

Hendrik Christoffel van de Hulst, 1918–2000

Associate of the RAS; physicist and pioneer radio astronomer; first President of COSPAR and leading light in ESRO, ESA and Dutch space research.

Hendrik van de Hulst died in Leiden on 31 July 2000, at the age of 81. He was one of the greatest Dutch astronomers of the past 150 years. In 1944 he had predicted that the amount of neutral atomic hydrogen in interstellar space would be so great as to produce a measurable signal at the radio wavelength of 21 cm. This prediction led to a breakthrough in astronomical research. It was a strikingly original contribution to the spectacular blossoming of astronomy which began after the Second World War and which continues unabated.

Henk van de Hulst was born in Utrecht, The Netherlands, on 19 November 1918. He was one of the six children born to W G van de Hulst, a well-known writer of children's books in Calvinist religious settings. Henk was not the only one of the children to be highly gifted; one of his brothers became a respected painter. Henk remembered growing up in a happy family atmosphere. The belief in the teachings of the Dutch Reformed Church were followed seriously at home and evidently the younger Henk adhered to them too: in his PhD thesis one finds the pious dedication "to Him who steers everything". Later in his life his religious beliefs loosened, although his knowledge of the Bible became a familiar signature in his discussions. At the most unexpected moments, and to his listeners' general surprise, he could cite an entirely appropriate verse from the Bible in order to put the topic under discussion directly in accurate perspective.

Henk's father was the principal of the elementary school where he received his first education. Henk was in rather poor health as a child, and frequently was confined to his house; this situation is difficult to assimilate with the physically powerful man that he later became. But his health problems did not interfere at all with his educational progress. He completed all of the problems in his high school arithmetic books during the summer vacation of 1930, before he had even entered high school. The aptitudes and interests that were evident before he reached his teens made it obvious that he was well-suited to a university education with a strong mathematical emphasis. He was, however, the first in his family to receive a university education, since universities at that time were still largely citadels for the privileged.

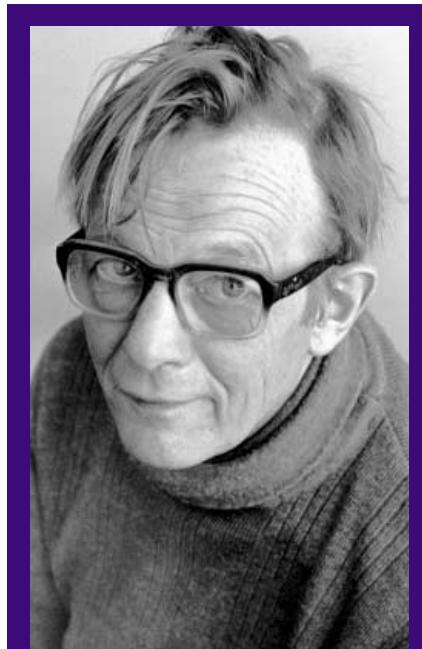
It was not immediately obvious that Henk would specialize in astronomy. During his high-

school years astronomy was just one of his numerous hobbies. He considered attending the Institute of Technology in Delft, but was dissuaded from this choice by an engineer who advised Henk that his talents were too strictly theoretical for a purely technical education. Henk followed this advice and remained grateful for it, yet one can question if his talents did not in fact also embrace mechanical matters. Throughout his entire life he enjoyed finding practical solutions to all sorts of technical problems: he improved the sagging foundation of his daughter's house in Amsterdam, he designed and installed the protective barrier on the dike guarding his vacation lake-house in Friesland, and he prepared a good model for the size and shape of the European instrument that was installed in the Hubble Space Telescope.

The decision to become an astronomer was taken in Henk's second year at the University of Utrecht, and was strongly influenced by the lectures given by M Minnaert, well-known for his educational talents. But Henk's studies were interrupted in 1939, when he was drafted into military service following the general mobilization shortly before the invasion of The Netherlands and the beginning of the Second World War. He was not involved in overt military operations while he was in the army, but upon his discharge the University was not effectively functioning: Minnaert, together with many other well-known Dutch, had been jailed as a hostage in St Michielsgestel.

Light scattering

Henk attempted to study on his own and to take examinations under these circumstances, but Minnaert was constrained by the regulations of his detention to answer with a few lines only. Nevertheless, shortly before he had been taken hostage Minnaert had introduced an important direction in Henk's career, by pointing out a prize competition that had been announced by the University of Leiden in 1941. This competition centred on the small particles of dust which had been discovered some 10 years earlier in interstellar space but which were still largely a mystery. Scattering of light by these particles of "interstellar smoke" determines much of the appearance of the Milky Way, which had made a deep impression on Henk during the years of the war, when city lights were extinguished. The subject of the competition challenged Henk, and he submitted his entry in April 1942. The jury, which includ-



Hendrik van de Hulst

ed among others J H Oort and H A Kramers, did not award the prize but instead offered two honourable mentions, one for Henk van de Hulst (citing "a mature scientific spirit") and one for the entry submitted by D ter Haar.

The competition had two particularly important consequences. Henk became acquainted with Jan Oort, and he became deeply interested in the general problem of light scattering in an astronomical context. This interest was soon reflected in his doctor's thesis, the "Optics of spherical particles". He was awarded the PhD *cum laude*, in June 1946, with Minnaert as his supervisor.

The subject of light scattering remained central to his interests for Henk's entire life. He wrote two monographs on the subject. The first of these, *Light Scattering by Small Particles*, was published in 1957 and was immediately recognized as a classic; it was republished by Dover in 1981. This book illustrates his best scientific talents. He begins with a very simple statement of the problem, and solves this problem in the most general manner. In the following chapters he continually expands the statement of the problem, offering solutions of increasing, but still straightforward, mathematical complexity, until he arrives at the Mie Theory. But the reader is gradually introduced to the general subject and becomes convinced that the constituent problems can be simply stated and simply solved. The presentation is elegant and clear; the illustrations are so efficient as to be almost self-explanatory; the historical background is given all appropriate attention. For these reasons the book was

widely consulted, beyond the confines of its obvious use in an astrophysical context. Henk himself proudly stated that the book "was written to explain the light of the Milky Way, but was in fact also used in dairy factories to measure the size of particles of fat in milk". His scientific interest in light scattering led to the establishment of a laboratory in Leiden in the 1970s, where J M Greenberg replicated interstellar scattering processes with considerable success.

We return to the year 1944. At that time scientific news from the United States had not reached Europe for several years. But news had arrived earlier which was to change astronomy fundamentally. An American engineer and radio amateur, Grote Reber, had proceeded from the discovery made several years earlier by Karl Jansky, in Jansky's investigation of the source of interference which disturbed long-distance communication systems. Reber had himself constructed a steerable antenna and with this instrument had made a map of cosmic radio emission. The emission was particularly strong in the general direction of the centre of the Milky Way. Reber's map, together with the news of an interpretation by two American astronomers that the emission could not be explained in terms of known mechanisms, reached Oort in Leiden. Oort immediately saw the challenge of a new subject of astronomical research, and also realized that radiation at radio wavelengths would penetrate the cloudy Dutch sky.

At a meeting of the Nederlandse Astronomen Club held at the Leiden Observatory on 15 April 1944, the possibilities and prospects of radio astronomy were discussed for the first time. Oort had asked Henk to consider the possibility of observing a spectral line in the radio regime. At the meeting, Henk gave a talk in which he suggested that neutral atomic hydrogen, which in its hyperfine transition radiates and absorbs at a wavelength of 21 cm, might be expected to occur at such high column densities as to provide a spectral line sufficiently strong as to be measurable. Shortly after the end of the war, several groups set about to test this prediction. The 21 cm line of atomic hydrogen was detected in 1951, first at Harvard University followed within a few weeks by Dutch observations made in Kootwijk and by Australian ones made near Sydney.

The discovery demonstrated that astronomical research, which at that time was based on observations of conventional light, could be complemented with observations at other wavelengths, revealing a range of new physical processes. Today, in addition to optical and radio astronomy, observations embrace X-rays,

gamma rays, and the infrared and ultraviolet regime. Of these "new astronomies" radio astronomy was the first, and its success following the prediction about the 21 cm spectral line has led to some of the most important astronomical discoveries of the past century.

Henk van de Hulst married Wilhelmina Mengerink in 1946; they had two sons and two daughters. Wil also initially studied astronomy in Utrecht, but after meeting Henk she changed her course to study psychology. Although she and Henk had quite different natures, the marriage was a stable one; Henk always spoke lovingly of his wife and children, confirming the impression that all his acquaintances had of the importance to him of his family.

America and back again

After receiving his doctor's degree, Henk and Wil left The Netherlands for the United States, where Henk had been awarded a postdoctoral fellowship at the Yerkes Observatory of the University of Chicago. At Yerkes he developed deep contacts with S Chandrasekhar, who was later to win the Nobel Prize, and with Gerard Kuiper, one of the numerous American astronomers with a Dutch background and education. Kuiper stimulated Henk's interest in the solar system, which lead to his work on the dust in the zodiacal belt.

Henk certainly had the opportunity to remain in the United States after his postdoctoral period, but Oort convinced him to return to The Netherlands. He was appointed at the University of Leiden, first in 1948 to the rank of Lector, and then to a professorship in 1952. He remained in Leiden throughout his career, becoming Professor Emeritus in 1984. He did return to the United States for several sabbatical leaves, at Harvard, Caltech, and the Institute for Space Studies in New York. He lectured regularly in Leiden, and guided numerous PhD projects.

In 1953, Henk co-authored a book with C A van Peursen about the foundations of the physical sciences. The authors concluded that it is not possible to give a reliable philosophical definition of the sciences. The book was written at about the same time that Henk dissociated himself from his earlier religious beliefs. It is possible that he had become too sceptical for a strongly felt rational belief. Was the emotional basis that he had been given not strong enough? A later development points in this direction.

Henk's career took on a new and unexpected turn during a conversation with Oort at the traditional Leiden Sterrewacht coffee time on 15 November 1958, shortly after the first artificial satellite, Sputnik I, had been launched. "Henk," Oort is reported to have said, "I just

had a telephone call from ICSU for a meeting in London, but I cannot possibly comply with the request. Could you go in my stead?" "I'd rather not," Henk replied, "because in doing so I would miss my daughter's fourth birthday. By the way, what does ICSU mean, and is it important?" Oort considered it important and Henk went, to return home one week later as the first president of COSPAR, a new, international organization for the peaceful exploitation of the universe. Later he said of the event: "I was launched into a space career."

The meeting had been called by the ICSU, the International Council of Scientific Unions, which was worried that, in the coming competition between the USA and the Soviet Union, the military aspects of space studies would supersede the scientific ones. That this was eventually not the case (even though the military importance remained great) must have been the result of a variety of reasons, but certainly COSPAR was an important factor. For Henk it was one of the highlights in his career when, at an important congress organized by COSPAR, he presented two astronauts (Glenn from the USA and Titov from the Soviet Union) each with a Dutch wooden shoe, cut from wood of the same tree, a gesture with symbolism that was clear to everybody.

For Henk, organizing space research rationally did not restrict itself to this super-national level. From 1960 to 1975 he was closely involved with the start of ESRO, the first European Space Research Organization, and after that, from 1975 to 1986, with ESA, the European Space Agency, the successor to ESRO. Henk held very important positions on the boards of both ESRO and ESA. He was also one of the pioneers of space research in The Netherlands, supervising much of its prosperous development. In 1959, also at his instigation, a committee for space research was formed within the Royal Academy of Sciences (of which he had become a member before he was 40 years old). He was president of this committee (GROC) until 1984, when it was incorporated into a new Institute, SRON, which now builds major instruments for space research under the auspices of the Dutch national science foundation.

Around 1965, Henk played an essential role in attracting a group of young Delft engineers who were to contribute in the subsequent decades to the spectacular growth of Dutch space research, and to whom Henk was the much admired example of the genuine researcher and accomplished administrator. The important role that SRON has played in space research since its foundation was confirmed recently by an international visiting

committee. Credit for this result is mainly due to Henk van de Hulst, who stated repeatedly that the way one may justify pure research is by providing outstanding quality, a paradigm that is of great importance to his followers.

As an administrator, scientist and teacher, Henk held firm beliefs. He was more open to discussions than many other Dutch celebrities of his generation. He listened to other people's opinions, but he remained resolute and mostly made his own final decisions. He was a strong, physically fit man, level-headed but with a good sense of humour. He was a philosophical person, with an ever-present analytical streak. When talking to him, one always had the feeling that the conversation was simultaneously unravelled and evaluated at a higher and more abstract level. Personal conversations, or discussions in committees, were always characterized by depth and simplicity. The best strategy with him always was the direct approach.

Precise metaphors

Henk had no desk, only a table, which was almost always empty. There were some documents in a corner, mostly loose sheets, under a stone, which clearly had some importance for him. Other than that, just some pencil stubs. Quality was certainly not in the paraphernalia. Often in conversations, precisely targeted metaphors occurred, frequently drawn from other trades and crafts such as carpentry or sailing. He often showed his appreciation of his conversation partner, but sparingly. A graduate student expressed his astonishment at realizing that Henk had taken his draft seriously, and noted how much that had encouraged him.

In a conversation about a university colleague, Henk summarized: "This is someone who hasn't yet found the equilibrium between his hubris and his humility." He applied this judgment on other occasions, which suggests that he recognized this need for balance in himself as well, and that this was more than a casual observation. This problem may be unavoidable for someone who must have been aware at an early age that he had an exceptional talent for rational analysis, and who had been raised in a religious tradition that emphasizes humility. In the search for his own answer to this dilemma he was certainly helped by a strong sense of the relativity of all things. He was a man with great talents, but without a mission. He laboured where he considered himself able to contribute, but had no explicit need to achieve great things. In that respect his personality was different from that of Jan Oort, his immediate colleague and paragon.

Henk was never the most audible voice in company, but those who spoke with him were

always impressed by his responses and by the points of view he took. Answers to specific questions were often unexpected and to the point. On one occasion he had been talking to some economists at a reception, and when Henk had left one of them asked another participant who this economist might be.

Naturally, his most powerful aspects were clearest in a setting of rational scientists. Thus it was a surprise to his colleagues and pupils when, around 20 years ago, Henk mentioned that he and his wife Wil had participated in a large European psychotherapy workshop, and that this had made a big impression on him. His wife, who leads psychological group therapies centred on Tibetan meditation, had already been present on several such occasions. Henk and Wil continued to visit these annual workshops and they gave him a satisfaction that he had not known in his younger days and that he now experienced as very meaningful. Surely this new endeavour deepened his domestic ties yet further.

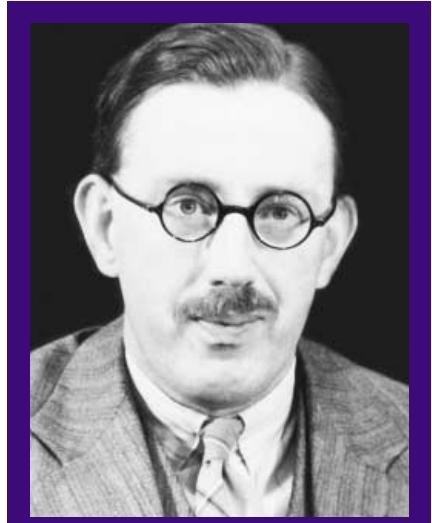
In 1995, the Dutch artist Carla Roodenberg was commissioned to paint three portraits of Henk: one for the van de Hulst family, one for the Sterrewacht, and one for SRON. Each recipient felt that they had obtained the best of the three; the painter and her model developed a mutual respect that must have contributed to this artistic feat. The works show Henk as we knew him best: contemplative but straightforward, and in robust health. But shortly thereafter a downward trend became apparent. He became thinner and occasionally seemed to be less focused. Almost by accident a calcium deficiency was diagnosed, and its treatment spruced him up, even though he did not seem to return to his former health. Suddenly, in the spring of 1999, he lost considerable weight. That autumn, he came to the Sterrewacht with the news that an inoperable lung carcinoma had been found and that his passing was imminent. He mentioned this quite serenely, adding that he had asked the doctor: "So I don't have to worry about the millennium bug?" Whereupon the surgeon sadly responded: "No, you don't."

Henk withstood this final fatal episode with the stoic attitude that fitted him so well: rational and accepting the unavoidable with his head held high. We, bystanders, were assured by him that he had received more from life than most men, and that he was at peace with parting. He was true to himself and to us from beginning to end. He was a most impressive man. ●

H J Habing, on behalf of his colleagues, friends, and students at the Sterrewacht Leiden. Translated by W B Burton.

Donald Robert Barber 1901–2000

Fellow of the RAS, prolific observer and talented photographer.



Donald Barber

Donald Barber was a Fellow of the Royal Astronomical Society for 63 years even though he did not join the Society until he was 36, shortly after he had been appointed as a night assistant at the Norman Lockyer Observatory at Sidmouth, Devon. While at the Observatory he carried out a long-term spectrophotometric programme of observation of the colour-temperatures of early-type stars. He was Superintendent of the Observatory from 1956 until his retirement in 1961. He continued to work on the analysis of the data after his retirement and the resulting monograph received high praise in the foreword by Prof. H H Plaskett of Oxford University, who wrote: "It is a remarkable achievement that Mr Barber, single-handed, has brought to a successful conclusion a piece of work comparable to that of Greaves and his colleagues with at their disposal all the resources of the Royal Observatory, Greenwich." In 1987 he was awarded an honorary degree of Master of Science by the University of Exeter.

Barber was born and educated in Exeter. He won scholarships to Hele's School and to the Royal Albert Memorial College, which became the University College of the South West of England. He was awarded an external degree in physics by the University of London in 1925 and he then carried out research on instrumentation at the College, on which he published a series of papers over the next dozen years. In