A BRIEF HISTORY OF THE KAPTEYN ASTRONOMICAL INSTITUTE

The Institute has been named after the founder, **Jacobus Cornelius Kapteyn**, who lived from 1851 to 1922. Kapteyn was appointed professor of astronomy and theoretical mechanics in 1878 at a time when no astronomical tradition, let alone an observatory, existed in Groningen. The chair was instituted as a result of the new law on higher education of 1876, in which it was stipulated that the three government subsidized universities at Groningen, Leiden and Utrecht each should have a chair in astronomy. The latter two did have observatories and the government found it difficult to subsidize another one at Groningen (and the other two together effectively blocked this).

In order to proceed with astronomical research, Kapteyn offered his services to Sir David Gill at Cape Town. Gill had been struck by the possibility of counting and cataloguing stars on photographic plates and out of this grew the *Carte du Ciel*. But he also proceeded to photograph the southern skies. Kapteyn measured Gill's plates and this resulted in the publication of the *Cape Photographic Durchmusterung* in three volumes between 1896 and 1900. In this Durchmusterung the positions and magnitudes of 454,875 stars are catalogued.

Kapteyn's main interest was the "Structure of the Sidereal System". His first major contribution was the discovery of the two "Star Streams", announced in 1904 at the St. Louis International Exposition. He found that the space motions of "common" stars in the solar neighbourhood showed two preferential directions; later this was explained by Karl Schwarzschild as the result of an anisotropy of stellar motions in a velocity ellipsoid with unequal axes. Kapteyn spent much time on deriving the space distribution of stars from star counts over the sky. He also worried extensively about absorption of star light by interstellar material and published two papers on that in the *Astrophysical Journal* in 1909. In the end he concluded that there was no evidence for such absorption –which we now know to be incorrect– and developed methods to statistically estimate distances of stars. Towards the end of his life in 1920 with his student and succesor **Pieter van Rhijn** a rough model for the *distribution of stars in space* (Astrophysical Journal, 1920), followed by his *first attempt at a theory of the arrangement and motion of the Sidereal System* (Astrophysical Journal, 1922). In this he laid the foundations for dynamical studies by combining observed space distributions with motions and derived a first value for the density of matter in the neighbourhood of the sun. Shortly after Kapteyn's death his model of the Sidereal System with the sun near the center was superceded by a much larger model, based on Harlow Shapley's determination of the distances to globular clusters and the confirmation of the existence of interstellar absorption.

Kapteyn also pioneered international collaborations and was very successful in that; in this the necessity for him to work with plates, taken by others and measured in his "observatory without a telescope", and his anglo-saxon orientation (contrary to the German orientation so common in those days) must have been important factors in this. He became a good friend of George Ellery Hale and between 1908 and 1914 spent his summer months as research associate at the Mount Wilson Observatory in California. In 1906 he published his *Plan of Selected Areas*, in which observatories all over the world would measure positions, magnitudes, proper motions (and for the brighter part also spectral types and radial velocities) in a set of carefully chosen fields distributed over the whole sky.

Kapteyn never succeeded in establishing an observatory at Groningen. But he did secure a building for his "Astronomical Laboratory", which was opened in 1896 in a temporary location and after a few moves to its final location (in the Broerstraat in the center of Groningen next to the University's central building) in 1913. After Kapteun's retirement in 1921 and shortly before his death in 1922, the curators of Groningen University decided to name the astronomical laboratory after Kapteyn.

In 1921 Kapteyn was succeeded as professor of astronomy and director of the laboratory by his assistent **Pieter J. van Rhijn**. Van Rhijn had obtained his Ph.D. under Kapteyn in 1915. Kapteyn's first student, **Willem de Sitter** (Ph.D. thesis in 1901) had become director of Leiden Observatory and **Jan Hendrik Oort**, who had been turned to astronomy by Kapteyn, obtained his Ph.D. under van Rhijn in 1926 and also moved after a brief period in the USA to Leiden. Other students of van Rhijn, such as **Peter van de Kamp** (Ph.D. in 1926), **Bart Jan Bok** (1932) and **Adriaan Blaauw** (1946) also moved to the USA (Blaauw eventually returned).

Under van Rhijn, the Kapteyn Astronomical Laboratory remained the center for the coordination of the *Plan of Selected Areas*. **Jan Schildt**, together with **Frits Zernike** (who had earlier worked for Kapteyn) developed methods to measure steller magnitudes from photographic plates with a photometer. With this instrument the plates from Harvard Observatory for the Plan of Selected Areas were measured. The Bergedorf Observatory in Germany provided the spectral data. This resulted in the *Bergedorfer Spektraldurchmusterung*, which contained 173,599 stars. The final installment was published in 1953. This Durchmusterung has kept the Kapteyn Laboratory busy for almost 20 years and was the main activity under van Rhijn.

A new phase in the survey work started in 1953 during the first Symposium of the International Astronomical Union on *"Coordination of Galactic Research"*, held near Groningen. Due also to the presence of Walter Baade a survey of distant RR Lyrae variables was initiated as the Groningen-Palomar Survey with the Palomar 48-inch Schmidt Telescope with special emphasis on the Galactic Center. **Lucas Plaut** conducted most of this and it culminated in a publication by Oort and Plaut in 1975 in on the distance to the center of the Galaxy, the rotation constants and the structure of the inner bulge.

Van Rhijn's attempts to obtain a telescope for the Laboratory with funds from the government failed. However, in 1931 he succeeded in requiring a 55-cm reflector and a dome on the Laboratory building financed with private funds. This telescope was mainly used by van Rhijn and **Jan Borgman** for studies of interstellar reddening. In 1959 the telescope was removed because of structural difficulties with the building.

In 1957, after the retirement of van Rhijn, **Adriaan Blaauw** was appointed as professor and director. The research broadened into various other area's. **Stuart R. Pottasch** was appointed as professor of astrophysics in 1963. Under **Jan Borgman**, the Kapteyn Observatory in Roden was opened in 1965 with a 61-cm reflector. Borgman also started a working group "photometry" for space research, that first used balloons but eventually gave rise to a strong involvement in the Astronomical Netherlands Satellite (ANS; an ultraviolet and X-ray space observatory), that was used in orbit between 1974 and 1976. The Kapteyn Observatory was also heavily involved in the early development of the European Southern Observatory (ESO), eventually situated in Chile. Galactic structure remained a central area of interest. Under **Hugo van Woerden** a group was started to use the 25-meter radiotelescope at Dwingeloo for studies og the neutral hydrogen gas in the Galaxy.

In 1968 Blaauw became parttime scientific director of ESO and in 1970 Director General. Also in 1970 the Kapteyn Laboratory moved to a new location on the campus site at the northern suburb Paddepoel of Groningen. The space research working group, now called the Laboratory for Space Research) also moved from Roden to Paddepoel. The original Kapteyn Laboratory was used for some time as part of the University's central adminstrative offices, but was destroyed in a fire in the 1980s. A restructuring of the university took place, in which astronomy became a sub-faculty. **Stuart R. Pottasch** became the first dean of the sub-faculty (later chairman of the department) from 1970 to 1982.

In 1970 also the Westerbork Synthesis Radio Telescope came into operation and the radio group of the Kapteyn Institute quickly became one of the heaviest users. Especially since observations using the 21-cm line of neutral hydrogen became possible, extensive studies were made of nearby galaxies, shifting the emphasis from structure of our own Milky Way Galaxy to that of external ones. Especially the so-called flat rotation curves and the evidence these present for large quantities of unknown "dark matter" became a major subject of study. The space research group, in the mean time under the direction of **Reinder J. van Duinen**, was a major contributor to the Infra-Red Astronomical Satellite IRAS, which was launched in 1983. Borgman had in 1975 become dean of the Faculty of Mathematics and Natural Sciences, then became Rector Magnificus and subsequently chairman of the Board of Groningen University and moved in 1988 to The Hague to become chairman of the Netherlands Organisation for Scientific Research (NWO). The space research laboratory became part of the Netherlands Foundation for Space Research (SRON), financed by NWO.

In 1981, with the beginning of the Netherlands involvement in the UK/NL Isaac Newton Group of optical telescopes at La Palma (Canary Islands), the Interuniversity Working Group for Astronomical Instrumentation was founded in Roden with personnel from Groningen and Leiden Universities. The Working Group was transferred to the Radio Observatory in Dwingeloo in 1995 and the observatory at Roden was closed. In 1983 the Kapteyn Astronomical Institute moved to its present location in the Zernike Building.

In 1982, Pottasch was succeeded by **Ronald J. Allen** as chairman of the department and this position was held by **Hugo van Woerden** from 1985 to 1991 and by **Pieter C. van der Kruit** from 1991 to 1994. In 1994, van der Kruit became dean of the Faculty of Mathematics and natural Sciences until the end of 1997. In 1992, the Netherlands astronomical institutes formed together the Netherlands Research School for Astronomy (NOVA) and were recognized as such by the Royal Netherlands Academy of Arts and Sciences. In 1994 the astronomy department was formally recognized by Groningen University as a research institute and renamed the Kapteyn Astronomical Institute. **Tjeerd S. van Albada** became the scientific director, succeeded in 1998 by **Pieter C. van der Kruit**. In 1998, the Minister of Education, Culture and Science organized an "bonus incentives" (dieptestrategie) program, in which the over 100 research schools in the Netherlands could compete for recognition as top research school and obtain considerable addition funding for a ten-year period. NOVA came out as number one in this nation-wide competition, in which only six were awarded the status top research school.

Literature:

- *Kapteyn, zijn Leven en Werken*, 1928, biography of Kapteyn by his daughter Henrietta Herzsprung-Kapteyn. Translated into English by Robert E. Paul as *The Life*

and Works of J.C. Kapteyn, published by Kluwer Academic Publishers, 1993, originally in Space Science Reviews, vol. **64** (translation is often unreliable).

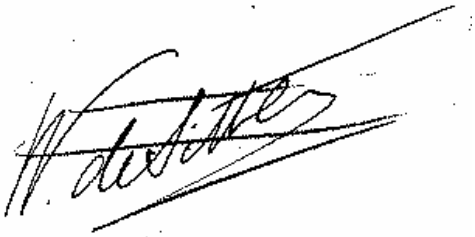
- *Jacobus Cornelius Kapteyn*, 1973, short biography of Kapteyn by A. Blaauw in Dictionary of Scientific Biography (ed. C.C. Gillispie).
- *Sterrenkijken Bekeken; Sterrenkunde aan de Groningse Universiteit vanaf 1914*, 1983, publication of the Groningen University Museum (eds. A. Blaauw, J.A de Boer, E. Dekker and J. Schuller tot Peursum-Meijer).
- *The Legacy of J.C. Kapteyn; Studies on Kapteyn and the Development of Modern Astronomy*, 2000, proceedings of a symposium on Kapteyn (eds. P.C. van der Kruit and K. van Berkel).

P.C. van der Kruit

Figure 1: Painting of J.C. Kapteyn at his desk by Jan Veth. This painting dates from 1918 and was made at the occassion of his 40-th anniversary as professor in Groningen. On the wall behind Kapteyn a picture of Sir David Gill can be seen. The painting now resides in the Kapteyn Room in the Kapteyn Astronomical Institute

Figure 2: This picture of Kapteyn was made at the Monastery (the residence of visiting astronomers) at the Mount Wilson Observatory during one of Kapteyn's annual visits in 1908. Kapteyn is holding a copy of the literary magazine *"The Dial"*. This picture has been supplied by Dr. T.D. Kinman, courtesy of the Observatories of the carnegie Institution of Washington.

Figure 3: This painting of Kapteyn, made at about the time of his retirement, hangs in the Senate Room of the University of Groningen. The walls of the Senate Room is covered with paintings of the most prominent scientists of Groningen University, all dressed in the formal gowns.



THE CAPE PHOTOGRAPHIC DURCHMUSTERUNG

FOR THE EQUINOX

1875,

BY

DAVID GILL, LL.D. (Abd. & Edin.), F.R.S., &c.,
HER MAJESTY'S ASTRONOMER AT THE CAPE,

AND

J. C. KAPTEYN, Sc.D., &c.,
PROFESSOR OF ASTRONOMY AT GRONINGEN.

PART I.

ZONES -18° TO -37°.

Figure 4: The title page of the first volume of the *Cape Photographic Durchmusterung*. The page shown here is from one of the copies of the CPD in the library of the Kapteyn Astronomical Institute. The signature of Willem de Sitter has been crossed out; it presumably has been de Sitter's private copy.

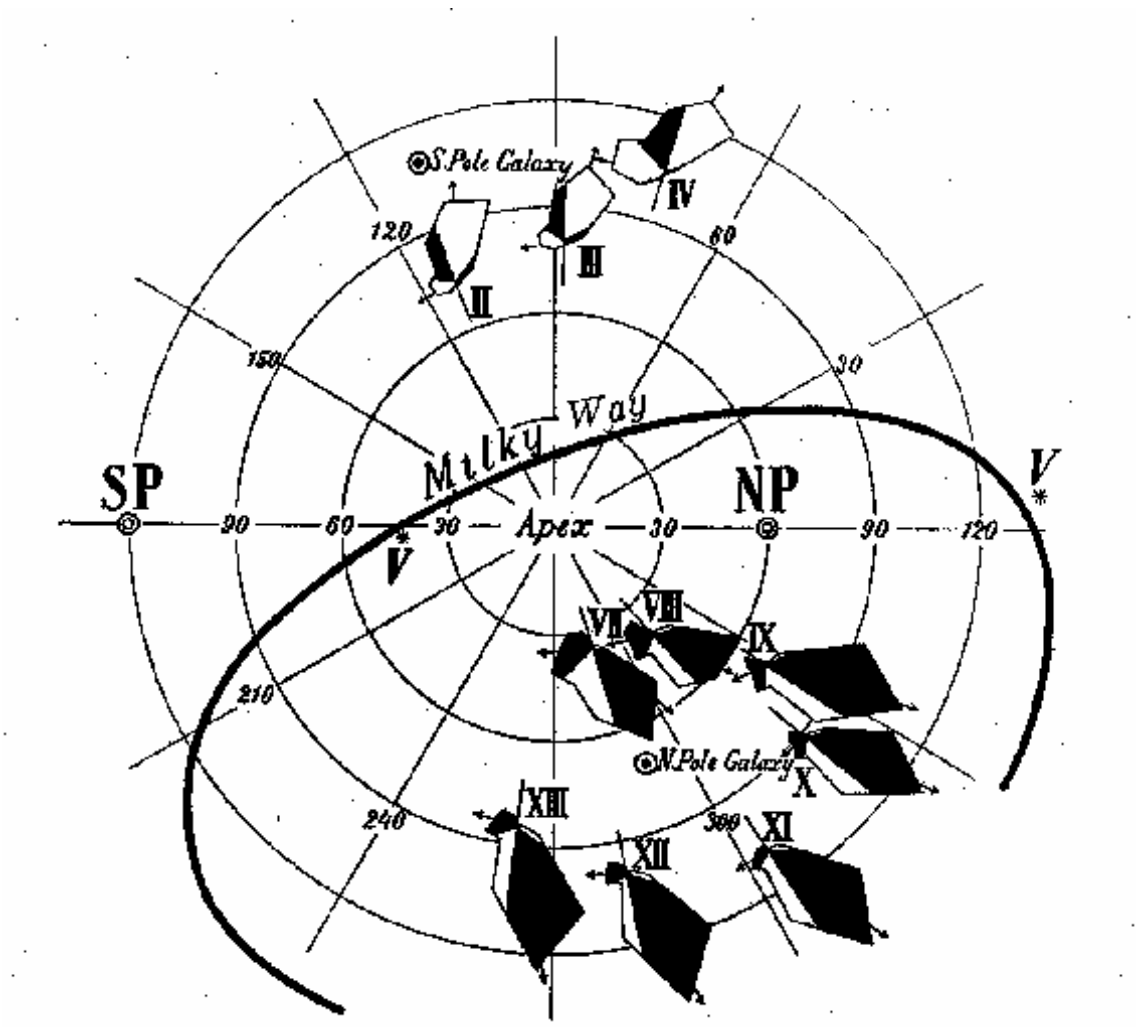
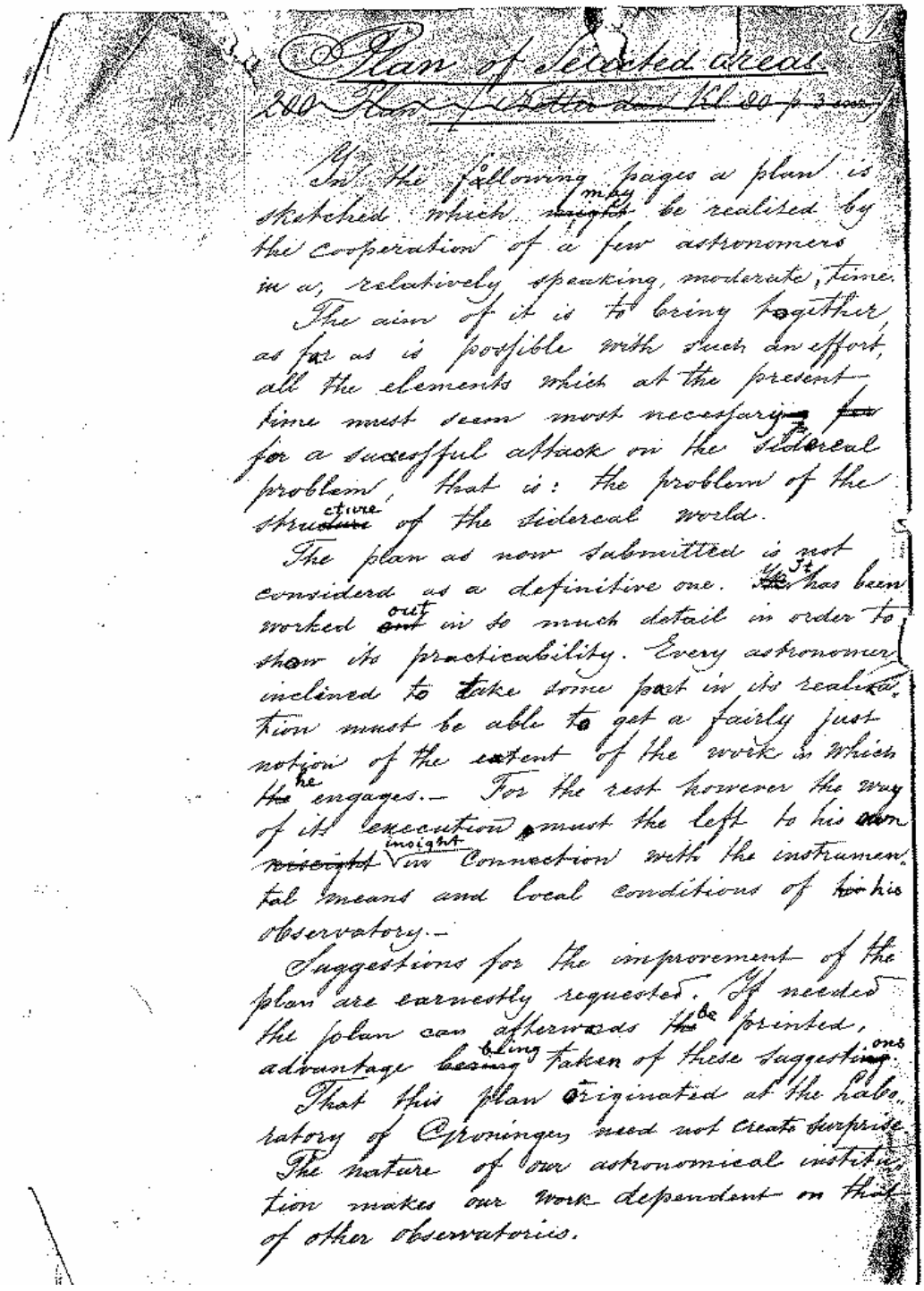


Figure 5: Kapteyn's illustration of his two Star Streams (1904). At only a selection of the regions for which he had data (10 of the available 28), he plots the distribution of proper motions on the sky. If there were no preferential streamings each distribution would be round, but Kapteyn found these distributions to be asymmetrical and to point to an apex in the middle of the figure. The systematic behaviour across the sky is evidence for two Star Streams. It was soon shown by K. Schwarzschild that the pattern could in an alternative, but much more physical manner be explained as an anisotropy in the distribution of the stellar velocities.



Plan of selected areas.

In the following pages a plan is sketched which may be realised by the cooperation of a few astronomers in a relatively speaking, moderate, time.

The aim of it is to bring together, as far as is possible with such an effort, all the elements which at the present time must seem most necessary for a successful attack on the sidereal problem, that is: the problem of the structure of the sidereal world.

The plan as now submitted is not considered as a definitive one. It has been worked out in so much detail in order to show its practicability. Every astronomer inclined to take some part in its realisation must be able to get a fairly just notion of the extent of the work in which he engages.— For the rest however the way of its execution must the left to his own insight in connection with the instrumental means and local conditions of his observatory.—

Suggestions for the improvement of the plan are earnestly requested. If needed the plan can afterwards be printed, advantage being taken of these suggestions.

That this plan originated at the Laboratory of Groningen need not create surprise. The nature of our astronomical institution makes our work dependent on that of other observatories.

Figure 6: First page of a manuscript (undated) by Kapteyn for the *"Plan of Selected Areas"*. At the bottom he says: *"Suggestions for the improvement of the plan are earnestly requested. If needed the plan can afterwards be printed, advantage being taken of these suggestions. That this plan originated at the Laboratory in Groningen need not create surprise. The nature of our astronomical institution makes our work dependent on that of other observatories."* This manuscript resides in the Kapteyn Room at the Kapteyn Astronomical Institute.

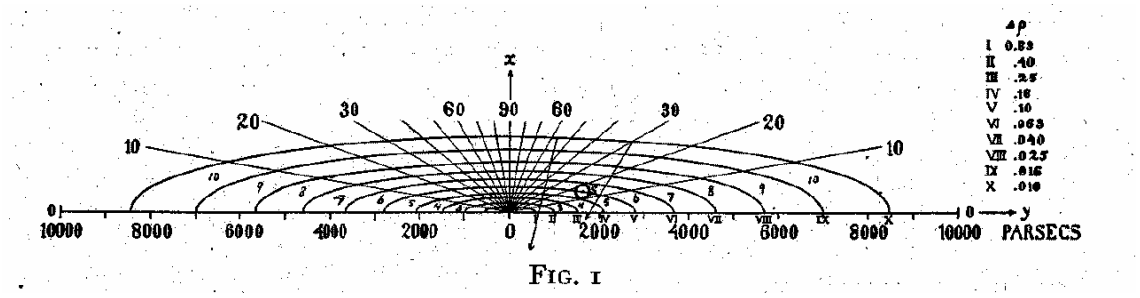
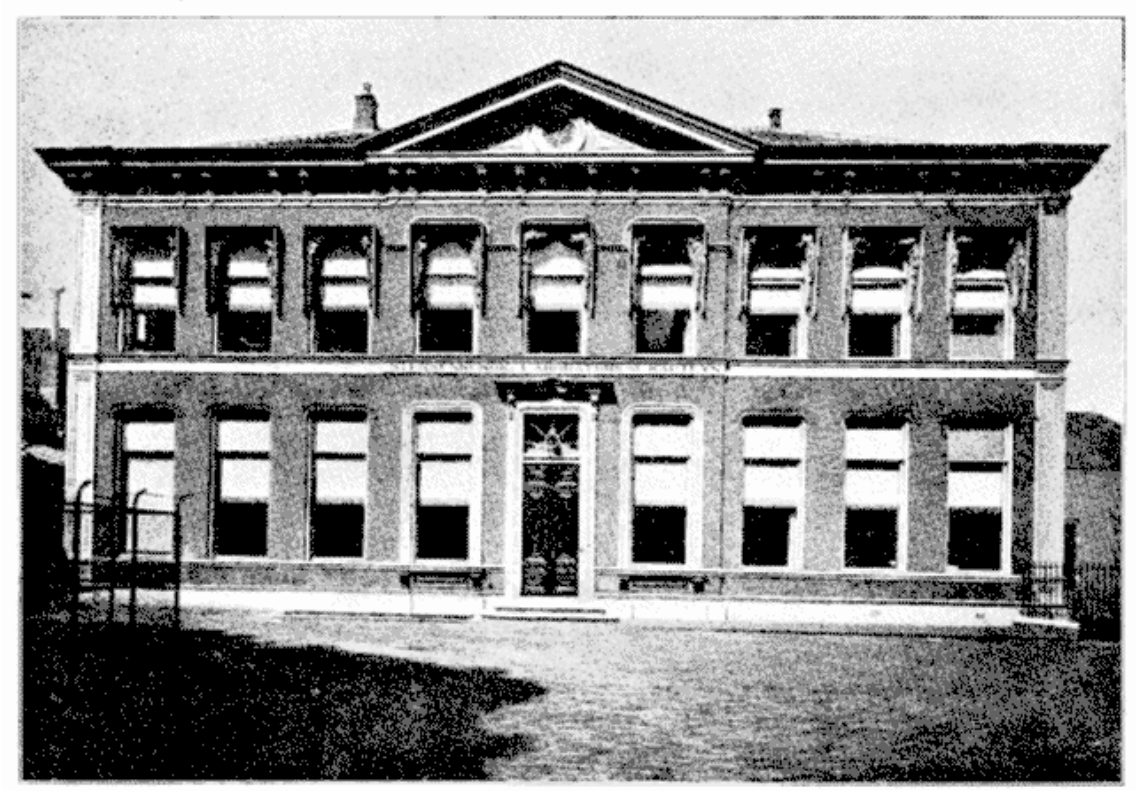


FIG. 1

Figure 7: Kapteyn's Universe, consisting of a set of concentric ellipsoids. The numbers on the right (0.63, 0.40, 0.25, 0.16, 0.10, etc.) show the density at the surfaces of the ellipsoids in units of the central density, which is taken to be the density of stars near the sun, and this was determined as 0.045 stars per pc^3. The circle labeled "S" indicates the position of the sun; this is located on ellipsoid 5, where the density is one-thenth of the central value. From Kapteyn (1922).



Sterrenkundig Laboratorium Kapteyn.

Figure 8: The original Kapteyn Astronomical Laboratory at the Broerstraat in the center of Groningen. This picture has been taken around 1920.

Figure 9: This memorial tablet is located at the front the house, where the Kapteyns from 1910 to 1918 on the Ossenmarkt 6. This tablet was unveiled during the Kapteyn Legacy Symposium in June 1999 by three of his great-great-grandchildren. The text reads: *Here lived and worked, 1910 – 1918, Professor Jacobus Cornelius Kapteyn, inspiring Groningen astronomer. "Quand on n'a pas ce qui qu'on aime, il faut aimer ce qu'on a"* (When one has not what one loves, one has to love what one has). *January 19, 1851 – June 18, 1922.*

Figure 10: Overview of the Kapteyn Room at the Kapteyn Astronomical Institute. The picture shows in the back Kapteyn's desk and globes, the painting by Jan Veth, and a pendulum at the right.

Figure 11: This picture of the Kapteyn Room on the left the cabinet that stores the documents from Kapteyn, van Rhijn, Blaauw and Plaut. On the table, the *"Red Table"* and the *"Crelle"*. On the wall, Adriaan Blaauw painted by M. Röling.

Figure 12: Kapteyn's desk with a sample of the *"Kladboeken"*, that Kapteyn used to make notes, do calculations and draft letters and papers, and more of these in the book-rack below the painting.

Figure 13: The cabinet showing on the bottom shelf of the middle section the series of bound volumes with the Laboratory Publications, and on the middle shelf two boxes with letters from Gill to Kapteyn.

Figure 14: On the left we see the copy of the CPD that Kapteyn dedicated to his wife. Next to these the four volumes containing the reprints of Kapteyn's publications and the volumes III to VII of the various hand-written tables.

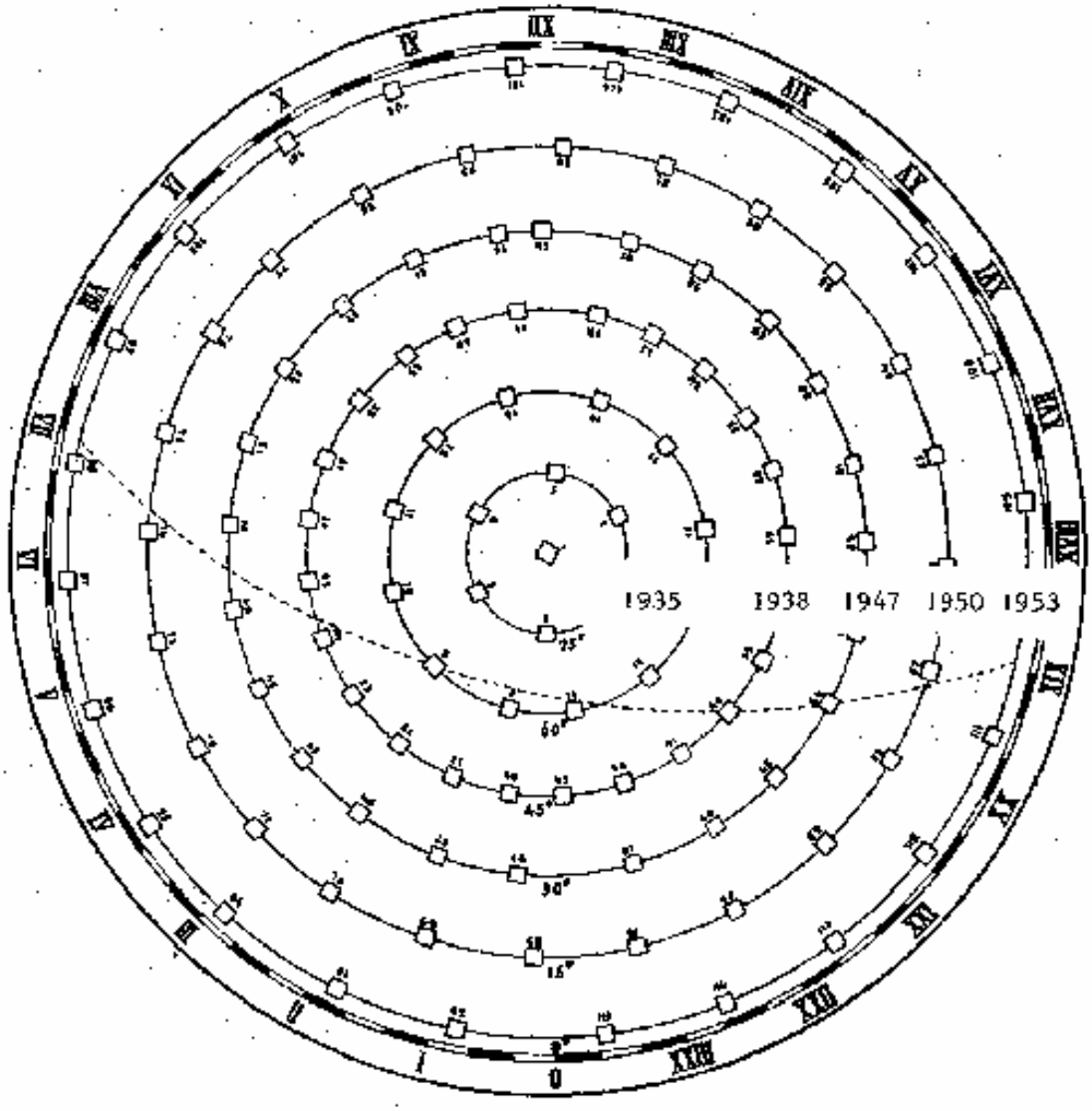


Figure 15: The distribution of the Selected Area's in the Northern Hemisphere. The *Bergedorfer Spektral Durchmusterung*, which contains for each of 173,599 stars a magnitude and spectral class, for each zone was completed in the years as indicated. The necessary measurements of the plates were for a large part performed at the Kapteyn Astronomical Laboratory under van Rhijn's directorschip. The dashed line indicates the plane of the Milky Way.

Figure 16: Prof. Adriaan Blaauw, third director of the Kapteyn Astronomical Laboratory is seen here giving a presentation in the Senate Room of the University of Groningen during the Symposium on Kapteyn's legacy in 1999.

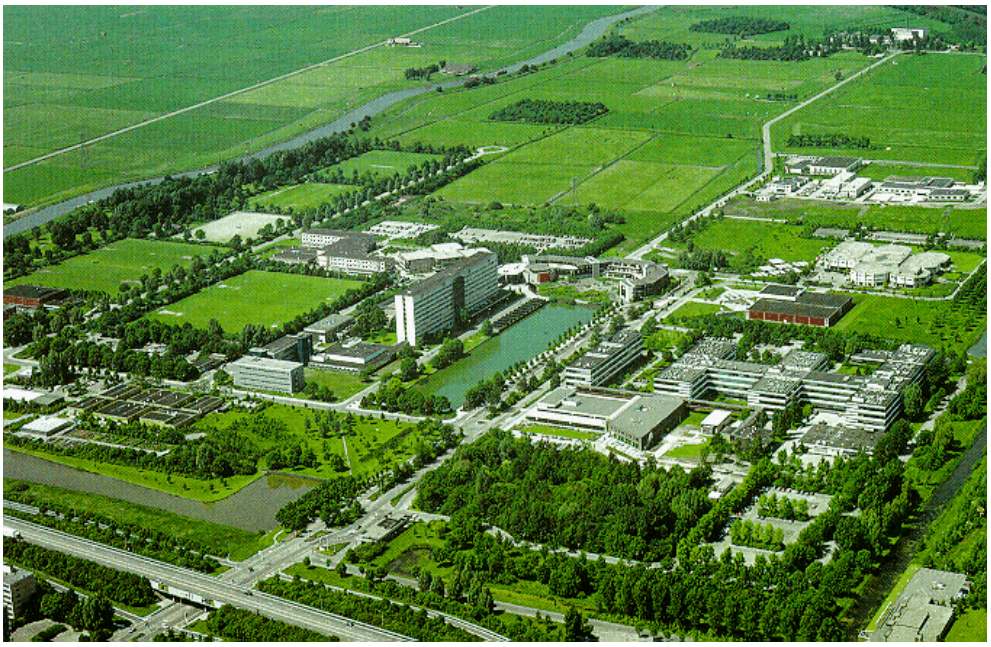


Figure 17: This areal photograph shows the Zernike Complex near the Paddepoel suburb at the northern side of the city of Groningen. The tall building just to the left of the middle and the large rectangular pond is the "Hoogbouw WSN", where the Kapteyn Astronomical Laboratory was housed on the third floor between 1970 and 1983. The Laboratory for Space Research was located on the second floor.

Figure 18: The "Zernike Building", where the Kapteyn Astronomical Institute is now housed on the first and partly second floor. The Laboratory for Space Research occupies the ground floor. The Zernike Building can also be seen in the previous picture just above the large pond. This picture was taken from the roof of the Hoogbouw WSN.