Pieter Zeeman
1865-1943

Zeeman was born on 25 May 1865 in the village of Zonnemaire (on the island of Schouwen-Duiveland, province of Zeeland) to Wilhelmina Worst and Catharinus Farandinus Zeeman, a Lutheran minister. He went to the HBS in nearby Zierikzee and then studied classical languages at the gymnasium in Delft for two years. During this period he published an account of an aurora borealis visible in Zonnemaire. He entered the University of Leiden in 1885, where he studied under Lorentz and Kamerlingh Onnes and became an assistant in Kamerlingh Onnes's laboratory in 1895. He received his doctorate in 1893 for a dissertation on the so-called Kerr Effect, for the research of which he had received the gold medal of the Hollandsche Maatschappij in the previous year. After a year in Strasbourg at the Kohlrausch Institute, he became *privat-dozent* at Leiden and married Elisabeth Lebret, with whom he had a son and three daughters. From 1896 until his retirement, Zeeman was on the faculty of the University of Amsterdam (lecturer, 1896; extraordinarius, 1900; ordinarius, 1908). In 1908 he succeeded Van der Waals as the director of the university's physics laboratory, the Physics Institute.

While still at Leiden, Zeeman discovered the effect named after him. He was searching for an interaction between magnetic and optical effects. Faraday had investigated the effect of a magnetic field on spectral lines as early as 1862, but without a positive result. Zeeman repeated the experiment, using a diffraction grating of high resolving power and found that the emission line of sodium was broadened (1896). Lorentz and Zeeman explained the phenomenon by supposing that the electron (discovered the previous year by J.J. Thomson) moved within the atom and emitted light. Measurements of the frequencies at the extremes of the broadened line allowed them to determine the e/m ratio. At Amsterdam, the following year, Zeeman was able to split the sodium line into a triplet, as predicted by Lorentz. For this work Zeeman and Lorentz received the Nobel Prize in physics in 1902.

Zeeman continued his research on the Zeeman effect, but the limitations of his laboratory in Amsterdam prevented great accuracy. This problem was not overcome until the construction of a new laboratory in 1923 (since 1940 the Zeeman Laboratory). He also measured the velocity of light in moving media, showing that the

value of the Fresnel coefficient varied with the wavelength, a prediction of relativity theory. Only after 1923 did he return to measurements of the Zeeman effect, measuring the spectral lines of several noble gases and rhenium.

Zeeman served as secretary (1912-1920) and chairman (1931) of the Physics division of the Royal Academy of Arts and Sciences; as president of the Commission Internationale des Poids et Mesures in Paris from 1940 to 1943; and as rector magnificus of the university of Amsterdam from 1920 to 1923. He received honorary doctorates from ten universities and prizes from the most prestigious scientific societies, including the Académie des Sciences, the Royal Society, and the National Academy of Sciences. With A.D. Fokker, he edited the papers of H.A. Lorentz ('s-Gravenhage: Martinus Nijhoff, 1934-1939). He died in Amsterdam on 9 October 1943.

Primary works

Poggendorff, vol. 4, 1682; vol. 5, 1404-1405; vol. 6, 2957-2958; vol. 7B, 6163-6165. *Metingen over het verschijnsel van Kerr bij polaire terugkaatsing op ijzer, kobalt en nikkel* (Measurements of the Kerr Effect in Polarized Reflection by Iron, Cobalt, and Nickel), 1893 (Doctoral dissertation). His papers on his magnetic optical experiments published from 1896 to 1913 are collected in H.A. Lorentz, H. Kamerlingh Onnes, I.M. Graftdijk, J.J. Hallo, and H.R. Woltjer eds, *Verhandelingen van Dr. P. Zeeman over magneto-optische verschijnselen* (Leiden: E. IJdo, 1921). *Researches in Magneto-Optics, with special reference to the magnetic resolution of spectrum lines* (London: Macmillan, 1913; German edition, 1914); P.J.M. Velthuys-Bechthold, *Inventory of the papers of Pieter Zeeman (1865-1943), physicist and Nobel Prize winner, c. 1877-1946.* Series: Inventarisreeks Rijksarchief in Noord-Holland, no. 3, (Haarlem, 1993).

Secondary sources

H. Kamerlingh Onnes, 'Zeemans ontdekking van het naar hem genoemde effect', *Physica* 1 (1921) 241-250; O. Lodge, 'The History of Zeeman's Discovery and its Reception in England', *Nature* 109 (1922) 66-69; J.D. van der Waals, Jr., 'Levensbericht van Pieter Zeeman', *Jaarboek der Nederlandsche Akademie van Wetenschappen* (1943-1944)

208-218; J.W. Strutt (Lord Rayleigh), 'Pieter Zeeman, 1865-1943', *Obituary Notices of Fellows of the Royal Society of London* 4 (1942-1944) 591-595; E.C. Watson, 'The Discovery of the Zeeman Effect', *American Journal of Physics* 22 (1954) 633-635; W.J.A. Schouten, *Pieter Zeeman, natuurkundige (1865-1943)* (Amsterdam, 1965); A.D. Fokker, 'Address to the Joint meeting of the University of Amsterdam and the members of the Zeeman centennial conference', *Nederlands Tijdschrift voor Natuurkunde* 32 (1966) 48-60; J. Brookes Spencer, 'On the Varieties of 19th-Century Magneto-Optical Discovery', *Isis* 61 (1970) 34-51; T. Arabatzis, 'The discovery of the Zeeman effect: A case study of the interplay between theory and experiment', *Studies in History and Philosophy of Science* 23 (1992) 365-388; A.J. Kox, 'Pieter Zeeman (1865-1943). Meester van het experiment', in: J.C.H. Blom et al., eds, *Een brandpunt van geleerdheid in de hoofdstad. De Universiteit van Amsterdam rond 1900 in vijftien portretten* (Amsterdam: Amsterdam University Press; Hilversum: Verloren, 1992) 213-228; A.J. Kox and W.P. Troelstra, 'Uit het Zeeman-archief: de ontdekking van het Zeeman-effect', *Gewina* 19 (1996) 153-166.
P.F.A. Klinkenberg, in: *BWN*, vol. 1, 672-674; J.B. Spencer, in: *DSB*, vol. 14, 597-599.

[A.v.H.]