2 Anton Pannekoek's Astronomy in Relation to his Political Activities, and the Founding of the Astronomical Institute of the University of Amsterdam

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Abstract

An overview is given of Anton Pannekoek's life as an astronomer, from his first steps at age twelve as an amateur until the end of his life. Particular attention is given to the interactions between his political activities and his astronomical career. Although Pannekoek was employed full-time in the service of the German Social Democratic Party in the years 1906-1914 and had intensive contacts with Lenin in the period 1913-1920, he remained involved in astronomy in his spare time, which enabled him to return to an astronomical career in 1919. Here we describe the events which led to his appointment at the University of Amsterdam, the founding of its Astronomical Institute in 1921, his Milky Way research, and his work as founder of astrophysical research in the Netherlands.

Keywords: Anton Pannekoek, Milky Way research, stellar astrophysics, council communism, University of Amsterdam, history of astronomy

Introduction

In online bookstores one can still find several of Pannekoek's books in print, for example, *Workers Councils* (Dutch original: 1946), with a preface by Noam Chomsky, *Lenin as Philosopher* (German original: 1938), translated in at least

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eighteen languages, and *A History of Astronomy* (Dutch original: 1951). Both his political and his scholarly work continue to resonate into the present.

In the final winter of the German occupation of the Netherlands (1944-1945), also known in Dutch as *de hongerwinter* ('the hunger winter'), Pannekoek wrote two separate autobiographies, one about his political life, 147 printed pages, and one about his life as an astronomer, 45 printed pages. Written 'by candlelight' as there was no electricity, they were originally meant only for his family. With their consent, the two autobiographies were published in 1982 in a single volume.[1] The difference in size might suggest that astronomy played a less important role in his life than politics, but I hope to convince the reader that astronomy certainly was the *love of his life*, from his early youth until his last days, and that his contributions to astronomy are of lasting value. However, from 1900 onwards, Pannekoek's scientific career was regularly influenced by his political work. Because the latter played an important role in the developments leading up to his appointment at the University of Amsterdam, I will also discuss parts of his political life.

In this paper, I will focus on Pannekoek's life as an astronomer, building on his published papers and autobiographies, but also on recollections shared with me by family members, colleagues, and students of Pannekoek. Especially the conversations with Dr David Koelbloed, who worked with Pannekoek from 1921 until the latter's retirement (Koelbloed himself retired in 1974), form a rich source of information about Pannekoek as a person and as a scientist.[2]

Youth and Early Astronomical Career

Anton Pannekoek was born on 2 January 1873 in Vaassen, a small village in the eastern part of the Netherlands, where his father was the manager of a small metal foundry and his mother a midwife. Their two daughters and two sons all received secondary education. Like his elder brother, Adolf, Anton went to the Hoogere Burger School (HBS) in nearby Apeldoorn. This type of

I am very grateful to Chaokang Tai and to the International Institute of Social History (IISG) of the Royal Netherlands Academy of Arts and Sciences for important background information about Pannekoek's astronomical and political work, and for helping with illustrations, and to Dr Karel A. van der Hucht for several illustrations about Pannekoek in Indonesia.

1 Pannekoek 1982.

2 Other notable sources include Pannekoek's colleagues, Dr Elsa van Dien, Prof. Jan de Boer, Prof. Frank Muller, Prof. Bart Bok, and his children, Prof. Antonie Johannes Pannekoek and Dr Anneke ten Houten-Pannekoek.

secondary school was created by the Dutch government in 1863 to provide a solid education for middle-class children to prepare them for a career in the practical higher professions, such as engineering. It focused strongly on the exact and natural sciences, including biology and astronomy. The introduction of the HBS had the – unintended – effect that it provided its pupils with a solid preparation for a university study in the exact sciences. The majority of the Dutch Nobel laureates came from this type of school, as well as almost all prominent Dutch astronomers.[3]

Astronomy was part of the HBS curriculum because the Dutch colonial empire in the East Indies – now Indonesia – required a large Dutch merchant fleet. At the outbreak of the World War II the Dutch merchant fleet was one of the largest in the world. The officers of this fleet needed astronomy for navigation and it was therefore logical to include astronomy in the curriculum of schools that prepared for a professional career. A side effect of this was that interest in astronomy could be stimulated from an early age and this may be one of the reasons why gifted HBS students regularly continued their education as students of astronomy. This was precisely what happened with Pannekoek.

Pannekoek was a fast learner and at the age of fifteen he had already completed the HBS curriculum, two years faster than most other children. By that time, he had grown passionate about astronomy and biology, subjects which he already intensively pursued as an amateur, and which would remain his most loved fields of study throughout his life. In his astronomical autobiography, Pannekoek described his first acquaintance with astronomy at the age of twelve. Using star charts from the astronomy schoolbook of his elder brother and a German school atlas, he was able to spot an extra star in the constellation of Gemini in the fall of 1885. After much thinking, he realized that this must be a planet, which turned out to be Saturn. After this experience, he learned more about astronomy from his physics teacher Dr J.M. Smit. Smit had socialist sympathies and was fired in 1887, because he had argued in favour of general suffrage at a political meeting – at that time, only property owners and tax payers were allowed to vote.[4]

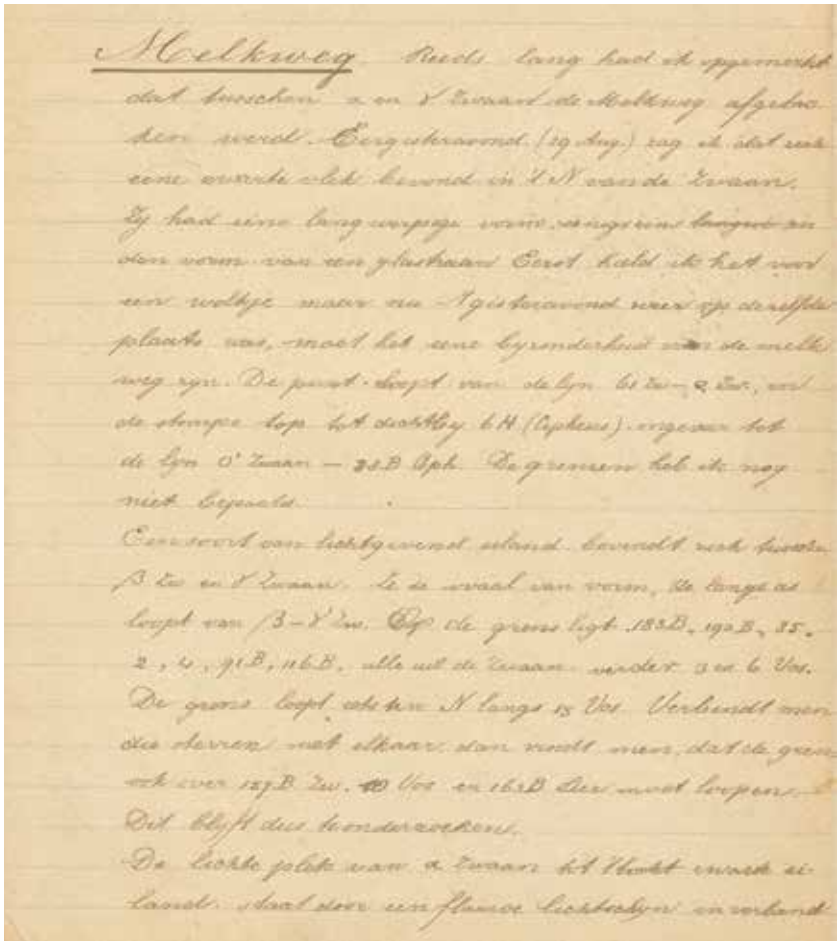
In Pannekoek's diaries, which he began at the age of fifteen, astronomical observations were alternated by notes on species of plants and flowers that he had found, and hearing the first nightingale on a spring night.[5] As

3 Of the nineteen Dutch-born Nobel laureates in the sciences (physics, chemistry, physiology or medicine, and economical sciences), twelve had attended the HBS, see Willink 1998.

4 For more on J.M. Smit, see Luikens 2001.

5 These diaries are now stored at API.

Figure 2.1 First page of Anton Pannekoek's diary, 31 August 1888



The page starts with: 'Already for a long time I had noticed that there is a gap in the Milky Way in the constellation Cygnus, between the stars α and γ Cygni.'

Source: Archive of the Anton Pannekoek Institute for Astronomy, University of Amsterdam

an illustration, Figure 2.1 shows the first page of his first diary, written on 31 August 1888. Pannekoek wrote here: 'For a long time, I had noticed that there is a gap in the Milky Way in the constellation Cygnus, between the stars α and γ Cygni.' A little further, he wrote that in the Milky Way 'there is an oval island of light between the stars β and γ Cygni'.[6] Both these features are clearly visible on current photographic images of this area. The Milky

6 Anton Pannekoek, dagboek 1, API, p. 1.

Way would remain a lifelong love of Pannekoek, and later in his scientific career he would devote much effort in attempting to unravel its structure.

Pannekoek's initial career goal had been to become a teacher, but his secondary school teachers convinced his parents to send him to university. However, with a HBS-certificate one could not immediately enter university. At the time, Dutch universities demanded of their students a fluent knowledge of Latin and Greek, languages that were not taught at the HBS. Furthermore, his parents considered him too young for university. He therefore stayed at home to study for the compulsory Latin and Greek exams, which he obtained only three years later, after failing the exams twice. In his autobiography, he explained this by claiming that he studied these languages 'rather unsystematically and inadequately'.[7] During the same period, he spent most of his energies on self-study, focusing on astronomy and biology. Following the advice of his physics teacher Smit, Pannekoek had begun to buy second-hand books at auctions during his secondary-school years, among them a guide for amateur observations by German astronomer Friedrich Wilhelm Argelander.[8] With this book, he taught himself to accurately estimate, with the naked eye, the brightness of a star by interpolating between the known brightnesses of both brighter and fainter neighbouring stars. He became very skilled in this technique and in his diaries he noted long series of brightness measurements of stars and of the Milky Way. At the age of seventeen, in the very clear and cold nights of December 1890 (the winter of 1890/1891 was, as my grandparents told me, one of the coldest of their lives), he discovered that the brightness of Polaris (α Ursae Minoris, the North Star) varies by a small amount over a period of about four days. His diary contains long series of observations of this star, extending until March 1891, documenting this variation. He continued to observe the variations until 1900, when he was already a professional astronomer. After seeing that Campbell at Lick Observatory in 1898 had found the radial velocity of the star to be variable with a period of 3,968 days, he published his findings in 1906 in a footnote in an article about the luminosities of stars of a different type.[9] Two years later, in 1908 (see below) this variation of the North Star was photographically confirmed by Hertzsprung, who found that it is a pulsating star of the Cepheid type.[10]

7 Pannekoek 1982, 229.
8 Argelander 1855.
9 Pannekoek 1906, 148.
10 Pannekoek 1982, 241; Hertzsprung 1911.

Figure 2.2 Anton Pannekoek and his wife Anna Pannekoek-Nassau Noordewier in the garden of their Leiden home around 1903-1906

Source: Private collection, courtesy of Laurence A. Marschall

In the fall of 1891, Pannekoek entered Leiden University and one year later he obtained his bachelor degree in physics and mathematics. In 1895, he graduated in these sciences, with astronomy as major. In 1892, he held the chair of the Leiden physics-student society 'Christiaan Huygens'. That same year, he started publishing his findings in research journals. His first scientific paper discussed the light variations of the eclipsing binary Algol (β Persei) in the German journal *Astronomische Nachrichten*.[11] In total, he authored well over a hundred peer-reviewed scientific publications.[12]

In the first two years after completing his undergraduate studies in 1895, Pannekoek worked as a geodetic engineer for the triangulation of the Netherlands, a national project with the aim of precisely measuring the dimensions of the country. For this, he travelled from the province of

11 Pannekoek 1892.

12 The SAO/NASA Astronomy and Astrophysics Data System (http://adsabs.harvard.edu) lists 110 publication by Pannekoek (accessed 22 August 2017), while a bibliographical list in API, compiled by David Koelbloed, lists 136.

Zeeland in the South to the island of Ameland in the North. As he mentioned in his autobiography, he enjoyed studying the different flora and fauna in the different parts of the country, and meeting people with different habits and dialects. After these two years, he was offered an assistantship at Leiden University Observatory, which allowed him to start research for a PhD. In 1902, he defended his PhD thesis on the light variations of the eclipsing binary Algol, on which he had published his first research paper ten years earlier.[13]

Pannekoek's Early Career in Socialism

While working at Leiden Observatory, Pannekoek first was a member of the Liberal Party – like most university staff. However, in 1899, he read the book *Equality* by the American Christian-socialist Edward Bellamy, which converted him to socialism.[14] The book made him realize the unfairness of the highly stratified society of that time, with miserable conditions for most of the workers and their families. In the first half of the twentieth century, Bellamy was popular throughout the world. My parents were great fans of him too, and they named me Edward after him. Bellamy, by the way, did not want to be called a 'socialist'; he called himself a 'nationalist', because he believed that giving every person an equal share in the wealth of the country would be in the best interest of the USA as a nation. At the time, all over the USA, more than one hundred 'nationalist' societies were founded aimed at realizing Bellamy's ideas.

Pannekoek joined the Dutch Social Democratic Workers' Party (Sociaal-Democratische Arbeiderspartij, SDAP) in 1899 and became one of the founders of its Leiden chapter. He started reading the works of Karl Marx and became an active teacher of Marxism for different branches of the party all over the country. During visits to Germany, he addressed meetings of the German Social Democratic Party (Sozialdemokratische Partei Deutschlands, SDP), at that time the largest and most respected socialist party in the world, with over 700,000 members. In the years in which Pannekoek became politically active, he also became more and more frustrated with how astronomy was done at the Observatory, and the way he had to do research himself. While the director of the Observatory, H.G. van den Sande Bakhuyzen (1838-1923) and his younger brother, and later successor as director, E.F.

13 Pannekoek 1902. A summary was published in Astronomische Nachrichten, Pannekoek 1903.
14 Pannekoek 1982, 72.

Figure 2.3 Opening of the SDP Party School in Berlin on 15 November 1906

From left to right: Anton Pannekoek, August Bebel (chair of the SDP), Arthur Stadthagen, Simon Katzenstein, Hugo Heinemann. Like Pannekoek, the latter three were also teachers at the Party School.

Source: International Institute for Social History, call nr. IISG BG A10/805

van den Sande Bakhuyzen (1848-1918), had been good astronomers in their time, by the turn of the century, they were old and did not want to hear of the new and more accurate observing methods and instruments that Pannekoek proposed. Moreover, the observations he had painfully carried out night after night with the highest possible precision disappeared in drawers and were never published. Pannekoek wrote in his autobiography that he felt more and more depressed and unfit for the job.[15] By 1906, he decided to abandon his position at the Observatory and started to apply for a position of secondary-school teacher in physics and mathematics. Just around that time, he received a letter from Karl Kautsky, the main theorist of the German SDP, who invited him to become teacher of Marxism at the new Party School that the SDP was establishing in Berlin. The party felt a need for such a school to train the leaders of the local party chapters throughout the country to improve their knowledge of the theoretical aspects of socialism and Marxism. Such a background, it was felt, was needed to properly lead the chapters and convince others to join the SDP.

15 Pannekoek 1982, 236-237.

Pannekoek accepted the invitation and quit his Leiden job. In his astronomical memoirs, he wrote that he thought that he had abandoned astronomy forever.[16] The official inauguration of the Party School took place on 15 November 1906, starting Pannekoek's career as a professional theorist of socialism (Figure 2.3). In a letter to his family in Holland, he described the large house he had rented in Berlin, with an interesting detail for a socialist: 'On the loft there also is a nice little room for the maidservant.'[17]

After a year, the German authorities forbade foreigners to continue their work at the Party School. In order to help him continue his socialist work, Kautsky helped Pannekoek to set up a weekly column ('Zeitungskorrespondenz') to which thirty socialist newspapers subscribed. This provided him with sufficient income during the next three years.[18] In addition to the weekly column, Pannekoek travelled the country and even visited Switzerland to give lectures for the local divisions of the party. Because of these activities, Pannekoek became a well-known socialist in both countries, as well as the in the Austrian empire. In 1910, he was invited by the Bremen chapter of the SDP to become lecturer at their new local party school. As a Free City (Freistadt), the German government had no authority in Bremen and therefore could not prohibit Pannekoek to teach there.

While Pannekoek was initially on good terms with his German mentor Kautsky, they later clashed on several issues. Pannekoek was much more radical than Kautsky and in 1912/1913, he wrote that all 'old' government officials and members of the civil service should be fired and replaced by socialists once the latter had come to power. Kautsky was much more pragmatic and did not want the country to turn into chaos, and called Pannekoek an anarchist. (Lenin agreed with Pannekoek's views and in 1913 wrote an article in his support.)[19]

In the years between 1906 and 1914, Pannekoek wrote ten brochures on varying subjects related to Marxism and socialism. Among these is the remarkable *Darwinisme en Marxisme* (1909), which contains a very clear explanation of Darwin's theory of evolution.[20] Pannekoek explained that the 'bourgeois' idea that Darwin's theory of natural selection would support capitalism was a wrong and vulgar interpretation of Darwinism. According to Pannekoek, humans have evolved as social beings. We thus owe our speech

16 Pannekoek 1982, 241.

17 Private communication from Dr David Koelbloed

18 Pannekoek 1982, 126-140.

19 For more detail, see Gerrit Voerman, 'Anton Pannekoek: A "Principled Theorist"', in this volume, 51-74.

20 Pannekoek 1909. An English translation was published in 1912 as *Marxism and Darwinism*, Pannekoek 1912.

and language faculties, as well as our abilities to make tools to our (biological) evolution. Over millions of years, our ancestors cooperated and supported each other, rather than competing and struggling with each other. With the rise of script and advanced tools, the biological evolution of humans ended. The only human evolution nowadays is the evolution of societies, which spans a relatively short timescale compared to the evolution of species. According to Pannekoek, this societal evolution proceeds according to the laws discovered by Marx. These laws were not yet completely known, as social science was still in its initial phase of development, like astronomy in the time of the Babylonians and Greeks, but just like with astronomy, continual development of these would eventually lead to the discovery of the definitive laws. Marxism, then, was a 'work in progress'. Pannekoek stated that Darwinism and Marxism had both destroyed old and rigid worldviews, but that each is valid only in its own domain; Darwinism in biology and Marxism in the social sciences.[21]

Much later, in 1944, he resumed the subject of Darwinism and Marxism, and wrote his book *Anthropogenese. Een studie over het ontstaan van den mensch* (*Anthropogenesis: A Study of the Origin of Man*), which was published in 1945.[22] It remains until this day an amazingly modern and far-sighted view on how humans and their brains and speech have evolved, due to toolmaking and social communication.

In 1909, to his great surprise, Pannekoek was visited by Ejnar Hertzsprung of the Imperial Observatory in Potsdam. Hertzsprung told him that, from a large number of photographic observations, he had fully confirmed Pannekoek's discovery of the variability of the Pole Star. He had found a regular period of about four days for this variability and an amplitude of 0.17 magnitudes, which corresponded to a maximum change of 16% in brightness of the star (this is a very small amount and means that Pannekoek must have had very good eyes to detect it in 1890/91). The conclusion was that the Pole Star is a pulsating star of the Cepheid type. When Hertzsprung invited him to visit the Potsdam Observatory, Pannekoek accepted because he wanted to renew his acquaintance with the director Karl Schwarzschild. As students, Pannekoek and Schwarzschild – who had studied in München – had regularly exchanged scientific articles. Meeting Schwarzschild was a great pleasure, and this visit and the meeting with Hertzsprung revived his interest in astronomy.[23]

21 For more on Pannekoek's writings on Marxism and Darwinism, see Omar W. Nasim, 'The Labour of Handwork in Astronomy', in this volume, 249-283.

22 Pannekoek 1945. English edition: Pannekoek [1944] 1953.

23 Pannekoek 1982, 241-242.

Shortly after the meeting, Pannekoek reduced his old naked-eye observations of the Pole Star of the period 1890-1900 and found that the regular period of four days that Hertzsprung had found was clearly present in his own observations He published these findings a few years later.[24] In his spare time, Pannekoek resumed his observations of the Milky Way and increasingly enjoyed astronomy again. He also renewed his interest in Babylonian astronomy, building on the new work by Franz Xaver Kugler. Pannekoek and his wife started to follow the motions of constellations, the sun, moon, and planets on a daily basis, to get a feeling of how the Babylonian astrologers had made their naked-eye observations. This inspired Pannekoek to resume the writing of a popular astronomy book, in German, which he had already started in 1903 in Leiden. The book was finished in the summer of 1914, a few months before World War I started.[25]

Return to the Netherlands and Pannekoek's Appointment at the University of Amsterdam

In the summer of 1914, Pannekoek's book had been typeset in lead, with over 140 copper engravings of the figures and star charts, and was ready to be printed in Dresden, when the war broke out. The German government abruptly confiscated all the lead and copper in the country, including the typesetting of Pannekoek's book, to be melted for bullets. As a result, the German edition of the book was never published.[26]

At the outbreak of the war, Pannekoek happened to be on holidays in the Netherlands, staying with his in-laws in Arnhem. He could not return to Germany, because the German government had banned all foreign socialists from the country. Pannekoek decided to translate his book into Dutch and have it published in the Netherlands. He translated the text in two months and it was published under the title *De Wonderbouw der Wereld* ('The Miraculous Construction of the World'), a title which Pannekoek did not like very much, but was conceived by the publisher.[27] It is a beautiful book, providing a lucid history of astronomy, starting from the discoveries of the regularities in the motions of the moon and planets by the Babylonians, which allowed them to predict eclipses of the Sun and Moon and the positions of the planets. The

24 Pannekoek 1913.
25 Pannekoek 1982, 239-240.
26 Pannekoek 1982, 240.
27 Pannekoek 1916.

Figure 2.4 Pannekoek in the library of Leiden Observatory in 1916

Source: Private collection, courtesy of Laurence A. Marschall

book impressed the leading Dutch astronomer Jacobus C. Kapteyn (professor in Groningen), as well as Kapteyn's former student Willem de Sitter (professor in Leiden). It convinced De Sitter in 1916 to offer Pannekoek an unpaid position at Leiden University (in Dutch: 'privaatdocent') to lecture on the history of astronomy. Pannekoek, who was earning his living as a secondary school teacher of physics at the time, gladly accepted this position (Figure 2.4).[28]

28 Pannekoek 1982, 240-241.

During Pannekoek's time as a social activist in Germany, Kapteyn had once mentioned to Pannekoek's father-in-law, Dr Hendrik J. Nassau Noordewier (linguist and principal of the Latin secondary school in Delft), how he regretted Pannekoek's departure from astronomy very much. Pannekoek wrote in his memoirs: 'I still know how this astonished me, and I had thought that I had left astronomy forever.'[29]

Because of his communist convictions, secondary schools in the Netherlands were hesitant to give Pannekoek a permanent job. Initially he could only get temporary jobs in various parts of the country as a replacement teacher, before being hired in 1916 for a longer-lasting job as a physics teacher in Bussum, a village located some twenty kilometres southeast of Amsterdam. During World War I, he remained politically active, although he refrained from attending public meetings and wrote most of his essays under pseudonyms. The war was a catastrophe for the international socialist movement. The German SPD supported the government's war effort in parliament, while the French socialists did the same with respect to their government. The situation was the same in Russia and England. In 1915, socialists from various countries who opposed the war held a meeting in Zimmerwald in Switzerland. Socialists from neutral nations, like the Netherlands, also participated in an effort to resurrect international solidarity. The conference was notably attended by three Russian communists living in exile in Switzerland: Vladimir Lenin, Grigory Zinoviev, and Karl Radek. From Holland, the famous poet Henriette Roland Holst attended, and Lenin approached her to start a new international communist journal together with Pannekoek. Both agreed and in 1916 the first issue of *Vorbote* appeared as the journal of the Zimmerwald Left – with Pannekoek and Roland Holst as editors (and financed by the wealthy Roland Holst). The first issue included articles by Lenin, Zinoviev, Radek, and Roland Holst. Even so, the journal did not last long and only two issues appeared. The Zimmerwald initiative ended among others due to Lenin's power grab in 1917 and the creation of the Soviet Union. Pannekoek was unaware of the horrors that accompanied the Russian Revolution and, like many socialists elsewhere, initially thought that the Russian communist takeover was a positive development that could start a socialist revolution all over the world.

Around the same time, a promising new opportunity arose for Pannekoek in astronomy. In 1917, Leiden Observatory director Ernst F. van den Sande Bakhuyzen suddenly passed away and Willem de Sitter was invited to become the institute's new director. After seeking advice from Kapteyn, de

29 Pannekoek 1982, 241.

Sitter put forward his conditions for acceptance: a drastic reorganization of the observatory. This included the appointment of two new professors, who would both act as deputy directors: Ejnar Hertzsprung and Anton Pannekoek. His plan was accepted by the Board of Leiden University and by the Minister of Science in 1918, and Hertzsprung was soon appointed. The minister, however, hesitated with the appointment of Pannekoek. At the end of the war, communist revolutions broke out in several places in Europe: in Munich, Berlin, and Brussels. From Russia, Lenin encouraged the revolutionaries to incite a 'world revolution'. Pannekoek and Henriette Roland Holst were heavily involved in debates about revolutionary politics, although Pannekoek refrained from doing so publicly, since he felt it his responsibility as a teacher, with respect to the parents of his pupils, to remain politically neutral. Even so, when, in 1919, a communist revolution broke out in Budapest, its leader Béla Kun declared Lenin, Pannekoek, and several other prominent socialists 'honorary members of the Hungarian communist republic'. This news received attention from Dutch newspapers, who added that Pannekoek was assigned to become deputy director of Leiden Observatory. De Sitter was angry at Pannekoek, because he felt that Pannekoek was responsible for sabotaging his own appointment, thus embarrassing De Sitter, but nonetheless he immediately went to The Hague to try to save the situation. But the government, led by the Catholic Prime Minister Ruys de Beerenbrouck, declared that Pannekoek under no condition would be appointed at a state university.[30]

In the meantime, however, another opportunity had arisen. At the University of Amsterdam – a municipal institution independent of the national government – mathematics professor Diederik J. Korteweg, whose appointment included lecturing astronomy, would soon retire. At the initiative of mathematician Luitzen Egbertus Jan Brouwer, the University offered the position to Pannekoek, under the condition that half his lectures would be in mathematics, teaching students who needed it as a support science, e.g. chemists, geologists, etc. The teaching load was nevertheless not too large, perhaps six to eight hours per week – far less than the 26 hours a week he had taught at the secondary school in Bussum. This left Pannekoek with substantial time to do research and establish an astronomical research unit. Pannekoek was appointed in 1919.

Shortly after, in January 1920, Pannekoek was visited by Dutch engineer Sebald Rutgers, who was Lenin's right hand in Moscow. Rutgers had earlier

30 Pannekoek 1982, 245-246. For an elaborate discussion of this episode, see Baneke 2004; and his 'Pannekoek's One Revolution', in this volume, 87-108.

worked as Head of Public Works on Sumatra in the Dutch East Indies. After hearing about the Russian revolution in 1917, he quit his job and travelled through Japan and Siberia to Moscow to join the revolution. Rutgers came to Amsterdam to invite Pannekoek, on behalf of Lenin, to come and work as a party theorist for the new Soviet Union in Moscow. Pannekoek refused, arguing that he did not want to be in a similar position as he had been in his German years when his income was dependent on his relation with a party and a government. He preferred to keep his job at the university but remain politically active. This way, he could develop his socialist ideas independently.

Although Pannekoek maintained a strict separation between his political and his astronomical activities, one clearly sees that in reality, there were strong connections between the two. In fact, the University of Amsterdam would not have had an astronomical institute if Pannekoek had not been a communist, because in that case he would have been appointed in Leiden. Secondly, his job as a lecturer – and later professor – of astronomy gave him a position from which he could develop his own ideas about socialism and revolutionary politics, leading ultimately to the development of council communism.

Already in 1920, Pannekoek realized that Lenin's 'dictatorship of the proletariat' and the dissolution of the soviets (revolutionary councils of workers and soldiers) was leading to a dictatorial regime of state capitalism, rather than a communist society. In his brochure, 'The New Blanquism' (1920), he criticized Lenin's politics. Blanqui was one of the leaders of the 1870 Paris commune, who had argued that a small group of skilled leaders should lead the revolution in a strictly centralized way, on behalf of the workers. According to Pannekoek, this was the same model envisioned by Lenin.[31]

Lenin replied with a booklet called *'Left-Wing' Communism: An Infantile Disorder*, in which he attacked Pannekoek and his associates. According to Lenin, they had 'shown most plainly that they consider themselves sound Marxists, but talk incredible nonsense in a most ridiculous manner and reveal their failure to understand the ABC of Marxism'.[32] Pannekoek's friend and comrade, the famous Dutch poet Herman Gorter, made one last attempt to convince Lenin and other Soviet leaders by travelling to Moscow in 1920, but he was unsuccessful, and returned to the Netherlands disappointed.

31 Pannekoek [1920] 1969.
32 Lenin [1920] 2008, 33.

Astronomical Research in Amsterdam

In the year of his clash with Lenin, Pannekoek published his major work on the Northern Milky Way in the Annals of the Leiden Observatory. It included the beautiful drawing 'The real aspect of the Milky Way, as true as possible', which was derived as a 'mean' of drawings by different observers, with much weight given to the work of Easton and to his own observations of 1897-1899 and 1910-1913.[33] In the previous year, Pannekoek had published an important paper in the *Monthly Notices of the Royal Astronomical Society* on the earth's distance from the centre of the Milky Way. By studying the distribution of star clouds in the Galaxy, Pannekoek calculated a distance to the galactic centre of 60,000 lightyears in the direction of the constellation Sagittarius.[34] This result supported the work of American astronomer Harlow Shapley, who claimed in 1918 that the Galactic Centre is located at a large distance in the direction of Sagittarius.[35] In 1920, Pannekoek received from Dr Herko Groot, his successor as physics teacher at the secondary school in Bussum, a few reprints of papers from Indian physicist Meghnad Saha (1893-1956), which Groot had received in exchange for his own work.[36] In these papers, Saha had derived and articulated the famous 'Saha law' on the ionization of gases as a function of temperature and density. This law would turn out to become a cornerstone of astrophysics. Thanks to this law, together with Boltzmann's laws for the excitation of atomic energy levels, astronomers finally understood why stellar spectral types depend on the temperature of the stellar atmosphere. In 1920, Saha's law was completely new, of course, and Pannekoek saw a beautiful opportunity to start a new field of research: stellar spectroscopy and the study of the physics of stellar atmospheres. In 1922, he published his first paper on the ionization in stellar atmospheres, in the *Bulletin of the Astronomical Institutes of the Netherlands*.[37] It was the beginning of astrophysical research in the Netherlands, and, as described above, the coincidence of the meeting between Pannekoek and his successor at the Bussum secondary school, Groot played a key role in this start.

Pannekoek, then almost 50 years old, quickly acquainted himself with the modern atomic physics, statistical physics and quantum mechanics, needed

33 Pannekoek 1920; for more on Pannekoek's Milky Way drawings, see Chaokang Tai, 'The Milly Way as Phenomenon', in this volume, 219-247; and Omar W. Nasim, 'The Labour of Handwork in Astronomy', in this volume, 249-283.

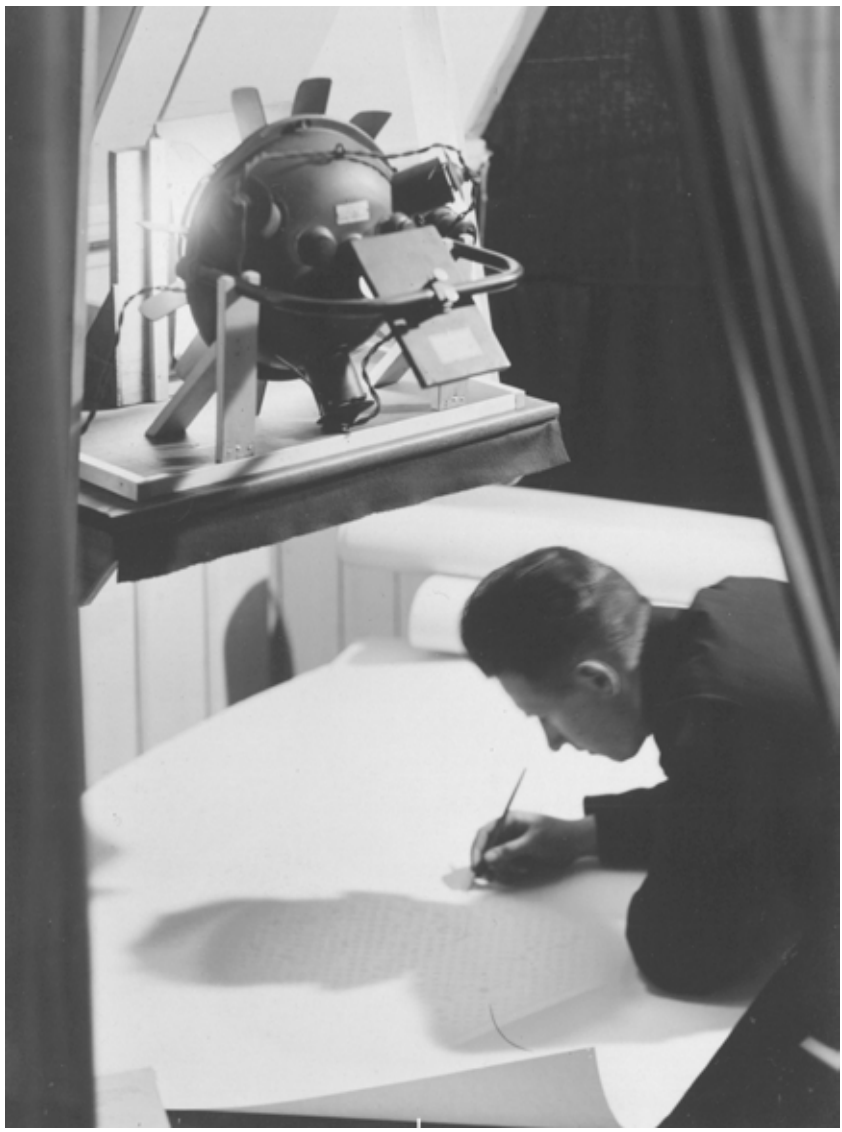
34 Pannekoek 1919.

35 For a detailed report, see Tai 2017, 235-237.

36 Pannekoek 1982, 251.

37 Pannekoek 1922.

Figure 2.5 Technician David Koelbloed (1905-1977)



Working on photometry of the Northern Milky Way at the astronomical institute (then located in the loft of the Oudemanhuispoort), in May 1932. Koelbloed had been hired at age fifteen in 1921 as the first employee of the institute, and retired as lecturer in Astronomy in September 1974.

Source: Archive of the Anton Pannekoek Institute for Astronomy, University of Amsterdam

for these astrophysical studies. The late professor Jan de Boer, founder of the Institute for Theoretical Physics of the University of Amsterdam, told me in the 1970s that in the 1920s none of the physics professors at the university taught this 'new physics'; he and his fellow students learned their atomic physics and quantum mechanics from Pannekoek. Other Amsterdam physics and chemistry professors, such as experimental physicist Frank Arnoud Muller, who had followed mathematics courses from Pannekoek, told me in the 1970s that they had very much enjoyed Pannekoek's brilliantly clear mathematics lectures.

In 1921, the university was able to support Pannekoek with a modest research budget, which allowed him to hire his first two technical staff members, the fifteen-year-old 'computers' David Koelbloed (Figure 2.5) and Hendrik Reus, who – with a three-year HBS certificate – were selected from a considerable number of candidates. With this, the Astronomical Institute of the University of Amsterdam was founded. As Pannekoek wrote in his autobiography, his aim was to establish an astronomical laboratory after the example of Kapteyn in Groningen. In such a laboratory, one carries out the reduction and theoretical interpretation of observational data taken elsewhere with telescopes, such as photographs, spectra, etc.[38]

In 1925, Pannekoek was elected to the Royal Netherlands Academy of Sciences – at that time an appointment by the queen – and was appointed associate professor. In earlier decades, the Royal Academy had supported expeditions to observe solar eclipses, because during a total solar eclipse the hot and tenuous layers of the outer atmosphere of the sun, called *chromosphere* and *corona*, become visible for the few minutes that the eclipse lasts. During these few minutes, one can take spectra and pictures of the eclipsed sun in different colours, which can later be analysed to gain important information on the physical state of the outer layers of the sun; like temperature, density, and chemical composition. Because of his new expertise on the ionization of hot gases, Pannekoek was invited to take part in the 'Eclipse Committee' of the Royal Academy, which was responsible for planning expeditions for observing future eclipses. When, in 1925, the Committee's chairman and Utrecht Professor Willem Julius died, Pannekoek was invited to become its new chairman. The first expedition was to the January 1926 total solar eclipse in Sumatra in the Dutch East Indies. Pannekoek was accompanied by solar physicist Marcel Minnaert (who in 1937 was to become the director of Utrecht Observatory), astronomer Jan van der Bilt and student Johanna Cornelia Thoden van Velzen, all from Utrecht. They

38 Pannekoek 1982, 248-249.

Figure 2.6 The solar eclipse team on Sumatra in January 1926, with soldiers of the Netherlands Indies Colonial Army

In the picture to the left of Pannekoek, Utrecht solar physicist Marcel Minnaert and to the right of Pannekoek, Utrecht PhD student Johanna Cornelia Thoden van Velzen

Source: Archive of the Anton Pannekoek Institute for Astronomy, University of Amsterdam

are all visible in the picture in Figure 2.6. Unfortunately, at the moment of the eclipse, it was cloudy, and the expedition was a failure. But Pannekoek had arranged to stay longer in Indonesia to study the Southern Milky Way, and to make drawings of it with the same care with which he had earlier mapped the Northern Milky Way. To this end, he had contacted Joan Voûte, director of the new Bosscha Observatory in Lembang (near Bandung) on Java, and had arranged for a three-month stay there, after the eclipse (Figure 2.7). The observatory, financed by tea-planter millionaire Karel Albert Rudolf Bosscha, was still being constructed at the time. A house at the observatory grounds was built especially for Pannekoek and is nowadays still called 'Rumah Pannekoek' (Indonesian for 'Pannekoek House').

During their three-month stay on Java, Pannekoek and his wife worked hard to make careful drawings of the Southern Milky Way, using his decades of experience in drawing the Northern Milky Way. The result was published in the *Annals of the Bosscha Observatory* in 1928 (the reduction

Figure 2.7 Anton Pannekoek and his wife Anna Pannekoek-Nassau Noordewier

Anton Pannekoek (standing left) and his wife Anna Pannekoek-Nassau Noordewier (sitting right) with the director Joan Voûte of the Bosscha Observatory and his wife, Frieda J.G.E. Voûte-Adloff on the veranda of the director's house, Lembang, Java, spring 1926

Source: Stichting Indisch Thee- en Familiearchief Van der Hucht c.s., courtesy of Dr Karel A. van der Hucht

of the observations had taken much time).[39] Next to manual drawings, Pannekoek also used photographic exposures to capture the star clouds in the Milky Way – taken by colleagues elsewhere, e.g. in Heidelberg, at Harvard University Observatory, and in Lembang – to unravel its structure.[40] One of the things he noticed during his studies of the Southern Milky Way was that certain parts of it were bluish in colour while others were more whitish or yellowish. He also found the clumping of blue B-type stars in certain parts of the Milky Way when he investigated their distribution using the Henry Draper Catalogue in 1929. These clumps were much less concentrated than star clusters, each clump extending over a considerable number of degrees on the sky.[41] As Groningen astronomer Adriaan Blaauw would remark

39 Pannekoek 1928.

40 See Chaokang Tai, 'The Milky Way as Optical Phenomenon', in this volume, 219-247.

41 Pannekoek 1929.

later, when he visited our Institute and saw Pannekoek's papers, this was already a hint to the existence of OB associations, which after World War II were recognized by Soviet astronomer Viktor Ambartsumian and Blaauw: expanding groups of very young massive O and B stars.

In the 1920s and 1930s, next to his Milky Way research, Pannekoek also continued his study of stellar spectra, to derive the physical conditions of stellar atmospheres. He started in 1923 with photographs of spectra that were taken in observatories elsewhere, such as Lick Observatory near San Jose, California and Dominion Astrophysical Observatory near Victoria, British Colombia. When, in 1928, Pannekoek again asked his Canadian colleague John S. Plaskett to take some more photographs of spectra for him, the answer was that he had no time to do this, but that Pannekoek was welcome to come to Victoria and take the spectra himself. Thus, Pannekoek went to Canada in 1929 for half a year to photograph spectra of a variety of stars with the 180cm reflecting telescope of the Dominion Astrophysical Observatory. As he described in his autobiography, he tremendously enjoyed this observing work with a large telescope: the beauty of the dark night sky when he was observing, the hard work after the night, the careful developing of the photographic plates of the spectra taken, etc.[42]

The spectra were analysed in Amsterdam by Pannekoek and his PhD students, and led to several PhD theses, including those of Sijtze Verweij, Gale Bruno van Albada, Theodore Walraven, and David Koelbloed.[43] The latter, after being hired as a fifteen-year-old computer in 1921, had completed a full secondary-school education in his spare time, then obtained teacher certificates for mathematics and physics, followed by an MSc, and then in the 1950s obtained his doctorate degree. He ended his career in 1974 at the age of 68, as a lecturer in astronomy. His career, with a length of 53 years in the service of the University of Amsterdam, is still an all-time record in the history of the university.

In the 1920s and 1930s, Pannekoek was the pioneer in numerically calculating the structure of stellar atmospheres, and the spectra produced by these atmospheres. This put him on the map as an international expert in the physics of stellar atmospheres and led to the invitation to co-author in 1930 the world's foremost standard astrophysics handbook, the *Handbuch der Astrophysik*, published by Springer.[44] Subsequently, he was invited by Shapley to teach at the 1935 Harvard University Astronomy Summer School.

42 Pannekoek 1982, 257-264.

43 Verweij 1936; van Albada 1945; Walraven 1848; Koelbloed 1953.

44 Pannekoek 1930.

It was a great success, and in 1936, at the tercentenary celebration of Harvard University, he was invited again and was awarded an Honorary Doctorate of this university for his pioneering works in Milky Way research and in astrophysics. In 1952, Pannekoek was awarded the Gold Medal of the Royal Astronomical Society, arguably the highest international award in astronomy.

Work after Retirement and Concluding Remarks

Pannekoek's retirement should officially have taken place in 1943, at the age of 70. But due to World War II, it was postponed until 1945. In 1946, he was succeeded by Herman Zanstra. After his retirement, he wrote his beautiful *De groei van ons wereldbeeld* ('the growth of our picture of the world'), which came out in Dutch in 1951 and, as *A History of Astronomy* in English in 1961.[45] The book was translated into English by American astronomer Priscilla Bok, the wife of Dutch-born Harvard astronomer Bart Bok, who had obtained his PhD with Professor Pieter J. van Rhijn in Groningen, the successor of Kapteyn. Bok told me in the 1970s that during his PhD work in Groningen in the late 1920s, he had wanted to go speak with Pannekoek in Amsterdam about determining stellar distances by means of 'spectroscopic parallaxes'. The ultra-conservative Van Rhijn, who knew nothing about stellar spectroscopy, thought that 'spectroscopic parallaxes' were nonsense, and forbade Bok to go speak with 'that man Pannekoek', whom he apparently hated because of his political ideas.[46] Bok told me that he nevertheless went to visit Pannekoek, whom he found to be very kind, and that he learned much from him that was useful for his PhD thesis. Bok himself was a wonderful man and a great popularizer of science. After obtaining his PhD in 1929, he obtained a position at Harvard University and worked the rest of his life in the USA and Australia.[47]

Pannekoek's *A History of Astronomy* is a special book. It not only discusses how astronomy developed, but also places this development in the context of the larger development of human societies. In Pannekoek's own words:

> When the astronomer looks back at his predecessors, he finds Babylonian priests and magicians, Greek philosophers, Mohammedan princes,

45 Pannekoek 1951; 1961.

46 In Dutch universities, a professor will normally always refer to his/her colleagues as 'colleague', never as: 'that man'.

47 For a biography of Bok, see Levy 1993.

> medieval monks, Renaissance nobles and clerics – until in the scholars of the seventeenth century he meets with modern citizens of his own kind. To all these men astronomy was not a limited branch of science but a world system interwoven with the whole of their concept of life. Not the traditional tasks of a professional guild, but the deepest problems of humanity inspired their work.[48]

This wonderful book is itself a great source of inspiration for all of those who are interested in how our science developed and for those who lecture astronomy.

Pannekoek was an unusually productive astronomer. His work on astronomy, leading to some 136 scientific publications, covers almost 70 years: from the 1888 diaries of his youth until 1957, when he published his last paper on colour differences in the Milky Way.[49] It is hard to fathom that this is indeed the work of only one man. It is even harder to believe that this man still devoted such a large part of his life to matters outside astronomy. I hope that, with this article, I have been able to convince the reader that, while Pannekoek is widely known for his political activities and contributions, he was an outstanding astronomer of the highest international calibre. And that, while to his political activities he was driven more by sense of responsibility for society and mankind, throughout his life, astronomy was his real love.

Archives

API Archive of the Anton Pannekoek Institute, University of Amsterdam.

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48 Pannekoek 1961, 13.

49 Pannekoek 1957.

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