

To America and M.I.T.

The Danish interlude drew to a close. Our home in Bleedaparken had been an oasis of friendship for many. Lore Misch, later married to Felix Bloch, lived with us as a refugee from Germany for a number of months, and various others passed through. All the famous theoretical physicists of today and tomorrow visited the Institute at one time or another. Fröken Schultz, Niels Bohr's excellent secretary, kept everybody happy, and the Bohr family extended their friendship even so far as to give us their summer home in Tisvilde while they went abroad (see Figures 58-64).¹

Opa Franck accepted a professorship at Johns Hopkins in Baltimore, where R.W. Wood ruled the Physics Department with wonderful originality. At the same time, I received an offer from Karl Compton to join the faculty of MIT. Father and Tante Bezi came for a farewell visit and Olga also managed to pass by. Peter and Arndt, who were growing happily, played in the sand on the Baltic shore, took rides on the handlebars of our bicycles, and felt at home in Carlsberg. But the idyll had to come to an end. At the end of August 1936, Niels and Harold Bohr with their families brought Opa Franck and us to our American ship, the "Scanstates." A lovely picture still exists of Opa, with his two grandsons holding his hands, published the next day in the newspaper *Ekstrabladet* (see Figure 65). And so we waved a final goodbye to our life in Europe.

After a voyage of about twelve days -- with dolphins guiding the ship, and Peter and Arndt enjoying the friendship of passengers and crew -- we steamed past the Statue of Liberty and landed on Ellis Island, in full view of the glorious skyline of New York. Since our "von" put us practically at the end of the alphabet, we expected a long wait. However, our passports with immigration visa and letters from MIT speeded the process. A launch took us to the mainland where Opa exuberantly ordered a taxi to drive us to the nearest "warehouse." In Germany, children's toys can be bought in "Warenhäusern" [department stores] but here we were driven to the outskirts of New York and found ourselves confronted by a manager inquiring where the furniture we wanted to store should be picked up.

Clearing up the hilarious confusion, we went back to the city and found a real toy store. We settled down in a hotel to await the arrival of Daggie's sister and brother-in-law, Lisa and Herman Lisco, due on a ship from Germany the next day. The Liscos arrived carrying their daughter Barbara ashore in a laundry basket and,

after a happy reunion of a few hours, we parted ways. The others went to Baltimore, we to Boston where our old friends the Oldenbergs received us. We settled down for a few days in Cambridge, and I went to introduce myself at MIT.

President Karl Compton proved to be a wonderfully friendly and impressive man. He was a very good physicist in his own right but also an ideal administrator. Full of human understanding, modesty, and scientific curiosity, he walked through MIT. in order to learn what was going on and where help or constructive criticism was needed. He enjoyed new insights, was not afraid to ask "foolish questions," and tried to keep the faculty responsible for its own affairs. As a result, the administration of MIT remained small, funds could easily be made available as seed money for new initiatives, and his door was always open for people in distress. We all cried when he died.

Compton had seen a recent article summarizing my research on "electrical breakdown in gases and solid insulators"² and invited me to become the physicist of the Electrical Engineering Department. The time had come to break away from the classical engineering concepts. Vannevar Bush was experimenting with computers and Harold Edgerton with stroboscopic photography; Van der Graff built his tremendous electrostatic generator; and others pushed electric oscillators toward microwave frequencies. The time was therefore ripe to introduce modern materials concepts into the field of electrical engineering.

I was handed over to Vanevar Bush, the Dean of Engineering, and brought by him to Professor Jackson, the Head of the Electrical Engineering Department. Soon I found myself involved with a group of its young faculty and generally warmly accepted.

While house hunting, we found a nice ground-floor apartment in the home of Belmont's high-school principal. Our boys were immediately invited to the birthday party of the little girl upstairs. When I came to pick them up, I heard the birthday child bragging, "My ancestors came over on the Mayflower!" Peter, innocently unimpressed, replied, "My ancestors came over on the "Scanstates!" Equal status was thereby restored.

Start at M.I.T.

The fall term was about to begin and I drew the assignment of teaching the Electrical Engineering Department's introductory course, "Circuits and Fields," with Ernie Guillemin. The subject was new to me and I approached it with misgivings, due to the lack of preparation time. Unexpectedly, fate intervened,

however. Our children contracted scarlet fever and the police put our apartment with its inhabitants under strict quarantine for thirty days. Dr. Heinrich Brugsch, who had just arrived from Göttingen as a refugee with his wife Ulla lived nearby and became our friend and doctor. During this time I had ample time to prepare for the new ordeal.

I was the oldest Assistant Professor in the Electrical Engineering Department and one of my colleagues feared I might be promoted before he was. A vendetta therefore began, of which I became aware only due to its consequences. He went to the Dean with the tale that I had been a Prussian officer and was mistreating the students. My students testified to the contrary, however. Next, the rumor was spread that my English pronunciation was horrible and the students could not understand me. Obviously I had a strong German accent. I have never seriously tried to get rid of it. So I was asked to give a colloquium for scientists and engineers. A professor of the Language Department was deputized by Dr. Compton to sit in the back of the hall and report his findings. This was Fred Fassett, who later became a friend. He reported that MIT should be glad to have such an interesting lecturer.

After this, I was left alone, but I wanted to do experimental work and at that time space was at a premium. I therefore settled down in the boiler room of the main building -- a dungeon without windows. There, I welded a metal frame together and mounted vacuum pumps and other paraphernalia needed for my studies of electrical breakdown in gases and solids. Slowly I got a little research money. Graduate students were interested in working with me. My first Ph.D. student, Mr. Molnar, was handed over to me by Professor Harrison of the Physics Department. I had him work on the color centers in alkali-halide crystals, and he found the M-bands named after him. He later joined the Bell Telephone Laboratories and advanced rapidly. We stayed friends. He was scheduled to become President of the Bell Laboratories when he died prematurely.

Fred Merrill and I clarified the initial stages of electric breakdown in gases using Lichtenberg figures.³ Our group also began to understand the propagation of electrons in single crystals as a wave phenomenon⁴ and the importance of order vs. disorder by comparing crystals with glasses.⁵ We also advanced to studies of the effects of temperature, frequency, and the transition from insulator to semiconductor and then to metal.

From the boiler room, I rose to better space on the third floor of building 8, and developing friendships with students and staff made my life at MIT much happier. Simultaneously, our home situation improved dramatically: Edward Bowles, a wonderfully outspoken associate professor, and his wife Louise, who had become friends, told us about a house located on the Jennings farm in Weston. The house

was empty because the previous tenant had had a second child and found the place too small. It was situated on rocks with a cow barn and meadows behind. We fell in love with it at first sight. We rented it in 1938 and it became our "Haus in der Sonne."

Life Before World War II

In Germany, we had been members of a family with roots many centuries deep. In the U.S., we started alone. Therefore we wanted more children so that the next generation would have relatives in the new country and be able to provide each other with mutual support in emergencies. Son Frank was born on December 26, 1937. Expected a few days earlier, he thoughtfully delayed his arrival so that his mother could visit home from the hospital for Christmas.

The situation in Germany had become ever more ominous. Hitler re-occupied the Rhineland in March 1936 and threatened Czechoslovakia in the fall of 1938. The persecution of the Jews increased and their deportation to concentration camps began in November 1938. Only at the end of World War II were the horrors of these camps revealed.⁶ For a short time, if a visa could be obtained for immigration into the US, it was still possible to buy the release of people. Opa Franck succeeded in getting his mother and sister to the States. They subsequently lived in Chicago.

We tried to get out Trude Rose, a schoolfriend of Marianne's and Daggie's who worked in the Zoo at Munich; but after we had paid the first ransom, the Nazis increased their demand. It took us some time to raise the additional sum and send it over through the Red Cross. After some months we were informed that she had been sent to a concentration camp. She perished and this tragedy is still a weight on my conscience. If we had known the situation, which only became apparent after World War II, we would have immediately borrowed by any means the money to get her out.

My salary at MIT was very small (about \$3500 per year)^{*} and stayed the same until the end of World War II. When three of our children were simultaneously hospitalized with ear infections, I had to sell my *Handbook of Physics* to bail them out.

^{*} According to the Consumer Price Index, \$3500 in 1940 (1945) dollars would be the equivalent of about \$27,000 (\$21,000) in 1985 dollars.

It was a relatively long trip from our new home to MIT, so we bought an old second-hand car for commuting and shopping.

I also wanted to learn more about New England. Therefore, in the winter of 1938, I made a trip with some MIT friends to New Hampshire. The first night we stayed in Passaconaway at the cabin of Cliff Pratt whom Charles Kingsley knew. It became ice cold during the night. Nevertheless, the next morning, we hiked to the Franconia Range and climbed Mt. Lafayette. A storm arose while we were on the mountain and we were trapped for two days in a deserted hut belonging to the Appalachian Mountain Club. To keep from freezing, we burned the benches, which we later replaced. After an icy descent, we reached the road through Franconia Notch and transportation home. I had acquired a love for the mountains of New Hampshire.

During the summer vacation of 1939, Daggie and I extended our explorations and drove across Maine, with its beautiful lakes, and past Fort Kent to the St. Lawrence River. We left Frankie with Claire Campbell and deposited Peter and Arndt in a small summer camp on the way. We then camped through the enormous stretches of forest owned by the Great Eastern Pulp Company and arrived at the St. Lawrence River rested and happy. Then disaster struck.

We had just given a farm girl a lift and were on our way to Quebec when Daggie, who was driving, suddenly lost control of the car. The front axle of our Ford car had broken. In vain I reached over and tried to help. We struck a telephone pole, which broke off, and we came crashing to a halt in a ditch. The first impact broke one of my vertebrae.

There we were. I, practically incapacitated, lay in the front seat with the severed telephone pole swaying on its wires over our heads. The subsequent events were nearly hilarious. First came the farmer, whose fence we had damaged in the crash. He did not offer any help but instead demanded \$5. Next a priest stopped, saw me gasping for air, and wanted to give me the last rites. Instead, we asked him to inform the nearest garage that we needed a tow truck. A highway patrol car also passed by, graciously pretended not to have noticed the damage, and moved on. Finally, a tow truck appeared, pulled us to the nearest railroad station, and took the car along for repairs.

I sat on a bench at the station -- still quite disabled -- while Daggie walked around the small building to the ticket office. Suddenly a cry, a loud commotion, a furiously barking dog -- and Daggie reappeared, her dress torn from top to bottom. Behind her came the station master, wringing his hands and asking for mercy. It turned out that his dog had attacked other people before and he was under orders to destroy it. Instead he had hidden the dog under the station building from where it had launched its attack. We agreed not to report him, Daggie was temporarily fixed

up, and I was helped onto the next train. Arriving in Quebec, we were rushed across the river to a hospital was run by nuns.

The nuns considered the appearance of a relatively young man as a happy event and treated me royally. The doctors taped my back and, three days later, I was discharged. After two days of exploring Quebec, we returned to the garage and found our Ford still unrepaired. This was now an emergency. With our vacation period run out, we had to pick up our children and return home. Therefore we decided to imitate the industrial workers of that period and staged a sit-down strike. One of us always stayed in the garage, preventing the owner from closing up until the repairs were finished at 3 AM the following morning. Then, driving out of sight into the nearest woods, we settled down and fell asleep.

Our return trip brought no further incidents. Peter and Arndt had enjoyed their camp, Frankie had prospered under Clare Campbell's care; and my co-workers at M.I.T. had not gone to sleep. But then the political catastrophe began: World War II broke out in Europe.*

Founding of the Laboratory for Insulation Research

The time had come for my research to officially break away from classical engineering concepts and departmental constrictions. I had attracted students from a variety of departments and we had started research ranging from gases to solids, from insulators to metals, and from d.c. to microwave frequencies. Therefore, in 1939, I founded -- with Dr. Compton's approval and a grant of \$5000 -- the "Laboratory for Insulation Research." The name avoided claiming other people's territories but later proved to be much too narrow. Still, it became known internationally and earned M.I.T. money and recognition in the field of "Modern Materials Research."

Before the U.S. was pushed into World War II and we into government-supported research, our sources of support were contracts with industry, which somehow had to be related to our areas of interest. An especially challenging problem arose when Colonel Behne, the founder of IT&T, came to my office-lab (at that time I only had one room for both) and sat down on one of our tripod stools for a discussion. One important product of his industry was selenium rectifiers, which had up to that time been manufactured in his German plant, the "Süddeutsche Apparate Werke." The war in Europe had cut off this source of

* On September 1, 1939, Germany invaded Poland.

supply and with it the knowledge of how to make them. The colonel had set up a new factory in New York, but with the most discouraging results -- about 95% of the product had to be thrown away.

I went to New York and found a most appalling situation. The director of the plant, a former bed-spring manufacturer, was completely oblivious to the temperamental nature of semiconductors. The plant was located between a soap factory and a chocolate factory. As a result, depending on the wind direction, it produced soap- or chocolate-doped rectifiers. Nickel-plated and sand-blasted iron disks were coated with the red, glassy phase of selenium. A three-day heating cycle transformed this material into the gray metallic state. After all this, only about five percent of the disks exhibited an acceptable a.c. to d.c. rectification characteristic.

I agreed to become a consultant to I.T.& T. and to accept a research contract for our laboratory. Our work proved scientifically successful and technically important. Also, the retainer I received released the family from its very tight financial situation.

After fixing the process so that the three-day process produced good rectifiers, we asked why couldn't selenium be electroplated? The literature and our experience told us that only the red amorphous phase would result, but we succeeded in developing a selenious-acid bath that produced metallic selenium and the old three-day manufacturing process was shortened to twenty minutes! A number of patents were obtained.⁷ An my insistence, MIT retained the "solar energy rights" because we had also succeeded in producing selenium photocells by electroplating.⁸

This demonstration of technical ability was a much needed and gratifying success for the Laboratory for Insulation Research. For the family the slogan "IT&T bezahlt's [pays]" created a happy optimism, so we decided to have an additional child. Son Eric was born on August 27, 1941.

The Solar Energy Episode

Mr. Cabot of Cabot, Cabot and Forbes, a far-sighted industrialist, was concerned about the wasteful method of burning gas flames against cold water pipes his company used to produce carbon black as filler material for automobile tires. He felt that his company might be one of the causes of a future energy crisis. Around 1940, therefore, he approached Dr. Compton with the suggestion that MIT set up a solar energy research program at his expense. An Interdepartmental Solar Energy

Committee was appointed, consisting of Professor Hottel of Chemical Engineering, Professor Huntress of Chemistry, and me representing Electrical Engineering. This "3-H Committee" caused me a lot of mental anguish.

Hoyt Hottel became deeply involved in solar energy work and built the first solar-heated house on Memorial Drive along the Charles River near the student dormitories. The house had a roof-mounted solar collector and a hot-water storage tank in the basement. To avoid over-heating, shutters would descend automatically over the windows. A young student couple moved into the house rent free on the condition that no auxiliary heating be used. They emerged after a few days, hollow-eyed and complaining loudly. The shutters clanging up and down, up and down, had driven them nearly crazy. Otherwise the design proved a technical success. However, it was not yet economical because the tank in the sub-basement where the solar-heated water was stored was nearly as large as the rest of the house.

My contribution was solar cells. We electroplated steel with selenium with our new method and were able to convert into electric power solar radiation in the range from red to ultraviolet. We wanted to go over to tellurium, in order to catch the infrared as well, but the approaching war interrupted our work.

We hired Dr. Rabinowitch to study photo-chemical transformations. He later became famous in the Manhattan Project through his collaboration with Opa Franck in writing the "Franck Report," a warning against dropping the atomic bomb on the Japanese cities. After the war, he founded the *Bulletin of the Atomic Scientists*. As a chemist, he unfortunately worked under Professor Huntress, who treated him badly. I should have protected him better, but the increasingly desperate plight of the British in the war in Europe forced me to shift my main attention to radar and the development of materials and techniques needed in the microwave region.



58. Dagmar, Arndt and Peter in front of the Bohr's summer home in Tisvilde

59. Tisvilde: Peter and Arndt get outfitted with paper hats

60. Peter and Arndt running with their paper hats



61. Tisvilde: Arthur, Peter and Arndt dig at the beach

62. Dagmar and Arthur go swimming

63. Opa cycles along the beach



64. Tisvilde: Arthur and Opa play chess.

EKSTRABLADET



Den amerikanske Nobelpristager i Fysik, Professor Jas. Franck, lynskudt i Morgen på „ScanYork“ med sine to smaa Dreng.

65. James Franck with his two grandchildren leaves for America on the ship *Scanstates* (photo from Copenhagen newspaper, *Ekstrabladet*)