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Interview by Ute Deichmann with Prof. Leslie Leiserowitz

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Leslie Leiserowitz was born in Johannesburg in 1934. He obtained a B. Sc. in electrical engineering at the University of Cape Town (UCT), followed by an M. Sc. in X-ray crystallography.

UD: Coming from South Africa, at the end of 1959 you joined the department of X-ray crystallography under Gerhard Schmidt at the Weizmann Institute. According to files at the Weizmann Institute archives, you spent just over a year a year, from late 1966 until early 1968, at the Dept. of Organic Chemistry of the University of Heidelberg, in order to help establish and run a new laboratory of X-ray crystallography for organic compounds. I would like to learn more about the crystallography department at the Weizmann Institute and its specific orientation. Was its approach similar to that at Oxford, where Gerhard Schmidt had studied?

LL: Our department, although titled the Dept. of X-ray crystallography, was primarily engaged in Solid State Chemistry. So that you can get a sense of what made the department so unique I would like to describe to you a little about the people who worked there from 1960-1965. The department was characterized by a hodgepodge of different languages. Gerhard Schmidt was fluent in German, English, and French. He also spoke Italian; which he probably learnt when he was in the Italian speaking sector of Switzerland after he left Germany with his mother. His Hebrew was not as perfect, but English was like a second mother tongue, probably because he attended a very good school in London and was still young enough to acquire an

English accent. He told me that as a boy he had been involved in street fights with the Nazis. Strangely enough, in 1938, four years after he had left Germany, he received call up papers from the German Army; bureaucracy functioned. In the early stages of the War, he was sent, together with many others in England, as an enemy alien to a camp in Australia; the inmates were treated badly during the first few months after which things improved when Schmidt sent a letter to a Quaker woman describing the conditions under which the inmates lived

The secretary Régine Luks was from Strasbourg, spoke four languages including Hebrew; the co-secretary Trude Schwartz originated from Innsbruck. The staff members had very different professional backgrounds: Mendel Cohen was born in Rhodesia, studied chemistry at UCT in Cape Town, had done post graduate work in the USA and immigrated to Israel in the 1950's. His field of interest was solid-state photochemistry, on which he collaborated with Gerhardt Schmidt. Fred Hirshfeld another member of the staff, was basically a physicist, who came from Brooklyn, where he had studied at the Yeshiva and Columbia Universities. He had a sharp mind and was gifted with innovative mathematical abilities that he applied to chemistry and crystallography. He was also a master computer programmer, which was one of the things that made our group effective since we were able to code many crystallographic and mathematical methods, which made us self-reliant. The computer we worked on was named the Weizac (Weizmann automatic computer), it was a variant of the MANIAC, one of the first universal electronic computers, designed and built by the group of Johnny (Janos) von Neumann at the Institute of Advanced Studies, Princeton. In the field of crystallography I should mention Philip Coppens who was from Amsterdam. In the early 1960s Philip was already close to the tail end of his PhD in Schmidt's group. He eventually moved to the USA where he carved out a very successful career in the field of electron density distribution in molecules. The dept. diversified with the coming of Wolfie Traub who joined the staff in the early 1960s. He was a crystallographer working in the field of molecular biology.

Wolfie was born in Latvia. Indeed, many South African Jews had their family roots in Latvia or Lithuania, my parents, too. My mother came from Latvia, my father from Lithuania. Wolfie was educated at UCT in Cape Town, did graduate work at Birkbeck College, London and also spent time at Columbia University.

The students of Gerhardt Schmidt were a mixed lot, including native-born Israelis or who had come to Israel at an early age, such as Dov Rabinovich, Moshe Luwish, Ilan Ron, Zvi Ludmer and Meir Lahav. Then there were those who had come from war-torn Europe, such as Israel Sonntag who did his PhD in solid-state photoreaction chemistry. He came from the Czernowitz region, which had once been part of the Austro-Hungarian Empire. Sonntag was a fluent polyglot, who spoke German with Schmidt, French with Regine Luks, Robert Goldstein, a PhD student from France (who had served with the French army in Algeria), and a newly-arrived student from Romania (she was initially under the impression Sonntag was of French origin), Romanian and Yiddish with the elderly woman who washed the lab glassware, English with Mendel Cohen and myself, and Hebrew with the Israeli students. Another particularly atypical PhD student was Uri Schmueli, whose mentor was Wolfie Traub. Uri was originally from Krakow in Poland. By the end of the war, he completed his schooling at a displacement camp in Italy, prior to coming to Israel. In Israel he worked as an optician preparing optical glass until his mid-twenties when he entered the Haifa Technion as a student. Uri, who remained thin as a rake all his life, eventually made a niche for himself in theoretical X-ray crystallography. He is still active as a Professor at Tel Aviv University. Worthy of mention at this point is Ada Yonath (who recently was awarded a Nobel Prize for her primary role in the structure determination of the ribosome), another early PhD student of Wolfie Traub.

The crystallography as practiced in our department bore the hallmarks by what Schmidt learned in England, but tempered by computer methods introduced by Fred Hirshfeld. After von Laue discovered the diffraction of X-rays by crystals, the centre of gravity in

X-ray crystallography moved to England, primarily because of the pioneering work of father and son William and Lawrence Bragg. They succeeded in developing methods to characterize the crystalline structure in terms of the X-ray diffraction data. Thus Gerhard Schmidt, who did his PhD in X-ray crystallography with Dorothy Crowfoot-Hodgkin at Oxford, learned the art of X-ray structure analysis at a group who were at the cutting edge of X-ray structure determination at the time.

I came to crystallography quite differently. I began as an electrical engineer, but did not find gainful employment in Cape Town, although I worked at the South African railways and at a factory constructing microwave equipment for measuring distances. Consequently I began to focus my attention to science and so continued my studies in the Physics Dept at UCT that had been headed by the famous British physicist Reginald William James, a participant in one of the expeditions to the Antarctic by the Irish polar explorer Ernest Shackleton. James developed X-ray crystallography in Cape Town. This is probably why Gerhard Schmidt accepted me.

UD: What was the reason for your helping the Heidelberg department of Organic Chemistry to establish crystallography?

LL: It was the intention of Heinz Staab, the head of the department, to set up a crystallography laboratory there with the help of the expertise of the Schmidt group at the Weizmann Institute.

UD: There were very good crystallography labs in Germany as well. Why did Staab ask the Weizmann Institute?

LL: I do not know exactly. There were strong crystallography groups in Munich and elsewhere. Indeed, Hans Metz, a very capable crystallographer working at the BASF, who received his PhD with Jack Dunitz at the ETH in Zurich, applied for a position as a crystallographer at the Organic Chemistry dept. in Heidelberg. But Metz, who was turned down, eventually took up a position at Ciba Geigy in Basel. Oddly enough, Jack Dunitz, Hans' former PhD

mentor, had been a close friend of Gerhard already from their days together at Oxford.

Staab may have turned to Gerhard Schmidt for several reasons. Perhaps the strong connection of crystallography to organic chemistry at the Weizmann Institute appeared convincing to Staab, given that Schmidt was one of the pioneers of solid- state chemistry, a mixture of crystallography and chemistry. In this respect I did have the impression at the time that Staab wanted to introduce solid state chemistry into his group. There is also the point that Staab would have had better control over the crystallographic work done in his dept. Finally he might have thought that the contact to the Weizmann Institute would be politically advantageous.

In any event, Schmidt convinced me to go to Heidelberg. I had just finished my PhD. By that time three German chemists, Hermann Irngartinger, Carl Krueger and Neithart Sommer, were spending time in our Dept. Irngartinger, was a PhD student of Staab who spent about six months in Rehovot to acquaint himself with X-ray crystallographic methods. Indeed I worked with Hermann later on in Heidelberg. Carl Krueger was from the MPI for Coal Research - he came originally from East Germany. He learned crystallography at our department and later set up a department for X-ray crystallography at this MPI. Neithart Sommer had already obtained his PhD degree in Heidelberg. His intention was to do work in solid-state chemistry; later I became very friendly with him in Heidelberg.

UD: How did the people in the department react to having Germans work with them?

LL: They reacted best to Neithart, who was outgoing and pleasant. Irngartinger was somewhat formal. Carl Krueger, who had spent time in the USA, was a little older than the rest of the students in our group. All in all, I thought people welcomed them and their spouses, particularly Neithart's wife Gloria and Hermann's wife Gisela, who had very friendly personalities. In retrospect, I think that many of us in the Dept. appreciated their attempt to engage with the Jewish people.

UD: What was your research in Heidelberg about?

LL: Staab wanted us to determine the structure of large molecules, basically (pseudo) aromatic macrocyclic systems incorporating several benzene rings, synthesized by his group. Staab had obtained an automatic X-ray diffractometer, which was constructed by the Siemens Co., based on a design by the Walter Hoppe crystallographic group in Munich. The bottleneck at that time was the time-consuming and laborious process of determination of complex crystal structures, which I wanted to avoid.

Therefore, well before taking up my position at Heidelberg, I programmed the method of Herbert Hauptman and Jerome Karle, for the direct determination of crystal structures, using the measured diffraction data – for which they later received a Nobel Prize. The code I prepared in the mid 1960s, albeit primitive, proved to be useful in Heildeberg and eventually back in Rehovot, until the early 1970s when excellent Direct Method computer programs became readily available. I also prepared other computer programs including the code to measure the crystal data for the diffractometer. Basically, I had to get all the computer programs up and running and so used to test the programs at the MPI for Nuclear Physics in Heidelberg, where I had the opportunity to meet Wolfgang Gentner, who was the director of MPI. Then I also helped student Hermann Irngartinger with the X-ray diffractometer and structure determination. My interest on the scientific side was the extraction of the charge density in the C-C bonds of the phenyl rings, for which the molecular systems were ideal at the time. I also had the time to think about and engineer molecular crystal systems to investigate different types of molecular interactions, work I was to do in the future on my return to the WIS.

Schmidt came every few months to Heidelberg to see how things were going on there. He did not really behave like a professor, as this example shows: The time came to extract the crystal structure via my Direct Methods program, which was a laborious, but straightforward process which took several days to run. The final stage involved mapping out the molecular structure to see whether it was correct. By

that time, which was well in the evening, I left Gerhard and Hermann and went home to my family. At about midnight, someone rang or doorbell. There was Gerhard standing at the front door with a bottle of wine and a big map of the molecule – at the time we contoured the atoms by hand, – exclaiming: “This is the end of crystallography as we knew it.”

UD: How did the contact with Prof. Staab come about?

LL: It may have come initially via Wolfgang Gentner, who was instrumental in setting up contacts with the Weizmann Institute. I had on a few occasions, accompanied Gerhard on evening visits to Gentner’s house, which was very close to the Organic Chemistry Institute. Gentner and Staab were very different personalities. Staab was astute, very clever, an excellent organizer and cool and collected under pressure. I remember him facing up to and addressing the University students at Heidelberg during the heady days in 1968. But, I never had real contact with him. I had the feeling he had little heart, although he treated me well enough, never imposing himself, and gave me a free hand. I should also say that his wife was very kind to Ruchama, my wife, whom she invited on occasion, together with our three young daughters.

UD: Did you meet Schmidt's father?

LL: I met him once when Gerhard and I attended a meeting on hydrogen bonding at Schloss Elmau (near Garmisch Partenkirchen) in the Spring-time of 1967. Gerhard’s father was staying in Bad Reichenhall at a cloister run by nuns. We travelled there by car, crossing the border to Austria, from where we took the road to our destination. Although the car was mine, Gerhard drove. He was a very fast and able driver, yet completely safe. He once mentioned that he would have liked to participate in car racing, indeed had passed a driving course taken by the London police. As an aside I can say that on occasion Gerhard and I drove to Beer Sheva and back at night, just to unwind. Gerhard’s father spoke little English. I sensed that he had a strong personality. He was concerned I would have to ride back to

Schloss Elmau that night. Gerhard spoke only little about his father and family in prewar Germany, although he once described a visit from family long settled in Saint Petersburg. Gerhard also mentioned that the first time he saw his father after the war was when he paid his father a visit in the mid-1950s. We should remember that from 1948 Gerhard was busy in Rehovot setting up a department and research projects from scratch. Schmidt was no control freak, certainly not as far as my work was concerned, he, by and large, allowed me do what I considered worthwhile, although the flip side of the coin was his very dominating personality. On the other hand, he was an interesting person and very inspiring.

UD: Did you stay in contact with the Heidelberg department after your return to Rehovot?

LL: In February-March of 1968 I returned to the Weizmann Institute, but four to five months later I went back to Heidelberg for about half a year, as I recall. This connection with Heidelberg carried on till the early 1970s. We had some PhD students and I worked with a postdoctoral fellow from Heidelberg after Gerhard died in 1971, particularly Franz Nader with whom I worked in the field of crystal engineering. Among the students was Axel Jung, who was tall, strong and decisive with a lot of energy and ambition. Axel, however, did not realize that Israel was not Germany, where things always function well. But I should have learnt to play my hand with Axel in a more disinterested and cool manner. Another post doc was Otto voor der Bruck. Both Otto and his wife played violin. During his student days at Heidelberg, Otto used to practice violin in the Chemistry dept. at night since his landlady was not partial to his music. So when Gerhard and I worked at night in the dept. there were times when violin music echoed through the building driving us to distraction, but we could never locate its source.

I reread the article you published in Angewandte Chemie. The part on IG Farben reminded me of an event which throws some light on Gerhardt Schmidt’s approach to the Nazi Era. On one of my various stays in Heidelberg I accompanied Schmidt to a visit he made to the

house of a certain industrial photo-chemist. He was a heavy set man with a florid appearance, who had visited the WIS on a few occasions. I think he was in his late thirties at the time. As I recall, his father had been one of the directors of IG Farben who spend some time in prison because of (formal) use of slave labour by IG Farben during the war. His house was situated not too far from the Schloss on the same side of the mountain, in a wealthy area, as I recall. Gerhardt rang the doorbell and suddenly froze. When the chemist's wife answered the door, Gerhardt pointed out to her that a small mezuza was attached to the wooden side panel of the door. The woman had never paid attention to the mezuza, indeed did not know what it signified. Moreover, Gerhard said that he will not enter the house if it had been confiscated during the Nazi era. The woman assured Gerhard that they had bought the house via an estate agent and paid a sum commensurate with its worth. She had no knowledge as to the previous occupants or owners.

UD: Were there anti-Semitic incidents when you were in Germany?

LL: Except for an Iranian colleague whom I sensed was very anti-Israeli by his looks, I did not experience anti-Semitism. Strangely enough, years later I met the Iranian at an international scientific conference and he was very congenial.

UD: What were the scientific benefits of the collaboration with the Heidelberg department?

LL: It was give and take, a two way street, so to speak. The Germans provided not only financial funding, also the opportunity for the beginning of scientific exchange of ideas and concrete cooperation. We provided knowledge in X-ray crystallography and solid-state chemistry. For our services in Heidelberg, we received a single-crystal automatic Siemens, X-ray diffractometer, funded by a German agency, Minerva or the VWstiftung, I do not recall."

UD: Did your own work benefit from the collaboration with Germany?

LL: Very much so. Firstly, as alluded to above, during my post doc in Heidelberg, I had enough time to plan my future research back in Rehovot in the fields of molecular interactions, crystal engineering and link it to the charge density studies started at Heidelberg. Then the need to prepare the computer programs at Heidelberg proved very useful back in Rehovot. Visiting Germany on so many occasions led to an easy switchover years later in about 1984, when we started a collaboration with the Danish physicists Jens Als-Nielsen and Kristian Kjaer, working on the design, preparation and characterization of thin crystalline molecular films at the air-solution interface, work The structure of the thin molecular films were studied on a liquid surface diffractometer by grazing incidence X-ray diffraction using synchrotron X-radiation. These experiments were done at DESY, Hamburg, where we meet about three ties a year. This research eventually had many ramifications, indeed to this day, when we are working in the field of malaria. Thus my scientific contact in Germany was mediated by the Danes.