

## Obituary

# H.C. van de Hulst<sup>☆</sup>

(19 November 1918–31 July 2000)

Hendrik (Henk) Christoffel van de Hulst was always interested in almost everything. As a young boy he played chess and was very fond of all kinds of puzzles. When a jigsaw puzzle was too simple for him, he tried to complete it upside down. But very soon he also started to love literature and to enjoy the wonders of nature in a broad sense. It was not long before he discovered his mathematical skills and developed these to a high level, partly in school, partly all by himself.

Henk went to the University of Utrecht in the heart of the Netherlands in 1936 and started studying mathematics and physics. But very soon he was attracted more and more to astronomy by the clear and inspiring lectures of Marcel Minnaert, the well-known author of “Light and Colour in the Open Air”. One of the other students in astronomy was Henk’s future wife, Wil Mengerink. They first met on the roof of the observatory, where students had to conduct some observations as part of their practical exercises.

In 1941, Leiden University organized a prize competition for an essay. The question was to discuss critically the origin and growth of solid particles in the interstellar environment. Henk attacked the problem forcefully. He visited many libraries and read books as well as papers on physics, chemistry and meteorology; he took copious notes and finally submitted his essay in April 1942. The jury did not award the prize, but instead offered two honorable mentions, one for Henk, saying that his essay showed he had a “mature scientific spirit”. Henk was only 23 years old at that time. One of the members of the jury was the famous Leiden astronomer Jan Oort, who was a master in getting talented people interested in astronomical problems. As a result, van de Hulst and Oort started collaborating on the problem of the growth of interstellar particles and that was the beginning of an association for life. But Henk also became very interested in the scattering of light by these interstellar particles and this was to become the subject of his thesis under the supervision of Minnaert. Oort suggested that he not just cite the results of Mie computations for light scattering by spherical particles, but to study Mie theory himself. Henk decided to do so and soon found himself writing chapter after chapter on Mie theory. Thus, this became the main topic of his Doctor’s thesis which was entitled “Optics of Spherical Particles” and was finished in 1946. It was a brilliant piece of work and the degree of Doctor was awarded with the highest honours. The thesis material formed the basis for van de Hulst’s book on “Light Scattering by Small Particles”, which was first published in 1957 and republished in 1981 as a Dover book. This book became extremely popular among scientists in a variety of disciplines. It was not only a comprehensive, unifying treatment of the subject, but also contained important new results in areas where little or nothing had been done before. The lucid style of the book is remarkable and inspiring. Arguments based on physical intuition are given wherever they illuminate the subject more clearly than a mathematical derivation.

During the Second World War Holland was occupied by Germany and life was difficult for most people. Almost no scientific news from abroad reached Holland and communications gradually dwindled to almost nothing. But Oort knew that cosmic radio emission had been discovered in the USA and he said: “If there were a spectral line which we could measure, then the Doppler shift could be used to map the motions in the Galaxy”. Oort asked Henk in 1944 to investigate this and after spending several months on a theoretical study

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of the problem Henk found that it should be possible to detect a spectral line at a wavelength of 21 cm which is produced by the spontaneous flip of the electron spin in the ground state of atomic hydrogen, the most abundant element in the Universe. Radio emission from interstellar gas at 21 cm was indeed detected in 1951 and this gave an enormous impetus to the field of radio astronomy. It was in particular this prediction of the 21 cm line which made Henk a famous astronomer.

In June 1946, Henk received his doctor's degree, got married and went to the USA. Gerard Kuiper had offered him a postdoctoral position at Yerkes Observatory, which is part of the University of Chicago, at which Chandrasekhar was located. Kuiper stimulated Henk's interest in the Solar System. Henk worked on the zodiacal light, which is light scattered by small interplanetary particles, and he studied Chandrasekhar's papers on radiative transfer. As a result Henk wrote a very clear and interesting chapter in a book edited by Kuiper, which was entitled "The Atmospheres of the Earth and Planets" and was published in 1949. The title of Henk's chapter was "Scattering in the Atmospheres of the Earth and Planets". In that chapter Henk provided a concise review of Chandrasekhar's theoretical treatment, but also followed his own course, emphasizing many aspects of a large variety of scattering phenomena. Henk's personal contacts with Chandrasekhar were friendly, but they never wrote a joint paper. Although both would make major contributions to the treatment of multiple light scattering, they would do so independently and in different, complimentary ways.

Henk enjoyed his postdoc years in the USA very much, but he could not resist the strong appeal by Oort to come back to the Netherlands. He was appointed at the University of Leiden in 1948 with the rank of Lector (approximately equivalent to Associate Professor) and in 1952 he became full professor of theoretical astronomy there. He remained in Leiden throughout the rest of his life, despite many enticing offers to take a position elsewhere.

During his life Henk spent a considerable amount of time on studies of light scattering, but he did much more than that. He always had a broad interest and the extremely diverse titles of the 28 dissertations that were written under his supervision testify to that. In fact, only one of these theses deals with light scattering.

From 1958 onwards, Henk became heavily involved in space research, both at a national and at an international level. He became the first President of COSPAR (COMmittee on SPace Research) of the ICSU (International Council of Scientific Unions) and held very important positions in the European Space Research Organisation (ESRO) and the European Space Agency (ESA). Nevertheless, he always managed to find time for his own research, usually very early in the morning. He worked very hard. He liked to reduce scientific problems to puzzles, which he then attacked with great mental power. Few problems survived such an attack. His work resulted in a large number of scientific papers, mostly on single and multiple light scattering. The latter subject culminated in his book "Multiple Light Scattering, Tables, Formulas, and Applications", which was published in 1980. The book is mainly devoted to scattering of electromagnetic radiation in plane-parallel atmospheres. Reciprocity relations and matrix operations play a fundamental role in the entire treatment of the subject. This is very helpful in gaining physical insight in many relations and numerical results that are usually drowned in the literature in a sea of mathematics.

After his retirement in 1984 Henk kept working on light scattering problems, though at a more relaxed pace. During the last few years he was more and more impeded by health problems. Yet, he was able to write the foreword for the book "Light Scattering by Nonspherical Particles", which was written after the New York conference with the same title held in 1998. He also finished one of several manuscripts he had in progress. It was entitled "Reciprocity Relations in Radiative Transfer by Spherical Clouds" and it was published in JQSRT early in 2000. This was his last scientific paper. I know he liked very much working on it. It is a typical van de Hulst paper and clearly illustrates the way he loved to work, which he once formulated as follows: "What I enjoyed most in my research were not the big successes, but rather the little discoveries when a sudden insight revealed a surprising connection between bits of information that seemed to be far apart".

Henk died peacefully in the evening of July 31 of 2000. I remember Henk as a great scientist, teacher and administrator. He was always very sincere and an excellent listener, who rapidly went to the core of a problem. In any conversation you could feel the breadth of his knowledge and the depth of his wisdom. His remarks, however brief, were always very useful. Henk loathed flattery, boasting and personality cult. He was a modest man, who seemed to consider his fame more like a burden than something of which to be proud. He

considered other things far more important, such as authenticity, sincerity and simplicity. Henk is no longer alive, but he will stay with us through his ideas, papers and books.

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