule**, I**. By utilizing ultrafast laser excitation, we were able to prove that the observation made by Schnepp, and Levy was a genuine Intra-EET process as they have argued.[98]



In 2000, after short sabbatical leave at the university of Vienna and at Humboldt University in Berlin, I started an ambitious project in which I aimed to explore the potential of using EET in combination with photoquenching effects in molecular electronics.[99]

I collaborated with Yoav Eichen in synthesizing and characterizing the molecular systems that were needed for this project [100-102] , and with Uri Peskin for establishing the theory needed for understanding controlled transfer prosseces.[103,104] Another important collaboration started with Professor Raphael Levine from the Hebrew University , on the concept of molecular logic.[105] We soon realized, that our approach of combining Intra-EET with photoquenching, in specially designed bichromophoric molecule, could be used for making a full-adder, molecular-scale logic circuit.[106-111]

In 2001, In recognition of my achievements in the field of molecular electronics, I received the Henry Taub Prize for Excellence in research. In 2002 I received the Medal of Honor from the Claude Bernard-University Lyon .

In 2003, I was asked to act as the President of the Israel Chemical Society, I served for three years but did not agree to a second term as it conflicted with my new duties at the Technion as the Dean of the Division of External Studies and Continuing (E&C) Education. During my tenure of six years as Dean of ES&C, I managed to expand the Division's activities and to increase its revenues by 400%.

An additional area of research I was involved with, just before retirement, was photo induced proton transfer. I collaborated on it with Menahem Kaftory, and our efforts resulted in several joint publications.[111-116]

In 2009, after finishing my tenure as Dean of the Division I took my last sabbatical leave at Ecole Normale Superiuer in Paris and at Columbia University in New York.

12. Life as an Emeritus Professor

Retirement In October 2010 came with the demand that I should give up my laboratory, thus I will not be able to pursue any experimental project. Accepted that decision and instead of starting a new career in theoretical aspects of my research interests, made different plans for my retirement. I was surprised, however, to discover upon returning from my sabbatical, that without my consent, laboratory equipment was taken by faculty members and threw away what was left of it. This act of "confiscating" my laboratory while I was still an active faculty member left me bitter and highly disappointed. The only consolation for me was the fact that a new talented Faculty member, Lilac Amirav, took over my old laboratory, thus keeping it as part of spectroscopy and laser interaction laboratories.

I rather enjoy my retirement. It gives me time to enjoy our eight grandchildren, travel a lot. I still go to scientific conferences, mostly as an invited speaker. I teach a course in thermodynamics at the International School of the Technion and enjoy the freedom to attend only seminars that interest me.

I started to paint, a childhood passion of mine, and enjoy the results. I study many aspects of classical music and even give popular lectures on music and art for interested parties.

Frank Sinatra, reflecting about the end of his life, claimed that “I did it My Way”, using the lyrics of his friend Paul Anika, who in turn wrote it to the music of the original song: “comme l’habitude” (“as usual”), by the French pop star, Claude Francois. I feel that “I did it My Way”, however, without Sinatra’s pessimism.

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