

Teach and travel
Leiden Observatory and the renaissance of Dutch astronomy in the Interwar years
David Baneke¹

Introduction

On Sunday 3 March 1918 Ernst Frederik van de Sande Bakhuyzen, director of Leiden Observatory, unexpectedly died. Within days Willem de Sitter was appointed acting director, pending further decisions. De Sitter immediately contacted J.C. Kapteyn, the grand old man of Dutch astronomy and his former mentor in Groningen, to discuss the future of the observatory. This was their chance to resurrect the observatory after decades of stagnation.

It was also a chance to make astronomy join the ‘second golden age’ of Dutch science that played a prominent role in contemporary cultural nationalism.² Scientists such as J.D. van der Waals, H.A. Lorentz, Heike Kamerlingh Onnes and Hugo de Vries were considered the direct heirs of Christiaan Huygens and Antoni van Leeuwenhoek, the heroes of the first ‘golden age’ in the seventeenth century. Kapteyn was a national pride too, but he was a lonely figure. He had built his reputation against all odds, having started without any facilities, funding or staff.³ The rest of Dutch astronomy did not share in the successes of the other sciences. The two observatories in Leiden and Utrecht were small and unexciting. A reorganisation and expansion of Leiden Observatory might change that.

De Sitter and Kapteyn seized the moment, and they succeeded beyond expectation. During De Sitter’s directorship, from 1918 until 1934, Leiden Observatory changed from a sleepy, run-down institute into an international centre of astronomy.⁴ It was the home institute of Willem de Sitter, Ejnar Hertzsprung and Jan Oort, and it became a breeding ground for a new generation of astronomers who would become prominent scientists in their own right, including Bart Bok, Gerard Kuiper, Dirk Brouwer, Willem Luyten, Piet Oosterhoff, Willem van den Bos and Adriaan Blaauw. In short, Leiden Observatory had become an active centre in the international astronomical community. This remarkable metamorphosis was the result of a

¹ Dr D.M. Baneke, Leiden Observatory, PO Box 9513, 2300 RA Leiden, The Netherlands, baneke@strw.leidenuniv.nl. I am grateful to David DeVorkin, Robert Smith, Frans van Lunteren and Klaas van Berkel for their helpful comments and suggestions.

Abbreviations:

WdS: Willem de Sitter papers, Leiden Observatory archives, Leiden University.

HA: Hertzsprung Archive, Institut for Videnskabsstudier, Århus University.

OH: Oral Histories, AIP Center for the History of Physics, Niels Bohr Library and Archives.

All quotes from Dutch sources were translated by the author.

² R.P.W. Visser, ‘Het “Nederlandsch Natuur- en Geneeskundig Congres” over de relatie natuurwetenschap en samenleving 1887-1900’ in: J.J. Kloek and W.W. Mijnhardt (eds.) *Balans en perspectief van de Nederlandse cultuurgeschiedenis. De productie, distributie en consumptie van cultuur* (Amsterdam, 1991), 37-48; K. van Berkel, ‘Natuurwetenschap en cultureel nationalisme in negentiende-eeuws Nederland’ in: idem, *Citaten uit het boek der natuur. Opstellen over de Nederlandse wetenschapsgeschiedenis* (Amsterdam, 1998), 221-239; B. Willink, *De tweede gouden eeuw. Nederland en de Nobelprijzen voor natuurwetenschappen 1870-1940* (Amsterdam 1998).

³ On Kapteyn: P.C. van der Kruit and K. van Berkel (eds.), *The legacy of J.C. Kapteyn. Studies on Kapteyn and the development of modern astronomy* (Dordrecht etc., 2000); A. Blaauw et al., *Sterrenkijken bekeken. Sterrenkunde aan de Groningse universiteit vanaf 1614* (Groningen, 1983); H. Hertzsprung-Kapteyn, *J.C. Kapteyn, zijn leven en werken* (Groningen, 1928; an English translation by E. Robert Paul was published in 1993).

⁴ On Leiden Observatory in this period: G. van Herk, H. Kleibrink and W. Bijleveld, *De Leidse sterrewacht. Vier eeuwen wacht bij dag en nacht* (Zwolle, 1983); D. Baneke, ‘“Als bij toverslag”. De reorganisatie en nieuwe bloei van de Leidse Sterrewacht, 1918-1924’, *Bijdragen en mededelingen betreffende de geschiedenis der Nederlanden* cxx (2005), 207-225. See also S. Röhle, *Willem de Sitter in Leiden – Ein Kapitel in der Rezeptionsgeschichte der Relativitätstheorien* (dissertation, Mainz, 2007), esp. ch. 6.

fundamental reorganisation that involved every aspect of the observatory: the organization of the staff, the research and education programs, as well as a change in publishing strategies. It was also closely related to a 180-degree turn of the international outlook, as American astronomy replaced the German as the example that was to be emulated. In short, it was a radical change in scientific culture.

The story of Leiden Observatory in the Interwar years is an important episode in the history of twentieth-century astronomy. It provides a case study of the fundamental changes in the political economy of astronomy in this period, such as the rise of American astronomy and the relative decline of Central Europe, the rise of ‘astronomical laboratories’ and the increasing spatial separation of observation and calculation, and most importantly a changing pedagogical culture. One could state that in this period, astronomy changed from a guild-like community into a modern academic discipline.

In this paper I will analyze the developments in Leiden in considerable detail. In the first part, I will describe the reorganisation of the staff and the research programs, including the cooperation with Union Observatory in Johannesburg. The second part of this paper addresses the new pedagogical culture: the introduction of a graduate program in astronomy and the career perspectives for the students, both in the Netherlands and the US. Finally, I will conclude with some general remarks about Dutch astronomy in this period, and I will offer some explanations for its remarkable renaissance.

Part 1: The reorganisation

Leiden Observatory until 1918

Leiden Observatory boasted a history going back to 1633, when Snellius installed his large quadrant in the Academy building.⁵ This would make it the oldest university observatory in Europe. But for all practical purposes, the modern observatory was founded in the mid-nineteenth century by Frederik Kaiser, after years of intense lobbying and raising private money. Its alignment along an East-West axis with a meridian instrument in one of the wings was modelled after the palace-like Imperial Observatory at Pulkowa. Kaiser’s main research program was fundamental astrometry with the Pistor & Martin meridian circle. He was assisted by one or two observers, which made Leiden the largest astronomical institute of the country. The only other observatory was that of Utrecht University. Besides, there were several small private observatories of amateurs and learned societies. There was no national observatory; until 1883, Leiden Observatory performed some services for the navy.

Like the rest of Dutch science, astronomy was strongly German-oriented. The main publication of Leiden Observatory was the *Annalen der Sternwarte in Leiden*, in German. Apart from that, the proceedings of the science section of the Royal Academy of Sciences were the most important national scientific journal. They were published in Dutch, but sometimes scientists published French translations of their Academy articles in the *Archives Néerlandaises* of the *Hollandse Maatschappij van Wetenschappen*, a learned society in Haarlem. Dutch astronomers also contributed regularly to the *Monthly Notices*, but more often to the *Astronomische Nachrichten*.

In 1872 Kaiser was succeeded by his student Hendrik van de Sande Bakhuyzen, who continued his research program. The meridian instrument remained the most important telescope, although a 10-inch Repsold refractor was acquired in 1885. Bakhuyzen was active in international networks, hosting the first annual meeting of the *Astronomische Gesellschaft*

⁵ On the history of Leiden Observatory: F. Kaiser, ‘Geschichte und Beschreibung der Sternwarte in Leiden’, *Annalen der Sternwarte in Leiden*, i (1868), i-lxxxvi; W. de Sitter, *Short history of the observatory of the university at Leiden 1633-1933* (Haarlem, 1933); Van Herk, et.al., *De Leidse sterrewacht* (ref. 4).

outside Germany or Austria in 1875. He was also a member of the international committee for the *Carte du Ciel*. Leiden Observatory did not contribute to the *Carte* itself, however, as that was considered too expensive and time-consuming.⁶ Instead, Bakhuyzen investigated certain systematic errors on *Carte* photographic plates. When a 33 cm (13 inch) photographic refractor of *Carte* specifications was erected in Leiden in 1898, it was also mainly used to investigate systematic errors, although it was also intended for parallax work.⁷ When Bakhuyzen retired in 1908, he was succeeded as director of the observatory by his brother and student Ernst, ten years his junior.

Like many nineteenth century astronomers, the Bakhuyzen brothers were extremely concerned with precision measurements. One of their research topics was the personal equation, the systematic difference in measurements of individual observers. But as each observation had to be corrected again and again, the result was that the number of publications of Leiden Observatory declined. Anton Pannekoek, who studied and worked in Leiden around the turn of the century, later described the atmosphere at the observatory as one of decline and tedium. It was one of the reasons that he accepted an invitation of Karl Kautsky in 1905 to teach socialist theory in Germany. Socialism was Pannekoek's other passion besides astronomy.⁸

Ernst Bakhuyzen continued his brother's research programs, but work at the observatory effectively ground to a halt. Even the publication of annual reports was stopped, though that may also have been related to paper shortages during the First World War. The Netherlands remained neutral during that war, but trading and transport were severely affected by it.

But Ernst Bakhuyzen was not the only one who succeeded his brother in 1908. At the same time, Willem de Sitter became professor of (theoretical) astronomy, a position that previously had been combined with the directorship of the observatory. De Sitter came from Groningen, where he had studied mathematics.⁹ In 1897, David Gill of the Royal Observatory at the Cape of Good Hope had invited him to South Africa. Gill had met him in Groningen while visiting Kapteyn, with whom he had worked on the *Cape Photographic Durchmusterung* in the previous decade. At his advice, De Sitter turned to celestial mechanics, especially the theory of the orbits and perturbations of the moons of Jupiter. This remained his main research topic for the rest of his life. It was also the topic of his PhD thesis, supervised by Kapteyn.

As professor in Leiden, De Sitter was not directly involved in the ongoing work at the observatory. He pursued his own research interests. Besides Jupiter moons, he also worked on relativity theory in this period. In 1916-17 he published three groundbreaking articles on general relativity in the *Monthly Notices*, introducing the new theory to the English speaking world and investigating its cosmological consequences.¹⁰ It possibly was his interest in gravity that connected the fields, but perhaps his preference for advanced mathematics was also a factor. In his student years, he had considered himself a mathematician rather than an astronomer.¹¹ But the fact that H.A. Lorentz and Paul Ehrenfest were De Sitter's closest

⁶ H.G. van de Sande Bakhuyzen, annual report of Leiden Observatory (1888).

⁷ Idem (1898).

⁸ A. Pannekoek, *Herinneringen* (Amsterdam, 1982). This book contains not one but two autobiographies: one concerning his political life (*Herinneringen aan de arbeidsbeweging*, with an introduction by B.A. Sijes) and one on his astronomical life (*Sterrekundige herinneringen*, with an introduction by E.P.J. van den Heuvel). Pannekoek always tried to keep the two spheres separated.

⁹ On De Sitter: Röhle, *Willem de Sitter in Leiden* (ref. 4); J. Guichelaar, *Willem de Sitter. Een alternatief voor Einsteins heelalmodel* (Amsterdam, 2009). See also the poetic but unfortunately not very detailed biography by his wife: E. de Sitter-Suermondt, *Willem de Sitter, een mensenleven* (Haarlem, 1948), 37.

¹⁰ W. de Sitter, 'On Einstein's theory of gravitation, and its astronomical consequences', *Monthly Notices of the Royal Astronomical Society*: First Paper: lxxvi suppl. (1916) 699-728; Second Paper: lxxvii no.2 (1916) 155-184; Third Paper: lxxviii no.1 (1917), 3-28.

¹¹ De Sitter to Gill, 12 August 1911, Archives of the Royal Geographical Society, DOG 159. See also a portrait of De Sitter as a 24 year old student by his friend Johan Huizinga, on which he is characterised as 'wiskonstenaar', mathematician (De Sitter family collection).

colleagues in the science faculty probably contributed to his interest in relativity theory as well. Both physicists were close friends and collaborators of Einstein, who was a regular guest in Leiden.

The new staff

After the younger Bakhuyzen died, De Sitter wrote a scathing report on the state of the observatory for the Board of Trustees of Leiden University.¹² He described how the publication of observations had stagnated because each observer was responsible for the tedious correction of his own observations, a system that did not meet his and Kapteyn's ideas about efficient division of labour (see next paragraph). He also reported that not a single observation of the photographic refractor had been published since its erection in 1898. The only things that had been measured were the systematic errors of the telescope itself. It must be the one of the best-known instruments in the world by now, De Sitter sarcastically observed, adding that it was in a perfect condition for high-quality observations.¹³

At the advice of Kapteyn, De Sitter accepted the position of acting director, so that he could influence the succession and the future course of the observatory.¹⁴ On 10 March 1918 the two men met in Leiden to discuss the future of the observatory. They decided that De Sitter should become director despite his poor health (he had a lung condition that later necessitated him to spend eighteen months in a resort in Switzerland, from October 1919 until April 1921).¹⁵ Thus, the positions of professor and director that had been separated in 1908 would be reunited, while a new *lector* (reader) would be appointed to take over some of the teaching duties. Furthermore, De Sitter would accept the directorship only at the condition that the observatory was to be expanded and reorganised and that the director's house in the West wing was improved. And most importantly, he wanted to appoint two vice directors of his choice: Ejnar Hertzsprung and Anton Pannekoek.¹⁶

What followed were eighteen months of bureaucratic and political complications.¹⁷ The appointments had to be approved by several institutions: first by the united professors of the Science faculty, then by the Board of Trustees of Leiden University, and finally by the national government in The Hague (Leiden was a state university). This process was far from smooth. For one thing, Jan van der Bilt from Utrecht Observatory had his eye on the directorship. His lobby caused severe delays in the procedures because he was supported by the influential Feith brothers, of whom one was a member of the Board of Trustees and the other a key official at the Department of Education in The Hague. Another cause for delay was the Parliament election of June 1918 and the subsequent transition of governments. But the main problem was De Sitter's wish to appoint Hertzsprung and Pannekoek as vice directors.

Hertzsprung, who worked in Potsdam at the time, had already published his groundbreaking work on the relation between the colour (spectral class) and magnitude of stars. He was the son-in-law of Kapteyn, having married Henrietta Kapteyn in 1913. It was probably Kapteyn

¹² De Sitter, *Verslag omtrent den staat van den Sterrewacht te Leiden en de aldaar volbrachte waarnemingen in April 1918*. A draft of this report can be found in WdS 224.1.

¹³ De Sitter, *Verslag* (ref. 12), 4.

¹⁴ In a first letter to Kapteyn, De Sitter mentioned Ejnar Hertzsprung, Anton Pannekoek and Frits Zernike as other possible candidates. These and other details can be found in a diary De Sitter kept during this period: WdS 223.

¹⁵ According to Schlesinger, De Sitter had got an overdose of aether during an operation in 1914. Guichelaar, *Willem de Sitter* (ref. 9), 50-51. Before he took this decision, De Sitter had a long conversation with his physician.

¹⁶ De Sitter to the Board of Trustees of Leiden University, 19 April 1918, draft in WdS 224.1.

¹⁷ Most of the related documents can be found in WdS 224. See also De Sitter's correspondence with Kapteyn (WdS 30), Pannekoek (WdS 45) and Hertzsprung (WdS 23 and AH C46) (all in Dutch). A detailed reconstruction of the complications surrounding the appointments based on these sources can be found in D. Baneke, "Hij kan toch moeilijk de sterren in de war schoppen". De afwijzing van Pannekoek als adjunct-directeur van de Leidse Sterrewacht in 1919', *Gewina*, xxvii (2004), 1-13.

who suggested him to De Sitter. Hertzprung's nomination for the position in Leiden met few principled objections; the complaints about his being foreign were easily brushed aside because there were no Dutch candidates of equal standing. But Hertzprung had some demands of his own. The two things that had kept him in Potsdam, he wrote, were the presence of Karl Schwarzschild and the great refractor.¹⁸ Schwarzschild had died in 1916, but Hertzprung wanted compensation for the loss of the large telescope. Leiden did not have an instrument of comparable size. Hertzprung had thought of a solution, however. He would be content with a small new instrument of his own design (a 'Schraffierkassette', known locally as the 'arceerkijker', a double photographic refractor with a movable plateholder, intended for photometry), provided that he would also get 'access to a Southern instrument'. Besides, he had certain conditions regarding salary and pensions, and he wanted a 'rekenmeisje', a girl computer.¹⁹

De Sitter agreed. Erecting a new large instrument in the Dutch climate would be a waste of capital anyway, he said. He promised Hertzprung that he would do his best to obtain facilities on the Southern hemisphere, for example in the Dutch East Indies (Indonesia).²⁰ Apparently, this promise was good enough for Hertzprung, for the moment at least. In the meantime, De Sitter lobbied for funding. This took some time, but it succeeded in the end: f 12.000 was granted for the Schraffierkassette, while Hertzprung's salary was f 8200 per year (one guilder was about \$ 0,33 - 0,40).²¹

Pannekoek, however, was a more difficult case. He had left Leiden to teach socialist theory in Germany, but he had had to quit his political work (he referred to it as his 'literary activities'²²) after the outbreak of the First World War. He had accepted a job as a teacher at a *Hoogere Burgerschool*, a type of secondary education with strong emphasis on science, but he wanted to return to professional astronomy. During his stay in Germany he had stayed in contact with several astronomers, including Schwarzschild and Hertzprung. In 1916 he had published a widely acclaimed book on popular astronomy, *Wonderbouw der Wereld*.

Pannekoek's only wish was a house with a garden, but that was not the problem.²³ His political conviction was. The appointment process took place in 1918-19, at a time when communist revolutions swept across Europe. Russia had fallen, and Germany and various other Central European countries seemed ready to follow. In November 1918 Troelstra, the leader of the Dutch socialist party, announced the rule of the workers in a speech in Parliament. This episode has gone into history as 'Troelstra's mistake' because it failed miserably within hours, but other politicians were shocked nonetheless. This caused serious problems for Pannekoek. Even though he abhorred Troelstra's action, Pannekoek was a known communist, having worked alongside Kautsky and Rosa Luxemburg for years. To appoint him in a position in which he could teach the future elite of the nation was a bridge too far for the government, especially after Pannekoek's name had appeared in several newspaper articles, relating him to the Hungarian revolution of Béla Kun and to the smuggling of imperial jewellery out of Communist Russia.²⁴ It was probably the Catholic Prime Minister Ruys de Beerenbrouck

¹⁸ Hertzprung to Kapteyn, 17 March 1918; copy in WdS 224.1.

¹⁹ Hertzprung to De Sitter, 1 May 1918, WdS 224.1.

²⁰ De Sitter to Hertzprung, 1 November 1918, AH, C46/10.

²¹ Hertzprung to De Sitter, 3 December 1920, AH, C46/9.

²² Pannekoek to De Sitter, 15 April 1919, WdS 45.1.

²³ Pannekoek to De Sitter, 29 March 1918, WdS 45.1.

²⁴ For example *Haagse Post*, 22 February 1919 and *Provinciale Groninger Courant*, 2 May 1919. In April 1919, Trustee J.E. Boddaert quoted another article, without mentioning its source. Boddaert to De Sitter, 16 April 1919, WdS 224.2. This folder also contains newspaper clippings of the other articles.

himself who vetoed Pannekoek's appointment.²⁵ Several Socialist members of Parliament protested, but without any result.²⁶

After it became clear that the situation was beyond hope, De Sitter briefly looked around for other candidates. He considered approaching Leopold Courvoisier of Berlin-Babelsberg, but eventually decided against it. At the initiative of Hertzsprung, he then asked Kapteyn to replace Pannekoek as vice director in 1920.²⁷ Kapteyn consented to come, but only on a part-time basis, until a suitable younger candidate was found. He hinted that there were two potential candidates among his students: Jan Schilt and Jan Oort, although he added that they would have to be trained in the 'Leiden school' first.²⁸ Kapteyn was attached to Leiden Observatory for one day per week until his death in June 1922. He was not succeeded for financial reasons. The second vice directorship remained open until 1924, when the post was definitively abolished. Instead, Oort became *conservator* in that year, a lesser but still senior position. He did not have his PhD yet at that time; he finished his thesis only in 1926, officially supervised by Kapteyn's successor P.J. van Rhijn in Groningen.

In the meantime, Pannekoek was appointed at the University of Amsterdam. As this university was funded by the city of Amsterdam, its appointments did not have to be approved by the national government. The Amsterdam city council was known for its tolerance of 'red professors'.²⁹ Pannekoek was also allowed to become a member of the Royal Academy of Sciences in 1925. The objections against him concerned the dangers of having a communist teaching susceptible students, not his person *an sich*. But when he wanted to go to Sumatra for an eclipse expedition in 1926, the colonial government forced him to sign a statement in which he promised to refrain from communist propaganda while in the East Indies. Pannekoek protested, but signed.³⁰

Apart from the new directors, several other appointments were made in the scientific staff of Leiden Observatory. The most important was observer Jan Woltjer, a former student of De Sitter (and father of future ESO director Lodewijk Woltjer), who became *lector* to relieve De Sitter's education duties. Apart from this there were some new observers, an instrument maker and a few computers. They replaced staff members who retired, left, died, and in one case were fired (observer J. Weeder). By 1924, Woltjer and De Sitter were the only remaining members of the scientific staff from before 1918.

All in all, it took a long time before the reorganisation could start in earnest. Especially Hertzsprung's patience was sorely tested. He partly blamed Pannekoek:

It is possible that the world can still be improved, but let us not try to do that in a way that harms the working conditions of our science.³¹

Hertzsprung wanted to get out of Germany because of the political and economic turmoil at the end of the First World War. Moreover, he was afraid to be drafted into the German army in

²⁵ Baneke, 'Hij kan toch moeilijk' (ref. 17) .

²⁶ *Handelingen van de Tweede Kamer der Staten Generaal*, 1919-1920, pp. 489, 495, 497-500, 524-526; and *Handelingen van de Eerste Kamer der Staten Generaal* 1919-1920, pp. 414, 419-421, and idem, *Bijlagen* 225, 250. This was after several newspapers revived the issue in September 1919, for example *Nieuws van de Dag*, 9 September 1919 (clipping in WdS 224.2).

²⁷ Hertzsprung to De Sitter, 1 April 1920, WdS 224.2; Kapteyn to De Sitter, 13 June 1920, WdS 30. Hertzsprung wrote that the idea of asking Kapteyn had occurred to him on 31 March at 7:03 pm. His wife, Kapteyn's daughter Henrietta, claims the idea was hers. Hertzsprung-Kapteyn, *J.C. Kapteyn* (ref. 3), 157.

²⁸ Kapteyn to De Sitter, 31 June 1920, WdS 1920.

²⁹ P.J. Knechtmans, *Een kwetsbaar centrum voor de geest: de Universiteit van Amsterdam tussen 1935 en 1950* (Amsterdam, 1998), 29. Among the other scientists to benefit from this were the mathematician Gerrit Mannoury and the historian Jan Romein.

³⁰ Pannekoek, *Herinneringen* (ref. 8), 212.

³¹ Hertzsprung to Pannekoek, undated draft in AH, C46/10. I am not entirely sure that this letter was actually sent.

September 1918 (his appointment in Potsdam had made him a German citizen).³² His appointment was only officially confirmed after he issued an ultimatum in June 1919. By then, De Sitter's appointment also had been approved. They could finally start with the reorganisation.

The new research program

In contrast to the appointments, the plans for the reorganisation and the expansion of the Observatory were approved almost without a hitch, so that the work could start immediately after the new staff was assembled. Construction work started in the beginning of August 1919. The first floor of the main building was expanded with several rooms, two small domes were added, and a new instrument workshop was set up on the ground floor. Besides, the living quarters in the two wings were expanded with a second floor and several new houses were built elsewhere on the premise for the caretaker and the observers. Other major improvements were the installation of a central heating system and an internal telephone network. Also, the observatory was connected to the municipal electric power system. Until that time, gas lighting was used. According to local legend, the famously conservative Ernst Bakhuyzen had special permission to keep using petroleum lamps. The cost of the expansion was initially estimated at f 300.000, but this was soon raised to f 650.000.³³

The expansion of the building was the most visible element of the reorganisation, but the most important part was the change in the working procedures. An outline of the new arrangements was already sketched by Kapteyn in a letter to the Trustees in March 1918.³⁴ De Sitter elaborated on this in his report of April and in subsequent plans and reports, with only minor changes.³⁵ Clearly, Kapteyn and De Sitter had already prepared these plans before Bakhuyzen's death. Bakhuyzen had been expected to retire soon.

The *piece de resistance* of the reorganisation was an overhaul of the relation between the scientific staff and the computers. In the old structure, the scientific staff did all the observations and supervised the reduction of the measurements. De Sitter wanted to change this. The computers were to be trained to do observations as well as calculations. Thus, a group of observer/computers, supervised by one faculty member, could conduct a research program that formerly would have required the work of several academically trained astronomers. At the same time, the instruments would be used more efficiently, as there were more trained observers available. The number of computers (tenured staff) increased slightly, from 9 in 1917 to 11 in 1925 (De Sitter wanted at least 14).

De Sitter described his new organisation as a transition to an 'English system', inspired by Airy's reorganisation of Greenwich observatory in the mid-nineteenth century.³⁶ He asked Astronomer Royal F.W. Dyson for details of the staff arrangements in Greenwich.³⁷ Smith and Schaffer have emphasized the increasing role of unskilled labour in Airy's 'factory-style' system, but De Sitter repeatedly emphasised that computers and observers were *not* unskilled workers.³⁸ Their work required specialized training and they were expected to be disciplined and devoted, as they had to be available literally day and night. Because of this, they deserved better payment than average clerks, he wrote to the Trustees and the government. He

³² Kapteyn to De Sitter, 4 September 1918, and notes by De Sitter in the margins of a letter from Trustee N. C. de Gijsselaar, 13 September 1918, WdS 224.2.

³³ *Handelingen van de Tweede Kamer der Staten Generaal*, 1922-1923, *Bijlagen* 263.

³⁴ Kapteyn to J. Oppenheim, 15 March 1918. Leiden University Library, Archive of the Board of Trustees, 1840.

³⁵ De Sitter, *Verslag* (ref. 12), and *Nota betreffende de formatie van het personeel der Sterrewacht*, WdS 234.

³⁶ W. de Sitter, *Toespraak bij de inwijding van de gereorganiseerde Sterrewacht te Leiden* (Haarlem, 1924), 8.

³⁷ De Sitter – Dyson correspondence, WdS 12.

³⁸ S. Schaffer, 'Astronomers mark time. Discipline and the personal equation', *Science in context*, ii (1988) 115-145; R.W. Smith, 'A national observatory transformed: Greenwich in the nineteenth century' in: *Journal for the history of astronomy*, xxii (1991), 5-20; De Sitter, *Verslag* (ref. 12) and *Nota* (ref. 35).

introduced a system of courses and exams. The computers could rise through several ranks, with corresponding salaries. In 1924, one of them (D. Gaykema) was even appointed chief of the computer department, a position previously reserved for a faculty member.³⁹

Apart from the computers, another group was also recruited to get involved in research: the students. De Sitter introduced (modestly) paid research assistant positions for them. Officially there were two such positions, but usually the available funding was divided over three students. They typically worked at the observatory during the last two or three years of their study, participating in ongoing research projects and collecting material for their PhD. This was a significant addition to the astronomical education program, to which I shall return later.

The involvement of lower staff in research was intended to increase efficiency. De Sitter called this the ‘essence’ of the reorganisation.⁴⁰ It would enable the increase of output without increasing the scientific staff and without any major increase in the annual budget, as this had proved to be impossible. In 1902, Kapteyn had already described the importance of ‘mechanical’ labour for efficiency:

I think we may lay it down as a pretty safe rule that the money will best put to the best advantage for the promotion of astronomy, if it is used for the payment of work which is more or less mechanical, taking the word ‘mechanical’ in its broadest and noblest sense; perhaps it would be better to say work that can be done by persons of which you can get any required number for money. Even if you wish to help scientific men, the money granted to them will probably always be used for such mechanical work.⁴¹

Kapteyn himself used this approach; he had no academically trained staff at his Astronomical Laboratory. The story that he had inmates from the local prison work on the CPD is probably a myth, however.⁴² But as we saw, De Sitter did not regard the work of the computer/observers as purely ‘mechanical’, as they had to be dedicated and skilled, though on a different level than the scientific staff. They resembled craftsmen rather than assembly line workers.

Mechanical labour in the literal sense was also used, though on a smaller scale: in 1920, De Sitter bought a Millionär calculating machine, while Hertzprung used an Archimedes calculator.⁴³

Apart from the new staff organisation, the research programs were also fundamentally restructured. Under the old regime, the observatory consisted of three more or less independent departments.⁴⁴ First, there was a ‘fundamental astronomy’ group headed by H.J. Zwiers. They worked with the meridian circle. The second group was described as the ‘photographic’ or ‘astrophysical’ department, although no spectroscopic research was done there. In fact, little work was done at all. This group was centred on the photographic refractor, of which De Sitter wrote that no observation had been published since its erection in 1898. The photographic department was headed by J.H. Wilterdink, who left the observatory in 1918. Finally, there was a ‘theoretical’ department, consisting of De Sitter himself, Woltjer and the computers. The

³⁹ De Sitter, *Nota* (ref. 35).

⁴⁰ He said so in the speech at the reopening of the Observatory in 1924: De Sitter, *Toespraak* (ref. 36), 18.

⁴¹ Kapteyn to Newcomb, 22 October 1902. Groningen university archives, archive of the Kapteyn Institute EB91; cf. J.C. Kapteyn, ‘Het Sterrekundig Laboratorium’ in: *Academia Groningana 1614-1914* (Groningen, 1914), 550-552.

⁴² According to an extended version of this story, the Socialist leader F. Domela Nieuwenhuis worked on the CPD while serving his time for insulting the king. Krul suggests that the myth was probably started by a remark from Eddington. W.E. Krul, ‘Kapteyn and Groningen: a portrait’, in: *The legacy of J.C. Kapteyn* (ref. 3), 72.

⁴³ De Sitter to Hertzprung, 29 September 1920, WdS 23.9; Hertzprung to De Sitter, 8 March 1921, AH C46/9.

⁴⁴ Kapteyn to J. Oppenheim, 15 March 1918. Leiden university library, archive of the Board of Trustees, inv. no. 1840; De Sitter, *Verslag* (ref. 12).

chief computer was J. Weeder, but De Sitter considered him incompetent. After some bickering, in which Weeder was supported by the eminent physicist H.A. Lorentz, he was fired.⁴⁵

The new directors decided to retain the departments under the new administration, though with radically changed research programs. Pannekoek had been the intended chief of the meridian department, but after his rejection Kapteyn was its official head. In practice, daily work was conducted mainly by the observers C.H. Hins and Zwiers (until his death in 1923). They were assisted by the new chief computer Gaykema and several other observer/computers. The time-consuming fundamental astrometry program was abolished, as was Leiden's contribution to the *Carte du Ciel*. That was relatively easy, as Leiden had never subscribed to deliver photos for the *Carte*. Within a few years, a red star catalogue based on relative instead of fundamental measurements was published. The Dutch astronomical journal *Hemel en Dampkring* reported that the reduction of the measurements had kept up with the observations in this project, which was unheard of at the time.⁴⁶ After the catalogue was finished, the meridian circle was used for Leiden's contribution to Kapteyn's *Plan of Selected Areas*. These programs clearly show the influence of Kapteyn, who disliked unwieldy projects like the *Carte*, propagating focussed large-scale data gathering with a specific research question in mind instead. His *Plan of Selected Areas* was a typical example of his research style, combining theoretical and observational astronomy.⁴⁷

Jan Oort also was officially assigned to the meridian department when he came to Leiden, but he had an independent position, pursuing his own research interests. In 1927 he published his famous proof of the rotation of the galaxy, based on statistical investigations of proper motions. It was a very Kapteynian research program. Another relatively independent researcher of this department was C. Sanders, an amateur astronomer from Matuba in Portuguese Congo (present-day Angola).⁴⁸ There, he worked on absolute declinations, following a method developed by Kapteyn that made use of his location near the equator. He reported weekly to De Sitter and Oort. In return, he enjoyed some modest financial support from Leiden Observatory. In 1926 he had to return to the Netherlands because of financial problems. His work was the foundation for two expeditions to Kenya in 1931-32 and the 1950s.⁴⁹ Finally, the meridian department included the timekeeping service, responsible for the chronometers of the observatory.

Hertzsprung took over the photographic department, using the photographic refractor and the new Schraffierkassette for his great research project on the relations between the colour, mass and absolute luminosity of stars. Hertzsprung also worked with material he had brought with him from Potsdam. In later years he travelled to Johannesburg and Harvard to obtain more observations, focussing on variable stars and double stars.⁵⁰ This department included most of the research assistants, as Hertzsprung supervised most PhD students. He also sometimes received foreign students, such as his fellow countryman Kaj Strand, who worked in Leiden for several years before going to the United States.⁵¹

The theoretical department remained relatively unchanged. De Sitter kept working on his Jupiter moons. He did not, however, proceed with his work on general relativity. According to De Sitter's wife Eleonora, A.S. Eddington once called him 'the man who discovered a universe

⁴⁵ Correspondence Weeder and Lorentz in WdS 225.

⁴⁶ Obituary of H.J. Zwiers, *Hemel en Dampkring*, xxii (1924), 37-38.

⁴⁷ W.T. Sullivan, 'Kapteyn's influence on the style and content of twentieth century Dutch astronomy', in *The legacy of J. C. Kapteyn* (ref. 3), 229-263, and the article by T.D. Kinman in the same volume.

⁴⁸ J.K. Katgert-Merkelijn, 'The Kenya expeditions of Leiden Observatory,' *Journal for the history of astronomy* 22 (1991) 267-296, and correspondence in WdS 49.

⁴⁹ Katgert-Merkelijn, 'The Kenya expeditions' (ref. 48).

⁵⁰ He was in Johannesburg in 1923-1925 and in Harvard in 1926-1927.

⁵¹ K. van Berkel, 'Growing astronomers for export: Dutch astronomers in the United States before World War II', in: *The legacy of J. C. Kapteyn* (ref. 3), 151-174, p. 171.

and then forgot about it'.⁵² This was probably due to his illness in 1919-21 and his time consuming management duties afterward. Besides being director of the observatory, he also served as Rector Magnificus (Vice Chancellor) of Leiden University in 1926 and president of the International Astronomical Union in 1925-28. He only returned to relativity theory in 1928, possibly after a conversation with Eddington on board the ship to a meeting of the BAAS in South Africa.⁵³ In the meantime, Woltjer worked on celestial mechanics (esp. Saturn's moon Hyperion), while he also closely followed developments in theoretical physics. He was the person who introduced quantum theory at the observatory, and he famously reviewed Eddington's *The Internal Constitution of the Stars* for *The Observatory*.

De Sitter sometimes referred to the instrument workshop as the fourth department, as it became more and more important. Its heart and soul was chief instrument maker H. Zunderman, who had a high standing among the observatory staff. When he was offered a position elsewhere, he immediately got a significant pay rise.⁵⁴ De Sitter reported several times that the workshop was the reason why the observatory could function at all with so small an instrument budget. The budget for materials, which included instruments, was increased from f 6600 in 1918 to f 15.000 in 1924, but De Sitter claimed that the purchasing power had remained unchanged, while the cost of publications had risen.⁵⁵

The workshop produced several versions of the Schilt Photometer for the observatories in Harvard and Uppsala. This instrument was designed by Jan Schilt, who like Oort worked in Leiden even though he officially still studied in Groningen. He had developed it in cooperation with Groningen physicist Frits Zernike, a famously brilliant instrument maker (who in 1953 would get a Nobel Prize for his invention of the phase contrast microscope). Apart from Schilt, no astronomy students worked at the workshop, but there often were interns from the instrument maker's school of physicist Heike Kamerlingh Onnes. They were known as the 'blauwe jongens', the blue boys, after the colour of their overalls.⁵⁶

It took several years before the reorganisation was completed. The construction work was delayed several times, to the frustration of Hertzprung, whose house was among the last to be finished. Another cause for delay was the absence of De Sitter, who between October 1919 and April 1921 stayed in the *Waldsanatorium* in Arosa, Switzerland, because of his lung condition. During this period Hertzprung was acting director, but De Sitter tried to keep directing things from a distance. He kept in regular, sometimes daily correspondence with Hertzprung and Kapteyn.

De Sitter had forbidden Hertzprung to interfere in financial matters while he was away. This caused some tensions, as Hertzprung felt that De Sitter did not trust him. It also meant that 1920 was essentially a lost year for the reorganisation. Similar tensions recurred several times during the next years. The two men had an extremely high opinion of each others' scientific abilities, but they did not always get on very well on a personal level. This was probably partly caused by Hertzprung's somewhat difficult character, but also by De Sitter's authoritarian style of leadership.⁵⁷ Hertzprung had complete freedom in scientific matters, but De Sitter

⁵² De Sitter-Suermondt, *Willem de Sitter* (ref. 9), 37.

⁵³ Guichelaar, *Willem de Sitter* (ref. 9), 125-126. De Sitter kept a diary during this journey, see WdS 205.

⁵⁴ De Sitter to Kapteyn, 26 September 1920 AH, C46/10).

⁵⁵ De Sitter, *Toespraak* (ref 36), 18

⁵⁶ D. van Delft, *Freezing physics: Heike Kamerlingh Onnes and the quest for cold* (transl. by B. Jackson, Amsterdam, 2007), 319-336.

⁵⁷ Adriaan Blaauw, interview with the author. See also the De Sitter-Hertzprung correspondence, which was always polite and respectful but never warm or personal. Possibly, their relation was further pressured by the fact that Hertzprung had fallen out with the Kapteyn family after his divorce from Henrietta in 1923. De Sitter was very close to the Kapteyn family. None of this is mentioned in D.B. Herrmann, *Ejnar Hertzprung, Pionier der Sternforschung* (Berlijn etc., 1994), or De Sitter-Suermondt, *Willem de Sitter* (ref. 9).

maintained an iron grip on the management and administration of the observatory. For this reason, Pannekoek later wrote that in retrospect he did not regret his forced move to Amsterdam. He was sure that an appointment in Leiden would have ended in conflict, no matter how much he respected De Sitter.⁵⁸

Open conflict between Hertzsprung and De Sitter never occurred, perhaps because Hertzsprung was away to Johannesburg and Harvard for most of the time between 1923 and 1927. An incident did occur however when De Sitter departed to the United States for a lecture tour in 1930. He had left the observatory finance in the care of Jan Oort. Hertzsprung was stung by this, as he was the official vice director. It was all resolved eventually, but the incident was characteristic of the personal relations. De Sitter wanted to spare Hertzsprung administrative work that he knew he abhorred, but he did not bother to discuss this with him. At the same time, he probably regarded Oort as his future successor. Hertzsprung was only one year his junior, so when De Sitter would retire at the age of 70, Hertzsprung would be too old to succeed him. It was only because De Sitter died prematurely in 1934 that Hertzsprung became director.⁵⁹

But despite these incidents, the reorganisation was considered a great success. Both the quantity and the quality of the scientific output had increased dramatically, and the observatory was lavished with praise from all quarters. The moment of glory came in 1928, when De Sitter presided over a meeting of the International Astronomical Union in Leiden. Soon after, both Hertzsprung and De Sitter received two of the most prestigious prizes in astronomy: the Gold Medal of the Royal Astronomical Society and the Bruce Medal. Hertzsprung proudly observed that Leiden was one of only two observatories with two Gold Medalists, together with Mount Wilson.⁶⁰ He did not know yet that Oort would receive both prizes as well.

The Leiden – Johannesburg cooperation

In 1923, De Sitter succeeded in providing Hertzsprung with the Southern telescope he had promised him in 1918. Even though it was not a part of the reorganisation, it was probably the most significant additions to the observing facilities. It was made possible by a deal with the Union Observatory in Johannesburg.

At first, the best prospects for a southern station seemed come from former Leiden observer J.G.E.G. Voûte, who wanted to establish a private southern observatory. De Sitter had promised him some funding and one of the lesser Leiden telescopes on loan, but Voûte had bigger plans. Initially he tried his luck in South Africa, but when his attempts there failed he went to the Dutch East Indies (Indonesia). There he founded an observatory in Lembang, near Bandung on the island of Java, with generous financial support from tea tycoon K.A.R. Bosscha and his cousin R. Kerkhoven. It was to be equipped with one of the largest refractors on the Southern Hemisphere: a double Zeiss refractor with two 60-cm (23,6 inch) lenses.⁶¹

De Sitter was somewhat taken by surprise by the speed of the developments. He tried to regain the initiative, because he wanted to direct the research program of the new observatory from Leiden:

⁵⁸ Pannekoek, *Herinneringen* (ref. 8), 247.

⁵⁹ J.K. Katgert-Merkelijn, 'De opvolging van W. de Sitter' in: *Leids jaarboekje* (1997), 128-143.

⁶⁰ Hertzsprung to De Sitter, 28 January 1931, WdS 23.7. Hertzsprung received the Gold Medal in 1929 and the Bruce Medal in 1937; De Sitter received both prizes in 1931. Oort would receive them in 1946 and 1942, respectively. At Mt. Wilson, both Hale and Adams had received the Gold Medal. Hertzsprung wrote that he did not count Michelson's medal, though he did not explain why.

⁶¹ On Voûte and the Bosscha Observatory: L. Pyenson, *Empire of reason. Exact sciences in Indonesia 1840-1940* (Leiden etc., 1989), 20-82 and H. Zuidervaart, 'Joan Voûte 1879-1963. Een reuzentelescoop op de Bosscha-sterrenwacht te Lembang', in: D. van Delft et.al. (eds.), *De telescoop, erfenis van een Nederlandse uitvinding* (Amsterdam, 2008), 45-51.

The point is not to measure parallaxes on Java, but to give Hertzsprung his southern instrument.⁶²

But the other Dutch astronomers, including Kapteyn, wanted the new observatory to be an independent institute. They feared (with good reason) that De Sitter tried to make Leiden the dominant astronomical institute of the nation, at the expense of the rest.⁶³ Eventually, Voûte got his way. The Bosscha Observatory was officially opened in 1928 as an independent institute.

Thus, a new southern observatory had been established, but Hertzsprung still did not have the southern instrument he wanted. A solution was finally found in South Africa. In 1923 De Sitter signed an agreement with R.T.A. Innes, the director of the Union Observatory in Johannesburg.⁶⁴ They were old friends from the time when De Sitter had worked at the Cape as a PhD student.

In the agreement, Innes and De Sitter explained the necessity of the cooperation. According to De Sitter and Innes the number of southern observatories, though small, was probably sufficient for research purposes, if only their instruments could be put to full use. But all too often that was not the case, mainly because of staff shortages. Many clear nights were unused while northern astronomers sat idle under clouded skies. Moreover, southern observatories had ample room to set up new instruments with which northern research programs could be extended to encompass the whole sky. The obvious solution was for northern and southern observatories to cooperate. Following the example of Harvard's Boyden Observatory in Peru, the observatories of Leiden and Johannesburg had agreed to cooperate, with the difference that in this case the two observatories were equal partners. Astronomers from Leiden could come to South Africa to work with the instruments there, and in exchange students from Johannesburg could enter Leiden Observatory as research students. The agreement was signed in Leiden in 1923. Leiden University awarded Innes an honorary doctorate at that occasion (he had no academic degree, having started his career as a wine merchant in Australia).⁶⁵

In practice, the relationship was mostly one-way: Dutch astronomers travelled to South Africa.⁶⁶ The first to go was Hertzsprung himself, who enjoyed it immensely, not least because his house at the observatory was still under construction at the time. But other factors contributed too:

I love working here, without any interference of other things, and – no wife who is jealous of my work. [...] And in addition to that: no rheumatism, no colds, and no tooth aches.⁶⁷

He had just been divorced. The main attractions of South Africa, however, were the rich southern sky and the many nights of good seeing.

Hertzsprung stayed in Johannesburg for 18 months. He was followed by three of his students: W.H. van den Bos, H. van Gent and Aernout de Sitter, the son of Willem. They sent huge amounts of photographic plates to Holland, where they were used for Hertzsprung's variable star program. Van Gent also discovered many minor planets (asteroids). De Sitter suggested

⁶² De Sitter to Hertzsprung, 14 May 1920, WdS 23.9.

⁶³ See the correspondence of De Sitter with Kapteyn and Hertzsprung from this period (De Sitter papers). In reaction to De Sitter's expansionist plans, Utrecht astronomer J. van der Bilt even proposed to found a new national observatory. Minutes of the meeting of the *Nederlandse Astronomenclub* on 3 January 1921, Leiden Observatory Archives.

⁶⁴ Drafts of the agreement and accompanying correspondence can be found in WdS 230.

⁶⁵ W. Orchiston, 'From amateur astronomer to observatory director: the curious case of R.T.A. Innes' in: *Publications of the astronomical society of Australia*, xviii (2001), 317-327.

⁶⁶ H.E. Wood and W.S. Finsen came from South Africa to Leiden before 1940, but I don't know for how long. W.S. Finsen, 'Recollections of William S. Finsen, former director of the Republic Observatory' in: *Monthly notices of the astronomical society of South Africa*, lxiv (2005), 45-66.

⁶⁷ Hertzsprung to De Sitter, 5/6 February 1924, WdS 23.4.

that he would give the credit for these to the Union Observatory, by way of compensation for the use of their telescope.⁶⁸

The cooperation with Johannesburg had a fortunate side effect. When De Sitter was looking for a location for a southern station, Frank Schlesinger of Yale was doing the same. Cooperation with another northern observatory appealed to him:

Other things being equal we should prefer to go where there are other astronomers and not too far from civilization [...] The fact that your observatory is to be represented there [in Johannesburg] will be not a small inducement for us to locate there as well.⁶⁹

Schlesinger wanted to establish a 'colony of astronomers' in South Africa. In 1925, Yale opened a Southern Station at the University of Witwatersrand, a few miles from Union Observatory. Leiden and Yale continued to cooperate closely, and several Dutch astronomers worked at Yale, including Jan Schilt, Dirk Brouwer and Jan Oort. When Van Gent was in Johannesburg, he also worked at Yale Southern Station occasionally.⁷⁰

The influence of Leiden at Union Observatory was considerable. When Innes retired in 1927, Hertzprung and De Sitter lobbied hard for observer H.E. Wood to succeed him, instead of a politically appointed administrator.⁷¹ This was partly because they wanted an astronomer to lead the observatory, but also because they wanted to defend the position of Van den Bos, who had stayed in Johannesburg after his contract from Leiden had ended. The case was complicated by the sensitivities between the English and the Afrikaners, as Wood did not speak Afrikaans. Hertzprung even considered succeeding Innes himself, but on reflection he judged himself too old.⁷² Eventually Wood was appointed, and in 1941 he was succeeded by Van den Bos.

In 1930, the Rockefeller Foundation granted \$ 110.000 for a new Leiden telescope in Johannesburg: sixty thousand for the instrument and fifty for endowment.⁷³ This was about *f* 275.000, more than fifteen times Leiden's annual materials budget.⁷⁴ The instrument, a twin telescope with two 40-cm (16 inch) lenses built by Grubb, Parsons & co., was mounted in 1938, although it only became fully operational after the war. It provided Leiden with a fully dependant southern station. In the same year, Aernout de Sitter went to Java to succeed Voûte as director of the Bosscha Observatory. In previous decades Kuiper, another student of Hertzprung's, had wanted to work in Lembang too, but that had failed at the last moment. In 1929 he was already in Java before Voûte told him he wasn't welcome.⁷⁵ Lewis Pyenson wrote that after Aernout's appointment, Hertzprung controlled two major southern observatories.⁷⁶ But the Second World War brought this situation to a premature end: De Sitter jr. died in a Japanese prison camp.

⁶⁸ De Sitter to Van Gent, 4-11-1929, WdS 18.

⁶⁹ Schlesinger to De Sitter, 14 February and 14 March 1923, WdS 52. Schlesinger had first considered establishing a southern station in New Zealand. D. Hoffleit, *Astronomy at Yale 1701-1968* (New Haven, 1992), 118-121.

⁷⁰ Hoffleit, *Astronomy at Yale* (ref. 66). Schilt was considered for the position of Yale astronomer in South Africa, but the appointment never materialized, partly because of some misunderstandings. WdS 18 and the De Sitter-Hertzprung correspondence of January-February 1925 in WdS 23.4.

⁷¹ De Sitter-Hertzprung correspondence 1927, WdS 23.5 and AH C46/6.

⁷² Schlesinger to De Sitter, 25 April 1927, WdS 52. Schlesinger had strongly advised against it: "I believe he would be harassed even more than most of us by administrative details".

⁷³ De Sitter to Wood, 7 May 1930, WdS 67.

⁷⁴ See draft budgets in WdS 241.

⁷⁵ Kuiper to Hertzprung, 8 June 1929. Copy in WdS 23.6. Kuiper contemplated to go to Java again in 1935 – see D. DeVorkin, *Henry Norris Russell, dean of American astronomers* (Princeton, 2000), 318 and D.E. Osterbrock, J.R. Gustafson and W.J. Shiloh Unruh, *Eye on the sky. Lick Observatory's first century* (Berkeley etc., 1988), 202.

⁷⁶ Pyenson, *Empire of reason* (ref. 61), 81.

De Sitter had told the Trustees that considering the available resources, he would be happy to make the Observatory occupy ‘a respectable position amongst institutes of secondary rank’.⁷⁷ But in 1926, Schlesinger counted Leiden among the world’s six leading observatories.⁷⁸ Much of the credit was for Hertzprung. One year later Schlesinger wrote to De Sitter that someone had asked him to

indicate what astronomers in Europe as well as in our own country were doing the most effective work. The list I gave him was a short one, comprising nine Europeans. Hertzprung was of course among them. [...] I have long felt, and I think I have expressed to you, a warm admiration for the way in which you have made it possible for Hertzprung to work effectively.⁷⁹

He undoubtedly referred to the cooperation with Johannesburg.

Part 2: The new pedagogical culture

The new education program

The reorganisation plans made no mention of the education program, but that did not mean that nothing changed. On the contrary, the education program was central to the renaissance of the observatory, possibly even more so than the research. In 1928 Harlow Shapley of Harvard wrote to De Sitter:

I remember your frequent statement that one principal function of your Observatory is to train and export highly capable young astronomers.⁸⁰

Indeed it was. Training students and sending them to prominent foreign observatories became the ‘core business’ of Leiden Observatory in the 1920s.

In the nineteenth century, students who wanted to specialise in astronomy had been rare. Only a handful PhD’s were awarded between 1861, when Kaiser opened the new observatory, and 1918.⁸¹ Kaiser frequently had German assistants because he could not find Dutch candidates. One of them was W. Valentiner, who later became director of the Bonn Observatory. There was no specialised graduate program in astronomy at Leiden University, or any other Dutch university for that matter. Most astronomers had studied mathematics or physics; some had no academic degree at all. Kaiser had no formal education, for example. H.G. van de Sande Bakhuyzen had studied civil engineering, while Kapteyn had studied mathematics and Hertzprung was a chemical engineer. Marcel Minnaert, a Flemish refugee who became professor of astronomy in at Utrecht University in 1937, had a PhD in biology.

⁷⁷ De Sitter, *Nota* (ref 35).

⁷⁸ Hertzprung to De Sitter, 20 January 1926, WdS 23.5. J. Stein cited further praise from Schlesinger in 1928. J. Stein SJ, ‘De Nederlandsche Astronomenclub 5 oct. 1918-5 oct. 1928’, *Hemel en Dampkring*, xxvi (1928), 335-347.

⁷⁹ Schlesinger to De Sitter, 6 December 1927, WdS 52. Hertzprung had just received a tempting offer from Copenhagen; in this letter, Schlesinger explained to De Sitter why he had told Hertzprung to stay in Leiden.

⁸⁰ Shapley to De Sitter, 22 December 1928, WdS 54. The remark that Leiden was the place “where they grow tulips and astronomers for export” is also attributed to Shapley, for example in Van Herk, *De Leidse Sterrewacht* (ref. 4), 85. The oldest quote of this remark I have found was from the South African minister for education in his speech at the opening of the relocated Leiden Southern Station in 1957. He said that Americans considered gin, tulips and astronomers as the main Dutch exports. ‘Rede deur sy Edele die Minister van Onderwys, Kuns en Wetenskap, mnr. J.H. Viljoen by geleentheid van die opening van die Leidse Sterrewag te Hartbeespoort’, *Hemel en Dampkring*, lv (1957), 213-215.

⁸¹ As far as I know, the only Leiden PhD students who pursued a career in astronomy from this period were H.G. and E.F. van de Sande Bakhuyzen, J.A.C. Oudemans, A. Pannekoek and J. Stein. J.G.E.G. Voite became an astronomer too, but he did not finish his PhD. Kapteyn was attached to Leiden observatory in the beginning of his career, but he studied in Utrecht and obtained a PhD in mathematics there.

This was not an exclusively Dutch phenomenon. The eminent David Gill of the Royal Observatory at the Cape of Good Hope was trained as a watchmaker, while Innes was originally a wine merchant. In America, too, several members of the scientific elite had no academic degree.⁸² Astronomers were usually trained on the job, while working at an observatory. It was only in the 1930s that a doctorate in astronomy became the standard entrance ticket into the discipline.⁸³

Leiden University was one of the first to develop a specialized graduate program in astronomy.⁸⁴ Every Dutch academic program started with a three-year program that culminated in a *kandidaatsexamen*, comparable to a Bachelor exam. Students who wanted to graduate in mathematics, physics or astronomy had to choose two of these three subjects as majors, with the third one as a minor. This meant that all astronomy students had to follow a fairly heavy combination of advanced mathematics and physics.⁸⁵ It also explains why De Sitter's first year Basic Astronomy course was attended by more than two dozen students, even though only a handful of them would go on to specialize in astronomy.⁸⁶ These selected few also had to follow specialized astronomy courses. De Sitter had introduced several new courses, including a seminar.⁸⁷ At first, the students were baffled by the high demands on their mathematical skills: in 1910, celestial mechanics had to be terminated because it was too difficult. Only three students attended the course the next year.⁸⁸ Later, this course was taken over by Woltjer. It remained notoriously difficult. The oral exam could take up to five days.⁸⁹

After finishing the *kandidaat* program, astronomy students could enter the *doctoraal* (graduate) phase of their study, in which they were engaged in research for the first time. However Hertzprung was not one for deterring an eager young student. In 1920 he was approached by N.W. Doorn, a first-year student of physicist Paul Ehrenfest, who 'burned with desire to begin with astronomy'. Hertzprung 'introduced' him to the microphotometer. He was quite happy with Doorn's work, already picturing him as his future assistant, although he conceded that this probably was a bit premature.⁹⁰ Adriaan Blaauw, too, reported that he started to do research before finishing his *kandidaats*, but he added that was quite rare.⁹¹

Putting students to work was Hertzprung's preferred way of teaching. He did not like to lecture: 'I am no teacher'.⁹² The majority of students would graduate in his department, where he would typically assign them a handful of variable stars to investigate.⁹³ Most of the observations came from Johannesburg. This reflects the way data was shared; the observatory had one data set that all researchers could use to their own end. Data from other observatories

⁸² J. Lankford, *American astronomy. Community, careers, and power, 1859-1940* (Chicago, 1997), 75 ff.

⁸³ Ibidem, and: R. Hutchins, *British University Observatories 1772-1939* (Aldershot 2008).

⁸⁴ It was made possible by the new Academisch Statuut (university statute) of 1921. M. Groen, *Het wetenschappelijk onderwijs in Nederland van 1915-1980, een onderwijskundig overzicht, vii: wis- en natuurkunde* (Eindhoven, 1986), 82-87.

⁸⁵ This described situation is that of after 1921; before that, the *doctoraal* degree was a combined degree in astronomy and mathematics.

⁸⁶ The De Sitter archive contains the lists of students who followed this course in 1927-1934, WdS 119.

⁸⁷ De Sitter-Suermondt, *Willem de Sitter* (ref. 9), 32; C. Hins, 'In Memoriam Willem de Sitter', *Leidsch Dagblad*, 22 november 1934.

⁸⁸ *Almanak van het Leidsch Studentencorps* (1910 and 1911).

⁸⁹ Adriaan Blaauw, interview with David DeVorkin (1979), OH.

⁹⁰ Hertzprung to De Sitter, 23 Oktober 1920, WdS 23.2. N.W. Doorn later obtained his PhD in Amsterdam with Pannekoek.

⁹¹ Adriaan Blaauw, interview with the author (2009).

⁹² Draft of a letter of Hertzprung to De Sitter, probably 1918. AH, C46/10. Schlesinger said that Hertzprung was "a very poor speaker in at least four languages". Hoffleit, *Astronomy at Yale* (ref. 69), 142.

⁹³ Bart Bok and Adriaan Blaauw, interviews with David DeVorkin (1979), OH.

was often used in the same way. This was different from the American style, where observations were considered more the domain of the observer who made them.⁹⁴

A few months after his arrival in Leiden, Hertzsprung described his pedagogical method:

I am quite happy here so far. The student Van den Bos did not show up at first, after he had been here once. So I sent [chief instrument maker] Zunderman after him. He met Van den Bos outside, grabbed him, and brought him here. Now he is working diligently with the microphotometer, and he already liked it when he had done nothing else but writing down the coordinates of the stars on the plates. If he does well, it can lead to a small publication in the A[stronomische] N[achrichten].⁹⁵

This shows that students were also encouraged to start publishing early.

Hertzsprung's teaching style was comparable to the nineteenth century astronomy education: he wanted students to learn the trade by doing it. The difference was, however, that obtaining research experience was integrated in an all-round graduate program. In the nineteenth century, students would only start after they graduated.

The most promising students could become research assistants. This was a novelty at the observatory, but it was already an established practice in chemistry and physics laboratories. There were usually two or three of them, who lived in a small apartment at the Observatory. Each of them would serve two or three years. After 1925, one assistant was always stationed in Johannesburg. Most assistants (including those in South Africa) worked for Hertzsprung's department. Because the number of positions was limited, students sometimes also went to Groningen, where Van Rhijn had one position to offer. Van Rhijn had few students of his own. The post in Groningen was much coveted, as it was better paid than those in Leiden.

Theoretically inclined students would study mostly with Oort or Woltjer. Dirk Brouwer was the only research assistant who worked for De Sitter, who usually was not closely involved with the students.⁹⁶ He did not teach relativity theory and he seems to have communicated little with the other astronomers about his cosmological work, preferring to correspond with Eddington, Lemaître and Einstein. Astronomy students who wanted to keep up with the latest developments in theoretical physics turned to Woltjer. They would also sometimes attend the famous colloquiums of physicist Paul Ehrenfest, who had come to Leiden in 1913 to succeed Lorentz. Ehrenfest invited leading scientists to give lectures and he stimulated students to contribute as well. For example, Bart Bok recollected how he had to give a talk on Eddington's *Internal Constitution of the Stars*.⁹⁷

The broad theoretical *kandidaat* and the research-oriented *doctoraal* programs together constituted the pride of the Observatory. By the time they got their degree, students were all-round research astronomers. Among the students who got their PhD during De Sitter's directorate were W.J. Luyten, W.H. van den Bos, Dirk Brouwer, Piet Oosterhoff and Gerard P. Kuiper. In the same period Jan Schilt, Jan Oort and Bart J. Bok obtained their PhD's in Groningen, but they all spent a major part of their study in Leiden. Adriaan Blaauw started his *kandidaat* in Leiden 1932. He, too, would finish his PhD with Van Rhijn in Groningen.

The demanded quality of the dissertations changed over time. In 1930, Hertzsprung said that in retrospect Luyten's dissertation from 1921 was not good enough. New dissertations had to be comparable to the work of established authorities of foreign institutions.⁹⁸ After all, the job market for astronomers was a small one.

⁹⁴ Cf. a conflict between Kapteyn and Kohlschütter and Adams at Mount Wilson. See: DeVorkin in: *The legacy of J. C. Kapteyn* (ref. 3), 143-145.

⁹⁵ Hertzsprung to De Sitter, 10 October 1919, WdS 23.2. cf. A. Wesselink, interview with David DeVorkin (1977), OH.

⁹⁶ Bart Bok, interview with David DeVorkin (1979), OH; Adriaan Blaauw, interview with the author (2009).

⁹⁷ Bart Bok, interview with David DeVorkin (1979), OH.

⁹⁸ Hertzsprung to De Sitter, 12 December 1930 and 14 January 1931, WdS 23.7. He referred to recent work by S.I. Bailey (Harvard) and J. Larink (Bergedorf, Bonn).

Career perspectives

Bok recalled how students in Leiden were prepared for the job market:

De Sitter called Kuiper, O[o]sterhoff and me in, and said, ‘Boys, when you get your PhD, you can either become a high school teacher, or you go to the United States’.⁹⁹

This was an accurate description of the possibilities. There were only a dozen tenured positions for astronomers in the Netherlands in the 1930s, so if nobody retired there were simply no jobs. This was the case in the Interwar years, as a new generation had just taken over most positions.

High schools were the most realistic alternative for most students. They could teach mathematics or physics at a Gymnasium or a *Hoogere Burgerschool* (HBS, a type of secondary education with a strong emphasis on science). Moreover, ‘cosmography’ was introduced as a subject at the HBS in the 1920s. Many prominent astronomers taught at a HBS or a Gymnasium at some point in their career.¹⁰⁰ Others went into related fields, like J.J. Raimond from Groningen, who became director of the Sijthoff Planetarium in The Hague. But for ambitious students who wanted to pursue a career in professional astronomy, the best option was to emigrate. Many did so.

As in many other fields, the promised land in astronomy was the United States. In this period many observatories were founded or expanded there. So many in fact, that there was a shortage of educated astronomers to staff them all, as John Lankford has described.¹⁰¹ There were simply not enough American university graduates in astronomy. De Sitter thought that the shortage of astronomers in America also had an economic background:

It is a post-war phenomenon: no young Americans can be found for badly paid scientific positions.¹⁰²

But apparently, Dutch graduates considered the payment not that bad at all.

The shortage was especially urgent in specific subjects. Hertzprung reported in 1927 that Yerkes had trouble finding an expert in photographic photometry, because ‘there is no school in America for this branch of astronomy’.¹⁰³ He used this information to the advantage of his students. Only weeks later, he remarked that Van Gent’s dissertation on photographic photometry was a ‘rather dull routine job’, but that it was highly appropriate ‘from a Yerkes-political point of view’.¹⁰⁴ This illustrates that foreign job opportunities were a central concern to the Leiden staff. In the same vein, Kuiper’s work on double stars propelled him to Lick Observatory.¹⁰⁵

The Dutch students were in a good position to profit from the American demand. Their combination of theoretical and observational skills was much sought after.¹⁰⁶ Schwarzschild once wrote that American astronomers often had little theoretical education, as many of them had a background in engineering.¹⁰⁷ In the Interwar period, only half of the American astronomy curricula included advanced mathematics, and even less included differentials and advanced statistics.¹⁰⁸ The education in Germany, on the other hand, was predominantly theoretical in this period. Telescopes were mainly the domain of the professors.

⁹⁹ Bart Bok, interview with David DeVorkin (1979), OH.

¹⁰⁰ Including H.G. van de Sande Bakhuyzen, J.A.C. Oudemans, A. Pannekoek and J. Stein.

¹⁰¹ Lankford, *American astronomy* (ref. 82), 136-139.

¹⁰² De Sitter to the Dutch ambassador in Washington, 7 May 1926, WdS 81.

¹⁰³ Hertzprung to De Sitter, 10 April 1927, WdS 23.5.

¹⁰⁴ Hertzprung to De Sitter, 22 April 1927, WdS 23.5.

¹⁰⁵ Osterbrock et.al, *Eye on the sky* (ref. 71), 200-203.

¹⁰⁶ Cf. DeVorkin, *Henry Norris Russell* (ref. 71), 315, 321.

¹⁰⁷ Herrmann, *Ejnar Hertzprung* (ref. 57), 50.

¹⁰⁸ Lankford, *American astronomy* (ref. 82), 93.

Of course, it helped that many Dutch astronomers had excellent contacts with their American colleagues. The first contacts had been established by Kapteyn. His work on the *Cape Photographic Durchmusterung* had led Simon Newcomb to invite him to the 1904 World Exhibition in St. Louis. There Kapteyn had met George Ellery Hale, who offered him a fellowship at Mount Wilson. From 1908 until 1914, Kapteyn stayed at Mount Wilson for two months every summer. He introduced several other European astronomers there, including Hertzsprung, Van Rhijn, Adriaan van Maanen and Arnold Kohlschütter. Other contacts were established through the Leiden – Yale cooperation in South Africa and through the IAU. Among the attendants of the 1928 IAU conference in Leiden were Shapley, Schlesinger and Russell, the three ‘generals’ of American astronomy.¹⁰⁹

The Dutch astronomers lobbied hard to obtain scholarships and positions for their students. During his stay in Harvard in 1926-27, Hertzsprung made a tour of US astronomical institutions:

As for my round trip: Albany – Rochester – Niagara – Ann Arbor – Chicago – Yerkes – Madison – Yerkes – Dearborn – Chicago – Allegheny – Washington – McCormick – New York – Newhaven. [...] I hope to have established connections that may be useful when we want to send out young men who are ready for first flight. I do not believe our applications for fellowships will be in vain, as long as we restrict ourselves to sending out A1 men.¹¹⁰

Hertzsprung also visited Dr. Wicliffe Rose of the General and International Education Boards of the Rockefeller Institute: several students travelled to the US on Rockefeller fellowships. Other students obtained Kellogg fellowships or other funding. Nearly all of them were funded by American foundations or institutes.

While Dutch astronomers encouraged their students to go to the US, this did not always mean they were happy about them leaving Holland. In 1922 Van Rhijn complained to De Sitter that, for the second time, he had lost his assistant to an American observatory. He had asked S.A. Mitchell of McCormick Observatory (University of Virginia) to send him some plates. “[Mitchell] replied that he could not do so, but that my assistant was welcome to come and measure the plates himself. This offer was too good to refuse. But now I am left without an assistant.”¹¹¹

The assistant in question was Peter van de Kamp. The previous assistant had been Oort, who had gone to Yale before coming to Leiden. Later, Van Rhijn’s assistants Bok and Blaauw would also cross the Atlantic. Bok’s journey to America was motivated by other reasons besides astronomy and career perspectives: at the IAU conference in 1928, he had fallen in love with Priscilla Fairfield. A few years later he joined her in America. They were married within days of his arrival.¹¹²

The number of students who successfully crossed the Atlantic was impressive.¹¹³ Those who did not go (especially theoretically inclined astronomers such as Pannekoek, De Sitter and Oort) embarked on extensive lecture tours. Pannekoek remarked how the Americans tried to squeeze out all usable knowledge from visiting European astronomers.¹¹⁴ In 1940, the Dutch were the

¹⁰⁹ They were called ‘the generals’ by Peter van de Kamp; interview with David DeVorkin (1977), OH.

¹¹⁰ Hertzsprung to De Sitter, 19-4-1927, WdS 23.5.

¹¹¹ Van Rhijn to De Sitter, 27-11-1922, WdS 48.

¹¹² Bart Bok, interview with David DeVorkin (1979), OH. See also D.H. Levy, *The man who sold the Milky Way: a biography of Bart Bok* (Tucson, 1995).

¹¹³ K. van Berkel, ‘Growing astronomers for export: Dutch astronomers in the United States before World War II’, in: *The legacy of J. C. Kapteyn* (ref. 3), 151-174; D. DeVorkin, ‘Internationalism, Kapteyn and the Dutch pipeline’, in: *The legacy of J. C. Kapteyn* (ref. 3), 129-150. See also: J. Oort, ‘Jongere Nederlandse sterrekundigen op belangrijke posten in het buitenland’, *Hemel en Dampkring* xxxix (1941), 355-363. These lists do not mention Kaj Strand, a Danish astronomer who also studied in Leiden in the 1930s.

¹¹⁴ Pannekoek, *Herinneringen* (ref. 8), 270.

second largest group among the 15% of American astronomers who were born outside the US, after Canadians.¹¹⁵

Not everyone was allowed to go. De Sitter and Hertzsprung were determined to keep Oort in Leiden, and they were also happy when Oosterhoff decided to come back to the Netherlands. Hertzsprung doubted if they were appreciated enough by the Americans:

I cannot avoid thinking that the Americans make a point of being able to buy anything – up to and including men of science [...] even when they can't judge their qualities by themselves – I have been asked in earnest who is the better astronomer, Oort or Luyten.¹¹⁶

The situation changed somewhat in the 1930s. The number of available positions fell due to the economic crisis, while the supply of American graduates rose and the number of foreign immigrants increased as a result of political developments in Europe.¹¹⁷ The fact that the Dutch were overrepresented among the foreigners did not go unnoticed. They were no longer automatically welcomed.¹¹⁸ Besides, Kuiper had antagonised several people by his attitude, especially at Lick Observatory. Some of the grudges may have been justified, considering a remark from Oosterhoff from Mount Wilson Observatory:

Being Dutch occasionally earns me an extra night, as dr. Van Maanen handles the schedules for the instruments during the dark-run.¹¹⁹

David DeVorkin has described how Hertzsprung and his students thought that American data and observatories would be best off in Dutch hands. He suggested that this was part of a Dutch cultural imperialism.¹²⁰ It was probably regarded as such by some American astronomers, but I would suggest that from the Dutch perspective, it was cultural nationalism rather than imperialism. National pride certainly was an important factor, and science played a prominent role in Dutch nationalism of the period.¹²¹ But there are no signs that Hertzsprung and De Sitter wanted to influence the administration of American observatories in the same way as they did in South Africa and Java (where imperialist notions did play a significant role). They probably were interested in obtaining observations – remember that the observational facilities of the Dutch institutes were relatively small.

Their views can be interpreted as part of a widespread ambivalence toward America that prevailed in the Netherlands in this period. Admiration for its energy and success was combined with a rather condescending attitude toward the 'superficial' and materialistic American culture.¹²² That explains why they thought that the best results would be produced by a combination of the theoretical sophistication provided by a European education with the large facilities provided by American entrepreneurship and, especially, money.¹²³ It would literally

¹¹⁵ Lankford, *American astronomy* (ref. 82), 361.

¹¹⁶ Hertzsprung to De Sitter, 20 January 1926, WdS 23.5. Cf. Pannekoek, *Herinneringen* (ref. 8), 269-270.

¹¹⁷ Lankford, *American astronomy* (ref. 82), 136-139.

¹¹⁸ DeVorkin, *Henry Norris Russell* (ref. 75), chapters 20 and 21; see also some letters from Kuiper to De Sitter, for example 30 October 1933, WdS 36.

¹¹⁹ Oosterhoff to De Sitter, 29 June 1934, WdS 84.

¹²⁰ DeVorkin, *Henry Norris Russell* (ref 75), 330.

¹²¹ Van Berkel, 'Natuurwetenschap' (ref. 2); Willink, *De tweede gouden eeuw* (ref. 2).

¹²² The most famous expression of this view was the book by De Sitter's close friend, the eminent historian Johan Huizinga: *Amerika levend en denkend* (1927). See also P.J. Knegtmans, 'De Amerikaanse verleiding. Veranderende oriëntaties in de Nederlandse wetenschapsbeoefening', in: F. Boterman en M. Vogel (eds.), *Nederland en Duitsland in het Interbellum* (Hilversum, 2003), 233-249; Klaas van Berkel, 'Amerikanisering van de Nederlandse universiteit? De chemicus H.R. Kruyt over Hoogeschool en Maatschappij (1931)', *Tijdschrift voor de geschiedenis der geneeskunde, natuurwetenschappen, wiskunde en techniek*, xii (1989), 198-225; F. Van Lunteren and M. Hollestelle, 'Paul Ehrenfest and the dilemmas of modernity' (forthcoming).

¹²³ Cf. the reaction of C.E. St John to De Sitter's request for gifts for the Kapteyn fund in 1924, about how Europeans seemed to regard America as an unlimited source of money. His reaction was forwarded to De Sitter by Hale. WdS 22.

combine the best of both worlds. This attitude was expressed by De Sitter in response to a worried father who wanted to know whether his son should study astronomy in Holland or in the US:

In conclusion, I would say: if your goal is to obtain a good position, studying in America gives the better chances, but if your goal is to become a good astronomer [...] Leiden is better.¹²⁴

Part 3: Dutch astronomy

The Dutch astronomical community

The renaissance of Leiden Observatory was the most important, but not the only, element of an impressive revival of Dutch astronomy. Before, Kapteyn had been a lonely torchbearer, but after the First World War a new generation entered the stage, including several of Kapteyn's students. De Sitter, Hertzsprung and Oort in Leiden, Pannekoek in Amsterdam, Van Rhijn in Groningen and Marcel Minnaert in Utrecht brought astronomy to a new level. After 1918, astronomy joined the 'second golden age' of Dutch science, in the period in which astronomy in other European countries declined.

Leiden was by far the largest astronomical institute of the Netherlands, followed by Utrecht Observatory. A.A. Nijland was director in Utrecht until 1937, assisted by Van der Bilt and Minnaert, who had come to Holland as a political refugee from Belgium in 1918 (he had been sentenced to fifteen years of forced labour for collaboration with the Germans during the First World War).¹²⁵ Minnaert mainly worked on photometry and solar physics, in cooperation with physicist W.H. Julius.¹²⁶ He also introduced new teaching methods, introducing students to practical work already during the first years of their study. Next to Leiden, Utrecht became the second centre for astronomy education in the Netherlands. Minnaert formally became professor in 1937, after he had been offered a position in Yerkes.¹²⁷ There were some protests because he had become a communist by then, but his appointment was approved. Apparently, he was considered less dangerous than Pannekoek in 1919.

The other two astronomical institutes were small, although Van Rhijn succeeded in obtaining a 55cm reflector in Groningen in 1931, mainly for teaching purposes.¹²⁸ There were few students there, but there was one assistant position (slightly better paid than those in Leiden). It was usually occupied by students from Leiden or Utrecht. Finally, Pannekoek in Amsterdam had few resources. Inspired by Kapteyn, he set to work without observations of his own, although he spent some months in observatories in Victoria, Canada, and in Lembang.¹²⁹ As he had few astronomy students before the Second World War, he mostly lectured on mathematics.

¹²⁴ De Sitter to Van Lonkhuyzen 6-6-1934, WdS 106. He mentioned Berkeley and Harvard (in that order) as the best places to study astronomy in the US. His remark on the chances of obtaining a position was motivated by his worries about the "universal infection of nationalism."

¹²⁵ Like many of his fellow Flemish nationalists, Minnaert had welcomed German support for the establishment a Dutch-language university in Gent. L. Molenaar, *De rok van het universum. Marcel Minnaert astrofysicus 1893-1970* (Amsterdam, 2003), esp. 136-145.

¹²⁶ H.G. Heijmans, *Wetenschap tussen universiteit en industrie. De experimentele natuurkunde in Utrecht onder W.H. Julius en L.S. Ornstein 1896-1940* (Rotterdam, 1994).

¹²⁷ Molenaar, *De rok van het universum* (ref. 125), 260.

¹²⁸ Trustees of Groningen University to the Minister for education, 10 April 1929; Groninger Archieven, papers of the Board of Trustees of Groningen University, 52.840. They also added that Van Rhijn had difficulties in getting observations from other observatories, as he did not have the international standing of Kapteyn. Van Rhijn to Trustees, 17 March 1928 and 22 February 1929.

¹²⁹ Pannekoek, *Herinneringen* (ref. 8), 255-264.

Already in 1896, Kapteyn had argued for a division of labour among the Dutch universities, ‘in concert with the spirit of the age’, as he said.¹³⁰ He posthumously got his way in 1923. In that year the combined directors of the astronomical institutions signed an address to the Minister for Education in which they outlined a division of tasks. Leiden would focus on celestial mechanics, fundamental astronomy and astrophysics ‘with preference for photographic methods’, while in Groningen, stellar astronomy would be central. In Amsterdam, Pannekoek had just established an institute ‘where photographic plates could be measured and reduced, and where research mainly concerns the field of stellar astronomy.’ Later, he also worked on astrophysics and spectrography. Utrecht Observatory was assigned visual photometry, but in later years it also specialized in solar research. This was especially Minnaert’s work.

All signatories, including De Sitter, stated that Leiden observatory should be prevented from becoming too dominant. Each of the smaller institutes should be provided with at least one observer, several computers and a decent budget for equipment.¹³¹ In later years a pattern emerged of close cooperation between Leiden and Groningen on the one hand, both specializing in stellar astronomy and galaxy research, and Utrecht and Amsterdam on the other, working on astrophysics. Their cooperation concerned both research and teaching: there was an active exchange of students between the astronomical institutions in the Netherlands.

The division of labour and other organizational matters were discussed in the meetings of the *Nederlandse Astronomenclub* (Dutch Astronomers Association). It was founded in 1918 as an informal organisation of professional astronomers ‘and their peers’, meaning that prominent non-professionals such as C. Easton or J. Stein (who was a teacher at the time) could also join.¹³² It initially had about twenty members, growing to about forty in 1940. It convened every three months to discuss current affairs and listen to two or three lectures on current research. Graduate students often attended these lectures.

The most important novelty in the Dutch astronomical community, however, was the founding of the *Bulletin of the Astronomical Institutes of the Netherlands* (BAN) in 1921. It was an initiative of Hertzprung, motivated by the demise of the *Astronomische Nachrichten*, which had become slow and expensive and, worst of all, had lost its international character after the First World War. The BAN also provided an alternative for the ‘graceful tomb’ of the *Proceedings of the Koninklijke Akademie van Wetenschappen*.¹³³ It was intended to provide a cheap and high-speed medium for astronomical communications, in contrast to the slow and expensive publications of the separate institutes. The BAN was modelled after the *Lick Observatory Bulletin*. The choice of English as the language for the new journal was never questioned. Moreover, De Sitter explicitly stated that the support of English and American astronomers should be secured before proceeding with the plans.¹³⁴

The BAN delivered on the high expectations. Schlesinger gladly accepted De Sitter’s offer to send it to Yale’s Southern Station. He added that the *Annalen* of Leiden Observatory were ‘hardly necessary’.¹³⁵ One year later, Hertzprung reported that the BAN was read carefully at

¹³⁰ J.C. Kapteyn, *Openbare les, gehouden bij gelegenheid van de opening van het Sterrenkundig Laboratorium te Groningen, den 16en Januari 1896* (Groningen, 1896), 5.

¹³¹ Adress 1923, WdS 229. Signatories were: Van Rhijn (Kapteyn Astronomical Laboratory, Groningen), De Sitter (Leiden Observatory), Nijland (Utrecht Observatory), Julius (Heliophysical Institute, Utrecht), Pannekoek (Astronomical Institute, Amsterdam).

¹³² Minutes of the meeting of the *Nederlandse Astronomenclub*, 5 October 1918, Leiden Observatory Archives.

¹³³ Hertzprung to De Sitter, 16 February 1921, WdS 23.2. The ‘graceful tomb’ remark was first made by Easton, but Hertzprung fully agreed with this diagnosis.

¹³⁴ De Sitter to Hertzprung, 18 February 1921, WdS 23.9. Around the same time, De Sitter considered publishing *Communications from the Observatory in Leiden* (in English), but on second thoughts, he deemed it too expensive. *Sterrewacht dagboek*, WdS 227.

¹³⁵ Schlesinger to De Sitter, 21 April 1926, WdS 52.

Harvard.¹³⁶ In subsequent years, the publications of the individual astronomical institutes were abolished one by one. In 1969 the BAN merged with other European journals into *Astronomy and Astrophysics*.

The renaissance of Dutch astronomy was celebrated in 1928 by Stein at the tenth anniversary of the *Nederlandse Astronomenclub*.¹³⁷ He described the dynamic atmosphere, the increasing number of students, and the international praise. And he especially praised Willem de Sitter, both for the reorganisation of Leiden Observatory and for the organisation of the meeting of the International Astronomical Union in Leiden a few months earlier. That meeting had been the high point of the revival.

The IAU meeting did not just appeal to the pride of the scientists themselves. It also appealed to the national values that were celebrated by contemporary cultural nationalism. This had been the first international conference after the First World War where German astronomers were invited. To symbolize the reestablishment of international contacts, De Sitter had arranged that both a French and a German astronomer received an honorary doctorate from Leiden University (H.A. Deslandres and F. Küstner, respectively).¹³⁸ He was not alone in his diplomatic efforts. Many Dutch scientists considered it their calling to restore international communications. It became a matter of national pride to 'restore civilization' after the madness of the First World War, in which the Netherlands had remained neutral. For Kapteyn, this calling led him to reject international organisations that excluded German members. After the Royal Dutch Academy of Sciences joined the International Research Council in 1919, Kapteyn boycotted its meetings for this reason.¹³⁹

Dutch cultural nationalists liked to characterize Holland as a small, neutral country with a tradition in international law. The legalistic approach of international affairs was supposed to go back all the way to Hugo de Groot (Grotius), one of the heroes of the Golden Age of the Netherlands in the seventeenth century. Paradoxically, internationalism was a distinctive feature of Dutch nationalism at the time. It also had a practical side: for a small country surrounded by great nations, careful international diplomacy was crucially important, both politically and economically.

The renaissance of Dutch astronomy

Having described the developments at Leiden Observatory in detail, and having briefly surveyed the rest of the Dutch astronomical community, how can we characterize Dutch astronomy in the Interwar years? I will attempt to sketch a few patterns, following the example of Lankford's *American Astronomy*.¹⁴⁰

The most striking feature of the Dutch astronomical community was the institutional uniformity. All astronomical institutes were attached to public universities. There were no private universities in the Netherlands, nor were there major private benefactors. More significantly, there also was no national observatory, as in most other European countries. King Willem I had tried to establish one in the early nineteenth century, but had it ended up on the other side of the border after Belgian independence in 1830, where it later became the Royal

¹³⁶ Hertzprung to De Sitter, 27 January 1927, WdS 23.5.

¹³⁷ Stein, 'De Nederlandse Astronomenclub' (ref. 78).

¹³⁸ A. Blaauw, *History of the IAU. The birth and first half-century of the International Astronomical Union* (Dordrecht, 1994), chapter 4; W. Otterspeer and J. Schuller tot Peursum-Meijer, *Wetenschap en wereldvrede. De Koninklijke Akademie van Wetenschappen en het herstel van de internationale wetenschap in het Interbellum* (Amsterdam, 1997).

¹³⁹ Blaauw, *History of the IAU* (ref. 137), 57-61; Otterspeer and Schuller, *Wetenschap en wereldvrede* (ref. 138), 99-117. Around the same time, American and French astronomers criticized Kapteyn's for having accepted a high German decoration in 1914. Krul, 'Kapteyn and Groningen', in *The legacy of J.C. Kapteyn* (ref. 3), 74-76.

¹⁴⁰ Lankford, *American Astronomy* (ref. 82), ch. 11.

Observatory of Brussels.¹⁴¹ Thus, all institutes were funded by the national, or in the case of Amsterdam local, government. Moreover, they all had an educational function, at least in principle. Shapley's remark that training students was the principal function of Leiden Observatory not only reflected the choice of the staff: it reflected the institutional reality too.

The one exception to the rule was the Bosscha Observatory in Lembang, not coincidentally in the colonies. It was the only private institute, and the only one that was exclusively devoted to research. At first, hopes for fruitful cooperation with the Dutch universities had been high, but in the end Pannekoek was the only Dutch astronomer who worked in Lembang during Voûte's directorship.¹⁴² Other private funding was obtained for travel expenses, for example for eclipse expeditions and for students travelling to America or South Africa, and for minor instruments.¹⁴³ Van Rhijn's new telescope was funded by the Kapteyn foundation and Groningen University foundation, both supported by private donations.¹⁴⁴

The pedagogical culture that emerged in this period resembled the rise of physics research laboratory training in the mid-nineteenth century. Then, the increasing importance of high-precision measurements had instigated a revolution in laboratory culture that also included education. The German physics laboratories became the model that was followed by experimental physicists in other countries.¹⁴⁵ But astronomical institutes followed only half a century later. This was probably due to the number of students. Only when career perspectives were boosted by the rise of large research observatories, did the number of students who wanted to specialize in astronomy become large enough to legitimize specialized graduate programs. By then, it was no longer German but British and American institutes that set the tone. The job opportunities in America were an important factor in the shaping of the educational program in Leiden.

The role of women in Dutch astronomy was not as significant as in American astronomy, though there always were several female computers in Leiden (De Sitter was once worried by their night-time visits to Luyten while he was observing in one of the domes, but it turned out to be false alarm).¹⁴⁶ There were also several women astronomy students. None of them obtained one of the assistant positions and none pursued a career in astronomy, but Heleen Kluyver acted as De Sitter's secretary for several years and J.C. Proost-Thoden van Velzen translated his popular astronomy book *Kosmos* into Dutch. It was originally written in English, as it was based on De Sitter's Lowell Lectures in Harvard, 1931.¹⁴⁷

¹⁴¹ F. Van Lunteren, 'De oprichting van het Koninklijk Nederlands Meteorologisch Instituut: Humboldtiaanse wetenschap, internationale samenwerking en praktisch nut', *Gewina* 21 (1998) 216-243; A.G. Velghe, 'Adolphe Quetelet, stichter en eerste directeur van de Koninklijke Sterrenwacht' in: *Mededelingen van de koninklijke Academie voor Wetenschappen, Letteren en Schone Kunsten van België, klasse der Wetenschappen* xxxvii no. 2 (1975), 5-14.

¹⁴² Pannekoek, *Herinneringen* (ref. 8), 256-257.

¹⁴³ On the expeditions: [R. van Gent], *De reizende astronoom. Nederlandse sterrenkundige expedities naar de Oost en de West* (Leiden, 1993); K. van Berkel, 'De Akademie, Indië en de bloei van de sterrenkunde in Nederland. De Eclipscommissie van 1899', in: idem (ed.), *De Akademie en de Tweede Gouden Eeuw* (Amsterdam, 2004), 107-138. Papers related to the funding of the expeditions can also be found in WdS 215.

¹⁴⁴ *Jaarboek Rijksuniversiteit Groningen* (1931).

¹⁴⁵ R.E. Kohler, 'The Ph.D. Machine: Building on the Collegiate Base', *Isis* 81 (1990) 638-662; G. Gooday, 'Precision measurement and the genesis of physics teaching laboratories in Victorian Britain', *British Journal for the History of Science*, xxiii (1990), 25-51; F. van Lunteren, "'Van meten tot weten" De opkomst der experimentele fysica aan de Nederlandse universiteiten in de negentiende eeuw', *Gewina*, xviii (1995), 102-138.

¹⁴⁶ De Sitter to Hertzprung, 10 and 28 February 1920, WdS 23.9; Hertzprung to De Sitter, 12 and 20 February 1920, 23.2. On the role of women in American astronomy; Lankford, *American Astronomy* (ref. 82), ch. 9. The first Dutch women doctor in astronomy was Etine Imke Smit, who obtained her PhD with Kapteyn in Groningen in 1914 – Krul, 'Kapteyn and Groningen', in: *The legacy of J.C. Kapteyn* (ref. 3), 71. She did not pursue a career in astronomy.

¹⁴⁷ W. de Sitter, *Kosmos* (Den Haag, 1934). See also correspondence in WdS 91.2.

The members of the astronomical community came from a varied background, although many of them had attended a HBS secondary school. They represented an extremely wide spectrum of ideological backgrounds, ranging from radical communist Pannekoek to the Jesuit priest Stein and the orthodox Calvinist Woltjer.¹⁴⁸ In Utrecht, communist Minnaert and ex-naval officer Van der Bilt were colleagues, while Leiden was the home of the liberal Protestants De Sitter and Oort. The ideological differences rarely lead to problems between the astronomers, however.¹⁴⁹ Foreigners Minnaert and Hertzsprung were incorporated without problem.

Lankford ascribed the specialisation of American institutes to the institutional variety and the competition between them.¹⁵⁰ In the Netherlands, however, it originated in consensus, necessitated by the scarcity of resources. The institutes were simply too small not to specialize. The research covered a fairly wide range of topics, though by no means the whole spectrum of astronomy. The ‘new astronomy’ or astrophysics, based on spectroscopy was introduced relatively late, for example. According to Hutchins astrophysics was an important factor for the establishment of astronomy as an academic subject at British universities, but it did not play such a role in the Netherlands.¹⁵¹ Another characteristic was the absence of large telescopes. After the turn of the century there were no serious attempts to establish one in the Netherlands. Instead, the efforts were directed at the southern hemisphere: Lembang and Johannesburg.

Scarcity was also the main motor behind the development of astronomical laboratories, astronomical institutes without telescopes, where observations from elsewhere were processed and interpreted. Kapteyn had started to do that because it was the only thing he could do in Groningen. Pannekoek followed his example for the same reason. In Leiden, the division of labour that was inspired by Kapteyn’s methods was combined with a British or American factory-style organisation of observational work, dramatically increasing efficiency.

Lankford considered the *Carte du Ciel* as a watershed between European and American astronomy.¹⁵² Its standards essentially froze the development of telescopes and other instruments in Europe for decades. Besides, the project consumed huge amounts of resources, which restricted new research initiatives. As we have seen, Van de Sande Bakhuyzen had been enthusiastic about the project, but for financial reasons he decided against full participation. Therefore it was relatively easy for De Sitter to terminate Bakhuyzen’s research projects: no international obligations were abandoned. Instead, he joined Kapteyn’s *Plan of Selected Areas*, a cooperation of mainly British and American observatories.

The switch from *Carte du Ciel* to *Selected Areas* reflects the two most important influences on Dutch astronomy in the Interwar years: the legacy of Kapteyn and the increasing importance of America at the expense of the European Continent. The latter development was also demonstrated by the rise of the International Astronomical Union that took over the role of the *Astronomische Gesellschaft* as the most important international organisation. The foundation of the BAN and the decline of the *Astronomische Nachrichten* were other symptoms of the changing balance of power in the international astronomical community. All these developments moved the Dutch astronomical community away from the Continent and closer to America. The foundation for this was laid, again, by Kapteyn, who first established contacts with leading American astronomers.

¹⁴⁸ On Stein: W.D. Daling, ‘De tweede gouden eeuw: pater Stein s.j. (1871-1951)’, *Gewina*, xvi (2003), 96-114. He became director of the Vatican Observatory in 1931.

¹⁴⁹ The one exception I could find was during an eclipse expedition to Sumatra in 1929. A participating engineer (recommended by Voûte) caused trouble by accusing Minnaert of political agitation. Report of the expedition by J. van der Bilt, WdS 215.6.

¹⁵⁰ Lankford, *American Astronomy* (ref. 82), 401.

¹⁵¹ Hutchins, *British University Observatories* (ref. 83), esp. 211-213.

¹⁵² Lankford, *American Astronomy* (ref. 82), 397-400.

In the decade after the First World War, Dutch astronomy changed from a small, guild-like community into a slightly bigger community that had all the characteristics of a modern academic discipline, with specialized graduate programs, a laboratory culture that was characterized by division of labour, a professional journal and a national professional organisation. These changes were closely related to the changing international orientation, from East to West. Thus, astronomy belatedly joined the other sciences in the perceived 'second golden age' of Dutch science. After the Second World War, when the second golden age was over, astronomy even became the primary torchbearer of Dutch science: Jan Oort succeeded in convincing the government to make radio astronomy a showcase of post-war reconstruction.¹⁵³ This resulted in the large radio telescopes of Dwingeloo and Westerbork that made Holland a centre of observational astronomy again. The international activities also continued, with Oort others playing a leading role in the establishment of international organisations such as the European Southern Observatory.

¹⁵³ K. van Berkel, 'Kwaliteit en zuinigheid in het wetenschappelijk onderzoek', in: K. Schuyt and E. Taverne (eds.), *1950. Welvaart in zwart-wit* (Den Haag, 2000), 331-354.