



Universiteit
Leiden
The Netherlands

Een gedreven buitenstaander: J.H. van 't Hoff de eerste Nobelprijswinnaar voor Scheikunde

Berg, R.E. van den

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Summary

J.H. van 't Hoff. A passionate outsider

Historical research is in my view more appropriate for a chemist in the twilight of his career when his ideas have run out and laboratory work has become too much of a burden. – J.H. van 't Hoff¹

This dissertation presents a new perspective on the life, work and character of the Dutch physical chemist Jacobus Henricus van 't Hoff, first recipient of the Nobel Prize in Chemistry, and one of the most important and colourful scientists in Dutch history. He was born in Rotterdam on the 30th of August 1852 as the oldest son of a medical doctor. Van 't Hoff was among the first to attend the newly created *hoogere burgerschool*, a type of education similar to the German *realschule* with an emphasis on the exact sciences. He then followed a rather unconventional path for his higher education, first studying chemical engineering at the Delft Polytechnic, followed by one year of mathematics at the University of Leiden. After discovering his heart was in chemistry, he left his homeland to continue his education in the laboratories of two renowned chemists, August Kekulé in Bonn and Adolphe Wurtz in Paris. Upon his return to the Netherlands, he completed his studies with a doctorate at the University of Utrecht. Just before finishing his dissertation, in September 1874, he published a small brochure in which he postulated the existence of the asymmetrical carbon atom. Together with the French chemist Joseph Le Bel, who came up with similar ideas a few months later, he was the first to realise the consequences of molecules having a three-dimensional structure. Whereas initially his ideas fell on deaf ears, a scathing critique from the German chemist Hermann Kolbe on the German translation of Van 't Hoff's brochure in 1877 finally drew attention to Van 't Hoff's ideas, after which many chemists rallied to his defence. Nowadays, Van 't Hoff is seen as one of the founders of the field of stereochemistry.

Van 't Hoff had a hard time finding an academic position. He first taught physics at a veterinary school in Utrecht, until the founding of the University of Amsterdam in 1877 offered him an opportunity and he was appointed full professor of chemistry, geology, and mineralogy. With his research group in Amsterdam, he initiated a programme aimed at understanding the dynamics of chemical reactions and chemical equilibrium, both experimentally and theoretically. Inspired by his favourite philosopher, the French positivist Auguste Comte, he wanted to develop a more rational, more mathematical view of chemistry. To this end he was among the first to apply the new science of thermodynamics in chemical studies. He also developed a theory of dilute solutions and of osmotic pressure. This brought him into contact with Wilhelm Ostwald from Germany and Svante Arrhenius from Sweden, who became his lifelong friends. In his doctoral research Arrhenius had already hypothesised that in solution electrolytes are dissociated and that salts break up into positively and negatively charged ions. To convincingly prove this, he used Van 't Hoff's theory on dilute solutions. With Ostwald, Van 't Hoff founded the highly influential *Zeitschrift für physikalische Chemie*, and together with both his brothers-in-arms – they became known as the Ionists – he defended their unconventional ideas against criticism

¹ Ch.M. van Deventer, J.H. van 't Hoff 1852-1911 In Memoriam, *De Gids*, 75 (1911) 138-155, p. 147.
'Historisch onderzoek lijkt mij iets voor een scheikundige in zijn nadagen, als hij geen vakideeën meer voortbrengt, en het laboratorium hem te zwaar valt.'

from various sides, notably from the English chemical establishment. With their studies the three Ionists, who each received a Nobel Prize, established the field of physical chemistry.

Towards the end of the nineteenth century, science was increasingly becoming an international activity. The number of international congresses and associations showed a spectacular growth and the Royal Dutch Academy of Sciences was receiving ever more requests from abroad to participate in international projects, for example in the field of standardisation. This led to pressure on the government, universities, and scientists to do everything in their power to enlarge national prestige. It is therefore no surprise that in June 1887 Van 't Hoff received an offer to a chair in physical chemistry at the University of Leipzig. Once this became publicly known, many of Van 't Hoff's colleagues, assistants and students, and even representatives from the city of Amsterdam expressed their displeasure about the possibility of his departure through letters and petitions. When the local authorities offered him a new chemistry laboratory, Van 't Hoff decided to turn down the Leipzig offer. His new laboratory opened its doors in 1891. However, only four years later Van 't Hoff received another, even more distinguished and more lucrative offer from Germany: a research professorship at the Prussian Academy in Berlin with a very limited teaching load.

The Prussian authorities realised that the successful German chemical industry required the support from universities, which at the time were dominated by organic chemists. Installing a major figure in physical chemistry like Van 't Hoff could help to redress this imbalance. The offer strongly resonated with Van 't Hoff since he wanted to free himself from his teaching load and administrative duties. His repeated pleas to allow more university professors to devote themselves fully to research instead of teaching fell on deaf ears in his home country. In the end, all efforts – both from local and national authorities and even private citizens – to keep him in Amsterdam only resulted in a painstakingly slow discussion on procedures, and ultimately proved to be in vain. Van 't Hoff decided to leave Amsterdam and in March 1896 he was instated as a permanent member of the Prussian Academy. In his private laboratory in Berlin, assisted by a host of mostly experienced students and researchers, he devoted himself to a wide-ranging study of salt formation, in support of the German salt industry in Stassfurt. It offered him the satisfaction of being able to fulfil his debt of honour to a country that had given him so much. In these years he became one of the great scientists of Europe, receiving numerous honorary doctorates, memberships, and prizes, culminating in the award of the first Nobel Prize in Chemistry in 1901.

While there has been quite some scholarly interest in his life and work from science historians, the only major biography (written in German by his friend and student Ernst Cohen) was published in 1912, and though it has been important as a reference, it is rather uncritical, if not glorifying. Therefore, a new biography was long overdue, covering all insights gained over the past hundred years into his scientific research, his personal life and their mutual influence. Public and especially family archives turned out to contain a wealth of previously unknown (personal) documents, letters and diaries. These offered numerous novel insights into Van 't Hoff's character, his behaviour, his (scientific) ideas and ways of working.

The image of Van 't Hoff that emerges from the research presented in this dissertation is that of someone with a strong drive to make a name in science, who nonetheless always remained an outsider. Whichever period of his life and whichever institution or group he belonged to, he never wholeheartedly took part, always isolating himself, always remaining on the sidelines. The letters he exchanged with his parents during his university

studies have brought to light the major influence his father played on his personal and intellectual development. On the one hand they illustrate his compliance with his father's demands to do well and be an example for his younger siblings, but on the other hand they are also a testament to his strong will to escape from this same pressure and give in to his romantic nature. This drive to do well and distinguish himself in science came to light in the publication of his revolutionary brochure and in his plea for the important role of imagination in science, with which he shocked many of his older colleagues. This also contributed to his outsider status in his own country. Being one of the fathers of the 'new science' of physical chemistry set him apart from most of the organic chemists in the Netherlands: they did not accept him as an editor of the new Dutch chemistry journal *Recueil*, and he experienced difficulties in getting elected to the Royal Dutch Academy of Sciences – only to rarely attend their meetings. Whereas the offer from Berlin could have been considered an honourable distinction for a Dutch scientist, he was frowned upon by his countrymen for accepting it and showing a lack of loyalty to his homeland. Even among the Ionists he proved to be somewhat of an outsider, fighting only reluctantly for the acceptance of their ideas, in contrast to Arrhenius and Ostwald.

Van 't Hoff could never see his scientific successes for what they truly were and always needed more confirmation, especially from his father. It is no coincidence that his scientific output virtually came to a standstill after his father's death in 1902. The Academy position in Berlin offered him, for the first time in his life, the chance to fully devote himself to ground-breaking research, but for more than ten years he was content to work in a rather rudimentary laboratory on a research topic that could equally well have been solved by someone with less brilliance and equal tenaciousness. All these new insights into his personality come together in this dissertation, which also considers broader science-historical developments: the emergence of new scientific disciplines, the important role of objectivity in nineteenth-century science, appointment policies at (inter)national universities, the growing internationalisation of science in the late nineteenth century, and the gradually changing balance between research and education at universities. Therefore, this dissertation not only furnishes new insights into Van 't Hoff's life and character, but also describes and analyses the interaction between the personality and the scientific work of this leading chemist of the nineteenth century for the first time.