University of Zurich[UZH]

Paul Karrer

Nobel Prize in Chemistry 1937

Nobel Prize in Chemistry 1937 "for his investigations on carotenoids, flavins and vitamins A and B_2"

* 21 April 1889 in Moscow
† 18 June 1971 in Zurich

1918–1958 Professor of Organic Chemistry at the University of Zurich
1950–51 President of the University of Zurich

Karrer's Carrots

Zurich was Paul Karrer's stomping ground. After studying at the Department of Chemistry of the University of Zurich under Nobel laureate Alfred Werner, he taught and researched for 40 years at the same institution. But Karrer experienced the key turning point in his academic career not in Zurich, but in Frankfurt am Main, during his years at the Georg-Speyer-Haus, a research institute led by Paul Ehrlich, Nobel Prize laureate and founder of modern chemotherapy. In Zurich, under the tutelage of Alfred Werner, Karrer had worked mainly in inorganic chemistry. The five and a half years he spent in Frankfurt after completing his doctorate, however, brought a fundamental change to the focus of his research. Inspired by Ehrlich, Karrer became increasingly interested in biological and medical questions.

When Karrer returned to Zurich to commence a position as associate professor of chemistry in the spring of 1918, he brought with him entirely new scientific ideas gleaned from his sojourn in Germany. Eighteen months later, following the early death of Alfred Werner, he was appointed full professor and director of the Department of Chemistry, and began to entirely reorganize and reorient research at the institute. The focus was no longer on Werner's inorganic complex chemistry but on the chemistry of biologically active natural substances – substances from plants, sugar, and plant dyes. Vitamins were added subsequently as a large, new, and extremely important field of work.

When Karrer returned from Frankfurt in 1918, the Department of Chemistry was in a desolate state; the First World War had clearly taken its toll on the seats of learning. "The many foreign students, particularly Russians and Poles, flew off like a swarm of bees, and tried to get back to their own countries," Karrer later recalled. And the Swiss chemistry students were required to do military service. The consequences were evident: The lecture halls and laboratories were deserted. When, in the spring of the final year of war, Karrer moved into his new domain at Rämistrasse 74, he found just five doctoral students. "There was an atmosphere of gloom," as he put it.

That was to change. In the following lengthy period in which Paul Karrer directed the fortunes of the Department of Chemistry, research blossomed splendidly. And flowers indeed occupied a prominent place in Karrer's laboratory: Plant dyes were a subject that had interested Karrer from an early stage, and he continued to work on them throughout his career. He achieved particular success with the carotenoids – chemical compounds that give fruit and vegetables such as carrots, tomatoes, saffron, and bell peppers their colors of yellow, orange, or red.

Paul Karrer showed that the carrot pigment beta carotene is used by the body to produce vitamin A.

Karrer was able to use chemical analysis to clarify the structure and composition of many such carotenoid compounds. And he identified a link to the vitamins essential to the human body. In the early 1930s, he was able to demonstrate that vitamin A, partially responsible for physical growth and also for the development of rhodopsin in the eye, was generated by the body

from the red carrot pigment, beta carotene, by splitting the molecule. He was also the first scientist to determine the structure of this important vitamin. It was in part for these achievements that Karrer was awarded the Nobel Prize in Chemistry in 1937.

Karrer was not shy of scientific competition. His research into carotene was spurred on vigorously by competition with the chemist Richard Kuhn for the newest insights about important plant dyes. Karrer found himself in a head-to-head race with Kuhn, who researched from 1926 to 1929 at ETH and then at the University of Heidelberg. As far as the Nobel Prize was concerned, Karrer narrowly won the scientific race: Richard Kuhn was awarded Stockholm's greatest honor in 1938, one year after Paul Karrer.

To make his scientific visions reality, Paul Karrer was prepared to work hard, with the utmost discipline, and an unrelenting determination to succeed. He had already displayed these characteristics as a student – or rather, had been obliged to display them. His father, a dentist in Schinznach in the Canton of Aargau, abandoned his family after suffering bankruptcy. In order not to be a financial burden on his mother, Paul Karrer drove himself to study and and earn his degree in only three years, an astonishing feat at the time.

In addition to his own strong work ethic, Karrer also demanded total commitment from his colleagues. At the Department of Chemistry, everything was under his personal control. Whenever possible, he made a twice-daily round of his laboratory, making sure he was informed by his researchers about every little detail of their work. On these occasions, he often took the opportunity to perform some particularly tricky crystallization himself. He concluded these reviews with instructions for the next steps, which his colleagues were then expected to carry out. His subordinates found the frequent presence of their director somewhat tiresome on occasion. "When some important piece of work was coming to a conclusion, Karrer's interest took forms that could be irritating to his colleagues," recalled Conrad Hans Eugster, later a professor of chemistry at the University of Zurich. Indeed, in the decisive phase of a research project, Karrer would visit Eugster in his laboratory up to eleven times a day. Such visitations also displayed the infallible memory for which Karrer was notorious: He was able to supervise up to 40 different experiments at the same time, keeping all the details of each project in his head.

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As a person, Paul Karrer was dignified, reserved, and quite literally buttoned up. A slight and wiry man with a moustache, at work he invariably wore a dark suit over a white shirt buttoned up right to the stand-up collar. With his colleagues in the laboratory, Karrer hardly ever indulged in personal discussions, on either political topics or cultural subjects, though they interested him as a well-read person. All that mattered was science and achieving the goals set for the research at hand – aside from one period of office as president, in 1950/51, during which Karrer was also responsible for the concerns of the whole University. On a personal level, he was happiest spending his evenings at home with his family; his weak stomach inclined him to avoid formal dinners. Tuesdays were an exception to his domestic habits: Then, he went to the Tonhalle, for which he had a season ticket, and enjoyed his fill of classical music.

Paul Karrer was also fairly reserved as a lecturer. At all events, the lectures that Conrad Hans Eugster attended as a student in the winter semester 1941/42 seem to have been less than enthralling: "They were very clearly structured, and accompanied by good experiments, but dry, dispassionate, and delivered with a quiet, monotonous voice … these lectures provided little food for thought." Not in the lecture hall perhaps, but Paul Karrer certainly did give students food for thought – over multiple generations – as an author. Karrer's organic chemistry textbook, written in 1927, became a veritable best-seller, running to 14 editions and being translated into seven languages.

Despite his reserved persona, Karrer nevertheless knew when celebrations were in order. From time to time he would invite colleagues to dinner at his house, with a good bottle of wine, to celebrate some particularly excellent piece of research. Karrer had a very attractive house on Spyristeig where, on the slopes of the Zürichberg, he lived with his wife, Helene, née Frölich, the daughter of the director of the psychiatric clinic at Königsfelden. They had three sons, one of whom died in childhood. Despite their prosperity, they lived modestly, and the well-remunerated chemistry professor possessed neither a holiday home nor a

car. He enjoyed working in his garden, but there, too, always in white shirt and tie. Every day he went to the Department of Chemistry by tram. One night in 1937, a casual observer would have

Paul Karrer was dignified and reserved: even in the lab he wore a dark suit and white shirt with a stand-up collar.

discerned a chain of lights wandering slowly from the Department up the hill towards Spyristeig: As was then the custom, Karrer's students had set out to honor their Nobel Prize-winning professor with a torchlight procession. *Roger Nickl*

Source: Margrit Wyder: *Einstein und Co. – Nobelpreisträger in Zürich;* Verlag NZZ libro, Zürich 2015 **Illustration:** Aline Telek
Translation: University of Zurich

Discovered in Zurich:

Plant Dyes and Vitamins

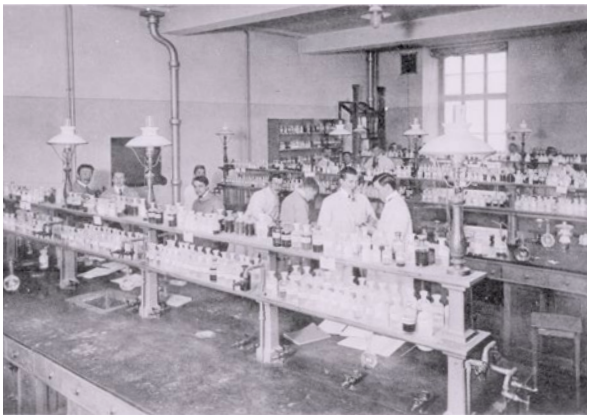
Paul Karrer researched the chemistry of natural substances – organic chemical compounds produced by plants that are often biologically active. A particular focus of his research was plant dyes, and above all carotenoids. These substances give carrots, tomatoes, bell peppers, and many fruits their yellow, red, or orange color, and also account for the bright red of a boiled lobster. Karrer was able to determine the hitherto unknown chemical composition of many such dyes. He was also able to demonstrate that the red carrot pigment beta carotene plays an important role in the human body: This compound is used by the body to produce the essential vitamin A.

At a time when chemistry had to make do with the simplest of technical equipment, determining molecular structures was a high art. In the absence of modern analytical techniques like spectroscopy, Karrer and his colleagues had first to isolate a compound, in order to then break it down, in a controlled process, into known, simple chemical compounds – effectively the fundamental building blocks. Then, in reverse as it were, they had to recreate the original substance from the building blocks. If this total synthesis, as it was known, was successful, it provided confirmation of the chemical make-up of a compound.

In the case of vitamin A, essential for human growth, Paul Karrer was the first researcher to succeed in isolating the active substance from fish liver oil. The vitamin had been known, on account of its effect, since 1906, but scientists had long been unsuccessful in their attempts to obtain the substance in a pure form. Paul Karrer not only solved this problem, but also determined the chemical composition of vitamin A and demonstrated how it originates in the body.

It was not only for these discoveries that Paul Karrer was awarded the Nobel Prize. No less prize-worthy was his research into flavins, naturally occurring yellow dyes. One of these compounds is riboflavin, better known as vitamin B_2, which plays a crucial role in human metabolism. Here, too, Paul Karrer was able to determine the structure of the vitamin. He also discovered ways of synthesizing the active substance artificially in the laboratory, and thus made large-scale production possible. Karrer was subsequently honored jointly with the British chemist Walter Norman Haworth for his research into carbohydrates and vitamin C.

Paul Karrer had an astonishing sense for research topics that were both scientifically important and commercially interesting, as shown by the 78 patents he registered during his career. His research findings are not only milestones in basic chemical and biological research; they also helped lay the foundations for the success of the chemical industry in Switzerland. *(RN)*



Karrer's laboratory at the Department of Chemistry of the University of Zurich at Rämistrasse 74/76.

Paul Karrer (far left) as a doctoral candidate at the home of Alfred Werner, his supervisor and a Nobel Prize laureate (middle).

Always in a suit and a stiff-collared shirt: Paul Karrer in his laboratory.
Photos: University of Zurich