Sol Kimel - Autobiography

In 1930, when I was one year old, my parents separated. My father stayed in Berlin while my mother and I moved in with her sister who lived in Amsterdam with her husband and children: one boy, Ab, about my age and another boy, Marco, born two years later. My childhood was uneventful in this harmonious, middle class family of six. The older cousin, Ab, and I went for two years to kindergarten and then for six years to an elementary school that belonged to a rather novel system called Montessori, where children were given freedom to study according to their own development; with little discipline and without report cards. This suited Ab and me very well because we were inquisitive youngsters. Years later, when we went to high school, we noted that we were way ahead of the regular school program. One of my class mates was Anne Frank and after the war our school was renamed the "Anne Frank School".

In May 1940, when I was eleven, our idyllic existence was rudely disrupted. Nazi Germany invaded Holland which capitulated after five days of fighting. The first year was relatively calm. Later we realized that the Nazis had used that year for extensive 'data mining' as it would be called today: Inconspicuously they registered population, including religious affiliation, assets in banks, real estate; everything that later turned out to be detrimental to the population as a whole but fatal for the Jews. Being law-abiding citizens, Dutch Jews complied with all directives not realizing then that they were signing their own death warrants.

In June 1941 the first anti-Jewish decrees were published. These included expulsion of Jewish students and teachers from the general education system and setting up a parallel system for the 140,000 Dutch Jews. In this way the Anne Frank School lost about one third of its students. Ab and I moved to a Jewish High School. During the next school year, anti-Jewish proclamations at ever increasing frequency became progressively more cruel: obligatory identity cards for the whole population were stamped with a red J for Jews; Jews were fired from all government jobs from professors or judges to lowly bureaucrats; they had to surrender property, bank assets, jewelry, radios etc; entry to restaurants, theaters, and cinemas was forbidden as were all public places like beaches, swimming pools, parks or even sitting on a street bench. In trams and buses Jews had to remain standing, travel by train needed special dispensation; they could shop only between 15:00-17:00 h. While a country-wide curfew was in place from midnight to 4 o'clock, Jews had to be inside their own house after 20:00 h. Again, Jews obeyed; defying a decree meant prison or worse.

In spite of these difficulties the school year 1941/42 somehow carried on. Matters turned for the worse when in May 1942 Jews were ordered to wear a yellow patch, marked with the word ɹooδ (**Jood**=Jew) on their clothes. It had to be worn at all times when outside, even when standing behind a window when visible from the street. This made all previous restrictions easily enforceable. Now it became clear what the real intention of the registration in 1940 had been, but it was too late - the trap was sprung. In the summer of 1942, Nazis, assisted by Dutch police, started to round up Jews from their houses for forced labor in the East: sometimes those living in a particular street, sometimes according to line of work but usually at random. A frantic search for documents ensued to prove the relative importance for the German war effort of metal workers, diamond cutters or furriers (who had to make jackets for German pilots). The Jewish Council created an elaborate system based on profession to 'save' people from deportation; of course members of the Jewish Council protected themselves. Indeed, at first people with the right papers were released if picked up at home or on the street. Nobody then knew that the Nazis merely wanted to cause the least possible panic by leaving hope for the remaining community. They were only interested in deporting about two thousand Jews per week to extermination camps; in the end, all 'protected' professions were also deported.

That year I attended school for only ten weeks; the atmosphere was dismal. Every morning the roll call showed who was missing. During those ten weeks ten students disappeared, mostly to 'Westerbork', the transition camp from where they were transported in cattle cars to the East, but occasionally into hiding as I found out after the war. We lived in parallel worlds; one ordinary: school, friends, homework etc, and the other hell: family and friends regularly disappearing. In November 1942 my mother was arrested during a chance visit to our family in a street that unexpectedly had been destined to become 'Judenrein', cleaned

of Jews. Her papers could not protect her and she was shipped to Westerbork and a short time later to Sobibor, where she perished. The Nazis, in one of their satanic strategies, made sure always to deport families together to 'live' in the East. My uncle refused to accept this make-believe trickery; he did not allow me to join my mother in Westerbork as I was obliged to do. Instead, I became a non-person and had to go into hiding. This was the end of my war-time high-school education.

With the help of a Dutch resistance leader I was placed on a farm. I lived with this family (10 children of whom 3 were married), working on their farm; never leaving the house and farm except for church on Sunday mornings like everybody else. Of course I did not know who, if anyone, of my family was still alive. In the course of this year, neighbors (some of them Nazis) started to gossip about the ‘strange’ youngster who never left the farm. One night in April 1944, I was taken to a neighboring farm, at 5 minute walking distance. At that farm lived a young family with two little children. I was elated when I discovered that my uncle, aunt, Ab and Marco were hidden there; they had arrived about one year earlier. As a precaution neither they nor I had any knowledge about us being so close. The five of us lived confined to one room (we slept in 2 cupboard beds), never even seeing the sun.

In February 1945 our hiding place was discovered by Dutch Nazis. The farmer was shot. My uncle was interrogated and beaten to death, never divulging that 4 more Jews were hidden in the house. Following both murders a thorough search yielded our emergency hiding place in the cellar. My aunt, both cousins and I were thrown into a prison cell. The next day we were, again, interrogated and transported by horse cart to Westerbork, which meanwhile had been transformed from a transition camp into a concentration camp, where 900 Jews remained because transportation by train to the East was no longer feasible. In April 1945 we were liberated by Canadian troops. After three more months in Westerbork we could return to Amsterdam. It was then that we learned the extent of the holocaust.

Back to education. While people on the street were celebrating the liberation, Ab and I rushed from one tutor to another, making up for three lost years, to get ready for school entrance exams. We were admitted into fourth grade, effectively losing one school year compared to our age group. The rest was standard: matriculation and higher education.

At the science faculty of Amsterdam University one could select one major plus one minor subject or two majors. I chose physics and chemistry for my BSc; and physical chemistry, with specialization in spectroscopy, for my MSc. By and large it was a happy time; I became exposed to the world of science, which after WWII was the most interesting of all. In retrospect I realize that study at the old-fashioned Dutch universities was too broadly based and took way too long. Typically, completing an MSc in science took seven years plus at least four more for a PhD. Nowadays I am happy to note that nowhere are PhD students kept for eleven years after entering university.

During my studies I was active in the Zionist youth movement, Habonim. Israel exerted a push-and-pull action on me: I felt alienated from Holland by memories of the war experiences while being attracted by the notion of a state in 'statu nascendi' that would develop into a just society (little did I foresee how Israel would look 60 years later).

I wrote to Dr. Joseph Jaffe of the Physics Department at the Weizmann Institute of Science in Rehovot, whose work in spectroscopy I had come across during my studies. Since I did not have any publications, he asked me to agree to be interviewed in Holland by a well-known physicist whom he personally knew. After this scientist reported back to Dr. Jaffe, I was offered a position as "Junior A". The Weizmann Institute then knew 6 academic ranks: Junior A, Junior B, Intermediate, Senior, Associate Professor and Full Professor. My aliya in September 1955 was without help or hindrance from the Sochnut. I simply took the train to Marseille and a boat to Haifa. Joe Jaffe met me in Haifa, drove me to Rehovot and installed me in a rented room. The next day I started work in his research group. During the first year I studied intensities of infrared absorption bands of solutes in different solvents and found a correlation between the apparent band intensity and a function containing the refractive index of the medium. Writing my first paper with Joe (and later papers too) was a truly edifying experience. Joe taught me to carefully weigh every word and I had to go through at least ten drafts; in later years my own students were similarly educated (I hope they don't resent it). I also collaborated with Joe and other members of his group

building a 12-m long infrared spectrometer-refractometer which was designed to achieve the highest spectral resolution known at that time. Overall it was an exhilarating period. The next year the spectrometer-refractometer was completed. I measured refraction spectra, n(l), through individual rotational lines in the vibration band of HCl at low pressure. The refractive index change, Dn(l), behaves like an odd function: zero at the center of an absorption line, positive and negative on its sides, with maxima depending on the line strength. It served as the subject of my PhD thesis, presented at the University of Amsterdam.

In the fall of 1956 I went back to Holland to marry Bianca whom I had known before my aliya. Shortly after returning to Rehovot we moved from my rented room to an apartment in shikun Anglo Saxim. In spite of its imposing name it was a 37 m^2 hole in the middle of nowhere, where we lived for three years. Our daughter Daphne and son Etan were born there. In 1960, when I had a PhD, a higher rank, and a family with 2 children, we became eligible for housing on the Weizmann campus. Meanwhile, Ab too had joined the Physics Department, as had Bianca's brother, contributing to an already active social life for Bianca and myself.

Based on my first paper on spectral intensities, I then proposed measuring spectral positions as a function of gas pressure, erroneously believing that Dn(l) would distort the line shape: positively on the high index side and negatively on the low side. I started a measurement program and was thrilled to discover a shift, Dl(p), of the line center at l with increasing pressure, p. However, other rotational lines yielded shifts different in magnitude and/or direction; while two lines were not shifted at all. That is to say, individual rotational lines are associated with a specific spectral shift which we could explain by effects of molecular collisions. We had stumbled upon an important discovery, though my initial interpretation was completely wrong.

In 1961 I took up a post-doctoral position with Prof. Donald Hornig at Princeton University, who was a world authority in spectroscopy. The instrumentation was not impressive compared to standards of the Weizmann Institute. Moreover, Hornig had just been appointed as Scientific Advisor of President Kennedy. He never came to the lab and the few times I managed to see him in his office to discuss problems in spectroscopy, he often would be interrupted by phone calls from Washington and discuss lunar orbiting versus earth orbiting (these were the traumatic post-Sputnik years, until the USA re-established predominance in space research by launching the 1969 Apollo mission to the moon). In Princeton we met Arza and Amiram Ron and our friendship continues till today. Arza also worked for Hornig so, naturally, we started to collaborate. I could not imagine then that 5 years later we would again become colleagues.

After two years Bianca and I returned to Rehovot. At the Institute I became interested in simplifying the problem of an HCl molecule interacting with colliding molecules in the gas phase. During a collision, intermolecular distances and orientations change and the interaction has to be calculated by integrating over the trajectory and averaging over the ensemble. Instead, an HCl molecule trapped at low temperatures in an inert gas matrix such as argon is exposed to a constant, well-defined environment. Surprisingly, HCl rotates in an inert gas cavity but the rotational lines are displaced compared to the gas phase. At that time, Dr. Harry Friedman, recently arrived from Brussels, had joined Joe's research team and we started to collaborate. I was fortunate; he proposed an ingenious approach to explain the shifts in a matrix, based on considering in an HCl molecule, the distance between the center of mass (near the Cl atom) and the electrical center of interaction (near the molecular midpoint). During constrained rotation of HCl in a matrix, its center of interaction remains fixed in the cavity, consequently the center of mass moves to and fro. This we termed rotation-translation coupling; it could explain shifts of rotational lines as well as observation of novel translational lines in a matrix spectrum.

In 1966 I was invited to join the Chemistry Department of the Technion. On the one hand, Bianca and I were reluctant to leave the superb facilities of the Weizmann Institute, where we had family and had made many friends. On the other hand, the Institute's all-embracing life style led to separation from the real world. Moreover, after eleven years I felt a need to change the direction of my research. Though our results were critically acclaimed, and there was a lot more to be done, I was beginning to lose interest in

the narrow field of high-resolution spectroscopy of small molecules. I asked for funds to set up the first laser laboratory in any chemistry department in Israel. Technion allocated the modest sum of $20,000 to buy a ruby laser and thus they 'bought' me too. We never regretted the move. After dusty Rehovot, we liked the open city with its unmatched views and beaches. We started a new life: Bianca taught English at the Reali High School, our children studied at the Reali school and later at Technion; they married Technion graduates; our first grandson is about to become a Technion freshman.

The physical chemistry laboratory comprised a wonderful group of colleagues, above all Arza with whom I immediately reconnected on the scientific and on the social level. My first doctoral student was Shammai Speiser, who measured the interaction of a very short (ns) laser pulse with iodoform dissolved in cyclohexane and benzene. He explained the strange differences between these two solvents by a non-linear effect called self focusing. Shammai being my first student at Technion, I believed all students were equally gifted. Shammai went on to become a senior member of the chemistry faculty and its dean. Later I realized that at Technion, like everywhere else, students range from brilliant to very good and I was lucky to have both kinds.

The next twenty years passed (too) quickly with doing laser chemistry of one sort or another. It became, again, time to reinvent myself. Looking at spectroscopic properties of porphyrins, I stumbled onto newly discovered biomedical applications. Some porphyrin derivatives have an ability to concentrate in tumors. Upon irradiation with lasers at selected wavelengths, they were shown to have a therapeutic effect on tumors, called photodynamic therapy (PDT). Production of excited oxygen (singlet molecular oxygen, $^1O_2$) which is a known cytotoxic agent was suspected to be responsible for PDT but little was known about the molecular, let alone biological mechanisms of cell kill. PDT became a major field of interest during the ten concluding years as an active Technion researcher. Together with Prof. Jim Winkelman (a guest researcher from Harvard) and Dr. Varda Gottfried (a postdoc at Technion) we quantified spectroscopically the production of $^1O_2$ from ambient O_2 when irradiating porphyrins. We were limited to chemical systems in solution, and our results were not convincing to the medical community.

Toward my sabbatical year 1987/88 I applied to the Beckman Laser Institute and Medical Clinic (BLI) at the University of California, Irvine. I proposed to measure generation of $^1O_2$ (due to irradiation) and its depletion (due to uptake) in cellular suspensions (in vitro) and in live animals (in vivo). The director of BLI agreed to the in vitro part of my proposal but questioned the feasibility of $^1O_2$ quantification in vivo, involving fluorescence- and phosphorescence based spectroscopic measurements. I was the first visitor at BLI with an exact science background and I had to interact with biologists and medical doctors. I knew little about growing/handling cells and even less about working with animals. But people at BLI knew little about laser physics or chemical detection of $^1O_2$. Collaboration between different disciplines turned out to be synergistic and mutually rewarding. Using an electrochemical capillary device I had brought with me from Technion, we were first to quantify $^1O_2$ uptake in living cells and to correlate uptake with cell death. The corresponding in vivo problem was indeed more difficult. Here I was fortunate again. A plastic surgeon from Israel (Dr. Arie Orenstein, Sheba Medical Center) happened to spend a sabbatical at BLI to improve laser surgery procedures. We started to discuss PDT in general and generation/depletion of $^1O_2$ *in vivo* in particular. He suggested employing a trans-cutaneous electrochemical electrode that had been in use for measuring oxygen levels in newborns, before the introduction of optical technologies. We scavenged hospitals around Irvine and found one department that had stored three units and was willing to share them with us. The last month of our stay at BLI, Arie and I measured, around the clock, O_2 levels in tumor-bearing rabbits: Irradiating a tumor implanted in one ear and measuring O_2 levels by affixing one electrode at the opposite side of that ear, together with two controls at different positions on both ears. The results not only allowed measuring O_2 levels but, in addition, we proved that PDT follows a vascular mechanism: $^1O_2$ does not attack tumor cells but endothelial cells in blood vessel walls, causing a collapse of the vascular bed supplying a tumor with O_2 and nourishment, thus starving the tumor. This was the beginning of a 19-year long collaboration when every summer Bianca and I spent three months in Irvine. In that period, BLI grew from a handful to about one hundred scientists, mostly physicists and chemists, thus vindicating the synergism hypothesis.

At Technion's chemistry department we do not have animal facilities. Luckily, Varda noticed in the Rappaport Medical School an animal look-alike, which we could adopt. The model is called the chicken egg chorioallantoic membrane (CAM). When a ten-day old fertilized egg is opened, a rich vasculature is exposed, showing venules and arterioles which can easily be distinguished under a microscope. This proved to be an ideal model for studying PDT. We could inject a selected porphyrin or apply it topically onto the membrane, irradiate with laser light and monitor, in real time, dosage related vascular effects. The model proved so convenient and elegant that it was also adopted at BLI.

In 1997, after having spent 31 happy years at Technion, I had to retire. This gave me an opportunity to accept a long-standing invitation from Arie Orenstein to become a senior advisor in the Advanced Technology Center (ATC) at the Sheba Medical Center, where I stayed for ten years. The ATC ran on soft money, thus emphasis was on obtaining research grants. This did not interfere with the quality of our research centered on biomedical applications of lasers and spectroscopy. I am happy to note that in several instances ATC could provide real solutions to problems in clinical areas.

Reflecting on the very long time that has passed since my childhood, I can say that apart from the five WWII years, life has been good: Healthy, happily married, with successful children and adorable grandsons, and to top it all a fulfilling position at Technion that provided me with the freedom to select my own research projects. The journey through 50 years of scientific progress, from high-resolution gas-phase spectroscopy and matrix spectroscopy, via laser chemistry to laser medicine has been truly rewarding.

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