



Gerhard M. J. Schmidt
1919–1971

GERHARD M. J. SCHMIDT

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Gerhard Martin Julius Schmidt was born in Berlin on 21st August 1919, the son of Erich and Charlotte (née Rund) Schmidt. His mother worked with Emil Fischer and her Ph.D. dissertation was concerned with sugar chemistry.* It was there in Fischer's Institute that she met her husband-to-be. When Gerhard was born his father was associated with a firm doing work on cellulose chemistry. The family moved to Munich when Gerhard was about four years old as his father received his Ruf from the University of Munich in 1923. Gerhard's precocity was compounded by his mother's attitude. She insisted that he be accepted in school at the age of four. It was therefore perhaps just that he managed to blow up the bathtub when he was nine. Only in 1934, when his father was dismissed from his post, did Gerhard realize that he was a Jew. This more or less coincided with an incident which endangered Gerhard at the time: he defended a small Jewish boy against a bully who had evidently been well trained by his brownshirted father, and evidently paid the bully in kind. Gerhard promptly had to be shipped out of Germany at several hours' notice, use being made of a still valid Swiss visa remaining from an earlier family vacation in Switzerland. He therefore left the Maximilian Gymnasium in Munich for the École Supérieure in Neuchâtel where he studied, alone, in 1935 - 36. He met his mother in London in 1936. Since his father was a chemist he was not permitted to leave Germany but ways were found for support of Gerhard and his mother until the war broke out in 1939. By that time Gerhard's mother, who had earned an M.D. degree in Munich and had specialized in psychiatry, was able to get a permit to work in the United Kingdom.

Gerhard studied at St. Paul's School in London during the period 1936-1938. In his eighth form report his chemistry tutor wrote prophetic words:

I cannot speak too highly of his work and general attitude to this subject. He has an unusual gift for Chemistry - especially for Organic - and he thoroughly deserves his distinction at Oxford [he won an open scholarship at Oriel in December 1937 - D.G.]. I congratulate him heartily. He should go far.

There are similar reports on other, non-scientific, subjects and a program of a concert at the School on 17th December 1936 gives evidence of another of Gerhard's talents: G.M.J. Schmidt played Handel's Sonata in G minor as a flute solo.

Gerhard went up to Oxford in 1938 and for his first year there was a Senior Science Scholar. It became known that he was not much of a chapel-goer. When the war broke out his financial situation took a turn for the worse. Gerhard loved to tell the story of being told what a pity it was that he didn't attend chapel because the College was

* E. Fischer and C. Rund, *Ber.*, 49: 88 (1916).

in need of a Bible Clerk, a post that carried with it a stipend of £25. Gerhard became a Bible Clerk in 1939! From 1940 his mother began to practise in the U.K. so that the problem of finances became less acute. Gerhard was nonetheless an Exhibitioner, St. Paul's School, and an Organ Scholar at Oriel in 1941, and a Senior Scholar in 1942 before being awarded the B.A. degree in 1943. But a study of the above dates will reveal a lacuna of about a year. This period was spent in a detention camp for enemy aliens in Australia. When some organization had been established at the camp, a letter of complaint was sent to Churchill. A committee of inquiry appeared on the scene and discovered that many of the inmates were Jewish refugees from Germany. These were returned to England and Gerhard renewed his life at Oriel.

On 14th July 1942, Sir Robert Robinson wrote to Gerhard inviting him to come to see him in order to discuss the subject for his Part II research. Gerhard's B.A. Thesis* bears the date, Trinity term 1943.

Gerhard used to make music with Ernst Chain who influenced him towards X-ray crystallography. This advice was taken and from 1943 until 1947 Gerhard worked with Dorothy Crowfoot (later Hodgkin) on "The X-ray Crystallography of Proteins" and in 1948 he was awarded a D.Phil. He took part, in a junior capacity, in the huge Anglo-American collaborative project concerned with elucidation of the structure of penicillin. Professor Hodgkin credits Gerhard for his part in the work:

Later examination of purified material established the fact that 2-pentenyl-penillamine crystallizes in two forms: A, probably hydrated, from water and B, anhydrous, from acetone (Crowfoot, Low and Schmidt, *Pen.*, 117:2).*

Crowfoot, Low and Schmidt (*CPS* 53) observed that the DL-synthetic penillamines, which are racemic compounds, are very closely related in crystal structure to the optically active forms:

The crystal unit cell of the racemic compound consists essentially of the unit cell of a D crystal and of an L crystal placed edge to edge and related to one another by a glide or pseudo glide plane of symmetry.†

Dr. Hodgkin observes that the correct penillamine structure was determined before the synthetic compound was resolved and truly identical compounds obtained.

One communication on work in the Oxford lab was published in *Nature* before Gerhard came to Israel. The only other paper based upon his work in Oxford was published a decade after the event.‡ This was concerned with the structure of gramicidin S. This X-ray work had been undertaken at the suggestion of R.L.M. Syngé in 1944.

At Oxford, Gerhard met and married Anita Kronheimer. They came to Rehovot in August 1948 after Gerhard had written to Ernst Bergmann regarding a post at the Weizmann Institute. I surmised after looking at Gerhard's publication list, which

* "An Attempted Synthesis of a Substance Related to the Sterols".

† D. Crowfoot, C. W. Bunn, D. W. Rogers-Low and A. Turner-Jones, "The X-ray Crystallographic Investigation of the Structure of Penicillin", in H. T. Clarke, J. R. Johnson, Sir Robert Robinson, eds., *The Chemistry of Penicillin*, Chap. XI, Princeton University Press, Princeton, 1949.

‡ G. M. J. Schmidt, D. C. Hodgkin and B. M. Oughton, *Biochem. J.*, 65: 744 (1957).

at the time comprised but a single paper,* that Bergmann must have had extremely good recommendations for Gerhard's potential but Professor Bergmann has assured me that this was not the reason for the appointment. He was really impressed by Gerhard's research plans. Bergmann's intuition was clearly at work; that the intuition was sound is obvious by hindsight.

Gerhard was a difficult person to know. It required effort and time to get past the gruff exterior he usually presented to the world. But to one who for several years lived in the flat below his in the Shikun of the Weizmann Institute and who often heard him playing early Baroque music beautifully on his flute, it is clear that this exterior was merely a protective veneer over a warmhearted personality, and those of us who heard and saw him sing, "Mein Hut, er hat drei Ecken . . ." recognized the real Gerhard.

I suppose that the atmosphere of Oxford in which Gerhard lived for a decade before coming to Rehovot could hardly have been more different from his new milieu, the bustling atmosphere of a newly set up expanding Institute in the midst of a crisis, with fighting and truce alternating during the first months of his arrival in the country. This contrast must have presented some difficulty.

He had additional difficulties. His first wife Anita, a young biologist, was not given a post at the Institute. This was a matter of policy at the time. There is little doubt that her frustration affected Gerhard, indeed sowed the seeds of future discord and separation. He would often come into the lab despondent but would shake this off as he became immersed in his work. His private life became a happy one after his divorce in 1965. He married Esther, *née* Dresdner, in that year. All of Gerhard's friends could see what a difference this happy marriage made in his life and outlook.

To return to 1948, Gerhard was ambitious to show what he was capable of doing. He was at the time still seeking problems. Undoubtedly, Ernst Bergmann's interest in polycyclic aromatic compounds rubbed off on Gerhard and the first structures tackled were concerned with molecular overcrowding.

In the lab Gerhard would join his students in measuring intensities. He would, in those early days at the Institute, come into the lab at 10 - 11 in the morning and stay on and work through until 1 - 2 A.M. of the next morning. I have been told of Gerhard at 2 A.M. polishing grammar in a paper to be submitted for publication whilst his co-author was reeling with exhaustion. If anyone in those days was the lab-technician it was Gerhard himself. He did the chemical work in the lab and only later on when he could no longer spare the time, he had students doing work in organic synthesis.

Gerhard's interest in instrumentation, combined with that of utilizing computer facilities, manifests itself early in his independent career. Those were the pre-four circle diffractometer days and an early paper published with Fred Hirshfeld† was concerned with the geometrical problem in Geiger-counter measurements of single-crystal Bragg reflections. It was also quite early in the Weizmann Institute days that Gerhard, fed up with looking up *sine* and *cosine* values in the respective tables, suggested a solution to this annoying problem. A device for its implementation was

* D. Crowfoot and G. M. J. Schmidt, *Nature*, 155: 504 (1945).

† F. L. Hirshfeld and G. M. J. Schmidt, *Bull. Res. Council. Isr.*, 3: 37 (1953).

promptly devised. * This interest, that of a meticulous instrumentalist, continued during his lifetime and its last major manifestation was in the design with Dov Rabinovich of a precession diffractometer which is being manufactured by Beta of Beersheva and marketed by Yeda Research and Development Corp.

Both as an organic chemist and as a crystallographer, Gerhard appreciated crystals and crystallization. It may have been from him that I first heard the story of those early bearded heroes of organic chemistry. When a student had difficulty in crystallizing a compound they would simply shake their beards over the flask containing the offending substance. Then, lo and behold, after nucleation had done its job, crystallization set in. Gerhard believed that the beard of an Adolf von Baeyer or an Otto Wallach could indeed be a source of crystals of every conceivable space group. But he was abreast of the times and realistically realized that, alas, the era of the patriarchal beard was over. He voiced the idea that one could, in principle, have a salt-shaker type of container in which there would be microcrystalline shapes made of an inert material. One shake would convert even the most cleanly shaven male graduate student, indeed, his female counterpart, into the equivalent (in this respect) of a Baeyer. This idea was not brought to fruition but I am not blind to the fact that this may be because Gerhard knew far more than I about the mechanism of crystallization.

By 1956 a number of papers were published with the first three graduate students in the lab, Efraim Harnik, Frank Herbstein and Fred Hirshfeld. These were concerned mainly with overcrowded aromatic compounds, e.g., dianthrone, 3,4-benzophenanthrene, tetrabenzonaphthalene and with the heterocyclic phenazine.

But although such interest continued thereafter, work on what was to become the major theme in Gerhard's scientific career began in 1951. This was to lead to the coining of the term "Topochemistry" and the larger series of Gerhard's publications from that time was related to this theme whether or not the term was used explicitly in the titles of the papers. Coincidence undoubtedly plays an important role in science as in other fields of human endeavor. It happens that Herbert Bernstein was at the Weizmann Institute upon Gerhard's arrival. Bernstein had earlier worked on the dimerization of cinnamic acid and introduced Gerhard into the intricacies of this apparently alchemical reaction. I remember hearing the words *truxillic* and *truxinic* bandied about with great abandon when I once came upon the two engaged in a heated discussion. It took time and Gerhard's talent as well as his unique constitution, already mentioned, of being both an organic chemist and a crystallographer to convert apparent alchemical chaos into esthetically beautiful and clearly understandable topochemistry. There is surely no need for me to explain the connotation of "topochemistry". I leave this to the crystal-clear sentences in the first paper of the series on topochemistry:†

The following Papers are mainly concerned with the thesis that the course of certain types of solid-state reactions are determined by the geometry of the reactant lattice, or in Hertel's phrase by "topochemical" factors. This thesis may

* G. M. J. Schmidt, *Acta Crystallogr.*, 4: 186 (1951). Of course, this was a problem at that particular (pre-computer) time.

† M. D. Cohen and G. M. J. Schmidt, *Topochemistry. Part I. A Survey. J. Chem. Soc.*, 1996 (1964).

be formulated as the postulate that *reaction in the solid state occurs with a minimum amount of atomic or molecular movement*. This postulate implies that solid-state reactions are controlled by the crystal structure, between potentially reactive centres. It follows that for each reaction type there should exist an upper limit for such distances beyond which reaction can no longer occur. Furthermore, bimolecular reactions are expected to take place between nearest neighbours, which in turn suggests that the molecular structure of the product might be a function of the geometric relation in the crystal lattice of reactant molecules. Finally, the postulate places restrictions on types and mechanism of solid-phase reactions, such as *cis-trans*-isomerisation which as a unimolecular process appears to be associated with large-scale atomic movement. Topochemical influences are expected to be dominant only in certain types of reaction: they are probably of minor importance when the reaction mechanism involves long-distance migration of electrons or of excitation energy, and are unlikely to operate in ionic systems of high symmetry (inorganic compounds); they will become effective where both the molecule and the crystal lattice are of low symmetry as in organic compounds.

Perhaps this is the point to describe Gerhard's organizational and administrative abilities. Upon arrival at the Weizmann Institute he had to administer a small section, i.e., the Laboratory of X-ray Crystallography. In 1956 the lab gained the status of a Department; coincident with this was Gerhard's promotion from the rank of "Senior scientist" to Professor and Head of Department. In 1967, in a reorganization following the acceptance of guidelines suggested in the Westheimer report to the Institute administration, several large and small units were combined into the newly-formed Department of Chemistry and Gerhard was appointed its Head. This confronted Gerhard with a number of serious organizational problems and he set to create from these very different units a viable whole. He was wise enough not to attempt the impossible. Despite the fact that he was a uniquely suited bridge and common denominator between spectroscopists and crystallographers on the one hand and organic chemists of varying interests on the other, he did not use his power as Department Head unjustly. I had occasion to see and hear about these problems more closely when I spent a semester in the 1967-1968 academic year in partial residence in Rehovot. It was not a simple matter to mould this new Department in view of the unhappy history of its largest component during more than fifteen years after its first Head had to leave Rehovot in 1951 and after a number of stopgap, albeit illustrious, successors had served and left in the interim. Gerhard threw himself into this work with characteristic energy. He made progress, yet alas, here perhaps more than in the cessation of his own scientific work the Institute has suffered a cruel loss through his death.

In 1970, when the Weizmann Institute was divided into Faculties each including several Departments, Gerhard became its first Dean of Chemistry. Gerhard brought to the latter two posts the wider experience and skill gained from other posts of even wider scope, those of Chairman of the Scientific Committee and Administrative Director of the Weizmann Institute (1959 - 61). Partly overlapping in time (1960 - 1964), he was Chairman of the Board of Yeda Research and Development Corporation. In these posts he made many international contacts, particularly with German science, in addition to discharging his internal Institute duties. He was again Director of the Weizmann Institute in 1969 - 1970 at the period of inauguration of its new President.

During the first period as Director of the Institute, Gerhard convinced both Paul Hoffman of the United Nations Special Fund and the pertinent agencies of the Government of Israel to set up in Israel a Centre for Industrial Research. During my tenure as chairman of the National Council for Research and Development the decision was made to build the Centre in Rehovot so as to utilize the wealth and quality of scientific manpower there. It was a personal tragedy for Gerhard that the vast majority of his scientific colleagues was against the geographical association of the Centre with the Weizmann Institute. The Centre was finally built, through default, at Technion City. It is now a going concern and insofar as it had a single founder, that founder was Gerhard Schmidt.

I think that Gerhard's interest in things practical was whetted by his visits to his father. I remember that he returned from one of these excited by the story that many chemical reactions were apparently being induced by the local heat generated by grinding solid components of the reaction mixture together in, say, a mortar. It is not surprising that Gerhard served as Chairman of two subcommittees of the National Council for Research and Development, the Committee on the Technical Applications of Photochemistry (1967 - 1969) and the Committee on Bromine Chemistry (1967 - 1969). He had been a member of the Board of Directors of the Dead Sea Works, Ltd. from 1960 (to 1968) so that industrial problems were by no means foreign to him. In 1967 he was appointed by the Prime Minister as member of the Board of Gerhard's brainchild, the Centre for Industrial Research. Finally, Gerhard was a founding member and the first President (1958 - 1960) of the Israel Crystallographic Society (associated with the International Union of Crystallography).

Gerhard was a Rockefeller Fellow in Professor Pepinsky's laboratory at Pennsylvania State University during the academic year 1952 - 1953. He was Visiting Professor at the Technion Department of Chemistry teaching graduate courses in chemical crystallography (1956 - 1959). He was worried about the lack of such courses in the chemistry curricula at Israeli universities and took up the gauntlet when challenged to give the course himself. On these occasions Gerhard lectured in English as he never really surmounted the psychological barrier against speaking Hebrew in public. It was clear, however, that his understanding of Hebrew was more than adequate. He gave a graduate course on solid-state chemistry at the Feinberg Graduate School in 1965 - 1966. When Heidelberg University decided to set up a laboratory of X-ray crystallography, Gerhard was invited to implement the decision. He first trained colleagues from Heidelberg at Rehovot. He also served as Visiting Professor at Heidelberg (1966 - 1968) in this connection and was helped in this task by L. Leiserowitz.

As an internationally known scholar Gerhard served as Advisory Editor of "Applied Materials Research" (1964 - 1967) and gave invited lectures at Conferences of IUCr and IUPAC and before the Swiss, German and Italian Chemical Societies as well as before the Institut Solvay de Chimie in Brussels. He had been invited to lecture at the University of Zürich a short time before his death. His friends knew the gravity of his condition. Even though Gerhard very likely knew that there was very little hope, hope springs eternal in the human breast. Knowing that Gerhard and Esther were flying to Zürich some ten days later my wife and I visited them on a Friday afternoon, being in Rehovot

"by chance." Even taking into account our knowledge that Gerhard had been long ill, sight of him and hearing his constant cough came as an extreme shock. Yet he was full of smiles and plans, pleased with his lecture tour in Zürich and Basel and his invitation to serve as Chairman of a scientific session at the IUPAC Congress in Boston a month hence. He repeated stories, some of which I had heard when I first knew him, of his Oxford days. We went back to Haifa depressed. A month later, after discharging his lecture duties in Zürich, (he was no longer able to do so in Basel), Gerhard died peacefully in his sleep at a Zürich hotel. He was laid to rest in Rehovot two days later.

I must add two stories to this account. The first is indicative not only of the man but of the wife. Esther related the story of the colleague who at a meeting with Gerhard asked how he had been so successful in his latter choice of a wife. Replied Gerhard without batting an eye: "By trial and error." The second I heard some months later from a great chemist and friend of Gerhard in Zürich. He described the lectures Gerhard had given there. My informant keenly felt the tragedy of watching Gerhard die. But during the question period, he was overwhelmed by the transfiguration in Gerhard who completely forgot his malady during excitement of scientific exchange.

In his latest Curriculum Vitae, prepared in January 1971, Gerhard listed the following *Current Research Activities*:

1. Solid-state chemistry of organic compounds.
2. The mechanism of organic reactions at solid-gas, solid-liquid and liquid-liquid interphases.
3. Solid-state chemistry of inorganic compounds under dynamic shock (in the 25 - 400 kbar region).
4. Solid-state spectroscopy of organic compounds.
5. Packing arrangements and intermolecular forces of organic molecules.
6. Highly refined X-ray structure analyses of organic molecules.
7. Heterogeneous catalysis at crystalline surfaces (metals, molecular sieves).
8. Interrelationship of molecular and crystal structures of solids and their physical chemical properties.
9. The application of computers to chemistry and laboratory automation.

I have also read a 20-page memorandum prepared by Gerhard in February 1971 in which he summarized the major directions of solid-state chemistry to be taken in the "next years". Such reading strengthens the feeling of grievous loss that the scientific community in Israel has suffered in Gerhard's passing. It is already known that the Chemistry Department which Gerhard led is to be divided into two parts. Evidently it was felt that there is little hope to find a successor with the unique talents and interests of Gerhard Schmidt. His major monument is first his published papers but foremost his close scientific associates and students. Hopefully we shall derive consolation in due course from their continuation of the very original work whose groundwork they laid under the leadership of Gerhard Schmidt.

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