

## Celebrating 105 Years Institute for Theoretical Physics

We typically associate the Institute for Theoretical Physics (ITP) in Utrecht to the Nobel Prize of Gerard 't Hooft and Martinus Veltman, perhaps to the statistical physics contributions of Nico van Kampen, Hans Kramers' works on quantum theory, and even to the Ornstein-Uhlenbeck effect describing Brownian Motion.<sup>i</sup> However, until quite recently, we did not know when the ITP was founded.

Last year, the director of the institute, René van Roij, prompted by the 30<sup>th</sup> anniversary celebrations of the Debye Institute for Nanomaterials Science<sup>ii</sup>, asked around for clues concerning the early days of ITP. I took up the baton and spent some time delving into the history of the theoretical physics at Utrecht, focusing on the first half of the twentieth century. The story of the foundation of the institute, turned out to be as much about the emergence of theoretical physics as it is about theoretical physics' complicated relationship with experimental physics.

Deep into the ninetieth century, there was just physics. The one professor surveyed both the experiments and theory, even though the latter assumed a supporting role. By the end of the ninetieth century, professionalization accelerated the physics research. As a result, specializations, like theoretical physics emerged. Nonetheless the theorists were mere assistants to the experimentalists; even Hendrik Lorentz was the theoretical left hand of Kamerlingh Onnes in Leiden.

In Utrecht, theoretical physics 'started' with the appointment of the first theory professor, Victor Julius<sup>iii</sup>, on the 12<sup>th</sup> of August 1896 (around 125 years ago). Alongside him was his nephew, director of the Physical Laboratory and professor experimental physics Willem Julius. Both worked in the lab, commissioned by Buys Ballot in 1875 at the Bijlhouwerstraat. Supporting classes for medicine and pharmacy students were also held at this location, besides physics research and education. Despite several reconstructions the lab suffered from a continuous shortage on space. Around 1900, there was no longer room for theoretical physics, with teaching and experiments consuming the whole lab. After Julius passed away in 1902, also his successors, Henri du Bois (1902-1904) and Cornelis Wind (1904-1911) did not carry theory in Utrecht into the twentieth century. Du Bois was at heart an experimentalist and Wind fancied meteorology.

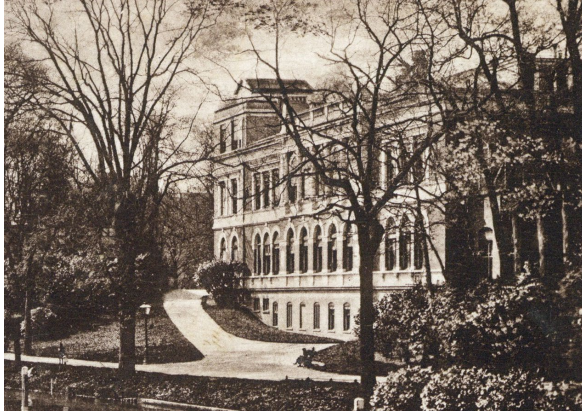
In 1912, the physics department hoped to spur on theoretical physics by appointing Peter Debye as Wind's successor. However, the lack of space in the lab was one of the reasons for Debye to leave for Göttingen already in 1914.<sup>iv</sup> Both the students as well as the university regretted his decision and requested the minister to allocate additional funding for both extensions of the lab as well as an assistant to facilitate the theory professor.<sup>v</sup> It would not persuade Debye to stay. Nonetheless, it would lay the foundation for acceptance of theoretical physics in Utrecht.



*Ornstein around 1917 - Universiteitsmuseum*

Within a year, plans for an extension were approved and the work started. In the meantime Leonard Ornstein was approached by Julius for the vacant theory seat. Ornstein was a lecturer in Groningen at the time, after doing his PhD in Leiden with Lorentz on statistical mechanics. He entered Utrecht in 1915 as a young, but determined theorist, immediately demanding both an assistant and several rooms for theoretical physics. The assistant was appointed less than a year later, concurrent with the completion of the lab renovation. Several rooms on the second floor of the new west wing were reserved for his newly formed research group. He named this group the Institute for Theoretical Physics. The first notion thereof dates to the 18<sup>th</sup> of September 1916, when the rector of the university acknowledges that Ornstein “founded the Institute for Theoretical Physics in the newly build rooms”.<sup>vi</sup> Hence, we can establish this as the founding date of the ITP, almost 105 years ago at the time of writing.

In the remainder of our story, we will discuss that the recognition of an independent group theorist was by no means guaranteed in the century that followed.



*Physical Laboratory at the Bijlhouwerstraat around 1920 - Utrechts Archief*

The first few years were fruitful for the ITP. Ornstein gathered a group of assistants, both theorists and experimentalists around him and promptly they started writing papers on liquid crystals, Brownian motion, fluid density theory etc.<sup>vii</sup> All of these were signed with Institute for Theoretical Physics, but most were based (partly) on experimental results. The pecking order had changed. Ornstein put experimentalists at work to support his theories, instead of the inverse relation of half a decade earlier. Ornstein had also changed. He came in as a pure theorist, looking down at experiments. Yet, the advanced instruments, designed by Julius and his assistant Moll, made him appreciate the value of experimental physics.

When Julius fell ill in 1920, Ornstein's group had practically taken over the lab, and it was more than reasonable that he took over as director. This again signaled a significant change for the ITP, as Ornstein altered course. He started to view theory and experiment as inseparable, all the work from the lab was to be published under *Physical Laboratory*. Moreover, Ornstein reserved the title (Physical) Institute for the entire lab. Nonetheless, there were always several dedicated theory assistants present and Ornstein remained the theory professor.

This would change just a few years later when Julius passed away in 1925. Ornstein took over his experimental seat (as was common for the director) and was looking to fill the theoretical physics vacancy with Herman Burger, a long-time assistant. The faculty preferred a more theoretically inclined candidate and selected Hans Kramers in 1926. As a student of both Niels Bohr and Paul Ehrenfest, Kramers was a representative of modern quantum theory, a supporter of the Copenhagen-interpretation. This stood in stark contrast with Ornstein's quantum philosophy, which was more in line with Arnold Sommerfeld and Alfred Einstein, built upon mathematical rigor on a deterministic worldview.

There was very little collaboration between Ornstein's and Kramers' groups, which gave Kramers a lot of independence to choose the direction of his theoretical research.<sup>viii</sup> After Kramers left for Leiden in 1934 another modern quantum mechanist, George Uhlenbeck (1936-1939) was appointed. Like his predecessor he experienced a great deal of independence, while working the experiment-dominated lab.

This carries us over to WWII. At the end of 1940, Ornstein was fired from the university, for being Jewish. The young professor Pim Milatz took over as director. Meanwhile, Léon Rosenfeld succeeded Uhlenbeck as professor theoretical physics. Together with assistant Abraham Pais he worked on the field theoretical description of mesons. When Pais sent a paper of their newest work to a Danish journal in 1943, he signed it with *Institute for Theoretical Physics*.<sup>ix</sup> This is the first time in twenty years that this name surfaced, and it was meant to stay. After the war all scientific contributions from the theory group bore the signature ITP, showing that Rosenfeld felt the urge and freedom to reinvigorate the institute from the 1910s.

Until 1952 the ITP took refuge in the Physical Laboratory, when the expansion of the group, led by Sybren de Groot, urged them to seek better housing. At first a temporary solution was found in the form of a single floor in a residential home at the Maliebaan. Fortunately, in 1955 a more permanent solution was realized at the Maliesingel.



Maliesingel 23, 1974 - Gemeentearchief Utrecht, 63356/collectie Het Utrechts Archief.

The ITP has survived several university reorganizations and in 1973 moved to the Uithof, nowadays occupying the top floor of the Buys Ballot Building. The discontent of Debye and the changing perspective on physics in the 1910s paved the way for a solid theoretical physics group. With the foundation of the ITP, Ornstein acknowledged this newly gained status. In the 1940s and 1950s, the institute matured under Rosenfeld and De Groot into an independent research group.

This year we celebrate the 105<sup>th</sup> anniversary. It is of course a shame that we are a few years late celebrating the centenary and due to current state of the pandemic, the festivities might be postponed to a later date. A more extensive Dutch overview will appear in the September issue of *het Nederlands Tijdschrift voor Natuurkunde*.



*Buys Ballot Building 1971 - P. van der Linden, 831240/collectie Het Utrechts Archief.*

## Jurriaan Wouters

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<sup>i</sup> Last year a mural dedicated to this work was revealed at the Oosterkade in Utrecht, close to the Physical Laboratory, also see FYLAKRA issue 3 of 2020.

<sup>ii</sup> See FYLAKRA issue 4 of 2019.

<sup>iii</sup> The one from the Julius institute

<sup>iv</sup> Interview with Peter Debye by Thomas S. Kuhn and George Uhlenbeck, 3 May 1962, Niels Bohr Library & Archives, American Institute of Physics.

<sup>v</sup> Letter from J.H.W.Q ter Spill to Minister van Binnenlandsche Zaken, d.d. 9 April 1914, in: Nationaal Archief, 2.04.13, 475; Letter from Curatoren to Minister van Binnenlandsche Zaken, d.d. 22 April 1914, in: Nationaal Archief, 2.04.13, 475;

<sup>vi</sup> E.J. Cohen, *Dingen en Menschen*, Utrecht, 18 september 1916

<sup>vii</sup> See for instance: W.J.H. Moll en L.S. Ornstein, *Bijdrage tot de studie der vloeibare kristallen.*, Versl K Akad Wet Amst 1916, 25, p. 682, 1916.

<sup>viii</sup> M. Dresden, *H.A. Kramers Between Tradition and Revolution* (Springer New York, 1987), p. 71

<sup>ix</sup> A. Pais, *On the photo-disintegration of the deuteron*, Dan Mat Fys Medd, vol. 20, nr. 17, p. 30, 1943.