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Van de Hulst Essay

Light scattering, aerosols, clouds, climate, Hendrik van de Hulst, and I

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ABSTRACT

It is not often that I have the opportunity to write something that is not a scientific paper, and I am thankful for this opportunity to express my thoughts with regard to pursuits that are greater than those of science. In this van de Hulst essay, to honor Hendrik van de Hulst, I briefly summarize a few points from Hendrik's life that I find especially interesting, including his interests in spiritual (or religious) aspects of life, and his decision to avoid involvement in nucleation problems, a critical and basic uncertainty of current climate models. After that, I present briefly a few episodes from my own experiences as an apprentice of science and life.

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1. Introduction

It is indeed a great honor to be selected a recipient of the 2017 van de Hulst Award for making landmark original contributions to the research field of electromagnetic scattering and its applications. I am thinking of many of my colleagues who are undoubtedly more deserving of this honor than I, and of those few famous light-scattering experts who were honored by the Award in preceding years [1–4].

Well, the world does not always work in a logical way. Thus I have to express my thanks to the van de Hulst Award Committee for the surprising result of their deliberation. It has now been more than a dozen years since I left the field of light scattering and submerged myself into the muddy darkness of climate research.

When I received an email from Elsevier's Jose Stoop with the Elsevier/JQSRT Van de Hulst Award in the subject line, I thought, oh they are asking me again to serve on the Van de Hulst Award Committee. When I opened the email later in the day I could not believe what I read.

To understand why these things happened, one has to reach into Chinese astrology. Instead of the usual twelve signs of zodiac, the Chinese have twelve animals. They combine these with the five elements. Thus, each combination of an element and an animal is repeated in a cycle of sixty years. In addition, the Chinese year starts at the second new moon after the winter solstice. It just happened that the deliberations of the van de Hulst Award Committee dealing with the 2017 Award coincided with the sign of a Fire Monkey.

If you search what the year of the Monkey means, you find expressions like erratic, clever, unpredictable, magical, and quixotic

(yes, named after Don Quixote). Thus, the Monkey (Fig. 1) is expected to turn everything upside down, opposite to the expected natural order of events. And the element of Fire just multiplies a thousand times what the Monkey does. Now it is easy to understand why I received the van de Hulst Award, why Donald Trump was elected president of the United States of America, why Great Britain is leaving European Union, and also why the world is in a general state of disarray. It was the year of the Fire Monkey. Well done, Monkey.

However, the year of the Fire Monkey ended at the second new moon after the winter 2016 solstice (on January 27, 2017); things are supposed to get normal (more serious) now. It is also a time to turn our attention to the lessons that can be gleaned from the life of Hendrik van de Hulst.

2. Early life and religion

There have been many obituaries written on behalf of van de Hulst (e.g. Hovenier [5]) and thus I do not consider it useful to repeat here the well-known facts that Hendrik was born on this day and died on that one. In between, he managed to think about hydrogen lines and composed his immortal book on Light Scattering by Small Particles [6]. One of the best stories about his life that I was able to find is his autobiographical note in the Annual Review of Astronomy and Astrophysics [7].

Instead of summarizing his biography, I will mention here features of van de Hulst's life that could be considered not so usual today. Hendrik's father was an elementary school principal who also wrote children's stories with religious themes. Hendrik grew up in a family with strong Calvinist Christian beliefs. Although I was not able to find any hints of Hendrik's thoughts during his younger years, the dedication in his 1946 Ph.D. thesis [8] "...to him who steers everything" suggests that Hendrik did not abandon, at

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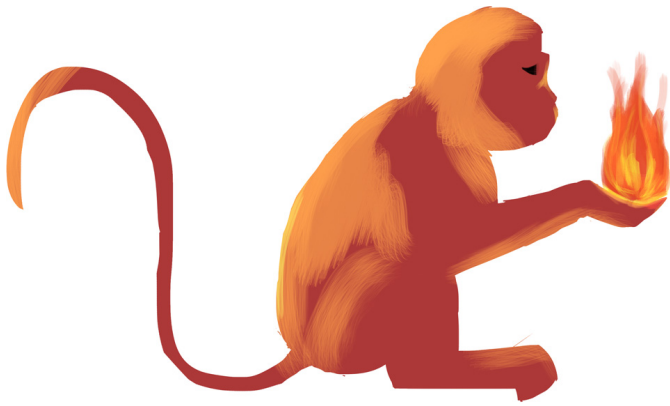


Fig. 1. Fire Monkey delivering the Award. Drawing by Lily Chylek.



Fig. 2. Old Observatory at Leiden University. Photo by Erik Zachte.

least at that time, his early childhood education and his family's beliefs.

In the obituary written by his Colleagues, friends, and students at Sterrewacht Leiden [8] we read:

"...his knowledge of the Bible became a familiar signature in his discussions. At the most unexpected moments, and to his listener's general surprise, he could cite an entirely appropriate verse from the Bible in order to put the topic under discussion directly in accurate perspective".

Those who are familiar with the scriptures would know that to accomplish this would require a deep understanding based on many hours of study. In later years of his life, Hendrik became interested in Tibetan style meditation and he apparently attended several Buddhist meditation retreats, which brought him at least a partial peace in the midst of failing health and an unsettled world.

3. How to listen

All of us in academia and science in general are used to talking; to lecture a class or to present our latest results to our colleagues at various meetings. However, fully listening to our colleagues' thoughts is a different matter. Each of us is full of our own wisdom and there is hardly any space left to accept the wisdom of others. Well, Hendrik provides an excellent example of how useful it may be to listen carefully to what others are telling us.

We often do not see what would be the best way forward at a given moment of our life. For others, who are not emotionally involved with affairs of our life, it may be easier to see what should be done. Thus when J. H. Oort, one of Henk's mentors during his student years, suggested that it might be useful to add to his Ph. D thesis his own Mie scattering calculation, instead of citing calculations done by others, Henk jumped with great enthusiasm to study papers on Mie theory. Soon he expanded the intended Mie scattering chapter of his astrophysical Ph.D. thesis into a completely new thesis topic, dealing exclusively with light scattering by spherical particles. This later became his famous book [6] from which a whole generation of scientists, including myself, learned light scattering.

4. Knowing one's limits

In his studies concerning optical properties of cosmic dust, Hendrik came across several papers dealing with a complex problem of nucleation and coagulation, transition of material from gaseous to solid or liquid phase. Hendrik cites his father's basic rule [7] "...better to understand a few things well than many things half..." and he makes an important decision: not to enter

the field of nucleation. Based on meteorological literature concerning nucleation of cloud droplets, he decided to stay away from even discussing the processes of nucleation of interstellar gas.

This decision shows considerable insight and a great ability for self-assessment, resulting in staying away from a field where it might have been beyond his ability to make a significant contribution in a given time frame. Today, cloud-droplets nucleation and the whole field of aerosol-cloud-climate interaction [9] is a major obstacle in making reliable climate predictions.

Manabe and Wetherald [10] published a paper in 1967 showing that the doubling of atmospheric carbon dioxide would produce the global warming of 1.3 °C while keeping absolute humidity constant, and about 2.3 °C when relative humidity is kept constant (introducing a water vapor feedback). Today, 50 years later, and after a few hundreds of billions of research funds spent on climate modeling, all we can say is that the doubling of carbon dioxide will likely produce a warming between 1.5 °C and 4.5 °C [11] with the uncertainty being due predominantly to the problem of nucleation processes: aerosol-cloud interaction. The range of warming uncertainty is even larger in the Arctic [12]. Could we have made more significant progress in climate modeling if van de Hulst would have spent some time on nucleation problems? Probably yes. However, from Hendrik's perspective the decision not to enter the field of nucleation was, I think, a correct one.

5. The last decade

Van de Hulst noticed that he was not very productive during the last decade of his life. Obviously, health problems contributed to this state of affairs. However, Hendrik complains [7] of too many committees, too many meetings, too many manuscripts to review, etc. This teaches us that we should not hesitate to decline various invitations to high visibility posts, to prestigious positions in powerful committees, etc., which all play into our feelings of great self-importance, but that rob us of the most valuable asset we have: our time.

I have never talked to Henk personally. Although I have seen him at several conferences I did not have any burning light-scattering problem at the time, and I did not feel important enough to bother him just with my presence. In 1995 I was supposed to spend the three summer months at Leiden Observatory (Fig. 2) based on an invitation by Mayo Greenberg [13], whom I knew from the early 1970s when he was a Chairman of the Astronomy Department at SUNY Albany. I already had reserved an on-campus apartment in Leiden, paid for a hotel accommodation in our planned stopover in Iceland, but, due to family health problems I had to cancel the visit. Now I am really sorry that visit did

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