Karl Schwarzschild, Annie J. Cannon and Cornelis Easton

van der Kruit, Pieter C.

Published in:
Journal of Astronomical History and Heritage

Journal of Astronomical History and Heritage, 24(2), 521–543 (2021).

KARL SCHWARZSCHILD, ANNIE J. CANNON AND CORNELIS EASTON: THE HONORARY PhDs OF JACOBUS C. KAPTEYN

Pieter C. van der Kruit
Kapteyn Astronomical Institute, University of Groningen,
P.O. Box 800, 9700 AV Groningen, the Netherlands.
E-mail: vdkruit@astro.rug.nl

Abstract: Honorary degrees and particularly doctorates are important instruments to enhance the standing of universities and professors, in addition to receiving these as a measure of a scientist's recognition. Jacobus C. Kapteyn from the University of Groningen in the Netherlands, one of the most prominent astronomers of his times, received three of these and has persuaded his university to award at least three, possibly five. I examine the background of the selection of the latter in view of developments in Kapteyn's time in his career, international astronomy and political and cultural circumstances.

Key words: Honorary degrees; statistical astronomy; Galactic astronomy; spectral classification; Selected Areas

1 INTRODUCTION

Universities boost their standing and prestige by appointing or keeping important scientists on their staff that have performed groundbreaking research, preferably while being employed by them, but if necessary when performed elsewhere. Listing alumni that have become leading researchers anywhere else but who started their careers by defending their thesis work at the university involved is also used to justify claims concerning success and status. Another important instrument is awarding honorary doctorates to prominent scientists or cultural or political figures.

One aspect of a professor's success may be taken to be who his or her students are. This involves for professors at most universities supervising research of students that leads to the defense of an important thesis, after which conferring a doctorate on the student as 'promotor'[1] on behalf of the Senate (or other body representing the university). But it is also possible to nominate persons for an honorary doctorate (Doctor *honoris causa*)[2] and act as an honorary promotor.

Jacobus C. Kapteyn (1851–1922; Figure 1) was a Professor of Astronomy at the University of Groningen in the Netherlands from 1878 to 1921. In his days he was one of the most prominent astronomers in the world, which can be illustrated by the fact that the most important observatories signed up to his 'Plan of Selected Areas' in which observations of stars in each of the 206 *Areas* were collected. Harvard College Observatory, under the directorship of Edward C. Pickering (1846–1919), photographed all these areas and sent large stacks of plates to Groningen for measurement of positions and magnitudes. Even more telling, George E. Hale (1868–1938) in 1908 adopted Kapteyn's 'Plan' as the primary program for his brand new, giant 60-inch telescope on Mount Wilson, the largest in the world, and had Kapteyn appointed for life as a Research Associate by the Carnegie Institution of Washington, and between 1908 and 1914 Kapteyn annually visited Mount Wilson.

Kapteyn did not have many students defending their theses under him during the tenure of his professorship. There were only eight, of which Willem de Sitter (1872–1934) undoubtedly is the most prominent. Pieter J. van Rhijn (1886–1960), who was to become his successor, has also gained some international standing. Actually, Adriaan van Maanen (1884–1946) might also be counted as a student of Kapteyn, since he performed a significant part of his thesis research in Groningen with Kapteyn; in spite of graduating under Albertus A. Nijland (1868–1936) in Utrecht he regarded Kapteyn as his real mentor. Three more students started their thesis work while Kapteyn was in office but

Figure 1: Jacobus C. Kapteyn from a drawing in 1908 by Cornelis Easton (courtesy: Kapteyn Astronomical Institute).

completed their theses only when van Rhijn had taken over (and in fact after Kapteyn had died). Of these Jan Schilt (1894–1982) pursued a very successful career in the USA, but without dispute the most prominent of Kapteyn's *nachwuchs* (i.e. including the ones who started their research under Kapteyn even though van Rhijn eventually was their thesis supervisor) is Jan Hendrik Oort (1900–1992). Much more on Kapteyn and Oort can be found in my academic (van der Kruit, 2015; 2019), and wider-audience (van der Kruit, 2021a; 2021b) biographies.

It is not well documented that Kapteyn was promotor in at least three cases of an honorary doctorate. The first one, awarded to journalist and amateur astronomer Cornelis Easton (1864–1929), is usually noted, but those of very prominent astronomers Karl Schwarzschild (1873–1916) and Annie Jump Cannon (1863–1941) are much less known. Schwarzschild's is rarely mentioned, Cannon's usually listed but understandably eclipsed by the more prestigious one she obtained a few years later from Oxford, and sometimes only the latter one is mentioned

The circumstances applying to the conferring of these degrees are the subject of this paper. Questions addressed are the following. Was this unusual? Why did Kapteyn select these people? Did Schwarzschild and Cannon actually come to Groningen to receive the honors? Kapteyn himself had three honorary doctorates, from Cape Town, Harvard and Edinburgh. How does this compare with others? He had none from English, German or French universities, where after all many of the leading astronomers in Europe were working. Does this tell us something or doesn't it?

This paper is aimed at an audience of historians and others interested, not necessarily with an astronomical expertise. I therefore will describe in some detail the required astronomical background to appreciate the significance of matters discussed. The reader is assumed to be familiar with basic astronomical concepts.

2 BACKGROUND

This section has been shortened, because it was thought most information in the original version should be known to the readers of this journal. A more extended version for those interested in more background of this paper is available on my homepage (van der Kruit, 2021c).

2.1 Honorary Degrees: General

According to Merriam-Webster an honorary degree is "a degree given by a college or university to someone who is not a student but who has done something important" (Merriam-Webster Dictionary, 2020). The first such degree seems to have been awarded by the University of Oxford, UK. According to their Website (Oxford University, 2020) this happened in 1478 or 1479.

In the USA the first honorary degree was awarded by Harvard University in 1692. Harvard claims to have awarded over 2300 honorary degrees by now (Harvard University, 2020). In the UK the Universities of Oxford and Cambridge are prolific awarding institutions; according to Heffernan and Jöns (2007), these awarded respectively 1487 and 1111 doctorates during the twentieth century. Both universities now award between eight and ten degrees per year. Harvard University nowadays awards between 5 and 15 degrees. But these of course are not all doctorate degrees.

The University of Groningen has awarded almost 300 honorary doctorates, the first occurring in 1717 (University of Groningen, 2020), which was for Abrahamus Trommius (Abraham Trom) in theology for a concordance of both the Old and the New Testament. However, already from 1618 onward there were doctorates awarded *sine examine*, so without submitting and defending a thesis. An interesting example is one awarded in 1634 to the famous theologian Gisbertus Voetius, who was a preacher who was being appointed Professor of Theology at Utrecht. It was felt undesirable that he would award PhDs without having obtained this degree himself and this is how that was solved. Astronomer Frederik Kaiser (1808–1872) in Leiden was a comparable case; he was awarded an honorary doctorate in 1835 so that he could be appointed lecturer in 1837 and eventually in 1840 Professor of Astronomy.

Honorary doctorates in Groningen are rare in most years but do occur in larger numbers in the years of an anniversary that is a multiple of fifty years. The peak at the tricentennial in 1914 was enormous, 67 in total starting with Queen Wilhelmina of the Netherlands. At other times the University has been more modest, in 2014 at the fourth centennial (aptly named 'for infinity' or '4∞') there were only nine. In recent years that were not a lustrum (quinquennium) it was mostly zero, sometimes one or exceptionally two. Groningen honorary doctorates are much, much rarer than Cambridge, Oxford or Harvard, but the latter ones are certainly more sought after.

For completeness I note that as a matter of principle some universities do not confer honorary degrees at all, but all Dutch universities do award honorary degrees.

Like the first one at Oxford, honorary doc-

torates are awarded often to royalty and political figures. In case of the Netherlands, for example Queen Juliana of the Netherlands has received honorary doctorates from both Leiden and Groningen and in addition eight more from foreign universities. Some renowned persons have tens of such honorary degrees; for example Nelson Mandela had over fifty, one of them from Leiden university. Kapteyn's University of Groningen honored the Queens of the Netherlands, Wilhelmina in 1914 at its 300-th anniversary and Juliana at its 350-th, and more recently international dignitaries Helmuth Kohl, Desmond Tutu and Ban Ki-Moon. This may sometimes be controversial, e.g. for the case of Groningen when Kohl a few years later was implicated in the CDU donations scandal, or when Oxford University's governing assembly, Congregation, by a large majority refused Margaret Thatcher an honorary doctorate.

2.2 Honorary Degrees: University of Groningen

For reference to the discussion in the remainder of this paper, I give some statistics on honorary doctorates at Groningen during Kapteyn's tenure of his professorship, actually between 1878 when he was appointed and 1922, one year after his retirement and the time of his death.

I already alluded to the remarkable peak of 67 in the year of the University's tricentennial, 1914. There were 14 in Kapteyn's day before that year, and five after. The first one, in 1884, did not set the scene; it was famous physician and microbiologist H.H. Robert Koch, one of the founders of bacteriology and the concept of infectious diseases. He would receive the Nobel Prize in 1905 for identifying the bacterium that caused tuberculosis.

After that there were only Dutch persons who had important academic contributions on their record, but for one reason or another had never been in a position to present a PhD thesis—what we might call 'corrective' honorary doctorates. One of these was amateur astronomer Cornelis Easton, to whom I will return below. Another example was the first woman who received an honorary doctorate from Groningen, Jantina Tammes, who studied for and obtained secondary teacher qualifications in a number of natural sciences and then worked as the assistant of Willem Moll, Professor of Botany in Groningen. Her contributions led to the award of an honorary doctorate in 1911. She went on to become the first female Professor at the University of Groningen and the second in the country (after Johanna Westerdijk from Amsterdam, who also was a botanist. These women held extraordinary professorships, i.e. added to the normal contingent; the lower status illustrates the slow progress toward gender equality). Except for Koch in 1884, all up to the 1914 peak were these 'corrective' honorary doctorates.

Another good example is Maria H.J.P. Thomassen, who was awarded an honorary degree by the Faculty of Medicine in 1905. This is also an amusing case, because this person was incorrectly claimed on the basis of the list on the University's Website (University of Groningen, 2020) to be a physician and the first female recipient of an honorary doctorate by Groningen (Nieuwsbad van het Noorden, 2018). However, Maria Thomassen was definitely male (from Roman Catholic parents in the southern province of Limburg, where boys named Maria were not uncommon), and he was not a physician, but a veterinarian. He had studied at the prominent School for Veterinarians in Utrecht, which could not award doctorates. Later he became a teacher at this School, and also did significant scientific research, sometimes together with Hartog Hamburger, Professor of Physiology at Groningen, who acted eventually as an honorary promotor. In 1925 this School would become a Faculty within the University of Utrecht and could then award doctorates.

It should be noted that cases of 'corrective' honorary degrees were not uncommon, because the occasion arose easily. An important illustration is related to the admission to universities. Initially, this was restricted to boys (no girls yet) from the Gymnasium (or grammar school). But in 1863 a new type of school—the Hoogere Burger School (HBS) or Higher Civic School)—was introduced, where much attention was paid to mathematics and the natural sciences, but where no Greek and Latin was taught. This was the preferred route around the end of the nineteenth century for boys and girls attracted to mathematics and science, where admission to the university was accomplished by taking a special, additional, exam. It is the route many Dutch Nobel Prize winners of that period had followed. The astronomer Jan Hendrik Oort also did this.

In 1914 there were 44 foreigners among the honorary doctorates awarded by Groningen, one of whom was Karl Schwarzschild. The other 43 were mostly important scientists, notably Léon Duguit, leading French scholar of public law; Niels Thorkild Rovsing, Danish surgeon; Arthur Louis Day, American geophysicist and volcanologist; Henri Pirenne, Belgian historian; and Britain's Alicia Stott (née Boole), female mathematician who never held an academic position but nevertheless made a num-

ber of valuable contributions in her field. These were definitely leaders in their fields, but probably the most important scientist was Svante August Arrhenius (1859–1927) from Sweden, founder of physical chemistry, who had received the Nobel Prize for Chemistry in 1903. Arrhenius also wrote papers and books on astronomy and astrophysics.

The remainder were influential Dutchmen, such as the famous architect Hendrik Petrus Berlage; social democrat but known as a communist sympathizer, well-known poet Albert Verwey; and musician, music teacher, composer and conductor of classical music Peter Gijsbert van Anrooy, who was a very good friend of Kapteyn. But also Carel Coenraad Geertsema, prominent politician and public administrator and at the time also President-Curator of Groningen University.

A special case was the doctorate awarded to steel magnate and philanthropist Andrew Carnegie (1835–1919). The archives at Groningen University contain a telegram from him in which he profoundly thanks the University for the honor but notifies them that he will not be present at the celebrations.

In 1914 there were 43 ordinary Professors at the University of Groningen, so most of these could have proposed two candidates (or more) for these honorary degrees. A number of candidates must have been chosen not by individual professors, but by the governing bodies within the University as a whole, especially the ones that concerned politicians or public administrators. Since van Anrooy was a very good friend of Kapteyn, the latter might very well have taken the initiative and proposed his name. Carnegie might very well have come out of Kapteyn's sleeve as well. After all, there was no other connection to my knowledge between the University of Groningen and Carnegie other than Kapteyn's appointment by the Carnegie Institution. It might have been a way of showing gratitude for this and the excellent and unique opportunities offered to Kapteyn to conduct his research at Mount Wilson Observatory. Then it would make sense that it was Kapteyn himself who came up with the idea.

Between 1914 and 1922 there were only five more honorary doctorates, four to Dutch public figures and one to Annie Cannon. Of the 19 awards during Kapteyn's Professorship and outside the celebrations in 1914, only two were international scientists (Koch and Cannon), the rest were Dutch persons who were awarded the degree in the 'corrective' sense defined above. That Kapteyn was allowed to propose a degree for a prominent foreign scientist in an ordinary year was very unusual and testifies to his exceptionally prominent status within the University. After all, Kapteyn's fame especially in the USA, evidenced by his collaboration at Mount Wilson and his appointment by the Carnegie Institution, must not have gone unnoticed by his peers, such as other professors and fellow members of the Senate. The numbers suggest that having proposed three and having that many accepted must have been highly unusual, but Kapteyn's status within the University was such that if someone was allowed that many it would have to be him.

On the other hand, we may ask: which Groningen professors were honored with an honorary doctorate elsewhere between 1878 and 1922? This information can be found in the annual summaries of events (the 'Lotgevallen' or Happenings, literally 'Fates') in the University by the Rector Magnificus. However, this may not always be complete, since the relevant installment fails to mention Kapteyn's honorary degree from Harvard! These were:

- Bernard Hendrik Kornelis van der Wijck, Professor of Philosophy and Logic (Edinburgh 1884),
- Jan Willem van Wijhe, Professor of Anatomy and Embryology, founder of the Anatomical Laboratory (Freiburg 1889, Aberdeen 1906),
- Jacobus Cornelius Kapteyn (Cape Town 1905, Harvard 1909, Edinburgh 1921),
- Hartog Jacob Hamburger, Professor of Physiology and Histology, founder of the Physiological Laboratory (Aberdeen 1906, Utrecht 1922, Padua 1922),
- Anton Gerard van Hamel, clergyman and Professor of French Language and Literature, Editor of the prominent Dutch literary magazine *De Gids* (Utrecht 1906),
- Barend Sijmons, Professor of German Language and Literature (St. Andrews 1912),
- Franz Marius Theodor de Liagre Bohl, Professor of Hebrew and Assyrian (Bonn 1915).

Hamburger's degree in Utrecht was actually awarded at the centennial of the School for Veterinary Science. The total count is then twelve degrees bestowed upon seven individuals in 45 years. Kapteyn's degrees from Cape Town and Harvard were the only ones from outside Europe.

2.3 Jacobus C. Kapteyn

Jacobus Cornelius Kapteyn, who lived from 1851 to 1922, is one of the most prominent founders of the field of statistical astronomy. A general introduction to this field with much background and Kapteyn's contributions can be found in Paul (1993), for Kapteyn himself see

my biographies of him (van der Kruit, 2015; 2021a).

Kapteyn's professional life's aim was to determine the distribution of stars in space, building on the approach of the 'Star Gauges' by William Herschel (1738–1822) about a century before him. His first contribution was the provision of a catalogue of stars in the Southern Hemisphere comparable to the *Bonner Durchmusterung* in the north and for this his part was to measure the photographic plates taken of the complete southern sky by David Gill (1843–1914) from Cape Town. This took him twelve years of labor. The *Cape Photographic Durchmusterung* was published in three installments, the last one in 1900, the final year of the nineteenth century, when Kapteyn approached the age of fifty. He developed the method of statistically estimating distances of groups of stars, so-called secular parallaxes, using their proper motions which contain a reflection of the motion of the Sun through space in addition to the peculiar motion of each star itself. His assumption was that these latter components were homogeneous and isotropic. For his goal of constructing the structure of the sidereal system he needed to make two more assumptions, namely that there was no attenuation of light in space by scattering or absorption by interstellar dust and that everywhere the mix of stars was the same.

By careful study of proper motions across the sky and looking for systematic patterns he discovered that this first assumption was false, and that in addition to random motions of the stars there seemed to be a set of two systematic streams—when corrected for the motion of the Sun—precisely opposite to each other, accurately directed along the Milky Way, and, using radial velocities from elsewhere, at a relative speed of about 40 km/sec. These are Kapteyn's 'Star Streams', which he announced at a large international congress during the St. Louis World Exhibition in 1904. Karl Schwarzschild, as we will see, soon came up with an alternative explanation that proved in the end to be the correct one. Of course, the presence of the 'Streams' significantly complicated Kapteyn's use of secular parallaxes, but did not make it impossible.

In order to proceed with his program to map the stellar distribution in space, he devised a very ambitious undertaking, defining 220 areas of sky that avoided bright stars and unusual crowding of fainter stars to derive properties of all stars to as faint levels as possible: magnitudes, colors, proper motions, radial velocities (because of the difficulty of obtaining sufficiently accurate spectra for all but the brighter stars this was not restricted to the formal areas), etc.

One very fundamental new property that he needed to consider as well was the spectral type, a classification of the stars in terms of the lines in their spectra that proved later fundamental in understanding differences among stars and their structure and evolution. This classification scheme was defined around 1901 by the work of Annie J. Cannon (building also on the work of others), although at the time the physics and astrophysics underlying it was not at all understood.

This 'Plan of Selected Areas' was defined in 1906, and Kapteyn succeeded in getting twenty major observatories to commit to providing observations. In the Introduction I already mentioned Harvard College Observatory under E. Pickering and Mount Wilson Observatory under George E. Hale which provided large amounts of observing time to expose plates for the star counts and colors. Some notable further contributions were from the German observatories at Bergedorf (Hamburg) and Potsdam (Berlin) for spectral typing using objective prisms; Radcliffe (Oxford), Yerkes, Yale and the Cape for proper motions and parallaxes; Lick and Mount Wilson for radial velocities; and quite a few others. It took decades to complete all of the observations.

To briefly round out the story on Kapteyn, I note that he did a number of studies on interstellar absorption (extinction), correctly inferring that it would be stronger in the blue and therefore give rise to increasing reddening of stars with increasing distance, but he kept worrying that he automatically selected in his studies different mixes and therefore colors of stars with distance. He actually arrived at quite reasonable values for the amount of extinction, as we know now, although to a significant extent this was fortuitous. In 1916, he quickly accepted evidence presented by Harlow Shapley (1885–1972) for absence of absorption when the latter found that with Kapteyn's absorption stars in globular clusters would have to be intrinsically some two magnitudes redder than observed. The option that dust was restricted to the plane of the Milky Way did not seem to have occurred to Kapteyn, Shapley or any other influential astronomer at the time. Although astronomers suspected the presence of absorbing dust, it took until the work by Robert J. Trumpler (1886–1956) in 1930 on diameters of star clusters that the case for interstellar absorption was convincingly settled and it had become clear that it was restricted to a thin layer in the plane of the Galaxy.

Neglecting absorption, near the end of his life Kapteyn used star counts and proper motions to make a 'first attempt' at deriving a rather flat model of the sidereal system. His final major contribution was to open up the field of stellar (nowadays usually referred to as galactic) dynamics, where he explained the equilibrium of the spatial distribution as a balance between the motions of stars and their collective gravitational force. In the perpendicular direction the distribution was maintained by random motions, in the plane of the system in addition by rotation and the associated centrifugal motion which he found was adequately provided by assuming two systems of stars rotating in opposite directions, which he identified with his 'Star Streams'. The Sun was in the inner parts, some 650 pc from the center.

Figure 2: Cornelis Easton in 1906. This photograph comes from the Album Amicorum, presented to H.G. van de Sande Bakhuyzen on the occasion of his retirement as Professor of Astronomy and Director of Leiden Observatory in 1908 (after Leiden Observatory, 1908).

Now, this contrasted with Shapley's more spherical and larger system of globular clusters. Eventually this was brought together in the picture of a disk and halo, with Kapteyn's system expanded by a factor of three or so when extinction was realized to affect the stellar distribution in the plane, and Shapley's shrunk by a factor of two. It took until 1938 before Jan Hendrik Oort used the accumulating data in the 'Plan of Selected Areas' to repeat Kapteyn's analysis allowing for absorption. For detailed discussions and references to major papers in the development of all of this see van der Kruit (2015; 2019; 2021a; 2021b). Note that any discussion on Kapteyn suffers from the fact that his archives, curiously except for the letters David Gill sent him, have been lost, presumably during the bombing of Rotterdam in 1940 (see the contribution by Petra van der Heijden in the 1999 'Kapteyn Legacy' symposium; van der Kruit and van Berkel, 2000).

3 DR. *HONORIS CAUSA* C. EASTON AND KAPTEYN'S 25th ANNIVERSARY AS A PROFESSOR IN 1903

Cornelis Easton (see Figure 2) lived from 1864 to 1929. He was primarily a journalist, but in addition was an accomplished amateur astronomer (see Blaauw (2014) for biographical notes; this and the English-language article by van E., (1929) are based on an extensive biographical article in Dutch by astronomer Johan W.J.A. Stein SJ (1929) from the Vatican Observatory).

After his secondary education (at the HBS), Easton spent a few years studying various subjects at what is now known as the Technical University of Delft, after which he switched to study French and obtained the qualifications for a secondary school teacher in that subject. But rather than picking up that profession he took on jobs as a newspaper journalist, eventually as editor (in-chief) of some daily or monthly newspapers and magazines.

He had developed a strong interest already as a child in astronomy and as a young man started producing drawings of the Milky Way, some of which he published. Very early on, he wondered what it would look like 'from space', that is to say from outside and from other directions, speculating there was spiral structure as in the famous drawing of the Whirlpool Nebula by William Parsons (1800–1867). This gave him the idea that the Milky Way had in fact the structure of a spiral-shaped star cluster.

So Easton had been intrigued by the observation of spiral nebulae and became convinced that our Galaxy should not be any different and had to have spiral structure as well. He therefore derived a model for the Galactic spiral structure on the basis of the assumption that the Sun was well away from the center and in areas in the Milky Way that were relatively bright we were looking along spiral arms and in darker areas in between such arms. In 1900 he published his ideas in a paper titled "A new theory of the Milky Way" in *The Astrophysical Journal* (Easton, 1900). He eventually improved this using photographs of the Milky Way from many sources, giving rise to the representation in Figure 3, taken from a later paper in *The Astrophysical Journal* (Easton, 1913). The ring at the outer edge is a sketch of the Milky Way on the sky between latitudes $+10^{\circ}$ and -10°, and the inner part the derived structure. It must be said that Kapteyn seemed to have judged this to be an unjustified over-interpretation.

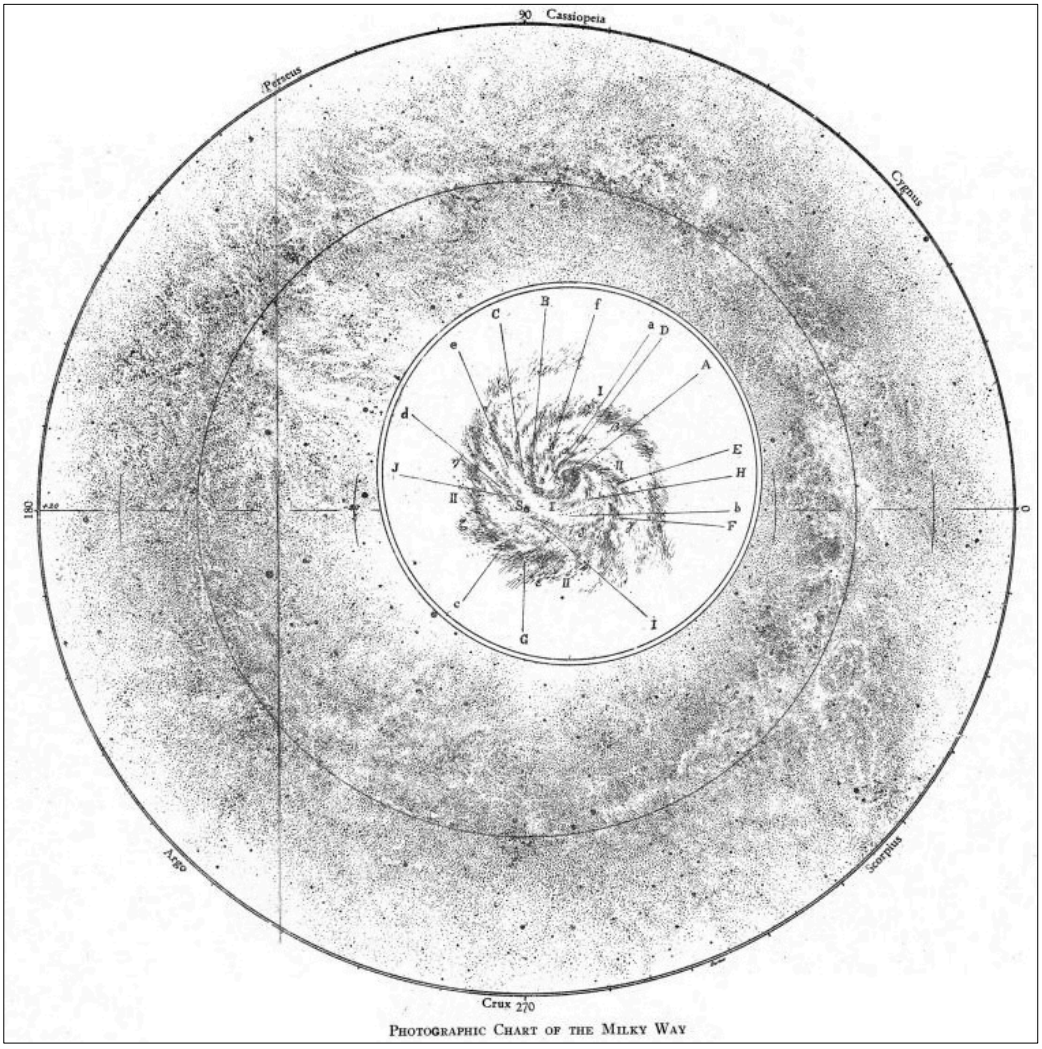


Figure 3: Easton's model for the spiral structure of the Stellar System, based on a sketch of the Milky Way from many photographs of the outer shell (after Easton, 1913: Plate 3).

Still, Easton's efforts were sufficient reason to propose an honorary doctorate in 1903. It is probably not a coincidence that Kapteyn that year celebrated his 25th anniversary as a Professor. In 1878 he was appointed to a new Chair in Astronomy in Groningen, spurred by the fact that a new law on higher education had come into force. This law stipulated among others that the curricula at the three state-funded universities should be the same and this gave rise to a very substantial increase in professors at and in the budgets of the universities. For Groningen a new Professorship in Astronomy was opened, but no accompanying observatory, which resulted in Kapteyn establishing an astronomical laboratory, an 'observatory without telescopes'. So there had been a burst of professorial appointments in 1878 and the Rector Magnificus in Groningen in his annual report on the 'Lotgevallen' of the University noted with great satisfaction that of these many jubilees Kapteyn had been the only one to be honored with a prestigious Knighthood in the Order of the Netherlands Lion. Maybe the University honored Kapteyn by allowing him to bestow an honorary doctorate.

From the 'Lotgevallen' of the University for the academic year 1902/1903:

> One doctoral award took place honoris causa, in a public and extraordinary session of the Senate. On the 13th June Mr. C. Easton from Rotterdam, where he is an editor of the Nieuwe Rotterdamse Courant, on the basis of his excellent service for the science of astronomy, was promoted honorably to doctor in mathematics and astronomy. Promotor was prof. Kapteyn.

In the NASA/Harvard Astrophysics Data System, Easton has no fewer than 22 publications, of which 11 are in leading international journals including, in addition to *The Astrophysical Journal*, *Monthly Notices of the Royal Astronomical Society*, *Nature*, *Astronomische Nachrichten*, and the *Bulletin of the Astronomical Institutes of the Netherlands*. Some of these publications concern correlations between the

distribution of bright stars and the brightness of the Milky Way and distances of features in the Milky Way.

He was also interested in long term patterns in the weather. Kapteyn had been interested in this also. From widths of tree rings in oak trees in the Trier area in Germany, Kapteyn had inferred also in the 1880s a periodicity of 12.4 years in the amount of rainfall between 1770 and 1880. Easton analyzed 'modern' temperature data for Western Europe since around 1850, less accurate ones in the one hundred years before that and classifications of the harshness of winters in the centuries before that. Easton then had found that there was an 89-year period in the occurrence of severe winters, about seven times the period of Kapteyn's cycle. Attempts to attribute that at least partly to the solar cycle were not successful.

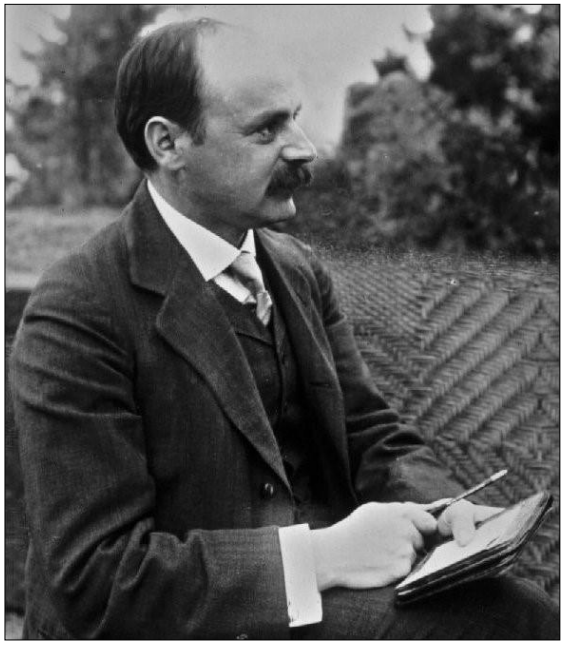


Figure 4: Karl Schwarzschild in one of the few pictures available of him (schoolsobservatory.org).

Easton eventually became Chairman of the amateur organization Netherlands Association for Meteorology and Astronomy and Editor-in-Chief of its periodical *Hemel & Dampkring* (*Sky & Atmosphere*). For an amateur astronomer his contribution was remarkable.

4 DR. *HONORIS CAUSA* K. SCHWARZSCHILD AND THE UNIVERSITY'S TRICENTENNIAL IN 1914

Karl Schwarzschild (see Figure 4) lived from 1873 to 1916 (for two authoritative obituaries see Hertzsprung, 1917, and Eddington, 1917). Already during his secondary school years he published two papers on the determination of the orbits of binary stars and as a student another paper on variable stars. He studied under Hugo H. Ritter von Seeliger (1849–1924) in Munich. Von Seeliger would later produce a model of the sidereal system much like Kapteyn's and at about the same time. However, it was more mathematical, schematic and difficult to follow. Schwarzschild wrote a PhD thesis on Poincaré's theory of rotating liquid bodies, after which he spent some time as Assistant at Vienna, where he developed new methods to derive stellar magnitudes from photographic plates. This had of course been done before, notably by Kapteyn and Gill in the *Cape Photographic Durchmusterung* (and also in the *Carte du Ciel*), but Schwarzschild improved the procedure considerably by using extra- or intra-focal exposures, in the process describing also the characteristic of reciprocity failure—although not by that name—in photographic plates (that at faint levels it takes more than twice the exposure time to reach the same level of photographic density for twice as faint incident light). He derived an empirical formula describing the relation between exposure (brightness multiplied by exposure time) and the resulting photographic density. Already in 1901, after a second period in München, he was appointed Professor and Director of the Observatory in Göttingen.

His most important work at that time was the 'Göttingen Actinometrie',[3] a survey of stellar magnitudes between the celestial equator and +20º declination, replacing his method of out-of-focus exposures by a new method based on a regular shaking of the plate during exposure to distribute the light over a larger area of emulsion. The instrument developed for this was called a 'Schraffierkassette'.

The 'Göttingen Actinometrie' contained 3500 stars. The word 'Actinometrie' was derived from the instrument that John Herschel (1792–1871) had built, with which he had determined the energy radiated by the Sun by measuring the increase in temperature in a closed volume that was exposed to sunlight. Herschel had named that an actinometer, from the Greek word 'aktina' for ray (of light). The term has also been used by John A. Parkhurst (1861–1925) who published about the same time as Karl Schwarzschild the 'Yerkes Actinometry' of stars around the North Celestial Pole, a kind of precursor of the 'North Polar Sequence'. The 'Göttingen Actinometrie' produced an important piece of information, namely a very tight correlation between stellar colors and spectral types, thus establishing Karl Schwarzschild's reputation.

In 1909 Schwarzschild was appointed Director of the Potsdam Astrophysical Observa-

tory, a very prestigious position. Potsdam took part in Kapteyn's 'Plan of Selected Areas', eventually providing accurate photographic magnitudes for stars in the northern 'Areas' that were too bright for the deep plates taken at Harvard and Mount Wilson. The Schwarzschild Archives at the Niedersächsische Staats- und Universitätsbibliothek Göttingen has provided me with scans of the relevant correspondence. Kapteyn and Schwarzschild corresponded regularly. The Kapteyns visited Potsdam in May 1911 and there is also some correspondence between Mrs Kapteyn and Mrs Schwarzschild, the former writing in English apologizing that German is 'beyond my power'.

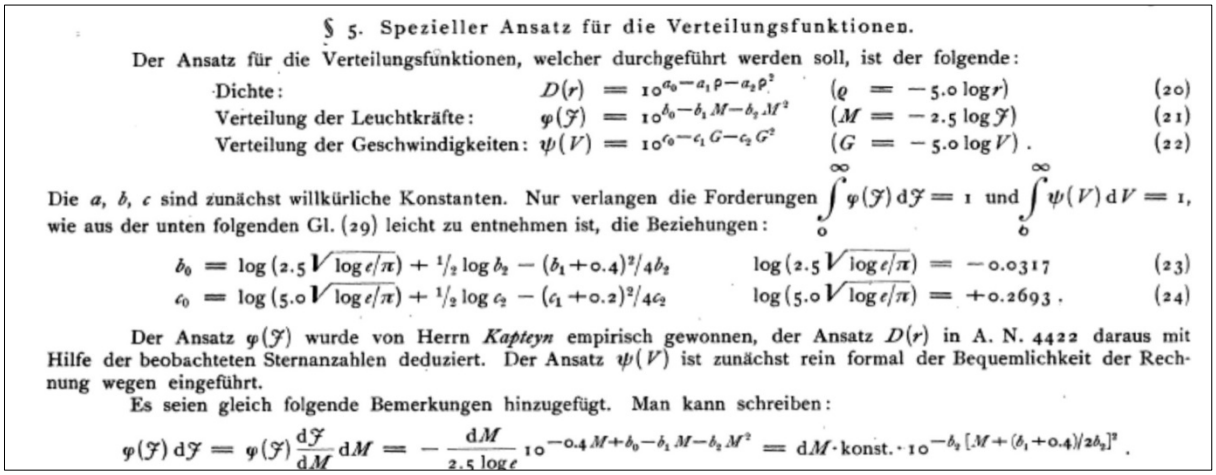
Kapteyn and Schwarzschild were on very good terms. The latter had asked support from Kapteyn to have two younger astronomers invited to spend some time at Mount Wilson, for which Kapteyn mediated by recommending them to George Hale. The first person that Kapteyn introduced to Hale on recommendation of Schwarzschild was Ernst Arnold Kohlschütter (1883–1969), who had obtained a PhD from Karl Schwarzschild while the latter was still at Göttingen and had moved to Hamburg afterwards. This opened what David DeVorkin (2000) has dubbed the 'Pipeline' (see his contribution to the 1999 'Legacy Symposium' on Kapteyn (van der Kruit and van Berkel, 2000) and that of Klaas van Berkel (2000) in the same volume). Kohlschütter went to Mount Wilson in 1911 and stayed until the start of WWI. He worked with Walter S. Adams (1876–1956) and they discovered the relation between the width of spectral lines and absolute magnitude (the dwarf–giant distinction for late types) and introduced the spectroscopic parallax. Later Kapteyn and Adams had a bitter argument when Kapteyn felt Kohlschütter did not get the credit he deserved from Adams.

The second person was Ejnar Hertzsprung (1873–1967), a Danish astronomer working for Karl Schwarzschild at Potsdam. Kapteyn introduced him to Hale in 1912 and took him along during his Mount Wilson visit that year. Before that Hertzsprung spent some time in Groningen and by the time they started out for California he was engaged to the younger daughter Henriette Kapteyn. They got married in May 1913 and Henriette moved with him to Potsdam that year.

Although the 'Actinometrie' was interesting work to Kapteyn, probably the most relevant in the context of the honorary degree was Schwarzschild's theoretical work related to the structure of the Milky Way as a Stellar System. There are two things to mention.

The first of these concerns Kapteyn's 'Star Streams'. Not long after Kapteyn's presentation of these in 1904, Schwarzschild noted that the interpretation of two distinct streams of stars moving through one another was not the only possibility. He had described the distribution of peculiar velocities of stars in space as much like that of molecules in a gas, which means according to the Maxwellian distribution. These velocities then are distributed as a Gaussian curve, but isotropic, so Gaussians with the same dispersion (or mean velocity) in all directions. Schwarzschild proposed a distribution that was also of this Maxwellian form but with dispersions that were different in three different perpendicular directions. These then were the observations equivalent to two opposite streams in the direction of the largest dispersion. It became known as an ellipsoidal distribution, which then would mimic two opposite streams while in fact it was a single distribution that happened to be anisotropic. Kapteyn had stuck to his interpretation of the distinct streams on the basis of the observed property that the make-up of stars in both streams was distinctly different. Prominent British astronomer Arthur Stanley Eddington (1882–1944) supported that view for a long time as well, until the evidence for different compositions of the streams disappeared with better data. Schwarzschild's proposal was adopted definitely after Jan Oort had discovered Galactic rotation and from dynamics showed that the long axis of the velocity ellipsoid had to point toward and away from the center of the Galaxy. That Kapteyn's streams deviated from this by 20º, an observational result that turned out to be correct and referred to as the deviation of the vertex, remained a problem until it was explained by Oort later as due to the gravitational influence of spiral structure. To honor his work in this area the velocity ellipsoid remains to be referred to as the Schwarzschild distribution.

There was however another contribution of Schwarzschild that might have been the strongest argument in favor of an honorary doctorate and that has to do with the derivation of the spatial distribution of stars from counts as a function of apparent magnitude. Suppose that we know the distribution of stellar types, and thus absolute magnitudes, at any position in the system. This 'luminosity function' was assumed to be the same everywhere and in principle can be determined locally using statistical studies and secular parallaxes. Now if we know this luminosity function and the stellar density, the distribution of stars, the counts of stars in a particular direction as a function of apparent magnitude, follows from a summation using these two functions. Take an apparent magnitude and a position on the sky. For each element of



§ 5. Spezieller Ansatz für die Verteilungsfunktionen.

Der Ansatz für die Verteilungsfunktionen, welcher durchgeführt werden soll, ist der folgende:

Dichte: $D(r) = 10^{a_0 - a_1 \varrho - a_2 \varrho^2}$ $(\varrho = -5.0 \log r)$ (20)

Verteilung der Leuchtkräfte: $\varphi(\mathcal{F}) = 10^{b_0 - b_1 M - b_2 M^2}$ $(M = -2.5 \log \mathcal{F})$ (21)

Verteilung der Geschwindigkeiten: $\psi(V) = 10^{c_0 - c_1 G - c_2 G^2}$ $(G = -5.0 \log V)$. (22)

Die a, b, c sind zunächst willkürliche Konstanten. Nur verlangen die Forderungen $\int_0^\infty \varphi(\mathcal{F})\, d\mathcal{F} = 1$ und $\int_0^\infty \psi(V)\, dV = 1$, wie aus der unten folgenden Gl. (29) leicht zu entnehmen ist, die Beziehungen:

$$b_0 = \log(2.5\sqrt{\log e/\pi}) + {}^1/_2 \log b_2 - (b_1 + 0.4)^2/4b_2 \qquad \log(2.5\sqrt{\log e/\pi}) = -0.0317 \quad (23)$$

$$c_0 = \log(5.0\sqrt{\log e/\pi}) + {}^1/_2 \log c_2 - (c_1 + 0.2)^2/4c_2 \qquad \log(5.0\sqrt{\log e/\pi}) = +0.2693\,. \quad (24)$$

Der Ansatz $\varphi(\mathcal{F})$ wurde von Herrn *Kapteyn* empirisch gewonnen, der Ansatz $D(r)$ in A. N. 4422 daraus mit Hilfe der beobachteten Sternanzahlen deduziert. Der Ansatz $\psi(V)$ ist zunächst rein formal der Bequemlichkeit der Rechnung wegen eingeführt.

Es seien gleich folgende Bemerkungen hinzugefügt. Man kann schreiben:

$$\varphi(\mathcal{F})\, d\mathcal{F} = \varphi(\mathcal{F}) \frac{d\mathcal{F}}{dM} dM = -\frac{dM}{2.5 \log e} 10^{-0.4M + b_0 - b_1 M - b_2 M^2} = dM \cdot \text{konst.} \cdot 10^{-b_2 [M + (b_1 + 0.4)/2b_2]^2}.$$

Figure 5: Part of the paper by Karl Schwarzschild where he developed a method to solve the integral inversion problem in statistical astronomy. Here he introduces special analytical forms of the distribution functions (after Schwarzschild: 1912: 367–368).

distance from the Sun along the corresponding line of sight each apparent magnitude corresponds to a certain absolute magnitude. The number of stars seen at that apparent magnitude from this element then is the total density of stars there multiplied by the fraction of stars of the required absolute magnitude, which is the value of the luminosity curve at that absolute magnitude. All such contributions from elements at other distances along the line of sight, corresponding to different absolute magnitudes, then have to be added up to find the total count of stars of that particular apparent magnitude.

Mathematically this is an integral, which can be evaluated in principle in a straightforward manner. But the solution required is the inverse. Given the form of the luminosity curve and the star counts at apparent magnitudes, the problem is to determine the total density as a function of distance. That means 'inverting' the integral and inversion of integral equations is notoriously difficult. Now in 1912 Karl Schwarzschild, being interested in this problem, possibly since he was a student after all of von Seeliger, had developed a method to solve this problem for the case that the luminosity curve was a Gaussian function (see Figure 5). Of course, this was of enormous importance to Kapteyn. Indeed, later in 1920 he and van Rhijn chose the Schwarzschild method to solve for the distribution of stars in space, which resulted in the Kapteyn Model.[4]

There are in the archives of the University of Groningen many notes related to the honorary doctorates in 1914, but although discussions about how to choose the candidates are recorded in minutes of the meetings of the Senate and Faculties, there is no record of supporting arguments for the choices. It seems obvious that Kapteyn had the work described above in mind when he proposed Schwarzschild. The archives in Göttingen contain the letter to him in which he was notified of the award. In accordance with the customs of the time it is in Latin. No explanation regarding the work the award was made for was given in the letter. Also, the diploma or 'bull' was phrased in Latin (see Figure 6).

The question is whether or not Karl Schwarzschild actually came to Groningen to receive the degree in person and attended the celebrations of the tricentennial. The answer is that he did. The direct evidence consists of two small pieces of paper, on which he wrote rather short notes to the Rector Magnificus (Schwarzschild, 1914a; 1914b). They were in German, but when translated into English they say:

> Potsdam, 20-IV-1914.
> To the Rector and Senate of the University of Groningen
> I express my cordial thanks for the honor you have extended to me. It will be a great pleasure to attend the celebration of the three hundredth anniversary of the university.
> Your sincerely dedicated
> K. Schwarzschild.

> Potsdam, 5 July 1914
> To the academic Senate of the National University of Groningen,
> I express cordial thanks for the sending of the beautiful medal that will help me to keep alive the remembrance of the impressive celebration in Groningen.
> Your fully dedicated
> K. Schwarzschild.

The archives of the University of Groningen contain a printed note by the Rector Magnificus, specifying the procedure to use in the selection of honorary doctorates: that each Faculty (there were five) would nominate six scientists, plus another fifteen representatives of foreign universities and learned societies, for a total of 45.

Rector et Senatus Universitatis Groninganae

S. P. D.

Sapienter a maioribus nostris institutum est, ut Rectori et Senatui Universitatis non modo liceret iis summos honores tribuere, qui studiorum curriculo rite peracto specimen quod dicitur litterarium Facultatis alicuius examini submisissent, sed etiam extra ordinem eos Doctoris titulo ornare, qui in ipsa patria sive extra fines eius de disciplinis vel litteris vel artibus optime meruissent atque omnium gentium cultui et humanitati mirum in modum profuissent. Sed imprimis ludorum saecularium celebratio et festi concelebrandi sollemnitas idoneam Rectori et Senatui occasionem praebere solebant opera illa et merita virorum doctorum atque artificum praestantium et diligenter recognoscendi et honorifice remunerandi. Qua opportunitate arrepta, cum dies natalis trecentesimus Universitatis Groninganae celebratur, Nos, Rector et Senatus Universitatis Groninganae, libenter iure nostro utimur, ut in virum egregium

Carolum Schwarzschild laureum Doctoralem honoris causa conferamus. Quapropter sollemni ritu eundem Carolum Schwarzschild Doctorem [illegible] creavimus et renuntiavimus eique concessimus, quidquid iuris et honoris legitime creato [illegible] Doctori aut lege aut longa consuetudine tribui haberique solet. Cuius rei quo esset certior ac testatior fides, Diploma hoc publicum manu Rectoris et Actuarii nostri subscriptum et maiore Universitatis sigillo confirmatum et tradendum curavimus.

Groningae, die [illegible] mensis [illegible], anno MCMXIV.

[illegible]
Rector Magnificus

[illegible]
Senatus Actuarius

Figure 6: Diploma or ‘doctoral bull’ for the honorary degree of Karl Schwarzschild from the University of Groningen in 1914 (courtesy: Schwarzschild Archives).

The Senate would take care that the final lists would be uniform in composition of nationalities, disciplines, etc. There is no good record in the archives of the Senate, Rector Magnificus or Faculty of Natural Sciences of which professor proposed which candidate. It would be a safe bet that Kapteyn proposed Karl Schwarzschild.

The University had 43 professors in five Faculties: Theology (6), Law (6), Medicine (11), Arts and Philosophy (10), and Natural Sciences (10). It must have been too difficult to decide which professor could and which could not propose a person and have his proposal accepted, so that—despite the 45 proposed by the Rector—in the end the number grew to 67.

The file in the Archives with organizational details of the tricentennial contains long lists of guests and representatives to the proceedings, and since the hotel accommodations in Groningen were limited, visitors were for the larger part invited to stay with professors in their private homes. The archives contain a map of the city of Groningen so that visitors could find their way around. It was oriented with the west at the top (note that the word *orientation* comes from putting the east at the top). The accommodation lists show that Schwarzschild and another honorary doctor, Peter van Anrooy, had been staying with Kapteyn. No doubt Karl Schwarzschild came to Groningen to receive the honorary degree and attend the celebrations. He is also on the printed list of the 283 attendees of the celebratory dinner, as are Kapteyn and van Anrooy.

The celebrations started on Monday 29 June, with a session where guests were received. A special commemorative book was presented (University of Groningen, 1916); it included an over 200-page history of the University written by well-known Professor of History Johan Huizinga (he would move to Leiden in 1915) and various other contributions on the University in the past or present, including a description by Kapteyn of his Astronomical Laboratory. Also, a special memorial medal was presented (Figure 7), of which Schwarzschild later had received a specimen according to his note above. The formalities of the celebration took place on 30 June in the Nieuwe Kerk, a major church in Groningen, but not in the large Martini Church in the center of town where cur-

Figure 7: The memorial medal that the University of Groningen had had struck for the celebration of its tricentennial in 1914 (after University of Groningen, 1914).

rently such festivities and ceremonies take place. The program was full of speeches by dignitaries and representatives from other universities and learned societies. Kapteyn had been asked by the US National Academy of Sciences to be its formal representative and given a text to read out (see van der Kruit (2015) for details); he had been elected a Fellow of the Academy in 1907. On the following day,1 July, a special session of the Senate took place during which the honorary degrees were officially bestowed upon the 67 laureates. The Rector Magnificus took care of the one for H.M. Queen Wilhelmina, the others were granted by the Deans of the Faculties, so there was no specific individual promotor. For Schwarzschild the Dean was biologist Jan Willem Moll. The degrees were bestowed by pronouncing the official formula in Latin. Karl Schwarzschild was honored for his "exceptional contributions to many aspects of astronomy and physics", and was proclaimed—somewhat contradictorily—a doctor of mathematics and astronomy.

Nowadays Karl Schwarzschild is principally known for the Schwarzschild radius of a black hole. This was work he did later. Weeks after the tricentennial the First World War broke out and Schwarzschild—although already 40 years of age—volunteered to serve in the German Army, where he eventually rose to lieutenant of the artillery. In 1915 he was stationed in Russia where he wrote three papers on General Relativity and Quantum Mechanics. He solved Einstein's field equations for the case of a point mass—or a single piece of very concentrated matter—and found that there was an event horizon. Gravity is so strong that light cannot escape through this horizon so that an outside observer cannot be aware of any events inside. This dimension of a black hole (a term coined later), defined as that of the event horizon, became known as the 'Schwarzschild radius'.

In Russia in 1915 Schwarzschild began to suffer from pemphigus, a rare autoimmune skin disease from which he died in 1916 at the age of only 42.

4.1 Interlude: Peter Gijsbert van Anrooy

Peter Gijsbert van Anrooy (1879–1954), who also stayed with the Kapteyns, was a musician, composer and conductor. He had been Director of the Symphony Orchestra in Groningen (the Groninger Orkest Vereeniging) between 1905 and 1911; later he worked in the Hague as Director of the renowned 'Residentie-orchestra' (Den Haag is the place of residence of the Government), and the 'Toonkunst-choir' (toonkunst is a now somewhat outdated word for music in general). In 1914 he worked in Arnhem in between these two assignments.

Henriette Hertzsprung-Kapteyn wrote a biography of her father (Hertzsprung-Kapteyn, 1928), from which I quote (in my English translation, also available on the Web, see Hertzsprung-Kapteyn, 1928):

> It was around his 60-th birthday that he start-ed to attend a course about music in order to better appreciate this art. He was not gifted as a musician, did not play an instrument and he did not have a good singing voice. He had his own manner of expressing himself using music, which at home was referred to as 'trumpeting'. As soon as he started producing this sound, Mrs. Kapteyn could not resist going to the piano and accompanying him, which had a very origin-

> al effect. You could hear him coming home while singing and sometimes while working he would suddenly start singing, usually parts of sonatas or symphonies that he was familiar with. He wanted to hear the same old pieces again and again, the new unknown ones having little appeal to him. But the art in itself, the depth of it, was a mystery to him; it filled him with a quiet, respectful awe and for an artist he felt the deepest admiration. He followed a course, taught by Peter van Anrooy, at that time the conductor of the Groningen orchestra, which interested him enormously. Every Wednesday evening he attended the concert of the orchestra in the 'Harmonie', concentrating on the beauty of music and always felt enriched by it. His acquaintance with van Anrooy, which soon became a close friendship, took him closer to art. He found many parallels between science and art. Isn't it true that both are in their ideal form unselfish and striving toward truth and purest expression? Oblivious to earthly fame and prosperity in order to give the highest that a person has to give? In that way he regarded art as the sister of science.

At the funeral of Kapteyn, van Anrooy played on the organ the final choir from Bach's *Matthäus Passion*. Considering this friendship and teacher–pupil relation it is not unlikely that van Anrooy was actually also proposed by Kapteyn for an honorary doctorate and was subsequently asked to put him up during the festivities. The Dean of the Faculty of Arts and Philosophy, Professor of English Literature and Sanskrit, Johan Hendrik Kern, praised van Anrooy in his laudatory as an "… expert musician, excellent and skillful orchestra conductor, who in our country successfully raised music to a higher standard." He was promoted to Doctor of Arts.

I note before ending this section that Andrew Carnegie, who I suspect had been proposed by Kapteyn, received an honorary doctorate in the Faculty of Law for "… his dedication to the laws of war and peace, not only in words but particularly in deeds."

5 DR. *HONORIS CAUSA* A.J. CANNON AND KAPTEYN'S RETIREMENT IN 1921

Annie Jump Cannon (1863–1941; Figure 8) studied physics from 1880 to 1884 at Wellesley College in Massachusetts, which was (and is) one of the top academic schools for women in the USA. Her middle name 'Jump' was her mother's maiden name. She returned home, developing an interest in photography and studied all aspects of it, perfecting her skills and as a photographer she traveled through Europe. In 1893, after returning home, she published her photographs, which drew some attention. At about the same time she suffered from scarlet fever which left her almost deaf. After her mother's death, she returned to Wellesley where she was hired to teach physics. It was also there that she developed an interest in astronomy and spectroscopy. She studied astronomy at Wellesley and for this took courses at Radcliffe College not far from Harvard College, where Edward Pickering, who taught there, noted her and hired her in 1896 as one of his assistants. She finished her Masters at Wellesley in astronomy in 1907. At Harvard, Cannon became a member of the Harvard group of female computers that Pickering had hired.

It is assumed that readers of the journal are familiar with the history of spectral types of stars and I will not recount that here. For those less informed on this issue I refer to the longer original version of this paper (van der Kruit, 2021c). Suffice it here to recall that the final result was published by Annie Cannon, who defined the now universally adopted sequence O, B, A, F, G, K, M, with each subdivided into ten sub-

Figure 8: Annie Jump Cannon in 1922 (commons.Wikimedia.org/wiki/File:AnnieJumpCannon1922Portrair.jpg).

classes. Cannon is said to have been able eventually to classify 200 stars per hour or 18 seconds per star. This work, which resulted in the Groningen award, was published by Cannon and Pickering in nine volumes of the Harvard Annals between 1918 and 1924, and it contained about 250,000 stars (and later it was expanded as the Henry Draper Extension).

Figure 9 shows two tables from the original publication in 1901, in which Cannon proposed more or less the sequence as we know it now and its subdivisions (although the second capital letter later disappeared). The type 'N' was later considered not part of the sequence and the 'O' was moved to the top of it.

The proposal by Kapteyn to award Cannon

The letters of the Draper Catalogue are used in the following discussion to denote the various classes of spectra. The relation between the letters of the Draper Catalogue and the five types in ordinary use for visual spectra is as follows : —

Type.	Letter.	Type.	Letter.
I	A, B	III	M
I–II	F	IV	N
II	G	V	O
II–III	K		

Group.	Div.	Constellation.	Desig.	Class.	Remarks.	Group.	Div.	Constellation.	Desig.	Class.	Remarks.
I	*b*	Monoceros ..	S	Oe 5 B	18	VIII	*c*	Cygnus	*a*	A 2 F Pec.	40, 154
II	*a*	Orion	ϵ	B		IX	*b*	Ursa Major..	δ	A 2 F	18
"	*b*	Orion	δ	"	18	X	*a*	Triangulum .	β	A 5 F	
III	*a*	Canis Major .	β	B 1 A		"	*b*	Aquila	*a*	"	18
"	*b*	Virgo	*a*	B 2 A	18	XI	*a*, *b*	Aquila	δ	F	
"	*c*	Orion	χ^2	"	40	XII	*a*	Canis Minor .	*a*	F 5 G	
IV	*a*	Orion	γ	"		"	*c*	Auriga	ϵ	" Pec.	40, 182
"	*b*	Ursa Major..	η	B 3 A	18	*XII*	*c*	Cygnus	35	"	180
IV	*a*	Orion	π^4	"		XIII	*a*	Orion	χ^1	F 8 G	
"	*b*	Canis Major .	ζ	"	18	"	*c*	Canis Major .	δ	" Pec.	40, 185
V	*a*	Taurus	η	B 5 A		*XIII*	*a*	Perseus	θ	G	
"	*b*	Orion	τ	"		XIV	*a*	Auriga	*a*	"	
"	*c*	Canis Major .	η	" Pec.	40, 96	*XIV*	*a*	Gemini	κ	G 5 K	
VI	*a*	Perseus	β	B 8 A		XV	*a*	Boötes	*a*	K	
"	*b*	Leo	*a*	"	18	*XV*	*a*	Cancer	β	K 2 M	
"	*c*	Orion	β	" Pec.	40, 112	XVI	*a*	Taurus	*a*	K 5 M	
VI	*b*	Aquarius	η	"	18	XVII	*a*	Andromeda..	β	Ma	
"	*c*	Camelop. ...	—	B 9 A	40	XVIII	*a*	Orion	*a*	"	211
VII	*a*	Canis Major .	*a*	A		XIX	*a*	Perseus	ρ	Mb	
"	*b*	Hercules	o	"	18	*XIX*	*a*	Hercules	*a*	"	214
"	*c*	Leo	η	" Pec.	40	XX	*a*	Cetus	o	Md	
VIII	*a*	Gemini	*a*	"		XXI	—	Pisces	19	N	
"	*b*	Ursa Major..	γ	"	18	XXII	—	Canis Major .	—	Ob	

Figure 9: Reproduction of the original introduction of the spectral types as we know them today in 1901. At the top the proposed order ('N' later dropped from being part of the sequence and 'O' was moved to the front). Below some typical stars and their classifications (after Cannon and Pickering, 1901: 139; 145).

an honorary doctorate is conserved in the Groningen Archives. To preserve the authenticity, I will reproduce it in translation in full:

> It is known that an entirely new field of research in classical astronomy has been added by the ascent of spectroscopy. A field in which insights have been given that in the past seemed impossible. – What we know about the evolution of cosmic bodies is based entirely, or at least for a major part, on spectroscopic observations and with the researches in the last few years it appears that the role spectroscopy will play in the study of the structure and motions of the sidereal world will become an almost equally fundamental one.
>
> In the meantime the faintness of stars is raising obstacles for the study, obstacles that for the moment can be overcome only for the brightest stars and then only after inexhaustible patience and tireless energy. Science however has to no lesser extent a need for spectra of fainter stars. It is especially for the faint stars, stars of magnitude 12, that statistical investigations have led to results concerning the structure of the universe. It is reasonable to expect that when such investigations can be done separately for each of the spectral types that the harvest of important results will be much richer.
>
> Unfortunately we are not there yet, but the most important step in this area appears to have been taken. After the Observatory in Potsdam in 1883 had obtained for a part of the sky spectra for 4000 stars, nothing was done in this field that in importance is a match to the work at the observatory at Harvard. In 1890 the so-called Draper Cat-

alogue was published for all stars that can just be seen by a sharp, naked eye. In total 10,000 stars.

Until almost the present time this is all that astronomers in general terms had at their disposal. The prospect of much extended determinations was not good. Telescopic stars need much more work and their number grows disturbingly quickly with every next unit of magnitude. Ten years ago no astronomer would have expected that now in 1921 we would have available 200,000 carefully determined spectral types of nearly all stars up to the 9th magnitude plus a large number even beyond that of 10th or even the 11th magnitude. A quarter of those, comprising four tomes is already available to astronomers, the rest is in press and will presumably be accessible to everybody within a year.

This gigantic effort, a true monument of organization, skill and perseverance is due to a single woman

Annie J. Cannon.

For all those who wish to study the evolution and the structure of the great stellar system the appearance of this publication is the most important event in the last few years. It opens the possibility described above to study separately stars of different spectral classes, classes just as diverse as the classes in the animal kingdom. What is missing to reach the same limit for all stars will also not take too long because completeness for the faintest stars will not be required.

In what urgent need the work of Miss Cannon will provide, is most clearly illustrated by the fact that the Harvard Observatory as reaction to urgent insistence of a large number of astronomers has made, by mail, available the manuscript with an enormous mass of data. The Groningen Laboratory would not have been able to complete its latest publications without the thousands of spectra that Miss Cannon with extraordinary kindness has made available.

I believe that it is a real obligation for astronomers to give a proof of their gratitude and bring homage for a piece of work for the satisfactory completion of which except for Miss Cannon possibly no one else in the world would have had the skill, perseverance and self-sacrifice; a piece of work so urgent and of such far-reaching significance. And since Groningen, possibly more than any other university, had the fortune to profit from this work, I believe that the Senate and University of Groningen should not forgo the privilege to associate itself with the author

Miss Annie J. Cannon

by offering her an honorary doctorate in Mathematics and Astronomy. (University of Groningen, 1921).

The Groningen work Kapteyn refers to is that of van Rhijn, who was making preparations, by determining mean parallaxes as a function of apparent magnitude, to repeat the analysis of the distribution of stars in space separately for various spectral types. The proposal was approved and Annie Cannon was duly informed of the decision. No record of this is present in the Groningen Archives, nor among the scans that were made for me of the Cannon Archives files on the Groningen and Oxford honorary doctorates at the Harvard University Archives – Pusey Library. The letter in reply is available at Harvard in handwritten and typed form, the latter being identical to the handwritten version that was actually sent to the Groningen Rector Magnificus. Dated 16 June 1921, it reads in part:

> To be ranked among the scholars of that ancient and renowned seat of learning founded just before the Pilgrim Fathers left Holland for the wilderness of my own Country, to be thus linked with the Groningen Astronomical Laboratory, made famous by Professor Kapteyn, the world's greatest astronomer of to-day, is indeed the highest honor of my life, far exceeding my fondest dreams.
>
> It will be impracticable for me to go to Groningen to receive the diploma in person, and therefore I shall be most grateful to you if you will be kind enough to forward it by mail ... (Cannon, 1921).

So Cannon did not come to Groningen, which may have been a real disappointment for Kapteyn. There was then no special celebratory session of the Senate at which the doctorate would have been bestowed. The files on her Oxford honorary doctorate in the Cannon Archives actually contain a letter from Kapteyn (1921) concerning her Groningen degree, dated 10 June 1921:

> Dear Miss Cannon,
> Let me be the first to congratulate you on the well earned honour conferred on you by the University of Groningen. As far as I know you and Schwarzschild are the only persons upon whom the doctorate in Mathematics and Astronomy 'honoris causa' has been bestowed. I hope you will find in this tribute at least some small return for a work which even in Astronomy has hardly a parallel, a work which is so urgently demanded for the further progress of science and which will earn for you the gratitude of all who try to penetrate somewhat further in the mysteries of the stellar Universe.
> Very truly yours,
> J. C. Kapteyn

Kapteyn fails to mention Easton, so maybe he did not consider him to be a 'real' astronomer. However, the phrasing is such that Easton should have been mentioned. The diploma was

sent from Groningen on 6 July, accompanied by a letter from the Rector expressing regret she would not come but 'understanding her motives'. It is noteworthy that the files in the Cannon Archives do contain a large number of congratulatory letters, telegrams and cards, mostly from friends and organizations (such as the President of Wellesley College), but only one from an astronomer (Otto J. Klotz, Director of the Dominion Observatory in Canada).

Among the further honors Cannon received were honorary doctorates from Wellesley College, her *Alma Mater*, where she had been both a student and a teacher, and from Oxford University in the UK. Note that she had received only a Master's degree from Wellesley but had not continued to submit a PhD thesis, so this was a special honor. This was in 1925 and the two proposed dates for the ceremonies almost excluded Annie Cannon from attending both. Not much correspondence is available on the two degrees in the Cannon Archives. The only relevant piece is a draft of a letter to the President of Wellesley College (Cannon, 1925), which begins as follows:

> It is with the deepest appreciation of the high honor proposed for me by the trustees of Wellesley College that I write you my acceptance and expectation to be present on May twenty-ninth. It is the very day I was booked to sail, but I find that I can change to a boat going a few days later which will put me in England in due season.

There are essentially no congratulatory letters, telegrams, etc. in the Cannon files associated with these two honorary degrees, so these must have been filed somewhere else.

There is a well-known photograph of Annie Cannon where she wears the gown and cap associated with her honorary doctorate from Oxford. She seems to have hoped to receive such a gown also from the University of Groningen. Both the Cannon and Groningen files contain a letter from the Rector Magnificus (original in handwriting, copy in Groningen typed) in response to a (missing) letter from Cannon. The reply letter is dated 26 October:

> Dear Miss Cannon,
> I have your letter of 10 October, for which my thanks. There is no gown or hood connected with the doctorate in this country; it was abolished already more than a century ago. Only the professors of the universities wear on official occasions a black velvet gown with white 'chabot' and black velvet cap. The universities have no colours nor utterly decorations, - all in the severe puritan style, as you see. I hope you will console yourself about this! (Rector Magnificus, 1921).

This is not to say that Annie Cannon would not have appreciated the high honor from Groningen. She obviously wore the Oxford gown and cap with pride. It is fully understandable she would have been more taken by and would not fail to attend the ceremony of the honorary doctorates from her own Wellesley College and the renowned University of Oxford.

6 DISCUSSION

In the first place I briefly discuss Kapteyn and his honors. He was awarded three honorary doctorates. It is of interest to note that there are none from universities in England, France, Germany, Russia, etc., which were leading nations in astronomical research. This may not be significant since Kapteyn's honors, listed in van der Kruit (2015: Appendix A.4) show that he definitely received high honors from a number of these nations, such as knighthoods, medals and memberships of academies and learned societies. By the way, the honorary degree from Edinburgh was unrelated to Kapteyn's collaboration with David Gill who, although Scottish, was raised in Aberdeen and studied there under Maxwell, and had nothing to do with Edinburgh.

It is interesting to briefly compare Kapteyn with his famous pupils de Sitter and Oort. Willem de Sitter has been awarded four honorary doctorates: Cambridge 1925, Cape Town 1929, Wesleyan 1931 and Oxford 1932. Did he take the initiative for Leiden University to award honorary degrees to astronomers? Yes, in three cases he did, namely for Robert T.A. Innes (1861–1933) in 1923 and Friedrich Küstner (1856–1936) and Henri-Alexandre Deslandres (1853–1948) in 1928.[5] Innes was Director of the Union Observatory in Johannesburg, with which de Sitter at about the same time had negotiated a collaboration and the establishment of Leiden's Southern Station on its premises in Johannesburg. Küstner was Emeritus Director of Bonn Observatory, and Deslandres was a French astronomer and Director of Meudon Observatory in Paris.

The award was on the occasion of the Leiden General Assembly of the International Astronomical Union, of which de Sitter was President at the time. There is more to note about this: de Sitter wanted to end the isolation of Germany, which after the First World War had been excluded from international organizations (see below for more on this), so he used his prerogative as President to invite individual German astronomers. In this spirit, he took the initiative to honor a French and a German astronomer with honorary doctorates. He had some difficulty convincing the Leiden Senate to

award two honorary titles in one discipline at the same time. While Küstner worked in astronomy relevant to the Leiden program—he had continued the tradition of the *Bonner Durchmusterung* by setting up photographic programs for positional astronomy, in particular for proper motions—Deslandres did not, his field being the Sun and its atmosphere. He was the ranking French astronomer and had been one of the Vice-Presidents of the IAU since 1922 and was ending his term in Leiden.

More remarkable is Jan Oort, who had ten honorary doctorates, including from Oxford, Cambridge and Harvard (see van der Kruit, 2019: Appendix A.5), yet did not take even a single initiative to award one by Leiden University. In fact the next astronomer after Küstner in 1928 to receive a Leiden honorary doctorate was later Nobel Prize laureate Reinhard Genzel in 2010![6] Pieter van Rhijn did not receive any honorary doctorates and did not take the initiative to have the University of Groningen award another one. In fact, no astronomer has received an honorary doctorate from Groningren since Cannon was awarded one.

What about Kapteyn's choices of Schwarzschild and Cannon? Who else might he have considered? Some of the most critically important persons for him in establishing his career and international fame had been David Gill (for the *Cape Photographic Durchmusterung*), Simon Newcomb (1835–1909) (for making his work known in America and Canada, and inviting him in 1904 to the St. Louis Congress), George Hale (for inviting him to Mount Wilson as a Carnegie Research Associate and adopting the 'Plan of Selected Areas' as a prime observing project for the 60-inch telescope), and Edward Pickering (for a major contribution from Harvard to the Plan).

Gill and Newcomb had died by 1914, but Pickering lived until 1919 and would have been an option in 1914. Kapteyn had received his honorary doctorate from Harvard in 1909 and could have reciprocated the honor. Kapteyn was very sensitive about giving credit where it belonged and realized that the work for the *Henry Draper Catalogue* for the most part must have been done really by Annie Cannon. There had been disagreements with Pickering, especially about the latter's insistence to include a 'Special Plan' of areas in the Milky Way, which meant much extra work; it had annoyed Kapteyn that he had to accept this to ensure Pickering's cooperation. In the end, he would have considered Schwarzschild's work more suitable and he had better relations with him. In any case, from a scientific as well as a personal point of view, Schwarzschild probably seemed a more agreeable choice.

Hale certainly would have been a possibility in 1914. This might have resulted in an uncomfortable situation with Andrew Carnegie receiving the same honor at the same time, who after all in a sense was Hale's superior or 'boss'. In fact, it is far from ruled out that Kapteyn was involved in selecting Carnegie (but who else on the Groningen University faculty would have a connection to him?), and then also including Hale might have been too much.

Then there is Anders S. Donner (1854–1938), who Kapteyn had first met at the great *Carte du Ciel* congress in Paris in 1887. Donner was Director of the Helsingfors Observatory (Swedish for Helsinki), where he acquired plates for his participation in the *Carte du Ciel*. Kapteyn and Donner had quickly become very good friends (they were among the younger attendees in Paris and not part of 'the establishment'), and over the years Donner had collected an enormous amount of photographic material for Kapteyn, which resulted in quite a number of joint papers of the *Publications of the Astronomical Laboratory* at Groningen. Until 1925, 39 volumes appeared in these *Publications*, of which no fewer than nine were based on plates taken by Donner. However, Donner had not published any significant papers himself; his vocation seemed to have been operating the telescope (at least in winter; at his latitude the observatory was closed from April through August when at night there is no end to astronomical twilight) and providing photographic plates for others.

There is one other person who has meant much to Kapteyn, and who might certainly have qualified for an honorary degree and that is Arthur S. Eddington (see Figure 10). Without doubt, Eddington was one of the most prominent astronomers of the twentieth century. When Kapteyn had presented his 'Star Streams' in 1904, within two years Eddington, who had just become Chief Assistant at the Royal Observatory Greenwich after having been one of the brightest students at Cambridge, devised a quantitative test and applied this to a set of stars in the *Groombridge Catalog* for which new proper motions were available at Greenwich. Whereas Kapteyn used brighter stars all over the sky, Eddington's material constituted more stars over a limited part of the sky, which also were fainter. His results did, as he wrote, "… strongly support Kapteyn's hypothesis of two star-drifts." (Eddington,1906: 63).

Now in 1914, Eddington was only 32 years of age and this would seem a little young for an honorary doctorate. But in 1921 he certainly could have been a good candidate. In addition

Figure 10: Arthur Eddington and Jacobus Kapteyn. It is not known when, where and by whom this photograph was taken. Oort was presented with a copy of this by S. Chandrasekhar. For the full story see van der Kruit (2019). It would seem that this photograph was taken around 1920 (courtesy: Oort Archives).

to confirming the 'Star Streams', in his book *Stellar Movements and the Structure of the Universe* (Eddington, 1914), which had drawn much attention, Eddington had prominently discussed the concept. In his introductory address on the occasion of the centenary celebration of the Royal Astronomical Society in 1922 he would list what in his opinion were the six "… outstanding landmarks in these hundred years …" (Eddington, 1922: 433). And Kapteyn's 'Star Streams' was one of these. He remarked: "But I think the great impetus on sidereal astronomy came from Kapteyn's discovery." (Eddington, 1922: 436). And he wrote later an obituary of Kapteyn of unusually high praise. This was after 1921 of course, but he must have had these opinions before that time and been a promoter of Kapteyn's work throughout the years.

The selection in 1921 at the time of Kapteyn's seventieth birthday and retirement has to be seen as well in the light of another development. Kapteyn had alienated a significant number of leading astronomers, particularly in England (and maybe other parts of the UK as well), France, Belgium and the USA, because of his stance after World War I on international organizations. Especially in these countries there was a strong sentiment and movement to ban the defeated nations from such organizat-

ions that were being formed just after the end of WWI. Kapteyn had vehemently opposed setting these up without participation from Germany, Austria, and the other Central Powers, in particular the International Research Council and the International Astronomical Union. More background on this can be found in an authoritative book by Kevles (1993), *The Physicists*. Together with his friend, physiology and psychology Professor Gerardus Heymans, Kapteyn took the initiative to circulate an open letter strongly protesting and condemning this attitude, which in the end was signed by almost 300 persons (however, Kevles fails to mention the role of Heymans; see van der Kruit (2015) for an excerpt from this letter).

When Kapteyn's 70th birthday was approaching in 1921, de Sitter took the initiative to prepare the publication of Kapteyn's selected works. A committee that was formed quickly ran into opposition in the UK, apparently because German Küstner was a member. So, when Frank W. Dyson (1868–1939), who then was at Greenwich, solicited help among British astronomers, he did get support from Arthur Eddington, but strong opposition from many others as well. French astronomer Jules Baillaud (1876–1960), Belgian Georges Lecointe (1869–1929), and English astronomer Herbert H. Turner (1861–1930) from Oxford were among the most outspoken among European astronomers in arguing for the exclusion of German scientists after the war. They and others incorrectly accused Kapteyn of having accepted the 'Orden pour le Mérite' from the German Kaiser at the same time as the captain of the submarine that had sunk the *Lusitania*. The 'Orden pour le Mérite' was a German distinction bestowed by the Kaiser. It was a very high honor for a foreign scientist to receive that distinction (a few foreign astronomers had preceded Kapteyn, such as Simon Newcomb, David Gill and Edward Pickering, as well as German astronomers Freidrich Argelander (1799–1875) and Arthur von Auwers (1838–1915), but also famous scientists had received it, such as Charles Darwin, Lord Rayleigh, Hendrik Lorentz, and others). Kapteyn had received the 'Orden' in 1914 just before the War, at the same time as von Seeliger and Max Planck. This was in the Scientific Class, but there also was a Military Class, which the captain of the submarine that sunk the passenger ocean liner *Lusitania*—an act that enraged the world and played an important role in the US joining the War—had received, but that was in 1917! Yet his stance did not prevent Kapteyn from being appointed not long after the War as a corresponding member of the French Academie and Foreign Member of the Royal Society (of London). De Sitter's plan came to naught and he and Kapteyn's successor in Groningen, Pieter van Rhijn, might have resorted to a plan to have an honorary doctorate selected by Kapteyn.

Now Eddington was the first Englishman who was prepared to work toward reconciliation. George Hale seemed to have sided with those opposing Germany, but he in any case defended Kapteyn as being far from pro-German. After all, in their correspondence during the War, Kapteyn had expressed repeatedly his view that Germany was to blame for the War and had also very strongly condemned the sinking of the *Lusitania*. In 1920 Eddington was the only Englishman who attended the congress of the *Astronomische Gesellschaft*. Whether avoiding further escalation played a role in not selecting Eddington in 1921 remains a matter of speculation, but considerations like these must have played a role, regardless of how appropriate it had been to honor him this way on scientific grounds.

In 1922 an argument against selecting Hale for an honorary doctorate might have been Kapteyn's very poor relations with Walter Adams, who was Hale's deputy. Adams might have seen this as a provocation against him, which Kapteyn would have wanted to avoid.

The choice of Annie Cannon seems to have had two other aspects. In the first place, a genuine appreciation and admiration for the work of stellar spectral classification at Harvard as a very fundamental and vital contribution to astronomy. Cannon, in that case, would easily qualify as the obvious first exponent of this work, as Kapteyn expressed in his arguments to the Senate when he proposed her. Kapteyn was rather strict about giving credit where it belonged, as was clear from the Adams and Kohlschütter case. Of course, the *Henry Draper Catalogue* was compiled under Pickering's directorship, but with the latter dead the honorary degree could easily go to Cannon, where Kapteyn must have felt the credit belonged, without passing over Pickering. The second thing that may also have played a role was that Kapteyn would have welcomed the fact that it would be a woman who was being honored. Kapteyn had a record of supporting women's rights.

One of his best friends in Groningen was the well-known Professor of Philosophy and Psychology Gerardus Heymans (see van der Kruit, 2015; 2021a). Heymans was among other matters interested in differences between men and women. He researched this with questionnaires, asking professors and lecturers at Dutch universities about character traits such as individuality, ability for abstraction, memory, etc., and whether they felt predominantly male

or female. Kapteyn and his calculators helped reduce these data and maybe contributed to this as well. Although Kapteyn and Heymans were good friends, they often had different opinions, but when it came to women's suffrage they were in perfect agreement. It is true that Heymans lobbied more actively for women's suffrage, but according to a thorough study by Inge de Wilde (1998) concerning *New Participants in Science: Female Students and Teachers at the University of Groningen, 1871–1919*, Kapteyn was certainly involved in Heymans' circle of acquaintances who worked for women's emancipation.

It is also remarkable that Kapteyn was the first astronomer in the Netherlands with a female PhD student, Etine Imke Smid. She obtained her PhD degree in 1914 on a thesis, which concerned the study of proper motions of more than one hundred stars. She was the first woman in the Netherlands to obtain a doctorate with an astronomical dissertation. After her defense, Etine Smid worked for Kamerlingh Onnes in Leiden for some time, but moved to Deventer after she got married and left science.

And I quote from Henriette Hertzsprung-Kapteyn's biography:

> The children had grown up by now and all three of them were doing academic studies. The two girls were among the first female students. The oldest had chosen medicine and I took law as subjects, which gave rise to much criticism in these turbulent days of the fight for women's rights, but Kapteyn felt that females studying at universities was so natural and unquestionable, that one did not get far with counter arguments. The son went to Freiburg in Saxony to study mining engineering. (Hertzsprung-Kapteyn, 1928).

The eldest daughter indeed studied medicine in Groningen, the younger law, for a while in Groningen, but she later switched to English in Amsterdam. The son went to Freiburg to study mining engineering; the fact that he did not go to Delft for this had to do with the lower costs of studying in Freiburg. His choice to send his daughters to university meant Kapteyn had to support three children during academic studies and that was a major financial burden. Professors did earn a respectable salary, but many of them, including Kapteyn, did extra teaching in order to be able to finance their children's studies. Kapteyn chose to carry the financial burden of his daughters entering university, even if this meant that his son would have to go and study in Germany. Female students at universities were still quite a rarity; the first female student at a Dutch university was Aletta Henriette Jacobs, who entered Groningen University to study medicine in 1871, followed six years later by her sister Charlotte, who studied pharmacy (hardly a generation before Kapteyn's daughters entered university).

So, Kapteyn was a supporter of women's emancipation. The fact that he was an unconventional man in a number of ways may have been a reaction to his strictly religious upbringing. But he did not allow reform on all fronts. His marriage was along conventional lines; his wife took care of the household, while Kapteyn saw the finances as his exclusive responsibility.

Still, he had 'caught two birds with one stone' by simultaneously honoring the great progress in stellar spectroscopy and selecting a female honorary doctorate. Excluding the avalanche of honorary degrees in 1914, Cannon's was the first honorary doctorate from Groningen to go to a foreign scientist since Robert Koch in 1884. And it was also only the second honorary doctorate to go to a female from abroad in the history of Groningen University, after Alice Boole Stott in the 1914 tricentennial. This 'drought' would last until 1958, when American Professor of Neuroanatomy, Elizabeth Caroline Crosby, would become the third.

After his formal retirement Kapteyn and his wife left Groningen. They had bought a house in Hilversum, and after some travel in Europe they moved in with their daughter and her husband in Amsterdam before settling in their new house. Leiden Observatory had offered Kapteyn a part-time appointment to take charge of the Astrometric Department, but by then the first signs of what would prove to be a fatal illness appeared, and he died in Amsterdam within a year of his retirement. Henriette Hertzsprung-Kapteyn (1928) tells us that Kapteyn and his wife had left Groningen quietly. They had said farewell to their friends during dinners in small numbers and left unnoticed one day at seven in the morning. It is a pity that Annie Cannon could not come to Groningen to accept the honor in person during a special ceremonial meeting of the Senate to mark the departure of possibly Groningen's most successful and celebrated professor.

7 CONCLUDING REMARKS

On three different occasions Kapteyn proposed honorary doctorates for the University of Groningen. The first one, in 1903, coincided with his 25th anniversary as a Professor in Groningen, and it went to Cornelis Easton, a Dutch journalist and amateur astronomer. The degree was awarded to honor him for his work on mapping the Milky Way by making drawings. Easton followed up on this by attempting to derive the spiral structure of our Galaxy.

In 1914 Kapteyn proposed the German astronomer Karl Schwarzschild for a Groningen

honorary doctorate, particularly for his theoretical contributions to the study of the structure and kinematics of stellar distributions in space.

Kapteyn most likely also proposed musician, composer, teacher and friend, Peter van Anrooy, who not only developed his taste and appreciation for music but taught him lessons as well to better understand music.

It is very well possible that Kapteyn also had a determining role in the selection of the American industrialist and philanthropist Andrew Carnegie, the benefactor of the Institution that bore his name and provided Kapteyn with a Research Associate position that facilitated much of his research, including his annual visits to Mount Wilson Observatory.

Maybe for this reason the option of selecting George Ellery Hale was not favored, while the otherwise very real option of Arthur Stanley Eddington was put aside because of his relatively young age.

There were a few controversies that may have limited the choice in 1921 and were to play an adverse role in many aspects of Kapteyn's legacy. One was the rather poor relations between him and Walter S. Adams, the Director of Mount Wilson Observatory, which prevented Kapteyn from returning to California after WWI, and which might have escalated had Hale been selected for a Groningen honorary doctorate.

Another was Kapteyn's stand on what he viewed as the extremely objectionable policy of excluding nations such as Germany and Austria that had been defeated in WWI from membership of international political and scientific organizations. Eddington also very strongly defended the same position as Kapteyn, but had Kapteyn selected him for an honorary Groningen degree this might have escalated tensions with others.

When Kapteyn retired in 1921 he proposed Annie Cannon for her fundamental and essential contributions to the Harvard spectral classification and the *Henry Draper Catalogue*. He might have felt that in this way she would receive the credit she deserved, which for women typically would go instead to the male director under whom they worked. The fact that Edward Pickering had died helped, since it meant that he did not have to be passed over. An important argument for Cannon's selection was Kapteyn's support for women's equality and rights. He must have welcomed the idea that she would be the first foreign female thus honored by the University of Groningen.

With the imminence of the outbreak of the War in 1914, Schwarzschild's enlisting in the German Army and his death during the War are probably the reasons why his honorary Groningen doctorate is seldom if ever mentioned, even in obituaries. In contrast, Cannon's Groningen degree usually is mentioned, although it was overshadowed by the one she received from the University of Oxford. Cannon's decision not to come to Groningen meant that there was no formal ceremony to mark Kapteyn's retirement and departure from Groningen.

8 NOTES

1. In the Netherlands, Belgium, Germany and a few other countries the professor who has supervised the research is designated as the promotor and bestows the degree upon the candidate on behalf of the university. When I use this word 'promotor' in this paper it may also refer to the equivalent in other European countries.
2. Although at the University of Groningen the official name of an honorary doctorate is a 'Doctor *honoris causa*', for simplicity we will usually refer to this as an honorary doctorate throughout this paper.
3. I have retained the German name 'Actinometrie', just as I have done with 'Durchmusterung' in the CPD.
4. When the luminosity function is unknown, there actually is a second integral equation to be solved simultaneously and that involves mean parallaxes as a function of apparent magnitude, derived from proper motions and secular parallaxes. Kapteyn had studied this mathematical problem around 1900 with his brother Willem, who was a Professor of Mathematics in Utrecht. This was cumbersome so Schwazrschild's method was to be preferred.
5. The site of Leiden University (2020) lists honorary doctorates, but erroneously lists Deslandres as having been awarded a doctorate in 1900.
6. In a formal sense this is incorrect, since Jacob Evert Baron de Vos van Steenwijk received one in 1959 from the Faculty of Law. He held a PhD in astronomy (from 1918 under Ernst van de Sande Bakhuyzen), but became a politician and administrator, with appointments such as Mayor, Queen's Commissioner and President-Curator of Leiden University. But throughout his career he was actively involved in Dutch astronomy and attended IAU General Assemblies.

9 ACKNOWLEDGEMENTS

I am grateful to the staff of the Archives at the Niedersächsische Staats- und Universitätsbibliothek Göttingen and of the Harvard University Archives – Pusey Library for providing scans of

the relevant correspondence in the Schwarzschild and Cannon archives. I thank historians Klaas van Berkel and David Baneke for critically reading a draft of this paper and for making useful comments and suggestions. I also thank staff of the Kapteyn Astronomical Institute for support and help and for hospitality extended to an Emeritus Professor as guest scientist.

10 REFERENCES

Blaauw, A., 2014. Easton, Cornelis. In Hockey, T., et al., (eds.), *The Biographical Encyclopedia of Astronomers*. Second Edition. New York, Springer. Pp. 633–634.

Cannon, A.J., and Pickering, E.C., 1901. Spectra of bright southern stars photographed with the 13-inch Boyden Telescope as part of the Henry Draper Memorial. *Annals of Harvard College Observatory*, 28, 129–263.

Cannon, A.J., 1921. Letter to the Rector Magnificus of the University of Groningen, dated 16 June. University of Groningen Archives.

Cannon, A.J., 1925. Undated letter to the President of Wellesley College. Cannon Archives, Harvard University Archives – Pusey Library.

DeVorkin, D., 2000. Internationalism, Kapteyn and the Dutch pipeline. In van der Kruit and van Berkel, 129–150.

de Wilde, I., 1998. *Nieuwe deelgenoten in de Wetenschap: Vrouwelijke studenten en docenten aan de Rijksuniversiteit Groningen 1871–1919*. Assen, van Gorcum.

Easton, C., 1900. A new theory of the Milky Way. *Astrophysical Journal*, 12, 136–158.

Easton, C, 1913. A photographic chart of the Milky Way and the spiral theory of the Galactic System. *Astrophysical Journal*, 37, 105–118.

Eddington, A.S., 1906. Systematic motions of the stars. *Monthly Notices of the Royal Astronomical Society*, 67, 34–36.

Eddington, A.S., 1914. *Stellar Movements and the Structure of the Universe*. London, Macmillan.

Eddington, A.S., 1917. Obituary Notice, Associate: Schwarzschild, Karl. *Monthly Notices of the Royal Astronomical Society*, 77, 314–319.

Eddington, A.S., 1922. Introductory address delivered on the occasion of the Society's centenary celebrations. *Monthly Notices of the Royal Astronomical Society*, 82, 433–437.

Harvard University, 2020. Honorary Degrees, 'honoca' (www.harvard.edu/oncampus/commencement/honorary-degrees).

Heffernan, M., and Jöns, H., 2007. Degrees of influence: the politics of honorary degrees in the Universities of Oxford and Cambridge, 1900–2000. *Minerva: A Review of Science, Learning and Policy*, 45(4), 389–416.

Hertzsprung, E., 1917. Karl Schwarzschild. *Astrophysical Journal*, 45, 285–292.

Hertzsprung-Kapteyn, H., 1928. *J.C. Kapteyn; Zijn leven en werken*. Groningen, Wolters (electronic version available at www.dbnl.org/tekst/hert042jcka01_01/; for more information and my English translation see www.astro.rug.nl/JCKapteyn/HHKbiog.html).

Kapteyn, J.C., 1921. Letter to Annie Jump Cannon, dated 10 June. Cannon Archives, Harvard University Archives – Pusey Library.

Kevles, D.J., 1995. *The Physicists: The History of a Scientific Community in Modern America*. Cambridge (Mass.), Harvard University Press.

Leiden Observatory, 1908. *Album Amicorum*, presented to H.G. van de Sande Bakhuyzen (see local.strw.leidenuniv.nl/album1908/book info.html).

Leiden University, 2020. Eredoctoraten en prijzen (see www.universiteitleiden.nl/over-ons/feiten-en-cijfers/eredoctoraten-en-prijzen).

Merriam-Webster Dictionary, 2020. Web site: www.merriam-webster.com/dictionary/honorary+degree.

Nieuwsblad van het Noorden, 2018. Web site: www.dvhn.nl/groningen/Dit-is-waarom-Ban-Ki-moon-een-eredoctoraat-van-de-Rijksuniversiteit-Groningen-verdient-23674056.html.

Oxford University, 2020: Honorary degrees, Early history (www.ox.ac.uk/news-and-events/The-University-Year/Encaenia/Honorary-Degrees-Early-History).

Paul, E.R., 1993. *The Milky Way Galaxy and Statistical Cosmology, 1890–1924*. Cambridge, Cambridge University Press.

Rector Magnificus, 1921. Letter to Annie Jump Cannon, dated 16 October. University of Groningen Archives.

Schwarzschild Archives. Niedersächsische Staats- und Universitätsbibliothek Göttingen, Germany.

Schwarzschild, K., 1912. Zür stellarstatistik. *Astronomische Nachrichten*, 190, 361–366.

Schwarzschild, K., 1914a. Note to the Rector and Senate, University of Groningen, dated 20 April. University of Groningen Archives.

Schwarzschild, K., 1914b. Note to the Senate, University of Groningen, dated 5 July. University of Groningen Archives.

Stein SJ, J.W.J.A., 1929. Dr. C. Easton, in memoriam. *Hemel & Dampkring*, 27, 225–236; 258–271.

University of Groningen, 1902/1903. *Lotgevallen*. University of Groningen Archives.

University of Groningen, 1914. *Academia Groningana, MDCXIV–MCMXIV*; Gedenkboek ter gelegenheid van het derde eeuwfeest der Universiteit te Groningen, uitgegeven in opdracht van den Academischen Senaat.

University of Groningen, 1916: *Academia Groningana 29 Juni – 1 Juli 1914*: Verslag van de herdenking van het 3de eeuwfeest der Universiteit te Groningen.

University of Groningen, 2020. *Overzicht eredoctoraten 1717–2018* (www.rug.nl/about-ug/pro_le/prizes-and-awards/honorary-doctorates/eredoctoraten-1717-2018.pdf.)

University of Groningen, 1921. Proposal by J.C. Kapteyn to award Annie Jump Cannon an Honorary Doctorate. University of Groningen Archives.

van Berkel, K., 2000. Growing astronomers for export: Dutch astronomers in the United States before World War

II. In van der Kruit and van Berkel, 151–174.
van der Kruit, P.C., and van Berkel, K., 2000. *The Legacy of J.C. Kapteyn: Studies on Kapteyn and the Development of Modern Astronomy*. Dordrecht, Kluwer.
van der Kruit, P.C., 2015. *Jacobus Cornelius Kapteyn: Born Investigator of the Heavens*. Springer International Publishing.
van der Kruit, P.C., 2019. *Jan Hendrik Oort: Master of the Galactic System*. Cham (Switzerland), Springer.
van der Kruit, P.C., 2021a. *Pioneer of Galactic Astronomy: A Biography of Jacobus Cornelius Kapteyn*. Cham (Switzerland), Springer.
van der Kruit, P.C., 2021b. *Master of Galactic Astronomy: A Biography of Jan Hendrik Oort*. Cham (Switzerland), Springer.
van der Kruit, P.C., 2021c. This is an expanded version of this paper, which is available from the author's web page: www.astro.rug.nl/~vdkruit
van E., E. [van Everdingen], 1929. Dr. C. Easton. *Nature*, 124(3130), 659.

Pieter C. van der Kruit is Emeritus Jacobus C. Kapteyn Distinguished Professor of Astronomy at the Kapteyn Astronomical Institute of the University of Groningen in the Netherlands. He obtained his PhD in astronomy from Leiden University in 1971 under Jan Hendrik Oort. He held a prestigious Carnegie Postdoctoral Fellowship at the Mount Wilson and Palomar Observatories in Pasadena (California), before moving to the University of Groningen in 1975. He has held visiting positions at various institutions, including Mount Stromlo Observatory in Canberra (Australia), the Institute of Astronomy in Cambridge (UK), the Space Telescope Science Institute in Baltimore (USA), the European Southern Observatory in Santiago (Chile), the Instituto de Astrofísica de Canarias in Tenerife (Spain) and the Carnegie Observatories in Pasadena (California).

His research concerns the structure and dynamics of disks in galaxies. He has published over 160 papers, more than half as lead or sole author, contributed substantially to over 20 more, and authored or edited eight books, among which are recent biographies of Jacobus Cornelius Kapteyn and Jan Hendrik Oort.

In Groningen he taught introductory astronomy and advanced level courses on the structure and dynamics of galaxies for many years, the latter also at a Saas-Fee winter school in Switzerland and in university curricula in Porto (Portugal), in Santiago (Chile) and in Beijing (China).

He is a former Director of the Kapteyn Astronomical Institute and has been a member and often chairman of numerous national and international boards and committees, notably President of Council of the European Southern Observatory and Chairman of the Board for the Atacama Large Millimeter Array (ALMA). In 2006 he received a Royal Decoration as Knight in the Order of the Netherlands Lion.