

Recollecting the Institute of Organic Chemistry, ETH Zürich, 1972–1990

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Jakob Schreiber In Memoriam

Abstract: The author recalls several visits to the Institute of Organic Chemistry, ETH Zürich. The faculty and staff of the Institute are remembered. Some circumstances surrounding the history of the publication of the total synthesis of vitamin B₁₂ are mentioned.

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I believe I first became aware of the Institute of Organic Chemistry (Laboratorium für Organische Chemie) of the ETH Zürich only in 1959, when I was a first-year graduate student in the Department of Chemistry at Harvard University. I was working in the research group of the man who was almost universally considered the foremost organic chemist of that time, Professor Robert Burns Woodward. At the postdoctoral level the Harvard department in general, and Woodward's group in particular, were very international in character. The Woodward Group had a large Swiss contingent, many of whose doctorates were from the ETH, and these coworkers were prominent among those who had spearheaded the total synthesis of chlorophyll (completed around the time I joined the group) and who then

went on to the pioneering efforts toward vitamin B₁₂. Without being unduly humble about the accomplishments of American chemistry, I nevertheless can say with truth that in general the Swiss chemists of that time possessed a technical mastery (from the Praktikum, or related academic structures, quite apart from more experience) that we Americans indubitably lacked, and in this respect nearly all of them helped me at one time or another.

Early in my time at Harvard, then, I heard of Albert Eschenmoser, the young chemist at the ETH who had just bested our revered boss in a friendly race to the finish line of the total synthesis of the complex alkaloid colchicine. Clearly, this was someone to be reckoned with! Not long thereafter I attended Eschenmoser's series of lectures at MIT, on colchicine and related topics, and from then on the idea formed in my mind that I must sometime study and work at the ETH, quite generally acknowledged at that time to stand with Harvard at the pinnacle of the discipline of organic chemistry – and most particularly with the man who in the field of natural products synthesis already was Woodward's greatest rival and who soon was to join with him in a collaboration of equals to complete the total synthesis of vitamin B₁₂, upon which both already had embarked separately. This dream gained further definition when I interacted with Vladimir Prelog, the Chairman of the Institute, while he held a six-week visiting lectureship at Yale University, where I was a faculty member from 1963 through 1968. In 1972–1973, after I had moved to the professorship at Haverford College, in

Pennsylvania, which would be my home base for the next 30 years, I finally was able to arrange a sabbatical year with Eschenmoser at the ETH. Two further sabbaticals, in 1976–1977 and 1989–1990, followed; and it is of these stays in Zürich that I now reminisce. I believe that in 1972 in some sense I just may have caught the Institute and the city – indeed, the entire country – engaged in a way of life in some respects largely unaltered since sometime prior to the World Wars; and so I will endeavor to sketch this period in time just before dramatic shifts, already then clearly in the offing, would lead to major transformations.

Change seems to move from West to East. In America so much begins in California, and moves eastward (if initially frequently jumping over the great midsection of the country). In the same way, much change – and, sadly, the bad with the good – has come from America to Europe, if with the delay of a decade or two. Switzerland in 1972 still retained many of its old ways, not least because it had not suffered physical damage during the wars. Thus, Zürich as I and my family experienced it when we arrived in 1972 still was in many respects – and even architecturally – a European city of the early part of the century, and it was of special significance to me that from it I was able to make a palpable extrapolation to the lives of my parents, who had grown up in prewar Leipzig and Budapest before coming to America in 1930. I think the same was true of academic life as I experienced it at the ETH of that time. In the course of the year 1972–1973 I came to realize, in ways I could not have before, how I was an

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American, and how American I was. At the same time I came to a better sense of how European in my perspective I also was, as a result of my background, and these European views became reinforced. In 1976–1977, at the time of our second stay in Zürich, the city – and also its academic life – already had begun to change profoundly. By 1989–1990, my final year of residence in the city, an entire set of alterations had become irreversible. No value judgment is intended – only again the sense that I am chronicling a largely bygone era.

At that time the entire ETH was located primarily in the Universitätsstrasse quarter (Photos 1 and 2). From the very first I was welcomed generously, above all by Albert Eschenmoser and Vladimir Prelog, but as well by a host of others. In 1972 the new chemistry tower at Universitätsstrasse 16 was just in the midst of construction, so that the teaching laboratories of the Institute for Organic Chemistry, and in addition a few of its research laboratories, still were housed in the historic old, original building, the ‘Altbau’, shared with the inorganic and physical institutes. However, most of the research activity in organic took place in the ‘Neubau’, the post-World War II structure at Universitätsstrasse 8 built especially for the organic chemists under the leadership of the great Leopold Ruzicka (Ruzicka still came to the labs to visit off and on in 1972, although by then he no longer was very active; I only met him briefly on a couple of occasions). I was assigned one of the six desks in a long, rather narrow room near the old library in the Altbau. Three desks were held by ETH-Privatdozenten, and three by visitors. By some standards this arrangement might have been considered lacking in privacy, but in fact it provided for an extremely stimulating atmosphere. We all respected long periods of relative quiet (and, as I remember, there was only a single telephone, which we were careful to use only for quick incoming messages). At the same time, scientific interactions were natural. Hans-Beat Bürgi occupied the adjoining desk, and as the year progressed I witnessed at first hand the development of the ideas now summed up in the concept of the Bürgi-Dunitz trajectory for nucleophilic chemical reactions at a carbonyl function.

As a result of crowding, all the groups of the Institute worked on top of one another, so to speak, the consequence being an environment with a great deal of intellectual cross fertilization. In addition, just above our office, on the top floor of the Altbau, was the ‘Chemie Bar’, the Institute’s cafeteria, where throughout the workday one found lively chemical conversations, accompanied by coffee and food. Architecture has much more influence on the easy movement of scientific ideas, and hence on



Photo 1. Entrance to the ‘Altbau’ of the Chemistry Department



Photo 2. Chemistry Buildings on Universitätsstrasse

real productivity, than I believe is appreciated, or at least properly acted upon, in the design of modern laboratories. During my second visit, just four years later, the splendid new tower was complete. Each member of the Institute had his own floor. I had my own private office. I do not wish to imply that this second visit was not a success in all respects, intellectually and otherwise – for, as will be seen below, quite the contrary certainly was true – but it was undeniable that the frequency of random interactions had been curtailed, and that I had to resort much more to meeting with people by appointment than had been true earlier.

Albert Eschenmoser is an extraordinary man. The son of a butcher, he grew up in Canton Uri and attended Oberrealschule in St. Gallen before receiving both his un-

dergraduate and graduate training at the ETH. His brilliance was soon recognized, and his uncovering of the relationships that ultimately would blossom into the biogenetic isoprene rule, building upon Ruzicka’s great work in this area, but reaching well beyond it, had brought him to the attention of the chemical world early in his career. Given the benefit of hindsight I now realize that, just at the time of my arrival in Zürich, Eschenmoser faced an interesting and critical juncture in his career. The immense collaborative effort of the total synthesis of vitamin B₁₂ had been completed in February of 1972, and while there remained some important matters to be worked out, it seemed evident that Eschenmoser was at the same time searching for a new domain of research. It now is clear that I was present at a pivotal moment: the end of Eschenmoser’s efforts in the area of high-profile organic natural products synthesis and the beginning of his exploration of the self-assembly of the molecules of life, the project that has occupied him ever since. One could say that, having in the 1950’s considered the question: How are the molecules of Nature (at least, the isoprenoids) assembled? – and then digressed a while to answer the question: Am I able to assemble Nature’s molecules? (Yes!) – he advanced to questions that are considerably more profound: How did the molecules of Nature become assembled in the first place? Why those particular molecules? However, to emphasize the point once again, little of this was apparent to me in 1972; I simply was visiting in the research group of one of the few organic chemists in the world – indeed, perhaps the only one at that moment – who stood on an equal footing with Woodward.

Certainly Eschenmoser led his laboratory, but at the same time there were two lieutenants who, in fact, oversaw essentially every practical aspect of its experimental operation: Jakob Schreiber (Photo 3) and Dorothee Felix. Neither one spent

more time on theory than necessary; on the other hand, if I think of the most accomplished all-around experimentalists I have met in my life as a chemist, these two stand alone for me at the top (and, indeed, they trained a number of the other gifted experimentalists I have known). As a young man Jakob (Schaggi) Schreiber had trained as a forester, coming relatively late in his life to the ETH, as a result of the good offices of a man in his village who recognized his scientific abilities. It needs to be emphasized that under the relatively restrictive mores of the Swiss society of that time, both academically and socially, this was quite an unusual circumstance. Although Schreiber was more or less Eschenmoser's age – in fact, somewhat older – he had been Eschenmoser's first doctoral student. When the two were together, one always sensed the exceptional bond that existed between them; while I have no real evidence, I suspect that each had a special empathy for the other as one who had risen from relatively humble roots in an era when it still was true that so many in academic life, and perhaps especially in European academia, came from the more comfortable upper middle classes, if not the upper class. Schreiber stayed on, devoting his entire career to the Eschenmoser lab. I think it is fair to say that otherwise he might have had a successful, but nevertheless relatively prosaic, career in the Swiss chemical industry. As it was, with his extraordinary practical intuition and manual dexterity, he made possible for Eschenmoser and for countless graduate students and postdoctoral fellows what otherwise might have been technically unattainable (it should not be forgotten that it was Schreiber's hands which had enabled the younger group at the ETH to best Woodward and his collaborators in the colchicine race.) Schreiber was the first to transform high-pressure liquid chromatography from a relatively obscure analytical method to a working technique usable for synthesis, just in time to overcome problems of separation that promised to present insurmountable practical obstacles on the path toward vitamin B₁₂. The credit for pioneering in this area (as opposed to developing a commercial instrument) that the Waters Corporation received at the time was misplaced.

A big, gruff man, of enormous physical strength, Schreiber was a person of deep integrity and unfailing generosity, totally devoted to the greater cause of the group and, beyond that, to the entire chemical enterprise at the ETH – for example, he made major contributions toward the design of space in the new chemistry tower at Universitätsstrasse 16. In addition to being a Forstmeister, he served as Jägermeister (responsible for, among other matters, the census of deer and the culling of the herd) in his town of Dietikon, outside Zürich, and

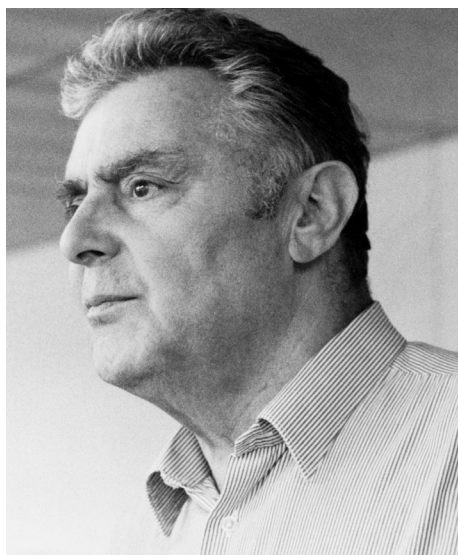


Photo 3. Jakob Schreiber Photo: P. Häfliger

in this status he shared a stake in a 'Waldhüsli' where Eschenmoser group festivities could be held. Especially for this purpose he had constructed from heavy gauge stainless steel a one-of-a-kind grill in the shape of a porphyrin ring, and this was brought out with ceremony at all group occasions. Moving well ahead in time, for his 70th birthday I had obtained an authentic GM poster of the vintage Corvette sports car he had driven during a research stay in the States, at NIH. Not to be outdone, he made for me in return the splendid, also one-of-a-kind, *corrin* grill (Photo 4) – as opposed to *porphyrin*, a difference, of course, of just a single carbon atom – which my family uses on festive picnics at our summer cottage in New Hampshire. During my last visit to the ETH, in 1989–1990, I visited the home in Alvaneu, in the Albulatal, which Schreiber had built for his family almost entirely with his own hands, and mostly from brand-new material discarded at construction sites – a fact that gave him enormous satisfaction (although the phenomenon of its very possi-

bility infuriated him to the core of his thrifty Swiss spirit). By that time a heart problem, which he treated only with nitroglycerine, had advanced; he suffered chest pain when walking up even a modest incline. Not long thereafter Schaggi Schreiber died of a massive heart attack, fittingly as he was sawing down trees near the Waldhüsli in Dietikon. In all he was a prodigious personality.

Although she, too, is as Swiss as Swiss can be, and also an early Eschenmoser doctoral student who spent her entire career with the group, in some respects one would be hard pressed to invent a more polar opposite to Schreiber than Dorothee Felix (Photo 5). Above all she was a technically proficient and scientifically confident woman in a nation which in 1972 barely had come around to granting women the right to vote in its elections – and even then still not in some cantonal ones – a society where it was taken for granted that the fundamental concerns of women were limited to the holy triad of Kinder, Kirche, Küche (a conception in which Schreiber believed fervently). Where Schreiber grew up in the countryside, her background is Stadt Zürich, through and through – careful, prosperous, frugal. Once, during the summer of 1991, I spent a few weeks as a guest in her lovely home while Eschenmoser and I were finishing some writing. In all ways she was a most generous hostess, but nevertheless I insisted on doing my share. We cooked breakfast and dinner together, and I did my share of the shopping. Noting a lack of salad oil in the house, I brought home from Migros some ordinary olive oil. Dorothee's comment: "So ein edles Öl ist fast nie in diesem Haus gewesen!"

Felix was, for all efforts employing the technique of gas chromatography in the group, what Schreiber was for high-pressure liquid chromatography: the source of authoritative information and experience that could, and often did, spell the difference between success and failure. Despite



Photo 4. Albert Eschenmoser, the author, and Jakob Schreiber, with the corrin grill made by Schreiber for the author



Photo 5. Dorothee Felix

all their differences in background and temperament, the two were extremely close friends, above all united by their loyalty, altruism, and devotion to the group. Unquestionably, they ran the lab as a duo. Every afternoon, promptly at four, Dorothee would make tea for herself, Schaggi, her apprentice students, 'der Chef' (Eschenmoser), and any visitors, such as myself. Cookies were served, and the discussion, though often of group matters, might cover almost any topic, especially the Swiss political scene. Dorothee also maintained plants and flowers throughout the entire laboratory. Once, when I took over the watering duties for her for a few weeks in her absence, I found out just how many there were! Always an active member of the Swiss Alpine Club, she still continues to hike and ski avidly.

A third pillar of stability in the group was Fräulein Hermine Gächter, soon to become Frau Zass (Engelbert Zass was an Eschenmoser Ph. D. who has stayed on at the ETH, in the broad area of informatics) (Photo 6). Hermie Zass has handled essentially every aspect of Eschenmoser's correspondence, publication, and administrative life for more than thirty years. Her skills (in three languages and a dialect), efficiency, and diplomacy were, and are, simply astounding. A complex manuscript that by any normal standard might have taken a person a week to type would be completed in an afternoon. Errors? For all practical purposes, there never were any; they simply are not permissible in her world view! Beyond this, she attended to myriad administrative matters for us all in the group, always seeming as if she had nothing else to do. It was to her effective searching that our family



Photo 6. Engelbert Zass and Hermine (Gächter) Zass



Photo 7. Duilio Arigoni and Vladimir Prelog

owed the extraordinarily attractive apartment we lived in on Clausiusstrasse during our second stay. She also found for me the similarly excellent flat on Hochstrasse in 1989–1990. As with Felix and Schreiber, over the years Hermie and Engelbert Zass became our close friends.

Other than Eschenmoser, the three members of the Institute with whom I interacted extensively were Vladimir Prelog, Jack Dunitz, and Duilio Arigoni (Photos 7 and 8). It was still three years before Prelog would be awarded the Nobel Prize. When he had taken over the chairmanship of the Institute at Ruzicka's retirement, Prelog had initiated the process of 'Americanizing' what had been until then a traditional Germanic structure with a single all-powerful Head; by the time I arrived, the Institute consisted of eight Full Professors having equal status (D. Arigoni, J. Dunitz, A. Eschenmoser, E. Hardegger, O. Jeger, J. Oth, V. Prelog, W. Simon). Also on the American model, the position of Chairman rotated, although Prelog unquestionably still was seen as the wise leader and father figure of the entire Institute, with Ruzicka being, so to speak, the grandfather. It is hard for me to recall a warmer, more generous person than Prelog, who remained personally entirely unspoiled

by all the honors he received in his lifetime. I immediately renewed my acquaintance with him, and with Dunitz, whom I likewise had met at Yale when he lectured there for a few weeks (Yale had tried, unsuccessfully, to hire Dunitz at that time). I also quickly came to know Arigoni, whom until then I had not met. His quickness and incisiveness of mind (in five languages) were breathtaking.

Let me now attempt to give a sketch of

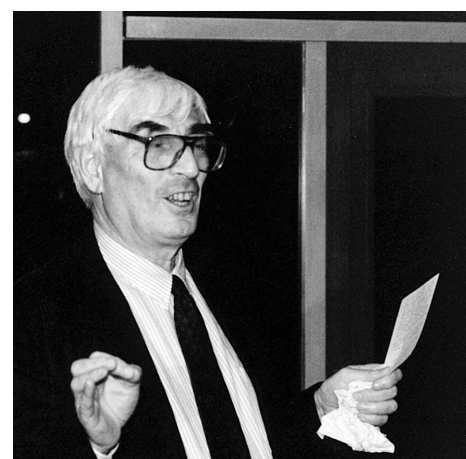


Photo 8. Jack Dunitz

the rhythm of a typical day for me at the ETH. I tended to get up very early, well before dawn, and take some exercise on the track at a school near Hotzestrasse, where we lived. I then helped my wife get our sons up, and we all would have breakfast together. Often I used the tram to get to the ETH. Because we lived at Schaffhauserplatz, where several branches of the Zürich transportation system come together, there were many options, each providing for me a projected (and nearly always real!) elapsed time of service of about twenty minutes. I could take the 14 or the 11 to Central, connecting with the 6 or 10 to ETH. Alternatively, I could hop on the 7 or the 15 to Haldenegg (one stop above Central), again connecting with the 6 or 10. Finally, there was the possibility of the 33 trackless trolley bus from Schaffhauserplatz to Seilbahn-Rigiblick, followed by the 9 or the 10 (but now in the other direction) to ETH. In 1972 the charge was just 70 Rappen (Centimes), so less than twenty cents at the rate I had changed my money on arrival, and about thirty after the dollar's fall (to which I shall return). However, just as often I walked. The elapsed time was more like half an hour, but I found great pleasure in observing the Zürich scene as I went along.

At the Institute Schreiber had assigned me some lab space in the Neubau, near his own, and I began a few experiments on work that continued from Haverford. However, my heart was not really in this, and so I soon gave up the experimental work entirely, realizing how much more I could profit instead from the lectures, both graduate and undergraduate, as well as the group seminars, regularly given by my extraordinary new colleagues, while concomitantly committing myself to extensively reading the literature in association with these offerings. I gained a new perspective on undergraduate teaching, for the lectures, on the European model, were designed to provide students with a comprehensive knowledge, to enable them to pass disciplinary examinations after two and four years rather than individual one-hour and final examinations on a per-course basis, as in the American system. I do not wish to overstate the differences, for the students still, indisputably, were compiling facts, if for a distant and potentially overwhelming examination. Nevertheless, on the whole attendance was excellent, and there was a refreshingly open and inquiring attitude, in contrast to the reflexive and so frequently intellectually defeating intensity which regularly builds up in an American college classroom with each successive assignment and hour-examination within a relatively narrow time frame, culminating in a final examination centered on a single course, which then is 'done'. From my own point of view I took home a new philosophy of

constructing a lecture, and never again in my career would I lecture toward specific short-term hour examination material.

Prelog soon began a tradition of treating me to Kaffee und Kuchen nearly every day at the Chemie Bar. Here I must digress for a moment regarding some Swiss customs that regulated the structure of the day. Most people ate an early breakfast (Frühstück) and were at work betimes – as early as seven o'clock, certainly by eight. Then, quite universally, sometime between nine and ten, everyone had a snack time – Znüni (zum neun). Children went off to Kindergarten each day with a special Znünitäschli; I still have my younger son's from 1976. For adults the standard Znüni was a cup of coffee and a sweet roll or some yogurt. Mittagessen, on the other hand, was a meal in flux. Traditionally this had been the big meal of the day. People went home, from work and from school, to eat, to have time with family, and to rest. The entire process might take two hours. However, this custom clearly was at odds with the pace of 'modern life', and by 1972 many people took their midday meal at their place of work (although children still came home from school). At four one broke again, for Zvieri (zum vier). Again, coffee, but now generally with something really sweet, for example, a nice piece of Torte or Kuchen. Work then continued until six or even seven. Abendessen at home traditionally was quite a light meal. In sum, the traditional work day might cover twelve hours, of which close to four were engaged in meal breaks. One cannot help but find this a civilized schedule; nor, on the other hand, were the Swiss ever known for not getting work done! Prelog gladly would have taken me along to both Znüni and Zvieri, but because I often had tea with Felix and Schreiber in the afternoon, Znüni (for Prelog, customarily, at ten) was more usual for us. I was particularly fond of a chocolate-covered hazelnut 'Hörnli', generally with a cup of tea. Sometimes others would join us, especially Arigoni. As I already have indicated, Prelog always insisted on paying, no matter how many people were in the party ("Ich bin ein reicher Mann!"). Indeed, since he was a member of Ciba's board of directors – and also even possessed a kilo of pure gold in prize medals – no one ever worried about his financial stability as a result of these outflows. Prelog always went home for his Mittagessen. Mine at the Chemie Bar frequently was with Eschenmoser, Dunitz, Felix, and Schreiber, and generally focused on chemical topics; Dunitz and Eschenmoser shared research ideas constantly.

In this context I should mention the language spoken, for this depended on the company and the situation, and might be dialect, German (that is, Hochdeutsch), or English. The official language of the Institute was, of

course, German, and all lectures were delivered in this language, despite the fact that it was, in fact, the true mother tongue only of native Germans and Austrians. Some group seminars were conducted in English, both because there often were many American and British (and some Asian) postdoctoral fellows and perhaps even more because the faculty recognized the value for their students to be able to communicate fluently in scientific English. Prelog's native language was Croatian, although his German was essentially perfect. His English was fluent as well, if riddled with small errors, comparable with mine in German. Nevertheless, in this circumstance it was natural for us to speak English together. Dunitz too spoke excellent German, and he delivered fluent lectures in that language. However, since he was a Scot, the language spoken around him more often than not also was English, and obviously the two of us spoke English with each other.

More interesting were the circumstances arising from the very real conflict among Swiss Germans about what their native language really is, and I shall return to this subject in somewhat more detail when I relate our children's experience. Schreiber, Felix, and Eschenmoser invariably spoke with each other in dialect; for them to speak High German among themselves was unnatural. However, when an English-speaking guest was present, the dialect generally could not be an appropriate medium of communication, and instead the conversation at the entire table almost invariably would switch to English, not German, even if (which was certainly by no means the rule!) the English-speaker could understand and speak German. I was able, after a while, to follow the dialect reasonably well, if never perfectly, but to actually speak it properly out of the depths of the throat was quite beyond my reach (in fact, somewhat the same circumstance regarding the dialect held for Prelog, Dunitz, and even also for Arigoni, though he was Swiss, from Ticino, and fluent also, as I already have indicated, in German, French, English, and Spanish, as well as his native Italian; in general, only the German-Swiss can handle their own dialect effortlessly). Appreciating, however, how much this particular American wished to immerse himself in another culture, my Swiss friends generally did me the enormous honor of communicating with me in German, mostly (except, sometimes, for Dorothee Felix) suffering in silence my grammatically incorrect, if reasonably fluent, renderings. Perhaps the saving grace for me in Switzerland has been that the Swiss do not worry too much about perfect German grammar. Indeed, in the dialect, many of the inflections are hidden. In any event, my efforts to join the community in this linguistic sense, even if imperfectly, differen-

tiated me from most – sadly, indeed, nearly all – other Americans. Both at the ETH and in the larger society, and certainly not least because of my wife's essentially flawless German (the result of her previous graduate study in German literature), we were welcomed as Americans with a distinctly European outlook, ultimately allowing us to develop a very special set of relationships that have been close and lasting.

As a seasoned veteran of the wars of student unrest in the United States, it was interesting for me to observe the initial stages of similar troubles, which in 1972 only were beginning to loom within the Swiss bastion. I tried to lend some warning and useful advice, but perhaps quite understandably – for Switzerland had, after all, fended off involvement in two World Wars! – my Swiss colleagues could not yet really comprehend the phenomenon of students confronting their teachers, seeing this as an American aberration, transplantable perhaps to Germany and France, but not to Switzerland. On the whole, they were of the opinion that, "It can't happen here". They were wrong, and unfortunately they were fated to experience over the next few years, if rather less violently than their colleagues in Germany, just how incorrect their assumption would prove to be.

Throughout the year I helped both Eschenmoser and Prelog with various projects, on the surface mostly with matters having to do with the proper English rendering of their Germanically inflected texts, but in the process I was able to become much closer to them and to the work taking place in their groups. Indeed, my perspectives in organic chemistry as a whole were very significantly broadened by these interactions. Quite randomly, off and on Eschenmoser generously would add a thousand francs to our budget – presumably when there was some grant money left over, although I don't believe I ever asked him about the source. This never was in response to any request from me, for it certainly had not been part of our agreement, nor did I actually need this money, but in fact it allowed the Wintners a few extra little extravagances in our new Swiss life. All in all, we felt as though we were very wealthy, in that we were able to do essentially everything we wanted to do. In this respect, however, I might add an extra note, for 1972–1973 was no ordinary year in the currency markets. I had arrived with a bank draft for \$9,000, which was all we had to carry us through the nine months of our intended sojourn. Sometime in October this was converted by the Bankverein in one lump sum into somewhat more than 35,000 Swiss francs – so, at an exchange rate of almost four-to-one. This, then, was our hoard for the year, to be budgeted at 4,000 francs per month.

At that time the entire society appeared

(to an American) to run largely on a cash basis. For example, I was astounded to discover that the graduate student teaching assistants at the ETH were paid in cash. On pay day the departmental secretary would go to the bank and withdraw literally tens of thousands of francs, which she then distributed to the students in envelopes. Few people had a checking account, and they walked about with what seemed to me to be enormous sums – several thousand francs – in their pockets, a habit that we would see change within a period of just a few years. Even I came to think nothing of carrying four or five hundred francs, whereas in America I never would have considered having more than thirty or forty dollars in my billfold. Of course, to place a value on 500 francs in the Swiss society compared with 125 dollars in America at that time, was not easy, just as today the equivalent exercise is not, for this varied considerably with the goods and services involved. Clothes and meat, for example, seemed extremely expensive; rent, despite Swiss complaints, less so – ours was 600 francs; transportation and milk products, subsidized by the state, were a bargain.

Little did I know when I made my unavoidably large transaction – which had seemed to me somewhat risky and irreversible at the moment – how serendipitously favorable my financial arrangements soon were to prove. By bringing in our money all at once and changing it at the beginning, I had, effectively, turned us into a Swiss family for the year. When, later that fall, the first great 'oil shock' hit the world financial markets as a result of the pull-back in production by the Organization of Petroleum-Exporting Countries, the exchange rate of the dollar vs. the Swiss franc fell within a period of just a few days from four-to-one to not much above two-to-one, finally settling at about 2.3. Suddenly it took 225 dollars, not 125, to buy the same 500 francs! Essentially overnight, all my American colleagues at the ETH who were on a regular monthly dollar stipend from the States had only half the buying power they had had the day before, and indeed many felt forced to return home within a month or two. However, for us, living frugally on a Swiss franc budget in a Swiss franc society, and with no new dollar income, there was essentially no effect, except the psychological one of realizing that a cup of coffee now cost a dollar and a half – and we quickly learned not to think this way! Indeed, this set of circumstances actually was just another aspect of the year that made us more 'Swiss' than I ever had imagined would be the case.

We returned to Zürich in 1976–1977 with the help of an American-Swiss Foundation grant which I was able to obtain with Eschenmoser's support, and it was during this year that we came perhaps as close as

Americans reasonably could, without being expatriates, to becoming a Swiss family, not least because of our ETH friends, as I now shall relate. Our older son was assigned to the Schulhaus Huttenstrasse, an excellent school located just up Universitätsstrasse from my office, and to his age group, which in Zürich was the first grade, Erste Klasse. This had commenced already the previous April, as still was the Zürich custom at that time. It is in Erste Klasse that, immersed as into a cold bath, the children begin their study of High German, which is to them, to a far greater degree than might be realized, a completely foreign language. I found (and so did my wife, even with her grammatically perfect German, and also my mother, native German speaker that she was) that young children in Zürich often could not understand a word I said, this being due not so much to my accent as to the fact that the spoken words of Hochdeutsch and of Züridütsch simply do not sound at all the same, not to speak of their varying grammatical and syntactical constructions. Thus, our son was learning German as a foreign language, but so were all the others in his class, and in this sense it was essentially no harder for him, especially as after the summer break the dialect quite specifically no longer was used in the classroom by the teacher, except under urgent circumstances, for which, in his case, she was able to speak English to him when absolutely necessary.

However, this was only half the story, for the moment the children went out to the school yard, dialect was the only language spoken. After some days it came out hesitantly from our son that he was being entirely left out of all the games, and that he found himself unable to break in. Asking their advice, I outlined this situation to Jakob Schreiber and Dorothee Felix at lunch in the Chemie Bar. First, after some extended debate, as I remember, they agreed upon the best formalism for the circumstance. Then, with considerably more effort, they taught me to say, so that I could transmit the question to our son: "Hchan-i-au-miitmache?" That is, in High German: "Kann ich auch mitmachen?" – "Can I join in?" (This is all run together, starting with the "Hchan" far, far back in the throat, the first "i" short, the double-"i" more, though not exactly, like an English long "e"; and, indeed, the written similarities between the renderings I have attempted actually are greater than are the oral). I went home and practiced this with our son. Our landlady then coached him further in pronunciation. This was all that was needed; it worked like a charm upon its very first use, and from then on our son made friends.

My activities at the ETH during this year were extremely rewarding. With Prelog I began the work that was to lead a few years later to my little paper on two-dimen-

sional chirality (*J. Chem. Educ.* **1983**, *60*, 550). Of greater significance, Eschenmoser and I wrote the paper for *Science* that, to this day, remains the sole 'scholarly' account by Eschenmoser in English of the great 'ETH route' to the pinnacle of the total synthesis of vitamin B₁₂. Although it is clear that for the most part my contributions had to be limited to the structural and linguistic spheres, as opposed to the scientific, I actually am very proud to have been a participant in the writing of this article (*Science* **1977**, *196* (No. 4297), 1410), for I think it probably would not have appeared at all – that is, in English and in *Science* – had I not been on the scene in 1976–1977. Nevertheless, it never has been lost on me that Eschenmoser's coworkers in the B₁₂ effort may have wondered how my name came to appear with his on this article, for clearly I had made no experimental or theoretical contribution to the work. Briefly, the circumstances were as follows.

By 1976 Eschenmoser found himself in a complex position. The total synthesis of the vitamin had been a fully collaborative effort, commanding the essentially undivided efforts of both laboratories and a hundred chemists for well over a decade, and a collaborative report was warranted. However, four years already had passed since the completion of the synthesis, and Woodward, now sixty years old, still had not published a full theoretical and experimental paper – as opposed to a communication – on chlorophyll, at that point sixteen years in the past. Clearly adding to the problem was the fact that throughout the period of the ongoing synthesis Woodward had quite regularly communicated on its progress, by means of published lectures (without experimental parts, of course), culminating in his IUPAC lecture in New Delhi (1972), where the successful conclusion was announced. However, in the four intervening years even the appearance of a more formal, joint preliminary communication with Eschenmoser, with at least the customary skeletal experimental summary, had been postponed.

On the other hand, there was the further complication that in the course of the undertaking two routes in fact had been developed. One was the fully joint effort, making use of Woodward's famous 'Western' (A-D) half, and Eschenmoser's 'Eastern' (B-C) half, as well as the ETH coupling methodology (and, of course, the inestimable contribution of Schreiber's HPLC), and it was this work that had been so highly publicized; indeed, by means of the aforementioned published lectures Woodward had presented a fairly comprehensive outline of this fully collaborative route to vitamin B₁₂. The second route, while it too relied on the collaborative vision in its final steps, nevertheless had at its heart the photochemi-

cal A-D coupling approach conceived and executed solely at the ETH; in this sense it could, and did, stand alone. Furthermore, material gained by means of this route actually had been used to first complete the final steps. However, this 'ETH route' had received considerably less publicity, although Eschenmoser had summarized his group's achievement in an article in *Naturwissenschaften* **1974**, *61*, 513, also essentially the transcript of a lecture he had delivered in Zürich to the Zürcher Naturforschende Gesellschaft.

While Eschenmoser naturally had hesitated to move forward further under these circumstances, I strongly encouraged him in his own vision that he might at least write an overview for *Science*, an expansion of the *Naturwissenschaften* article, and especially in his idea to include additionally what had not appeared in explicit form in *Naturwissenschaften*: a full formulaic reaction scheme for the 'ETH route' with a table of the experimental conditions for each individual reaction step as well as the reference to the ETH thesis where the corresponding detailed procedure could be located. In sum, my role evolved to some extent from what had begun as that of simply a translator or editor to one where I was what I might term – lacking a better word – a companion in the somewhat enlarged enterprise of bringing out the *Science* paper. In contrast to Eschenmoser, who doubtless was too close to the matter emotionally, it was my own opinion that Woodward could not, and would not, be offended if this action were taken. I think my intuition in this regard proved to be correct. I saw Woodward for the last time in June of 1979, when I stopped by his office one afternoon, just before flying out of Boston on a trip. He was in an expansive mood, and we talked for several hours. In the course of the conversation he made clear to me several times not only that he was not affronted, but – on the contrary – that he had been pleased, and even relieved, that we had published the *Science* article and thereby clearly delineated Eschenmoser's great, and independent, contribution. When I returned to Boston, on July 10, I was handed Woodward's obituary in the *Boston Globe* from the day before.

I spent the academic year 1984–1985 on sabbatical leave at Harvard, where I taught the large undergraduate course in organic chemistry, Chemistry 20, in the fall semester and was entirely free of teaching duties in the spring. As it happened, that fall I overlapped for several months with Eschenmoser, who also was in residence at Harvard, holding the then-newly-created Woodward Visiting Professorship. Eschenmoser suggested I write an article for undergraduates on bent bonds, a subject that had intrigued him for some time, and the result was a paper published in *J. Chem. Educ.* **1987**, *64*,

587. Our interaction renewed my desire to work with him once again at the ETH. By 1989 I was feeling somewhat worn down by a relatively heavy administrative and teaching load at Haverford, and so when Eschenmoser invited me to return to Zürich in 1989–1990, I jumped at the opportunity. I worked with him on his HOMO-DNA project, as well as on an appreciation of Woodward's chlorophyll synthesis and the Woodward A-D ring strategy for the vitamin B₁₂ synthesis, initially conceived as a contribution toward a planned obituary for Woodward. The obituary ultimately took another form, and we did not publish this work, although, when I returned to Haverford, I incorporated the perspectives given me by this study of the chlorophyll synthesis into a new course offering.

Taking my midday meals with my friends at the ETH – Dorothee Felix and Jakob Schreiber, Hermie and Engelbert Zass, Arigoni, Dunitz, Prelog, Eschenmoser – and in the evenings dining with the students at the Mensa (my wife could not leave her teaching position in America that year), once again I came to feel almost Swiss, as I savored all the small delights of Zürich. Also, my German had become more and more instinctive (even if grammatically hardly less imperfect), and I actually began to dream in German. Finally, I might add that this was an extraordinary period for Europe, not to say the entire world: on 9 November 1989 I watched on television as jubilant crowds began to stream freely through the Berlin Wall at 'Checkpoint Charlie'.

My years in Zürich broadened profoundly my intellectual perspective as a person, and certainly also as a chemist and teacher. I suppose that as a chemist I remain above all the product of my study with Woodward and, as a teacher, of my apprenticeship in teaching with William Doering when he was at Yale. But at the same time I cannot acknowledge strongly enough the collegial mentoring I received over a period of more than two decades from so many people at the ETH, and above all from Albert Eschenmoser and Vladimir Prelog.

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