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SCIENCE/LIFE

Many Handicaps and a Lot of Good Luck. A Scientific Autobiography

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INTRODUCTION

I never thought that I would write an autobiography, as I thought, in my opinion, that my personal history was of no interest to anyone except my close family. However, Professor Ilan Marek very kindly invited me to consider writing down the development of several scientific ideas in which I participated. At first I hesitated, but then I thought perhaps there was something special in how I became a scientist. I still feel that in my story the unusual thing is the combination of terrible handicaps on the one hand and a measure of extraordinarily good luck on the other. In order to understand this I have to tell you my personal story from the beginning and then I can show the scientific steps taken and try to illustrate in each case how I found the problem and how I arrived at the solution.

EARLY LIFE WITH MY GRANDFATHER

I was born on August 8, 1920, in Szoreg, Hungary. My father was a veterinary surgeon and grew up in a small village in the Mátra mountains, where my paternal grandfather was a shopkeeper. My father was the only son who went to university; all of his other sons remained in the village as shopkeepers.

My father took part in the First World War, where he was taken prisoner, and there he developed a heart condition. He died very young in 1922. He was only 33 years old; as I was only two years old, I have no recollection of him. We were quite poor, so my mother had to go to work. She got a job as a clerk supervising children in foster homes in another town, so I was left in the care of my maternal grandparents.

My maternal grandfather, Dr. Alexander Popper, was about 65, a retired district doctor who still had several private patients. In spite of the great difference in age, he became a father to me. He was an extraordinary person, a good physician with wide interest in languages, literature, and geography. He liked books very much, from which he learned French. Thus when Szoreg was occupied by French troops at the end of the First World War, he was able to speak with the French officers. He learned Hebrew, and knew it so well that when a new translation of the Hebrew Bible was published in Hungarian, he uncovered some translation errors in the first volume. He wrote to the editors, after which they sent each volume to him before publication to correct errors in the translation. At the end of the very last volume, the editors thanked many people, most of them Hebrew scholars, but they also thanked Dr. Alexander Popper for his careful remarks.

My father (Ferenc Pauncz at the time of the First World War). Credit: Courtesy of Ruben Pauncz.

My grandfather, Dr. Alexander (Sandor) Popper. Credit: Courtesy of Ruben Pauncz.

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He knew Latin very well, and when I attended the gymnasium, we walked along from our house in the street every afternoon, practicing Latin declensions and conjugations. In the higher classes he advised me, against my wishes, to study Greek. I had wanted to study French, but he taught me personally; we also practiced stenography. He had tremendous influence on my development, and from him, I too learned to love books. Though we were quite poor, he still found ways of buying books. This "vice" was one that I certainly inherited from him. I started devouring the many books that he owned at an early age and later took to buying many books on my own; the first I wrote was dedicated to his memory.

SCHOOL YEARS

I have very little recollection of my early days at school, except for one episode: one of the bullies in the class beat me up saying: "because you killed Jesus." I went home crying, and when I told my grandparents what had happened, I remember that they looked very sad. Despite this unfortunate situation, I had quite a few good friends at the school. In fact, many years later, I received an Honorary Doctorate from the University of Szeged. Professor Peter Laszlo arranged a meeting in Szoreg with my schoolmates from elementary school including my old friend, Pavo Árpád, who now lives in Budapest, about 200 km to the north from Szoreg, but who came back especially for this occasion.

I started gymnasium (ages 10−18) in the town of Szeged, only 5 km away from Szoreg. I went by bus, or sometimes I rode my bicycle. My grandfather chose the Piarist Gymnasium for its high standard, especially in Latin and Greek.

I remember my first year, when the fifth level mathematics teacher asked me to solve a problem on the blackboard as a punishment—to show the fifth class students that even a first class student could solve the problem.

Despite my natural agility in mathematics, I had trouble in the fifth class. I was afraid of the teacher, who was well-known for his terrible temper. Normally, I always received the highest grades in each subject, but this year I came in second. My whole family, including my grandfather, were worried for my chances at getting a spot in university. Thankfully the following year, a young and sympathetic teacher renewed my love of mathematics. During my school years I had many good friends, mainly other Jews. But I also had a special friend who had a great influence on my development, Gezi Szadeczky, from whom I learned the love of literature, music, and the arts. His father was a librarian in the University of Szeged who was instrumental in getting me accepted. Despite my good grades, there had been very little chance for me to continue my education due to *numerus clausus*, a quota that limited the acceptance of Jews to the university.

Thanks to the influence of Gezi's father I was accepted to the university as a first year student of chemistry. Gezi was enrolled in the same faculty and we frequently studied together. The mathematics taught at the university was at a very high level; they employed on the academic staff some well-known mathematicians like Frederic Riesz. Unfortunately, in the second year Gezi left for the Technical University in Budapest though we kept in touch during the summers. I had another good friend at the university, Sandorfy Kamill. He too had experienced the effect of anti-Semitism in university enrollment. Though his father was a Judge in the High Court, he was not accepted in the university in Budapest because of his Jewish origins. We studied under the same doctoral supervisor: Professor Árpád Kiss, a physical chemist. My thesis was on the absorption spectra of Schiff bases. I synthesized several compounds, and measured their spectra, which was the easy part. The difficult part began when we tried to interpret the behavior of the spectra. Eventually I arrived at the conclusion that in order to understand the phenomena we would have to study quantum mechanical methods.

Unfortunately, no one taught quantum mechanics or quantum chemistry at our university at the time. I returned to my old friends: books. In the library of the Nobel Laureate Szent-Gyorgyi, I found Pauling and Wilson's *Introduction to Quantum Mechanics* and studied it very carefully. In our chemistry library I found another book: Hans Hellmann's *Einfuhrung in die Quantenchemie*, an excellent monograph, that was so integral to my development that I translated it into Hungarian for my personal use. I consider myself to be a Hellmann student, even though I never met him. After the Communist takeover, we were "asked" to give lectures about eminent Soviet scientists. I chose Hellmann, and I gave a very enthusiastic talk about his scientific achievements. At that time I did not know his tragic fate: Forced to leave Germany because his wife was Jewish, Hellman moved to the Soviet Union where he became a a very successful member of the Karpov Institute. Jealous of his success, several colleagues denounced him as a German spy, and at just age 35, he was executed in a Soviet prison. Had anyone in the audience known this, perhaps I would not be able to write this autobiography today.

NAZI TIMES

I have already mentioned the fact that for a Jew it was almost impossible to get into the university. During my university years, there were several anti-Semitic outbursts among the

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students, mostly among those in the Law School. In my class (we were about 20 students) most of the students were alright, and would warn me if there was to be an anti-Semitic demonstration. The war started one year after I entered the university, in 1939. We followed the advance of the German forces in Europe with trepidation. In Hungary new laws appeared: Jews were not permitted to serve in the Army, instead they had to serve in special units, called work service units; these were very dangerous, and many of my friends perished while serving. I was extremely lucky that my work service was postponed each year while studying at the university. I even took additional courses (theoretical physics and mathematics and teacher training courses) in order to further prolong my studies. By March 19, 1944, the Hungarian Government decided to withdraw from the German war. The Germans retaliated and very quickly Hungary was overrun with Nazi forces. I watched the German tanks arrive in Szeged on this very date. I knew it was crucial to finish my university studies as quickly as possible, and fortunately my doctoral thesis was ready. I took the doctoral examination in early April—even on that day I had to wear the Yellow Star. My thesis was approved, but I did not receive my doctor's degree. Within a week of my taking my exam there was an edict that no Jew could receive a university degree.

Other decrees promptly followed. In June we had to leave our home and were transferred to a Ghetto in Szeged. In July came the last step, all the Jews in Szeged were to be deported. There were three transports from Szeged. By some extraordinary luck my mother and I went in the first transport. After spending a day or two cramped with too many people in a cattle car, we arrived in Austria (Strasshof). I say that this was lucky because the two other transports were sent to Auschwitz—though we did not know that name at the time. My grandfather, my grandmother, and my aunt were sent in the second transport. Fortunately, a bombardment by the Allied Forces diverted the train on its way, and they also arrived at Strasshof to our great joy. Sadly the third transport went to Auschwitz, and very few survived.

We stayed in Strasshof for a month, and then with a small group of people we were sent to Amaliendorf by Gmund. During our stay in Strasshof, my grandfather, who was 80 at the time, became ill and very weak. He died on the first day in Amaliendorf and was buried in a cemetery in a neighboring village. Many years after the war, I visited the place together with my wife Kathy. We did not find my grandfather's grave, but found mention of his name on a small plaque.

We worked in a factory which produced pullovers for the German army. We lived in a barrack near to the factory. My grandmother worked in the kitchen, while my mother and aunt were in the sewing workshop and I worked in the manufacture of the pullovers. Every day we worked about 10 hours receiving very little to eat. At the end of the war I weighed only 35 kilos—half my usual weight. Despite such hardship, we were very lucky to be in this place; it was a better place to be in than all the other places where Jews were sent.

In the Spring of 1945 we were sent to a new place: Theresienstadt, north of Prague. Then in May 1945 the Russian troops liberated us. I became very ill with Fleck typhus and was treated in a Russian field hospital. Fortunately I survived this very dangerous illness, and a few weeks later we were sent in another cattle wagon in the direction of Hungary. After traveling for quite a few days we finally arrived home in Szeged.

AFTER THE WAR

We were very lucky to have survived this terrible Holocaust, but many of our relatives died during this period. Almost my entire family on my father's side from Matra perished. Many of my best friends did not return from the war.

The situation in Szeged was relatively better than in other places in Hungary—Szeged did not suffer as much from the war. Nevertheless it was very difficult.

We returned from the deportation and had to start from scratch. I had to find work, and I accepted a job as an analytical chemist in the laboratory of a textile factory in Papa, several hundred kilometers away. I spent about six months in the laboratory and found the work terribly dull. At home I started to read some scientific books (on non-Euclidean geometry, among others). My heart ached for mental stimulation. I decided to leave my job and try to make my way illegally to Israel.

I returned home to say goodbye to my family, but my plan did not materialize, as I fell ill with tuberculosis. I was hospitalized in a tuberculosis sanatorium near Gyula for almost 2 years. The doctors found that the tuberculosis was concentrated in parts of my bones but fortunately there was no infection in my lungs. I underwent a very difficult 5 h operation in which the infected parts of the bone were cut out. It proved successful, and after a month or so, I was finally able to leave the Sanatorium and return to Szeged. After such a long time in the hospital it was quite impossible to leave for Israel, so I started to look for an opening in the University of Szeged, however there was no opening in Chemistry. Again I had a stroke of luck as one of the teaching assistants in the Department of Theoretical Physics

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decided to leave for France and his job became vacant. The head of the department (Professor K. Szell) knew me well from my university years and accepted me.

MY RETURN TO THE UNIVERSITY

Now four years had passed since I had left university: a year from the deportation, more than half a year in the textile factory, and about two years in the sanatorium. I had almost lost touch with the scientific world, and now my most immediate task was to be a good teaching assistant. However, here I had a serious problem: I had almost never spoken in public, so I started my first class with some trepidation despite only having two students, both of whom are now professors. Fortunately this problem was solved in a short time and I discovered the joy of presenting new material to an audience. My second problem was with the subject of theoretical physics. Although I had studied it especially toward the end of my university years, my basic training was in chemistry. I had to work especially hard to prepare lessons in the beginning, but it was a great joy to be back in university. After a while I once again had free time to look into the literature. My main interest was in the use of quantum mechanics to interpret molecular structures. First, I refreshed my knowledge of basic quantum mechanics, and then began to tackle the current literature in quantum mechanics and quantum chemistry.

I still had some contact with my previous research advisor, Árpád Kiss, and together we were able to publish a paper on my doctoral thesis. I wrote another paper soon thereafter, in which I compared the two methods used in quantum chemical calculations, the molecular orbital and valence bond methods. Being able to study both theoretical physics and the new developments in quantum chemistry gave me a great sense of satisfaction to be back in the field of science—I truly felt that this was where I belonged.

A HAPPY MEETING

Now remember, I was only half a year out of the sanatorium and, with all my hard work, I now felt that I needed a vacation. Fortunately I managed to find a place in a convalescence home aimed to help survivors of the Holocaust in the Mátra mountains, where my family was from originally. While I was there, I met many people my age, including an especially attractive one named Miriam Jakobovits. She had been in some of the worst imaginable places: in Auschwitz, in other camps, and finally in Bergen-Belsen. She too suffered from tuberculosis, and one of her lungs was incapacitated and no longer in use.

We fell in love, and after 3 weeks, we decided to become engaged. Both of our families were astonished. She came from a deeply religious background, and her family was not sure that I would be a good husband. My family were surprised that I was able to decide such an important issue in such a short time. We then returned to our respective homes, exchanging letters and visiting each other until we were married six months later, in April 1949. Her family wanted to go to Israel and had to leave very suddenly, so it was a very modest wedding in the yard of one of her best friends and without any members of either family present. Our living quarters were cramped, sharing a two room flat with my mother, aunt, and grandmother.

Manyi (Miriam) and I at our wedding. Credit: Courtesy of Ruben Pauncz.

MY FIRST RESEARCH PAPERS

My first piece of research of interest was my encounter with Hellmann's book in which he considers the Thomas−Fermi model of the atom in detail. One can calculate the kinetic energy of an electron gas included in a given volume following the derivation given by Fermi. If one compares this result with the one based on a quantum mechanical model (for example, particles in the box), then the Fermi result is much lower than the quantum mechanical one. For some time I studied the origin of this discrepancy, and I finally found the answer. In the Fermi derivation, one assumes that the electronic kinetic energy starts from zero and goes up to a maximum value. In the quantum mechanical model, the energy can never be zero (uncertainty relations), as there is a lowest energy level. One can translate this into the Fermi derivation, and instead of zero, one starts from the smallest value. The new derivation gave a good agreement with the quantum mechanical results.

I showed this derivation to Paul Gombas, a leading Hungarian theoretician, and he liked it, presenting the paper on this subject to the Hungarian Academy of Sciences. On his invitation, I spent 3 weeks at his institute and made the acquaintance of his co-workers, among them Tibor Hoffman and Rezso Gaspar.

My second research paper was connected to a problem treated by Platt. He discussed the spectra of a series of

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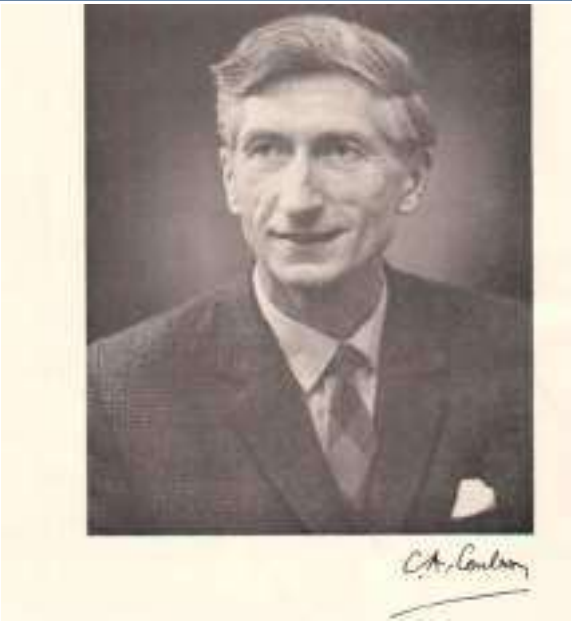
linearly condensed aromatic compounds. He showed that one can understand the regularities found in the spectra of these molecules using a simple planar rotator model. I generalized his treatment, replacing the simple planar rotator by an elliptical rotator. This meant solving a new quantum mechanical problem.

The third paper was a critical analysis of Moffitt's method, where he tried to interpret the structure of molecules by using both the homopolar bonds and the ionic structures of the constituent atoms. I looked at the case of the hydrogen molecule where one can calculate the atomic and ionic states to a greater accuracy. The use of the more correct ionic function gives a much weaker result: a surprising result. From this, it follows that it is not correct to interpret the ground state of the hydrogen molecule as a superposition of homopolar and ionic states.

For several years I worked completely by myself, but finally I was able to engage a very able co-worker. I managed to convince a high school teacher named Ferenc Berenc to return to the university, and we had a very fruitful collaboration. We wrote quite a number of theoretical papers dealing with the structure, diamagnetic anisotropy, and spectra of condensed aromatic compounds.

While I was studying the condensed aromatic compounds, I came across a new paper by Edgar Heilbronner in which he used a brilliant argument. Instead of considering individual compounds, he (fictitiously) joined them together to form a torus, whose higher symmetry provided an easy way to calculate the eigenvalues. He then recovered the original molecules by "cutting" the torus in half, i.e., considering those solutions in which the coefficients on the atoms used in building the torus are zero. As Berenc and I had already calculated some molecules from this series by the conventional method, we were able to verify Heilbronner's results, though they disappointingly did not agree. But then I was able to find the source of this discrepancy: Heilbronner's results corresponded to molecules which differed from the real ones, in that the Coulomb integrals on some atoms differed from the original ones by ± 1. Following this discovery, I sent Edgar my paper, which thankfully he received in a pleasant manner. We eventually met in Haifa and later became friends, and I was privileged to have spent one of my sabbaticals at his institute a few years later.

In my last paper from this period, I used perturbation methods for the treatment of systems built up from identical units. I was inspired by a paper by C. A. Coulson and G. S. Rushbroke. Their treatment refers to the case when the connection between the repeating units occurs only in one place. I generalized their arguments to the case where there are multiple connections. As an example we considered the series of molecules built up from naphthalene or anthracene units. I obtained closed form expressions in which I could use the data referring to the basic units and the number of units. In 1955, I was allowed to attend the first Summer School in Oxford arranged by C. A. Coulson. I presented my paper in a seminar, and it was favorably received by Coulson.



Charles Alfred Coulson. Credit: Courtesy of Ruben Pauncz.

■ ALIYAH

We had wanted to come to Israel for a long time, but it was impossible to leave during the communist regime. They were incredibly restrictive; for instance, when I was allowed to attend the Oxford Summer School, I had to go by myself—my wife and son remaining at home. The situation changed dramatically during a 1956 uprising, when for some time one could cross the border, with little impunity.

It was not an easy decision to leave. I had a very good position at the university, and I was well-known in Hungary, giving lectures. In addition, Miriam was 5 months pregnant, and our Shmuli was only two and a half, but we decided to take the risk anyway. We crossed the Austrian border during the night, and in the morning we were taken to a refugee camp. I phoned the Israeli Embassy in Vienna; they sent a taxi for us and gave us passports, and within a few days we were on our way to Haifa.

I shall never forget the first view of Haifa from the sea, and we were happy to be in Israel. A few days later, I visited the Technion (still in Hadar, then) in order to look up *Chemical Abstracts*, where my 25 papers were indexed. I met David Ginsburg, head of the department, who offered me a position as a Research Associate. I also visited the Weizmann

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Institute and interviewed with Aron Katzir, who also offered me a position. At that time there was no teaching at the Weizmann Institute, and since I very much enjoyed giving lectures, I accepted David Ginsburg's offer.

At the Technion in 1956. Credit: courtesy of Ruben Pauncz.

We were placed in an Aliya Center for those people with an academic background in Kiryat Hayim. The first years were quite difficult, as we had come on aliyah without anything, but we immediately felt at home. My second son (Avraham) was born in April 1957.

I knew only a few words in Hebrew, learned from my grandfather many years ago. David advised me to attend an intensive course in Hebrew, but because I preferred to start working immediately, I started to learn Hebrew by myself in the afternoons, and in the mornings I worked at the Technion. A few months later, I wrote a new paper ("The Structure of Circumanthracene"), and following David's suggestion I submitted it to the *Journal of Chemistry (London)*, where it was immediately accepted.

Once my Hebrew ability was sufficiently strong, I did end up attending a two month intensive course, giving my first course in Hebrew, some months later.

COLLABORATIONS, TRAVELS, AND SCIENTIFIC FRIENDS

I decided to approach a new field of research related to work being done in the department. I found a great collaborator in Amitai Halevi, an excellent physical organic chemist, who was then investigating second order isotope effects. In our third joint paper, Amitai's student Arza Ron also contributed. And through that I found a great friend.

I also found a common interest with David Ginsburg. He was a first rate organic chemist and at the same time an excellent head of the department. We had a joint paper in which I made calculations on the structure of some organic molecules. Later, I had many discussions on this subject with Shneor Lifson from the Weizmann Institute.

About a year into my time in Israel Per-Olov Lowdin gave me one of just 30 invitations to attend a six week Summer School he was organizing in Sweden. David arranged for me to receive a travel allowance for this purpose, and I was on my way to Sweden. I knew Per-Oloy very well from the literature and also sent him the reprints of some of my papers. With just the 30 invited students, the course was very intensive—I was gratified to help the other participants in solving some of the exercise problems, and at the end I gave a seminar on my last work in Hungary. This impressed Lowdin, and he invited me to come to Sweden for a year and to be one of the main lecturers in the next Summer School.

David found the idea premature, suggesting that I should wait for my first sabbatical. But I explained to him how I had never had a teacher and how I hungered to have that opportunity to learn from a famous scientist. And so David agreed and in 1959 I was on my way to Stockholm.

My year in Uppsala surpassed all my expectations with an incredibly vigorous scientific atmosphere. I had the good fortune to work with Lowdin and one of his guests, Joop de Heer. During the first Summer School in Oxford, C. A. Coulson (University of Oxford) had spoken about a promising new method proposed by Lowdin: the "alternant molecular orbital method" proposed by Lowdin. In my time in Uppsala we generalized the method and its applications for alternant conjugated systems. This field of research

Per-Olov Lowdin. Credit: Courtesy of Ruben Pauncz.

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became one of the central themes in my research for at least a decade. With Lowdin, de Heer, and a PhD student of mine, Zeev Ritter, we published a large number of papers. Lowdin asked me to stay another year, but I declined and returned home, where my work abroad soon earned me the title Associate Professor (1960).

In Uppsala, the second Summer School was attended by a great number of scientists (Amitai Halevi and Joshua Jortner were participants from Israel, as was Roald Hoffmann, then a research student). I was involved with over 30 of the summer schools over the years, teaching two thousand students from around the world. The connections I made in Sweden also resulted in invitations to winter schools in Florida, where Lowdin held another position at the University of Florida, Gainesville. I enjoyed the states on my first visit, so when, one year later, I received an invitation from the University of Florida to be one of the Graduate Research Professors alongside John C. Slater, a founding father of quantum mechanics, it was tempting, though I stayed at Technion, where I received a promotion to full professorship in 1962.

The late 1950s and 1960s were productive for me and my graduate students as we continued to apply alternant molecular orbital methods for condensed aromatic hydrocarbons and make generalizations of the method. In 1964, I spent time in Florida, giving lectures in the Graduate School and continuing to lecture in the Winter School on Sanibel Island. I received an invitation to write a monograph on the alternant molecular orbital method, and it took me a whole year to finish it; I incorporated most of our research. I received permission from the Technion to stay another year. After finishing the book, my research interest turned to other subjects. While I was gone, David Ginsburg carefully planned and executed the move of the Chemistry Department from the Hadar site to its current building. This move meant a great improvement in the research facilities.

I was fortunate to have some brilliant research students: with Harel Weinstein (now at Cornell University), we investigated the use of localization methods in quantum chemical calculations and wrote both research and review papers. Others included Uzi Landman, who became a leading theoretician of the time. Another, Gabriel Kventsel, came from the Soviet Union, where he had made important contributions, but he still needed a degree; supervising him was an extremely easy job. He remained on the faculty until 2007 doing good research with an outstanding teaching record. It was gratifying to see where my students ended up. I put forth Shalom Srebrenik and Yoram Tal for postgraduate positions in Richard Bader's department at McMaster University. Bader was very grateful for my recommendations.

I discovered with Arie Lemberger that the usual interpretation of Hund's rule is not correct. This research was continued by one of my outstanding students, Jacob Katriel, himself now a Professor Emeritus

■ ACADEMY OF QUANTUM MOLECULAR SCIENCES

In 1967, some leading quantum chemists met in Menton, France, including R. Daudel, A. and B. Pullman, P. O. Lowdin, C. A. Coulson, R. G. Parr, C. Roothaan, and J. A. Pople. They decided to establish an Academy of Quantum Molecular Sciences to help advance the field, arranging international congresses every third year and honoring young outstanding researchers with a medal. Raphie Levine from Israel received the first medal, and Joshua Jortner followed soon after. They also co-opted some leading theoreticians such as John C. Slater, Robert Mulliken, and Linus Pauling. The following year was the first election of new members, and four well-known scientists were elected (E. Huckel, J. Van Vleck, E. B. Wilson, and J. O. Hirschfelder). The fifth member to be elected was a much younger person: and that was I.

Lowdin told me that I had been elected to the Academy during the Summer School in 1968. At first I did not believe him, as I thought that he was pulling my leg. But when I returned to Haifa I found the letter from the President of the Academy in which he announced my election. I was definitely embarrassed on seeing that some very good scientists in the field whose work I estimated very highly were still not members. Subsequently, I worked very hard during the following election meetings to bring some of my esteemed contemporaries onto the board of the Academy, succeeding thankfully in many cases.

Starting in 1970 I had a very difficult period. After so many years of creative activity, I suddenly experienced a "writer's block". I felt that I had no new ideas. It was a very unpleasant feeling. While I still derived much satisfaction from teaching, the future felt extremely bleak.

A change in this situation came unexpectedly with an invitation to write a monograph on the subject of construction of spin eigenfunctions. I had received a similar invitation years earlier, but at that time I did not feel ready to tackle the subject. Now I had plenty of experience, including my teaching of part of the subject in the International Winter and Summer Schools. I worked on the book for almost four years, and it had a marvelous influence on me. I found that I had plenty of new ideas all connected to the book's subject. The thought process required for the writing the book led to

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a couplele of published papers, and a very pleasant sabbatical in Basel with Edgar Heilbronner.

Al Matsen introduced me to the use of the symmetric group in quantum chemistry, and he also advocated the idea of spin-free quantum chemistry. In the 1970s, Matsen made early contributions to a new method that treated configuration interaction based on the implementation of the representations of the unitary group. Later great progress was made by Joseph Paldus at Waterloo University and Isaiah Shavitt. I became interested in the subject during a sabbatical taken with Joe Paldus and Jiri Cizek in Waterloo. I invited both Matsen and Paldus to give lectures at the Technion. Finally, Matsen invited me to coauthor a book with him on the use of the representations of the unitary group in quantum chemistry. I spent part of my sabbatical at Matsen's Institute, and the book appeared in 1986.

The inscription reads: "To Ruben Pauncz with fond memories of a long and fruitful collaboration. Al Matsen." Credit: Courtesy of Ruben Pauncz.

A PERSONAL TRAGEDY AND A NEW LIFE

My wife, Miriam, became very ill in the beginning of 1983, having suffered from the loss of one of her lungs (a legacy of Auschwitz). After a year of illness, she died on February 5, 1984. She was a wonderful wife, the mother of my two sons, and the grandmother of the first two grandchildren.

After a year of mourning, I met my future wife: Kathy. Her husband died at about the same time as Miriam. We married in the fall of 1985. We have been very lucky with each other, as it is very seldom that a second marriage can succeed as well as ours.

My dear friend and "scientific grandson" Nimrod Moiseyev arranged a symposium in 1985, and he invited all the leading theoreticians in Israel to each give a lecture. Mrs. Kohava Reznik, our highly efficient departmental secretary, arranged

Kathy and I at our wedding. Credit: Courtesy of Ruben Pauncz.

that my friends from abroad sent congratulations by telegram. David Ginsburg gave the introductory talk with his famous dry humor, and I was deeply honored by the presence of all the leading theoreticians at that time.

Nimrod also had another initiative: he was the guest editor of a special issue of the *Israel Journal of Chemistry* (Vol. 31, No. 4, 1991) with the title "New Trends in Quantum Chemistry", and this special issue was dedicated to me. There were 19 contributions by my former students, and my scientific friends. I was greatly honored by his kind action.

I spent my last sabbatical in two different places. The first sabbatical was spent at Santa Barbara, California, where I ended up having a fruitful collaboration with my host, Bernie Kirtman. I looked once more at the alternant molecular orbital method, attemping to generalize it for arbitrary systems. The final results were a little disappointing, as the method worked very well for conjugated hydrocarbons, but for other systems it was less successful.

My final sojourn was back to Waterloo University in Canada with Jiri Cizek and Joe Paldus, a pleasant stay resulting in a couple of publications.

THE LATER CHAPTERS

I became Professor Emeritus in 1988 though I kept my office and did not feel any great change. I still gave some graduate courses and continued my research. However, this gave me more time to read the recent developments in our field where I felt very fortunate to be part of a Department conducting such vigorous research in quantum chemistry. Nimrod Moiseyev became a very important member of the group, eventually becoming the head of the Theoretical Group.

I received an invitation from Doug Klein to write a monograph on the use of the symmetric group in quantum chemistry. This project was a unique pleasure to work on,

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and was the first book that I had written using the LaTeX language, meaning that at the end I sent the publishers only a disk—notable at the time.

In 2005, close to my 85th birthday, I received the medal of the Israel Chemical Society. I was deeply moved by this great honor: all the recipients are great scientists. I felt that it was in recognition of the role that I played in helping to bring quantum chemistry in Israel to the high level where it is today. In my mind, however, I was simply lucky that when I arrived in 1956 this field was still in its infancy and I had the great fortune to introduce it to the Technion, and later to the Weizmann Institute of Science and the Bar-Ilan University through guest graduate courses.

During many years of scientific activity I collaborated with quite a few scientists both in Israel and abroad. Some of them became my personal friends. I cannot finish the reminiscences without speaking about them. I have mentioned already Sándorfy Kamill, Alfred Coulson, Per Olov Lowdin, Al Matsen, and Edgar Heilbronner. To my great sorrow they are no longer with us. I shall always treasure their memory.

Roy McWeeny. I met Roy for the first time in Valadalen. I was well acquainted with his work: he was one of the lecturers there. We have stayed in close touch since then, and I invited him to Haifa, where he gave an excellent lecture course. I have stayed with Kathy at their home in Pisa. Virginia and Roy were excellent hosts.

Bob Parr. I spent part of my sabbatical at his institute. He is one of the leading theoreticians in our field and he has given lectures at the Technion.

Joe Paldus and Jiri Cizek. I visited Waterloo several times, and we had several close collaborations. I invited Joe Paldus to Haifa, where he gave a very interesting course.

Bernie Kirtman. I spent a sabbatical in Santa Barbara and found Bernie and Tybe to be wonderful hosts.

Joop de Heer. We spent a year together in Uppsala collaborating on the alternant molecular orbital method. Joop later invited me to Boulder, Colorado, where I gave a week of lectures. We have remained close friends since then.

Sten Rettrup. He participated in one of the Summer Schools. In one of my lectures I mentioned an unsolved problem, and the very next morning Sten came up with the solution. We have remained friends since then, and he invited me to Copenhagen, where I gave a couple of lectures.

Jan Lindenberg. When I arrived in Valadalen in 1958, Jan was one of the graduate students. We have remained close since then; Jan invited me to Aarhus, where I gave a short series of lectures.

I started my recollections by saying that I had terrible handicaps, but I have also had great luck. I feel very lucky that in spite of the handicaps I was able to fulfill many of my aspirations. I am grateful to Ilan Marek for suggesting that I write these recollections down. I would like to thank my wife, Kathy, and my sons, daughters-in-law, and six grandchildren for their loving help. This paper is dedicated to Hagit and Shmuli, Yael and Avri.

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