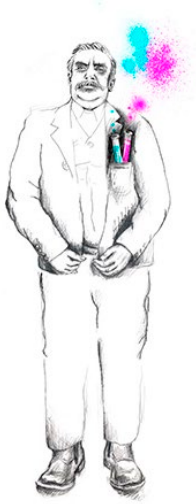
University of Zurich[UZH]

Alfred Werner

Nobel Prize for Chemistry 1913



Nobel Prize for Chemistry 1913 "in recognition of his work on the linkage of atoms in molecules by which he has thrown new light on earlier investigations and opened up new fields of research especially in inorganic chemistry"

* 12 December 1866 in Mulhouse, Alsace
† 15 November 1919 in Zurich

1893 Privatdozent
1893–1918 Professor of Chemistry
at the University of Zurich

Brainwave at the Hotel Pfauen

A stroke of genius in the middle of the night was the beginning of Alfred Werner's fame as a scientist: In 1892, the 26-year-old chemist was staying at the Hotel Pfauen at Heimplatz in Zurich. One night, Werner woke up with the solution to a problem that had long troubled him. At two o'clock in the morning he sat down at his desk and, in a 17-hour marathon of thinking and writing, he set out the fundamentals of his coordination theory; a radical breakthrough that would ultimately revolutionize inorganic chemistry. Drinking countless cups of coffee to keep himself awake, Werner completed his work at five o'clock the following afternoon. The work resulting from this cerebral tour de force was titled "Beitrag zur Konstitution anorganischer Chemie" (on the constitution of inorganic chemistry) and was published in 1893.

In his publication, Alfred Werner developed entirely new ideas on how inorganic complex compounds are arranged spatially, thus creating the basis for modern complex chemistry. Most remarkably, Werner's groundbreaking theory was a purely intellectual feat: At that time, he had had not carried out a single experiment on the subject. As such, he confirmed Albert Einstein's dictum that imagination is more important than knowledge. A German colleague later described Werner's grand achievement as "the impertinence of genius." For his new theory, which in the following years was indeed substantiated by experiments, Werner was awarded the Noble Prize in Chemistry in 1913, the first Swiss to be so honored.

When Alfred Werner's groundbreaking article appeared, he was an associate professor at the University of Zurich; two years later he was appointed full professor. The young professor traveled by bicycle to the Department of Chemistry at Rämistrasse 45 – then a fairly unusual means of transport for an academic of his standing. To conceal his youth and distinguish himself from his students, Werner at the time wore a full beard. Only later did he adopt the moustache that, with the omnipresent cigar, became a hallmark of this corpulent researcher.

Alfred Werner was a bon vivant with a love for convivial evenings, wine, and good food. And he was a dedicated researcher who had discovered his passion for chemistry at an early age.

As a youth in Alsace, the young Werner set up his first laboratory in his parent's barn.

Already as a youth in Alsace, which at that time belonged to Germany, the young Werner set up his first laboratory in a barn on his parents' farm. There he experimented with chemicals that he bought with money he had earned himself. He wrote his first scholarly paper at 18 and presented it to the director of Mulhouse's school of chemistry. The young scientist wanted not only to hear the director's verdict on the quality of his research; he also wanted to learn how long it would take him to become a professor of chemistry. As it proved, Werner required only an extraordinarily short time. From 1886 to 1890, he studied chemistry at the Federal Polytechnical School (today's

ETH) in Zurich, even earning doctorate in this period. Then, after a brief stay in Paris, he returned to Zurich and submitted his habilitation. A little later, on 31 August 1893, Alfred Werner was appointed professor of chemistry at the University of Zurich.

Werner was self-assured, sociable, straightforward, and uncompromising. And because his verdicts on the intellectual abilities of students and colleagues often verged on the scathing, he could appear somewhat formidable. Students referred to him respectfully as the "old man." But Werner also had a reputation as a charismatic teacher who was well able to present complex chemical interrelationships simply and comprehensibly. When he lectured, the auditorium was always full to the rafters. "They sat on the windowsills, in the aisles, and crowded round the laboratory bench in front of the lecturer," wrote Paul Karrer, who studied under Alfred Werner and who succeeded him as head of the Department of Chemistry at the University of Zurich.

Whereas the Polytechnical School had possessed a modern chemistry building since 1886, research at the University was carried out under crude and, by today's standards, unbelievably primitive conditions. The laboratories in the basement of the building at Rämistrasse 45 – the "catacombs" – were legendary. The rooms were gloomy, the floors cold, and there was nothing in the way of ventilation. A doctoral student's workplace was far more sparsely equipped than that of a first-year student today, and even the equipment in Werner's laboratory was extremely rudimentary. On his bench stood a Bunsen burner, a microfilter, a platinum spatula, and numerous reagents. Nevertheless, Werner was known for his ability to exploit these simple means and to draw conclusions about chemical processes solely through precise observation – and by applying his brilliant imagination and his vast knowledge. He could often surmise the nature of a newly created inorganic complex compound simply by observing alterations in the color of a solution.

The Department of Chemistry at the University of Zurich flourished under Alfred Werner's leadership. Many new students and doctoral candidates came from abroad – including many women – and the chemistry building threatened to burst at the seams. To remedy the situation, Werner submitted several applications to the Zurich Department of Education. At first, no heed was paid to his complaints. Only when he threatened publicly to accept an invitation to the University of Vienna did the authorities take notice. Eventually, the cantonal parliament issued a grant of 1.4 million francs for a new building at Rämistrasse 74. The new chemistry building, which today houses the University's Institute of Law, was inaugurated in the summer semester 1909. It was largely designed in accordance with the wishes of Alfred Werner.

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A particularity of the building, a veritable palace after its predecessor, was the way Werner's office was situated. From it, he had direct access to all the most important areas: His private laboratory, the library, a room for doctoral candidates, and a small auditorium were located right next to it; the large auditorium and a student laboratory could be reached by a specially installed iron spiral staircase. Thus, Alfred Werner could traverse his scholarly empire without ever using a public corridor.

Werner's private realm in Zurich, after he had moved out of the "Pfauen," was first located at Klosbachstrasse 48. He moved there with his wife, Emma Wilhelmine, née Giesker, whom he had married on 1 October 1894. That same month, Werner acquired Swiss citizenship. When the apartment proved too small after the birth of his first son, Alfred Albert, Werner built an apartment house at Freiestrasse 111, which today bears a commemorative plaque. In April 1898, the Werners moved into the first floor. "Our apartment is magnificent and we have a wonderful view of the city and the Uetliberg," he wrote to his mother that year. His daughter, Johanna Emma Charlotte, was born there in 1902.

Alfred Werner had, however, little opportunity to enjoy much of family life or the view of the Uetliberg. Over time he became fully engrossed by his work and spent most of his time in the laboratory. His immense dedication was notorious: He was not only in his office or laboratory on Saturdays – the six-day week still applied at the time – but could also be found there on Sundays. When not immersed in his work, he would occasionally go hunting with friends in the Canton of Aargau.

Werner not only worked hard, he also played hard. In the evening, he often relaxed with other scientists in the bars of Zurich, discussing work and sharing a drink. He also enjoyed

games: He particularly liked chess, billiards, and bowling, and he played countless games of Jass in Zurich's bars. A celebrated host, his Christmas parties were legendary. "He was born to be extraordinary: In his work ethic, in fulfilling his duties, and even in his social life," is how Paul Keller, with his typical dry humor, later summed up the characteristics of his mentor and predecessor.

Shortly after Alfred Werner was awarded the Nobel Prize for Chemistry in 1913, the shades of his early and tragic death began to gather. His doctors diagnosed a "general arteriosclerosis, particularly of the brain."

Werner liked chess, billiards, and bowling, and played countless games of Jass in Zurich's bars.

Werner was already weakened by permanent overwork and excessive alcohol consumption, and had little resistance left. From 1915 onward, he was repeatedly unable to lecture, and had to be represented by his colleagues. On 6 May 1919, Emma Werner was forced to write to the Zurich Department of Education, requesting them to relieve her husband of his duties. Six months later, Alfred Werner, who had revolutionized inorganic chemistry, died at just 53 in the Burghölzli hospital in Zurich. *Roger Nickl*

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

Created in Zurich:

A New Theory of Coordination

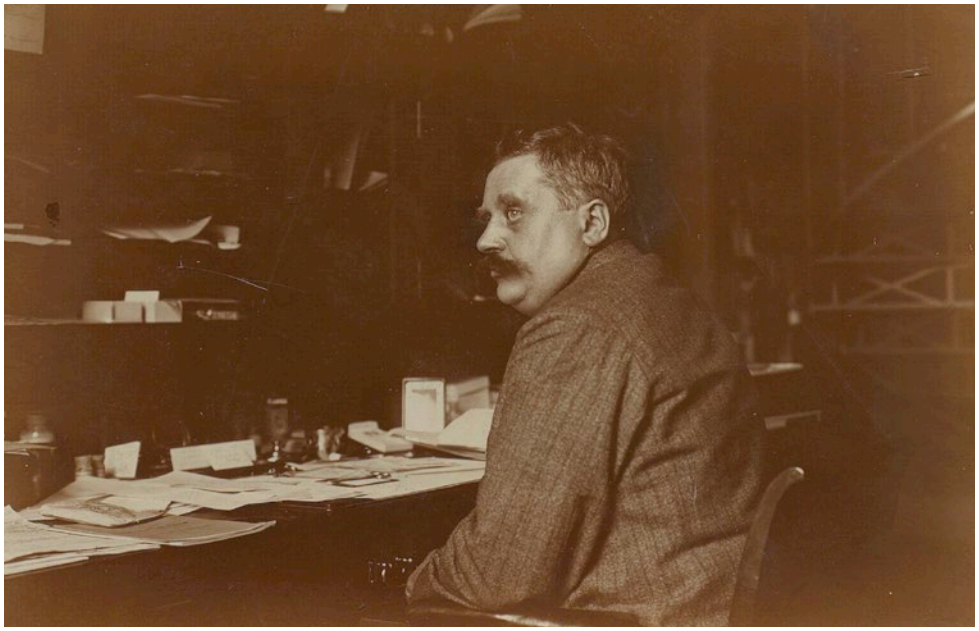
At the end of the 19th century, organic chemistry and its ground-breaking research on carbon compounds had reached its zenith. By contrast, inorganic chemistry, which was concerned with all non-carbon compounds, was deemed uninspiring and generally discounted.

Research in organic chemistry was at that time focused on the three-dimensional structure of molecules: By more clearly defining the spatial structure of chemical compounds, researchers were increasingly able to describe their behavior. Yet inorganic chemistry was dogged by a complete absence of any viable theory for the spatial structure of molecules. There was, however, a vigorous theoretical dispute among researchers in this area – a dispute in which Alfred Werner joined energetically.

The Danish chemist Sophus Mads Jorgensen, Werner's toughest opponent in this battle of ideas, attempted to impose concepts from organic chemistry on inorganic chemistry. He hoped thus to settle the open question of the structure of inorganic complex compounds. An adherent of the so-called chain theory, Jorgensen postulated that inorganic compounds consisted of atom chains attached to a metal atom. The atom chains, as Jorgensen envisioned them, resembled the hydrocarbon chains already familiar in organic chemistry. Werner saw things very differently and, in the end, was able to demonstrate that inorganic complex compounds have a geometric spatial structure. It was this insight that enabled researchers to conclusively explain the chemical behavior of complex compounds in the laboratory.

Alfred Werner first outlined his coordination theory in 1893, in an article published in the *Zeitschrift für anorganische Chemie:* "Beitrag zur Konstitution anorganischer Chemie" (On the constitution of inorganic chemistry). At that point in time, Werner had still done no experiments to confirm his then radically new understanding of inorganic complex compounds. In the years that followed, Werner's laboratory experiments provided proof that his theoretical assumptions were entirely correct. It was in recognition of this work that, in 1913, he was awarded the Nobel Prize in Chemistry. He was not only the first Swiss to be so honored but also the first inorganic chemist to receive the distinction. *(RN)*

A striking moustache was Alfred Werner's signature feature.



Werner initially developed his groundbreaking theory on inorganic complex compounds at his desk: Only later did he prove it with laboratory experiments.

Legendary laboratory: The "catacombs" in the old chemistry building at Rämistrasse 54.

Alfred Werner was instrumental in the construction of a modern chemistry building at the University of Zurich. The new premises at Rämistrasse 74/76 opened in 1909. Photo: Zentralbibliothek Zürich