



100 YEARS OF PHILIPS RESEARCH

Dirk van Delft – Museum Boerhaave – PO Box 11280 – 2301 EG Leiden – the Netherlands
dirkvandelft@museumboerhaave.nl – DOI: 10.1051/eprn/2014204

On Thursday 23 October 1913, a Dutch newspaper published the following advertisement: Hiring: *A capable young scientist with a doctorate in physics. Must be a good experimenter. Letters containing information on age, life history and references may be submitted to Philips in Eindhoven.* Two days later, a candidate applied: Gilles Holst. At that time, Holst was working in Leiden as an assistant to Heike Kamerlingh Onnes, a recent Nobel Prize winner.

In this position, he had played an important role in the 1911 discovery of superconductivity in the Leiden cryogenic laboratory [1]. The 27-year-old Holst was invited for an interview with Gerard Philips, who had begun producing incandescent light bulbs in a vacant factory on Emmasingel in Eindhoven – which is now the location of the Philips Museum.

▼ FIG. 1: The two men quickly reached an agreement and, on 2

January 1914, Holst started to work on the fourth floor of the Philips factory building in Eindhoven. He was excited. In a letter to Adriaan Fokker, a colleague and a friend, he wrote, 'I will be furnishing an entire laboratory, and I will be doing all types of measurements that will tell us the formula of the incandescent light bulb'. Known as the *NatLab*, this *Natuurkundig Laboratorium* (physics laboratory) would gain international fame and serve Philips exceptionally well.

► FIG. 2: **From Copying to Inventing**

From 1891 on, Philips had been able to fend off the competition by taking over and adapting innovations that had been developed elsewhere (for example in the research laboratory of General Electric, founded in 1900). Launching original new ideas was not a part of the strategy. This put the company in a technologically vulnerable position. The re-introduction of a patent law in the Netherlands made the matter even more urgent. Holst's first challenge was to become familiar with the half-watt lamp, which Philips had copied from General

Electric and brought into production shortly before his arrival in Eindhoven. In addition to research, Holst's duties included testing, monitoring and troubleshooting. One stubborn problem involved the tendency of the inside of the light bulb to turn black due to the vaporisation of the filament.

The 1920 appointment of the German physicist Gustav Hertz was a signal that research was being conducted in Eindhoven at an academic level. The development of radio tubes and X-ray tubes only served to reinforce this signal. The *NatLab* generated new products and contributed to the progress of Philips. The people around Holst had to be excellent scientists. In his *NatLab* he therefore provided an academic climate that made people feel that they were working in a high-level scientific environment. Holst encouraged publication in scientific journals, which reflected well on Philips, the *NatLab* and the individual researcher. He also organised colloquiums with renowned physicists, who informed the staff members of *NatLab* about new developments on the scientific front. Paul Ehrenfest, a professor of theoretical physics, made dozens of appearances in Eindhoven, accompanied by speakers from his own colloquium in Leiden.

Enter Casimir

In 1946, Hendrik Casimir belonged to the triumvirate to succeed Holst, together with the engineer and inventor Herre Rinia and the chemist-physicist Evert Verweij.



Casimir, a brilliant physicist who had worked with Niels Bohr and Wolfgang Pauli and who had a great future in academia before him, caused quite a sensation with this step. During the first years after the war, the *NatLab* clearly had more to offer talented scientists like Casimir than the university did. Pauli was not particularly amused to see one of his students, 'nicht ganz dumm' (*i.e.*, who was not entirely stupid), voluntarily descend to the nether regions of industrial research. From that time on, he would address Casimir ironically as 'Herr Direktor'. Nevertheless, Casimir remained loyal to Philips and repeatedly rejected offers of prestigious positions, including professorial appointments at Cambridge and Leiden, and a director's position at CERN, the European Organisation for Nuclear Research [2]. (Later, 1972-1976, he did become the second President of the EPS!)

While *NatLab* research under Holst had always been related to a concrete product, the opposite was the case during the Casimir era. In his vision, the *NatLab* served as a think tank to support the long-term policies of the product divisions with regard to their product portfolios. To this end, the *NatLab* conducted research that offered no direct prospects for application. This approach also called for *NatLab* research to be organised according to discipline (*i.e.*, by topic area). According to Casimir, a structure based on product divisions would be fatal to the innovative character, as that would raise the risk of introducing short-term thinking in the research.

The *NatLab* was always in search of new research areas. Nuclear physics, superconductivity, astrophysics – anything was possible. Topics on which sufficient knowledge already existed (*e.g.*, electric discharge in gases) were rejected. The fact that Philips earned good money on gas-discharge lamps did not matter. The Household Appliances division also received a raw deal due to the lack of possibilities for fundamental research. In 1960, Casimir complained about his inadequate opportunities for fundamental research. In many areas, the *NatLab* had made useful contributions, but they had yet to achieve any major breakthrough like the transistor developed by Bell Labs. It would nevertheless be quite wrong to assume that the fundamental research of the *NatLab* yielded only meagre results. Materials research on ferrite (magnets in loudspeakers) and research on the storage of hydrogen in a lanthanum-nickel compound (rechargeable batteries) were highly successful.

The two most remarkable successes from the Casimir period were the invention of the Plumbicon (a T.V. camera tube) and LOCOS (a process for manufacturing semi-conductors for the production of integrated circuits). Whether these breakthroughs would have occurred if the *NatLab* researchers had enjoyed less freedom remains an open question. The fact is that, during the period 1946-1972, Philips could afford to maintain a laboratory characterised by considerable

◀ FIG. 3:
Gerard Philips (1858-1942), co-founder Philips, took the initiative to set up a Philips research laboratory, starting in 1914 with Gilles Holst as its first director.

▼ FIG. 4:
1931, Philips launched the Philora low-pressure sodium lamp. The name Philora is a combination of 'Philips' and 'aurora'. Highways, ports and classification yards proved particularly well suited for illuminating with Philora lighting.



▲ FIG. 5: scientific freedom. Even if this freedom led to frustration in the contacts with product divisions, what would it matter, as long as the company as a whole was flourishing?

3D imaging research at Redhill, 1997. The British Philips Research facility was originally based at the Mullard Research Laboratories site. It has been based in Cambridge since 2008.

From Technology Push to Market Pull

After decades of economic prosperity, the tide started to turn at the end of the 1960s. This had repercussions for the *NatLab*. When Eduard Pannenberg succeeded Casimir in 1972, a new wind began to blow in Waalre,

► FIG. 6: Hendrik Casimir explaining the model of the new location of Philips Research at Waalre (near Eindhoven). Construction started in 1959. Casimir would later become the second EPS president.

town to the south of Eindhoven where a new *NatLab* had been built in the 1960s. Pannenberg saw greater advantage in 'market pull' than in the 'technology push' strategy according to which the initiative lay with the product divisions. What now mattered was to listen to the market. Whereas Casimir encouraged the exploration of new areas of research, Pannenberg placed the priority on making optimum use of the existing science. In the Casimir era,

there had always been fundamental questions that remain unanswered and offered an excuse to continue the research. Under Pannenberg's watch, subjects such as the Stirling engine, futurology and biology were abandoned because of lack of interest from the product divisions. Superconductivity suffered the same fate: decades of research and still no sign of any positive result.

In terms of its size, the *NatLab* had by now passed its peak. The new complex in Waalre had been designed for 3,000 employees, but this peaked at 2,600 at the end of the 1960s. As part of Centurion, the major cost-cutting exercise announced by Philips' boss Jan Timmer in 1990, the total research contingent (the *NatLab* and the laboratories abroad) had to be reduced from 4,000 to 3,300 employees. In 1989, the funding also changed. Previously, *NatLab* had always been allocated its budget (about 1% of Philips' annual turnover) directly 'from above', from the Executive Board. That very same Executive Board decided that the *NatLab* would henceforth have to secure two-thirds of its budget via contract research from the product divisions. The move was seen as a bitter defeat and the end of independence. However, what the move did achieve was to boost the mutual commitment between the *NatLab* and the product divisions, which had been sorely lacking with Casimir at the helm. When developing the electronics for a digital audio converter, which was important for the compact disc [3], the *NatLab* and the product divisions Audio and Elcoma (Electronic Components and Materials) worked together constructively.

NOTE

On view in Museum Boerhaave (Leiden, the Netherlands) until 26 October 2014: '100 YEARS OF INVENTIONS, Made by Philips Research', an exhibition celebrating the first centenary of Philips Research. See www.museumboerhaave.nl/english

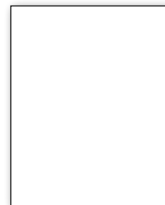
Three focus areas

The modern-day Philips – and with it also Philips Research – focuses on three areas: *Healthcare*, *Consumer Lifestyle* and *Lighting*. No more CD players, computers or televisions, but MRI scanners, Senseo and LED lighting instead. The products may be different, but there is a startling continuity in the underlying technology. Philips Research has also retained its independence, on the proviso that a research success is only truly successful if it is also a commercial success. Philips Research (headquartered in Eindhoven, with locations in Bangalore, Briarcliff, Cambridge, Hamburg, Paris and Shanghai) employs around 1,500 staff after several cost-cutting exercises. Its research budget continues to be around 1% of Philips' total turnover (Research & Development for the whole of Philips was 7% of the annual turnover in 2012). The Waalre site has recently been updated and extended to become High Tech Campus Eindhoven, where Philips Research and other Philips divisions have since been joined by more than a hundred institutes and businesses working on technologies and products of the future.

Philips Research engages in what it calls 'open innovation', making its expertise available to third parties, and making use of the services of university laboratories or start-up companies across the world. Approximately 65% of Philips Research projects are carried out in alliance with universities, knowledge institutions or government bodies. Customers, suppliers or partners of Philips businesses are involved in around half of these projects.

Through all of this, Philips Research hopes to broaden its perspective and at the same time raise its profile as an attractive employer that gives talent room to grow. ■

About the author



Dirk van Delft is director of Museum Boerhaave, the Dutch museum for the history of science and medicine, and part-time professor 'Heritage of the Sciences' at Leiden University. In 2007 he published *Freezing Physics. Heike Kamerlingh Onnes and the Quest for Cold* (Edita, Amsterdam).

References

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Further reading

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◀ FIG. 7: Molecular Beam Epitaxy for silicium devices; 1995.

▲ FIG. 8: A biosensor made by Philips Research with conventional chip manufacturing techniques, after which they are printed with proteins using the inkjet printer method; 2013.

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