Telescopes from Leiden Observatory and other collections 1656 – 1859

A Descriptive Catalogue

Huib J. Zuidervaart

LEIDEN OBSERVATORY

Telescopes from Leiden Observatory and other collections 1656 – 1859

A Descriptive Catalogue

Huib J. Zuidervaart

Leiden 2007
Museum Boerhaave Communication 320

Contents

Foreword

This seventh catalogue in the series of Museum Boerhaave collections features the telescope. It arrives at an opportune moment: in the run-up to the festive commemoration of the fact that on 25 September 1608 Hans Lipperhey, spectacle maker of Middelburg, applied for a patent on the telescope. Museum Boerhaave has an extensive and extremely valuable collection of telescopes. They reflect the high level at which astronomy was pursued in the Netherlands by pioneers such as Christiaan Huygens and Frederik Kaiser.

The collection contains telescopes of the best known telescope makers of Dutch (Huygens, Hartsoeker, Marcel, Van Musschenbroek), Frisian (Van der Bildt, Foppes, Rienks,), English (Short, Dollond) and German (Fraunhofer, Merz, Steinheil) origin. Highlights include the lenses of Constantijn and Christiaan Huygens, one of Hearne's oldest reflecting telescopes and the earliest Dutch achromatic lens telescope of Van Deijl. But the collection is much broader and the strength of this catalogue can be found in its completeness. We hope that this book will find its way to science historians, cultural historians, specialists and collectors.

The introduction and the descriptions that follow are from the hand of Huib Zuidervaart, former staff member of our museum, nowadays employed by the Huygens Institute for the History of Literature, Science and Scholarship of the Royal Netherlands Academy of Sciences. His point of departure was the Engberts catalogue of 1970 (Communication No. 138 of the Rijksmuseum voor de Geschiedenis der Natuurwetenschappen, renamed Museum Boerhaave in 1976). We are very grateful to Zuidervaart for his efforts. Support from the Museum Boerhaave information centre came from Mara Scheelings, Maaike van Rossum and Gerdine van der Dool. The photography was provided by Tom Haartsen, assisted by staff of the Museum Boerhaave restoration department. The coordination of the production of this book was in the hands of Hans Hooijmaijers, curator at Museum Boerhaave.

Dirk van Delft
Director

Introduction

1 The refracting telescope: its emergence as a scientific instrument

At the end of September 1608 the Dutch spectacle maker Hans Lipperhey travelled from Middelburg, a city in the province of Zeeland, to The Hague in order to apply to the States General, then the sovereign body of the Dutch Republic, for a patent concerning 'a certain instrument for seeing far'. As the priority of his discovery was disputed, in the end no patent was granted.[1] Nevertheless, Lipperhey's application is the oldest known record anywhere in the world of an actual and usable telescope.[2] During his stay in The Hague he demonstrated the telescope to Prince Maurits of Orange and several court officials. At the time the city of The Hague was hosting a peace conference, held between the representatives of the young Dutch Republic and the Spanish government from which it had been fighting for its independence. The city was teeming with European diplomats, so news of the demonstration of the new strategic 'spyglass' spread throughout Europe like wildfire. The demonstration in The Hague was recorded in a French pamphlet published in October 1608, and the unknown author of the text pointed out both the strategic military use of the instrument and its potential astronomical usefulness. As a result, within less than six months of its first demonstration, the telescope was in the possession of the main European authorities: there was at least one telescope at the States General; another was held by Prince Maurits, their commander-in-chief; a third and a fourth had been sent to the French King and his prime minister; another instrument was in the hands of Archduke Albertus, governor of the Southern Spanish Netherlands, and even the Pope in Rome had received a telescope, a gift from one of the Vatican diplomats. The importance of the invention was thus recognized very quickly. And the significance of the instrument was confirmed and increased when, starting in late 1609, Galileo Gallilei used such a telescope of 'Dutch design' for his astronomical discoveries, of which the satellites of Jupiter are the most famous. Now the telescope was also a major tool for astronomy. A real 'philosophical' instrument was born.

Although the Low Countries may boast of being the cradle of the telescope, remarkably enough the Dutch Republic played virtually no role in its subsequent development during the first half of the seventeenth century. To be sure, there were some Dutch constructors of telescopes and some Dutch scholars studied or used the instrument, but

it seems that the instrument was used only rarely for astronomical purposes.[3,4] Not until the second half of the century were contributions to the development of the telescope made by Dutch scholars: the brothers Christiaan and Constantijn Huygens made some of the best telescopes in Europe, while Christiaan elucidated the optics of the instrument. Christiaan's most celebrated discovery was the true nature of Saturn's rings.[5]

This low profile of telescope use in the seventeenth century Netherlands is reflected in the collection described here. The National Museum for the History of Science in the Netherlands (later called 'Museum Boerhaave') has been collecting specimens of telescopes, for astronomical, terrestrial and maritime use, since its founding years, 1926-1931. The main body of this collection was acquired in 1931, when the obsolete instruments of Leiden Observatory were given into the custody of the Museum. A very important part of this acquisition was the collection of Huygens artefacts, including the many telescope lenses produced by (or for) the brothers Huygens. Almost all these objects had been bequeathed to Leiden University as historical relics in 1809.
The rest of the collection presented a puzzling picture: all the other telescopes seemed to have been constructed in the eighteenth century and after. Apart from the Huygens objects, almost a century of telescope development seemed to have vanished. This raised the question: what had happened to the seventeenth-century telescopes used in the Netherlands? Why were all these relics lost? What circumstances determined which historical instruments survived the centuries and which did not?
Any answer needed a thorough investigation of the provenance and history of the instruments: both the preserved telescopes and those that had been lost (see appendix). In practise this meant that we were limited almost entirely to a study of the use of the telescope as an observational instrument within the context of Leiden Observatory. In the first place this is by far the greater part of the Boerhaave collection of telescopes and, secondly, it appeared that most other telescopes in the collection have no – or only short – provenance. So only Leiden University provided the necessary inventories and other archival material connected with the lost and preserved telescopes. Consequently, in this introduction we have chosen to illustrate the internal development and use of the telescope as an observational key instrument, by sketching the history of the telescopic equipment at Leiden Observatory.

2 Refracting telescopes at Leiden Observatory, 1669-1730

2.1 The founding of an Astronomical Observatory

Leiden University was founded in 1575, just a few years after the onset of the struggle for independence of the Northern Netherlands. Its founding provided an answer to the need of the new 'Republic of the Seven United Provinces' to meet the intellectual demand for well-trained protestant theologians as well as skilled medical doctors. However, according to the medieval academic tradition, right from the start Leiden University also provided academic instruction in other fields, such as philosophy and mathematics.[6]
It was probably Leiden's second mathematics professor, Willebrord Snel van Royen (1580-1626), better known by his Latinised name 'Snellius', who introduced mathematical instruments at the University. Some time before his appointment, during a 'Grand Tour' in the years 1600-1601, Snellius had spent some time in Prague with the astronomers Tycho Brahe and Johannes Kepler. This intellectual contact appeared to be of major importance for his development as a practical mathematician. In Prague Snellius had probably seen one of the large quadrants that had made Tycho Brahe famous as an astronomer. With such a large quadrant one could measure the coordinates of an astronomical object with the accuracy of a fraction of a degree, using the (naked-eye) sights designed by Brahe.
On his return to the Netherlands, probably in about 1610, Snellius ordered a similar large quadrant from the Amsterdam cartographer, publisher and instrument maker Willem Jansz, who would later call himself by the surname 'Blaeu'. This artisan was indeed fit for the job, for Blaeu too had spent some time with Brahe, on which occasion he had probably learned the craft of making astronomical instruments. After 1613, when Snellius was appointed to the Leiden chair of mathematics, he used his large iron quadrant intensively. In the years that followed Snellius undertook a huge geodetic survey, establishing a standard triangulation network between the major cities of the province Holland, being the first of its kind in the Netherlands. In this process he used his large quadrant to determine astronomical coordinates. With these results he was able to determine the length of the Earth's circumsphere, a result he published in 1617 in the book *Erathosthenes Batavus*, a title that referred to the old Greek scholar who had established this value for the first time. With this performance Snellius raised the art of surveying in the Netherlands to a much higher level. A surveying instrument developed in the process (the 'Hollandsche Cirkel' or Dutch circle) remained the standard equipment

for Dutch surveyors for more than a century.[7] Snellius tried to enhance his geodetic achievements up to his death in 1626. In his ambition to obtain a higher degree of accuracy Snellius ordered from Willem Jansz Blaeu a new, probably more accurate quadrant, made of wood and brass. It was this second quadrant that would initiate the establishment of the Leiden astronomical observatory. For after Snellius's death Jacob Gool, professor of oriental languages, who would become his successor in the mathematics' chair, bought the two large quadrants from Snellius's heirs.[8] In 1632 Golius sold the second wooden quadrant to Leiden University.[9] As the use of such a large astronomical quadrant required a proper housing, a rectangular platform and a small octagonal turret were constructed on the roof of the main university building. The structure with the name 'Observatorium' stands out proudly on a city map printed in the 1640s.[10]

2.2 The use of telescopes at Leiden Observatory during the seventeenth century

In the early decades of its existence hardly any observations were collected at this astronomical observatory. This had everything to do with the fact that at the time a university was a place devoted solely to theoretical instruction. Practical research was virtually non-existent. As a consequence, the Leiden astronomical observatory was first and foremost a place for the demonstration of theoretical astronomy. It was a 'Demonstratorium' rather than an 'Observatorium' in any modern sense. Observations – mostly of eclipses – served primarily as a tool for checking the theory of calculations. Consequently, a quadrant was a necessary and useful instrument, worth the investment, but telescopes were not. It is even questionable whether telescopes were used at all at the observatory before the middle of the century. This had everything to do with the optical properties of the telescope in the early decades of its existence, especially the poor quality of the available glass. Air bubbles and other impurities, which had played only a minor role in the production of simple eyeglasses or spectacles, posed a severe problem in the performance of telescopes. Whereas a spectacle lens needed only an appropriate curvature in the area of the pupil of the eye, a telescope objective demanded uniform properties over the entire area of the aperture. The telescope also required a precise alignment of the lenses along its optical axis. These requirements made the construction of a telescope quite difficult for many decades after its 'invention'. Moreover, telescopes used only for astronomical purposes (having two convex lenses) produced an upside down image, a feature that made them quite impractical for terrestrial use. But 'Dutch telescopes' (having a convex objective and a concave ocular) had such a limited field of view, that only observers blessed with a firm hand, a sharp eye and great expertise, could benefit from the use of these telescopes. This situation changed rapidly in the second half of the seventeenth century. More adequate purifying techniques produced more homogeneous glass with fewer air bubbles, and the parallel development of the compound eyepiece with a field lens resulted in a much larger field of view for terrestrial use. It made the telescope a much more useful instrument. These developments also stimulated the acceptance of the results the instrument produced.[11]

Consequently, when Christaan Melder succeeded the late Jacobus Golius in 1669, it made sense to replace the naked-eye sight of the large quadrant with a telescopic sight. By then, the telescope had matured into a useful piece of equipment for astronomy. Nevertheless, for quite some time this telescope (whose tube can still be seen attached to the quadrant in Museum Boerhaave) remained the only telescope owned by the Observatory. Other telescopes used on the platform at the observatory were, as was customary at the time, the private property of the university professor. Just as a carpenter had to bring his own tools to a job, likewise a university professor was expected to provide the necessary 'tools' for instruction. A glimpse of these privately owned instruments used by the various mathematics professors can be gained from the surviving catalogues of the auctions of their private libraries. During the seventeenth century it became standard practice for curiosities collected by the owners of the libraries – such as scientific instruments – to be sold at the end of every auction. By chance some of these catalogues have survived, allowing us to reconstruct the increasing use of telescopes at Leiden Observatory in the course of the seventeenth century.

2.3 Telescopes in the private possession of Leiden University professors

Almost from the very beginning the telescope was known in Leiden University circles. In as early as 1610 Snellius corresponded with a friend abroad about the optical properties of the telescope.[12] But, as we have said before, in the early decades of its existence the telescope was more a curiosity than a practical instrument. So, in 1628, a scholar visiting Leiden could find a 'glass for seeing far' in a local curiosity cabinet, but when a year later the instruments of Snellius were auctioned, amongst his assets one would search in vain for a telescope.[13] As an instrument

used in 'natural philosophy' the telescope remained a rarity well into the seventeenth century, even among mathematicians whose interest in astronomy was beyond any doubt.[14] It was not until 1644 that a telescope was mentioned in an inventory drawn up by a Leiden public notary.[15] This small instrument had belonged to a university student. The first time we come across a Leiden University professor with a small telescope in his cabinet was in 1661, when the estate of Adriaan Heereboord, professor of philosophy, was auctioned.[16] Ten years later another telescope was in the possession of Florentius Schuyl, professor of medicine and botany.[17] His colleague Franciscus de le Boë Sylvius, also professor of medicine, who died in 1673, actually owned three large telescopes, stored in the attic of his house on the Rapenburg, suggesting he had used them for astronomical purposes.[18]
As was to be expected, astronomical telescopes also appeared in the auction catalogues of Golius, the founder of the Leiden Observatory, and his assistant Samuel Carolus Kechel ab Hollensteyn. Both libraries were sold in 1668. Amongst the 40 or so mathematical and philosophical instruments Golius's heirs put up for auction there were two telescopes.[19] Kechel, who had in fact been the most ardent observer at the Leiden observatory, possessed twice as many. Amongst Kechel's 122 mathematical instruments there were four telescopes, the largest one having a length of twelve feet (= c. 3.7 m).[20,21] A similar number of telescopes is mentioned in the 1682 catalogue of Christiaan Melder, who served as the mathematics professor in charge of the Observatory between 1668 and 1682.[22]
A striking fact concerning the telescopes of both Kechel and Melder is that in the inventories the telescope tubes were mentioned separately from their glasses, suggesting the practice of assembling the telescopes each time the instruments were used. In later years this would become the standard procedure at Leiden Observatory, and this probably is the reason why most old telescope objectives were engraved with their focal length.
On Melder's death it also appeared that the few astronomical instruments the university had paid for had been stored at Melder's home, mixed in with his own instruments. This commingling of private and university property led to problems with Melder's widow, who refused to give the university instruments to Burchard de Volder, Melder's successor. In conclusion therefore we can state as a fact that most telescopes used at Leiden Observatory in the seventeenth century were in the private possession of the academic professors.

2.4 The introduction of very long telescopes

The arrival of De Volder sees the start of another chapter in the history of the telescope at Leiden Observatory. Just like his predecessor had done shortly after his appointment, he too asked the board of the university for some investment in the Observatory's equipment. One of the desired new items concerned the erection of a 'mast, on which the large telescopes could rest'. Another was 'a stand for the largest telescope'.[23]
With these 'large telescopes' De Volder was referring to a further important development that had taken place in the second half of the seventeenth century, the trend towards increasing magnification of the astronomical telescopes. Years of experience had taught optical instrument makers that spherical and chromatical aberration was minimized if these lenses were ground to a very shallow curvature. This requirement resulted in very long focal distances. Consequently, telescopes with very long tubes dominated the European observatories in the final quarter of the seventeenth century. Drawings made in the early eighteenth century confirm the fact that such lengthy telescope tubes were used at Leiden Observatory. In pictures one can see the observatory platform at the top of the main university building, provided with large masts evidently used for the occasional erection of long telescopes (see fig.1).[24]

But how many of these telescopes were used at the Observatory? This question is not easy to answer. The first inventory of instruments owned by Leiden Observatory was made by De Volder in 1706. But scanning this list of 15 instruments we only come across *one* telescope, having a rather modest length of 12 feet, the other instruments being a quadrant and a sextant, a few globes, two timekeepers and some smaller items. Amongst these latter, there were an object glass for an aerial telescope of 50 feet (= c. 15 m), a second object glass for a telescope of 18 feet (= c. 5.5 m) and a few eyeglasses (see appendix nos. 8, 20 and 21). Was this all? Were there perhaps more telescopes in De Volder's private collection? Strangely enough there were not. De Volder's own collection of instruments, auctioned only three years later, contained only *two* telescopes: a small one and a 'Moon-telescope' with its large 'pedestal'.[25] But could it be that in the years 1706-1709 there were only *three* to *five* telescopes available at the Leiden Observatory? The answer is a clearly 'no'. In the first place it is evident from testimonies and inventories from a later date that De Volder's inventory did not specify all the instruments available. In 1711 for instance Baron von Uffenbach gave an extensive description of the Observatory in his travel diary. In a room in the attic he had seen 'several old tubes' of telescopes. Analyses of all the

remaining inventories of the observatory indeed suggest that at the turn of the century there were at least *eight* telescopes present. These inventories also reveal the habit of storing the large telescopes in pieces: the long tubes were stored in the upper attic of the former convent and the lenses were kept in a cupboard elsewhere. So apparently a large telescope was assembled on the spot, each time an observation was made.

Another factor explaining the small number of telescopes was the fact that at the turn of the century a second astronomer was using the Observatory. This private scholar, Lotharius Zumbach de Koesfeld, a 'silent but polite' man, possessed a large number of telescopes. From 1685 till 1688 he had been court mathematician and musician of Maximiliaan Heinrich, the Elector of Trier. In 1688 Zumbach had come to Leiden to study medicine, in which subject he received a degree in 1693. During those years Lotharius earned his money as a private teacher of mathematics and astronomy with quite a reputation, although his efforts to obtain an official university position failed twice.[26,27] However, De Volder, whose attention was fixed on the 'new' field of experimental physics rather than 'old' astronomy, allowed Zumbach use of the observatory. This status became official in 1706, when De Volder resigned for reasons of health and Lotharius received permission to use the observatory on his own authority. It was on this occasion that De Volder drew up his inventories, both for the observatory and the physics cabinet.[28] The university curators granted Zumbach permission to have all the astronomical instruments cleaned and repaired. For the continuation of his 'studium astronomium' he was also allowed to erect a larger mast for the 'telescopium' – this time having a height of about 40 to 50 feet – with 'its tin pair of compasses and a wooden spout'.[29] However, as Zumbach was again passed over for an official appointment at Leiden University, he tried his luck elsewhere and with success. In November 1707 he was appointed professor of astronomy to the Landgrave of Hesse in Kassel, and so Zumbach left Leiden Observatory and his personal collection of telescopes went with him. These 'beautiful' telescopes were observed by Baron von Uffenbach, who visited Zumbach shortly after his arrival in Kassel.[30] It is interesting to note that Zumbach used large object glasses in Kassel in a way he had probably learned at Leiden Observatory. In about 1690, after Christiaan Huygens had returned to the Netherlands from Paris, Leiden Observatory had received a Hugenian aerial telescope.[31] The design for such a 'tubeless telescope', published in Huygens' 1684 *Astroscopia Compendiaria*, was also adopted by others, like Nicolaas Hartsoeker, whose 50-feet object glass had also been present at Leiden Observatory. According to Uffenbach's description, at Kassel Zumbach used precisely this 'tube less' arrangement. A year after his visit to Kassel Observatory Von Uffenbach also went to Leiden. According to his travel diary he seemed quite enthusiastic about the facility:

> 'Most important is the Observatory, on the roof of the *Collegio*, which is quite spacious and good. From the gallery one can view the entire city. There are two turrets here. In the first one there is a very nice and large sextant, made by the mathematician Me[t]z at Amsterdam [...] It looks very good and very accurate. In the other turret there is a quadrant, of which it is said [...] that it is made by the famous Blaeu. The roofs of the turrets are made in a very clever way, both being able to turn around [...] In another room there were some instruments, among which some telescope tubes [...] and this small telescope stand on which the backward end of a telescope tube can be laid to rest. In that position the tube can move very smoothly to all sides [...] with such a continuous and gentle movement, that the observed object always stays in front of the tube' (see fig. 2).[32]

Full of enthusiasm, Von Uffenbach went to Jacques Bernard, the newly appointed lector of philosophy and mathematics, but it did not escape Von Uffenbach's critical attention that this scholar possessed neither any traceable interest nor any skills in astronomy.[33] Owing to Bernard's

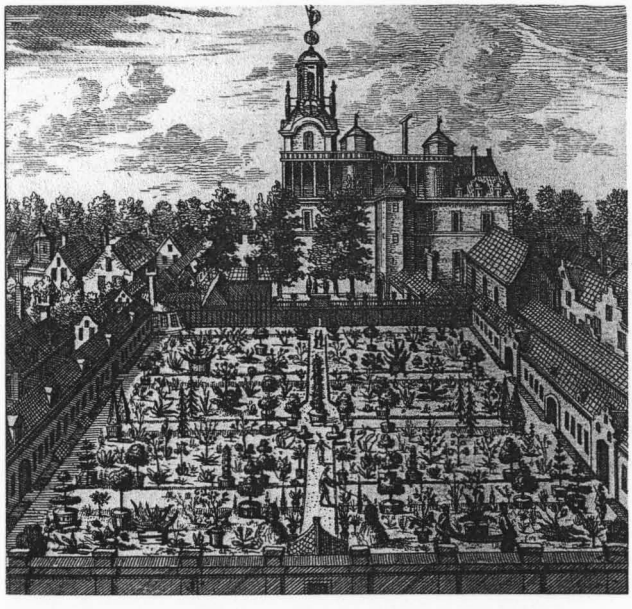


Fig. 1

Leiden Observatory around 1700. On the roof of the Academy Building a wooden platform was constructed, with two movable domes for the housing of astronomical instruments. In the middle of the platform a large mast was erected as support for a long refracting telescope.

Fragment of an engraving from Van der Aa 1712

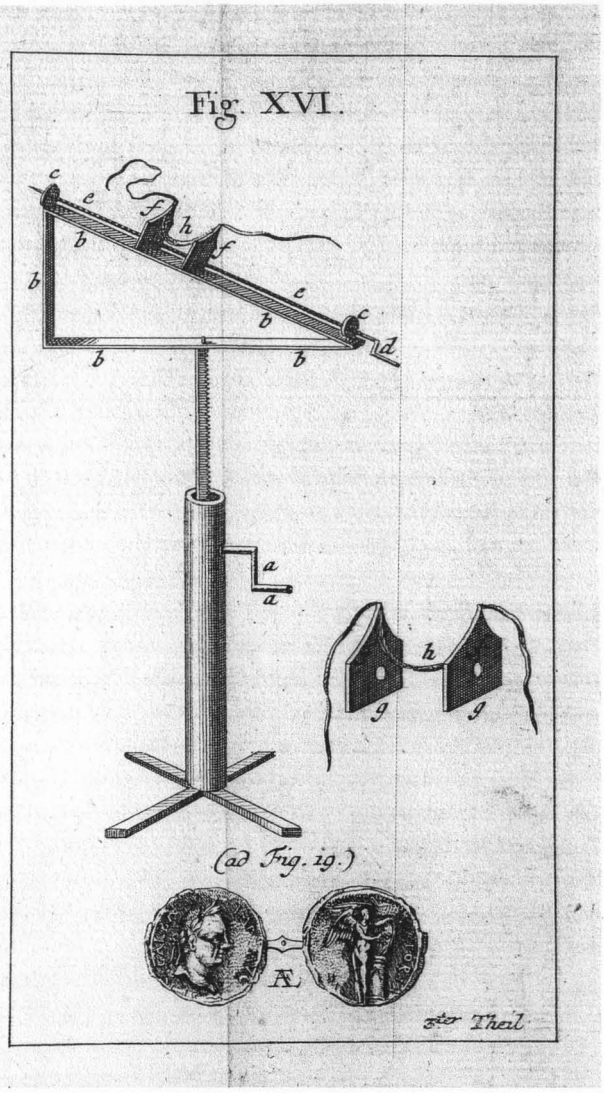


Fig. 2

Stand for a refracting telescope drawn in 1711 at Leiden Observatory by Zacharias Conrad von Uffenbach.

Engraving from Von Uffenbach 1754

lack of expertise the Observatory was barely used for a little less than a decade. During those quiet years the astronomical instruments were kept in order by the local instrument maker Jan van Musschenbroek, who had been appointed 'keeper' of the *Theatrum Astronomicum* in 1707, following Zumbach's departure.[34] In his instrument shop on the Rapenburg, a Leiden canal, Van Musschenbroek also made and sold telescopes, but according to Von Uffenbach, these were of poor quality.[35] As time went by it would become apparent that Van Musschenbroek's qualities as an instrument maker would culminate in fields other than telescopy. In 1717 the lawyer Willem Jacob 's-Gravesande was appointed to a new chair, especially devoted to mathematics and astronomy. As a university professor 's-Gravesande would acquire great fame as an impressive advocate of the new Newtonian Philosophy, having Jan van Musschenbroek as his personal technician, both men designing various machines for the demonstration of Newtonian physics. But in his early years 's-Gravesande would also bring new fervour to the Astronomical Observatory. A quick inspection of the premises had shown him that the astronomical instruments were in bad shape. But following their repair the observatory was used again, as witnessed by the scholar Albrecht von Haller in 1724. That same year the Amsterdam instrument maker Coenraad Metz informed 's-Gravesande that an unfinished brass quadrant, ordered by De Volder in about 1706, still stood unfinished in his Amsterdam workshop. This order had probably been a private one, as nothing can be found in university records about an authorization for the acquisition of such a quadrant. Nevertheless, 's-Gravesande managed to convince university curators to buy this instrument, equipped with two finder telescopes, for Leiden Observatory. In November 1725, they personally inspected this 'ingenious' quadrant with their very eyes. For 's-Gravesande this was the perfect occasion to demonstrate to the curators the necessity of updating the telescopic equipment. As a result he was allowed to hire the lens grinder Arnold Marcel to grind some new lenses for the observatory's telescopes.

3 The reflecting telescope

3.1 The development of the reflecting telescope

In about the same period, the 1720s, a decisive breakthrough was achieved in the development of a new type of telescope: the reflector. In 1668 Isaac Newton had made the first working version of this instrument. Newton realised that in a lens light is refracted differently for each colour and that this problem could be avoided by using a mirror as the primary receptor. A theoretical scheme for such a reflector had already been published by James Gregory in 1663. In that design Gregory had combined a concave parabolic mirror with a smaller elliptically shaped concave mirror. In theory this mirror combination produces a sharp image that can be observed with an ocular. However, the practical construction of this Gregorian telescope floundered in the face of insurmountable problems. So Newton developed a simpler design. His telescope had a concave spherical mirror, in combination with a flat secondary mirror that projected the light onto an ocular lens. By keeping the primary mirror small in relation to its focal length, the deviation of the necessary parabolic

form was not noticeable in practice. Nonetheless, Newton's success may be described as exceptional. In the years that followed almost no one succeeded in constructing a working example of a reflecting telescope. A French design published by Cassegrain in 1672, using a convex secondary mirror, also remained on the drawing board. Time would reveal that only the thorough and lengthy practice in casting, grinding and polishing mirrors would lead to acceptable results. A suitable alloy for the mirror metal was also hard to find. Once polished the mirrors soon became tarnished. These were the reasons why hardly any reflecting telescopes were constructed in the first 50 years after Newton's invention.

In about 1720 the problem was tackled again, this time by John Hadley, a gentleman scientist who eventually became vice-president of the Royal Society of London. Hadley had considerable funds at his disposal and his unlimited time, money and patience eventually brought him success. In 1723 the first 'Hadleyan' ("Newtonian") reflecting telescope was presented to the Royal Society. In a direct comparison with a long-focus refractor made by Huygens, this instrument proved superior. Encouraged by this success, in 1726 Hadley also succeeded in constructing a Gregorian reflecting telescope. To ensure the commercial production of these Newtonian and Gregorian telescopes, Hadley deliberately passed on the technical knowledge to two professional instrument makers. These artisans were Edward Scarlett († 1743) and George Hearne († 1741), both working in London. In the following decade these two opticians would become the most important constructors of reflecting telescopes, joined in the early 1730s by the Scottish optician James Short.

3.2 The reflecting telescope in the Netherlands

It was probably the English Newtonian John Theophilus Desaguliers who introduced the reflecting telescope into the Netherlands. In the early 1730s Desaguliers crossed the North Sea several times on successful lecturing tours, visiting a number of Dutch cities. In his appearances he demonstrated and praised this new kind of telescope.[36]

One of his first customers was Petrus van Musschenbroek (the younger brother of the aforementioned Jan van Musschenbroek), then professor of physics and astronomy at Utrecht University. In the early 1730s he ordered two Scarlett reflectors, one according to the Newtonian and the other according to the Gregorian design (both now being in the Boerhaave collection).

The first reflector at Leiden Observatory was imported by 's-Gravesande in 1736. This was a seven-foot Newtonian telescope with octagonal wooden tube made by George Hearne. At the time it was the largest model available and the instrument represented state-of-the-art technology. The purchase required the sum of 862 guilders, an amount equivalent to 's-Gravesande's annual salary as a university professor.

Soon afterwards reflecting telescopes were also made on Dutch soil. The most important Dutch instrument maker in this field was undoubtedly Jan van der Bildt of Franeker. He made reflectors from about 1745 until his death in 1790. Van der Bildt's talents were highly regarded. Some contemporary tests indicated that Van der Bildt's telescopes compared favourably with those of English construction. When in 1750 Van der Bildt made a spare mirror for the Hearne-telescope at the Leiden Observatory, his product was characterised as being of 'unparalleled quality'. With his reputation thus made, Van der Bildt became the most prolific maker of reflecting telescopes in the Netherlands, having a lifetime production of some 550 – mostly Gregorian – reflectors. He also had several imitators, including two of his sons and a grandson.

The success of the reflecting telescope made the 'refracting telescopes with long focal length completely obsolete', as was concluded in 1752 by the *Hollandsche Maatschappij der Wetenschappen*, the first official Dutch Society of Sciences.[37]

4 The achromatic telescope: its reception in the Netherlands

In 1758 a new development returned the 'obsolete' refracting telescope to the centre of attention. An invention by the London-based optician John Dollond had significantly reduced one of the most pressing problems of the refractor. In ordinary telescope lenses the chromatic refraction of white light produced different focal points for different colours, resulting in a blurring of the image. This mixture of coloured images was corrected in Dollond's achromatic telescope using the combination of two kinds of glass having different refractive indices ('flint glass' and 'crown glass'). Again it was Petrus van Musschenbroek – now lecturing at Leiden University – who brought the earliest achromatic telescopes to the Netherlands. In 1760 he bought 'an achromatic telescope of Mr. Dollond at London with 7 glasses' for the university's physics cabinet, probably together with two others for his private cabinet, listed in the 1762-auction catalogue of his estate.[38] As Dollond had been very secretive about his invention, Van Musschenbroek studied the functioning of these achromatic telescopes in depth.[39] Shortly before his death in the autumn of 1761 he even designed a demonstration model, this being one of the first attempts to illustrate the achromatic principles for educational purposes.[40]

Others in the Netherlands also tried to understand Dollond's secret. In 1761 the brass caster Carl Ulrich Bley and the lens grinder Jan van Deijl, both from Amsterdam, succeeded in imitating Dollond's invention. Together they built a prototype of an achromatic telescope. Encouraged by this success, Jan van Deijl established a workshop that would rapidly develop into an important Dutch counterpart of the Dollond company, producing a number of achromatic telescopes until in the mid-1790s when the French occupation of the Netherlands halted the import of the necessary English flint glass.

This important achromatic development however never reached Leiden Observatory. In August 1768 Johan Lulofs, who had succeeded 's-Gravesande as professor of astronomy in 1742, filed a letter of complaint to the university curators, stating that the study and practice of astronomy at Leiden University was severely obstructed by the lack of proper instruments. In contrast to promises made at the time of his appointment, Leiden Observatory had never been equipped with adequate astronomical instruments. But now, in preparation for the coming transit of Venus of June 1769, Lulofs urgently required some new apparatus, above all a new equal altitude telescope, replacing an older instrument supplied by Sisson in 1740, but between the lines one could read that an achromatic telescope would also be welcomed.[41] Johan Lulofs did not however live to see his wishes fulfilled. He died suddenly in the autumn of 1768, with the result that no achromatic telescope was ever delivered to Leiden Observatory.[42] In 1775 Lulofs's successor Dionysius van de Wijnpersse repeated the request, stating that the Observatory urgently needed a large achromatic telescope, but university curators refused to fulfil his wishes. In 1781 only the physics cabinet was granted permission to purchase a small achromatic Dollond telescope from the estate of the late curator Willem Bentinck, but this was all that could be achieved. And because Van de Wynpersse was a better philosopher than astronomer, the observatory once again fell into neglect. Nothing had happened to change Lalande's opinion of his visit to the Observatory in 1774: 'at that place I did not see an astronomer or an instrument worth mentioning'.[43]

Whereas the Leiden Observatory went without an achromate for decades, private owned achromatic telescopes were abundantly present in the Netherlands, especially in the city of Amsterdam. As early as 1763 wealthy merchants such as Jacob Hop and Gerard Aernout Hasselaer had bought the first achromatic telescopes from the Van Deijl workshop for their cabinets of scientific instruments. One of the most lavish private cabinets was owned by the Amsterdam merchant Ernestus Ebeling. He possessed one of the largest Van Deijl telescopes, dating from 1781. The instrument was purchased in 1791 for the scientific cabinet of Teylers Foundation, a privately funded institution in Haarlem. A similar large achromate, dating from 1776, is now in the Boerhaave collection. At Teylers a 2.5-foot Dollond achromate had previously been purchased in 1788, ordered directly from his London-based manufacturer. Another interesting purchase at Teylers Museum was the binocular Van Deijl telescope, designed by the Dutch philosopher Frans Hemsterhuis in the 1770s, being bought in 1792. However, even at Teylers Museum these high-quality instruments were never used for observational astronomy, being kept securely in lockers, far away from the hands of skilled users. So, when the young professional observer Frederik Kaiser wanted to observe the return of Halley's Comet in 1835, he had to borrow a large achromatic telescope from the Amsterdam banker J.B. Stoop, because his employer – the Leiden Observatory – did not have such an instrument.

5 An increasing variety of telescopes

Whereas the astronomical utility of the telescope had become broadly recognised by the mid-seventeenth century, right from the start telescopes had also been developed for terrestrial use, for instance for military or navigational purposes. But even in these fields recognition was difficult to achieve. In the Netherlands for instance it was not until 1731 that the navigational telescope was enlisted as a standard piece of equipment for the ships of the Dutch East India Company (VOC). Nevertheless, having achieved recognition as a usable instrument, the telescope soon entered the domain of the bourgeois citizen in the early eighteenth century. Now more domestic uses of the telescope were developed, such as the pocket telescope, an item that could be used at theatrical performances. Most of these small refractors – and later on reflectors too – were unsigned, so little is known about their producers. However, one of these 'invisible technicians' who made and sold these kind of telescopes was the English-born instrument maker Jonathan Cuthbertson, working in Rotterdam since the 1770s. After some 20 years' experience as an instrument maker and optician, Cuthbertson published a leaflet in 1794 giving a review of the telescope brands he sold to the general public.[44] This ephemeral document provides us with an excellent view of the diversity of telescopic products made for the general consumer at the end of the eighteenth century.

Whereas in 1699 Nicolaas Hartsoeker had listed only three types of telescopes, a century later Cuthbertson listed twice as many.[45] Hartsoeker, in his *Proeve der Deurzichtkunde*, had

recommended to his readers, first the original Dutch telescope, having a convex object glass and a concave ocular; secondly he had praised the astronomical telescope made of two convex lenses as the very best, and finally he had discussed the refracting telescopes with four or more lenses, in which field lenses increased the field of view, but at the cost of severe loss of light and a progressive blurring of the image produced.

Jonathan Cuthbertson, according to his *Verhandeling over de Verrekijkers*, offered his consumers at least seven 'flavours'. Climbing in a progressing quality from worse to better, Cuthbertson discussed first (1) the *Toneelkijker*: a very small type of telescope, having a rather large object glass and a reasonable field of view, but possessing also a very small magnification. This item was made within a large variety of drawtubes, and was equipped with oculars ranging from very simple to very complex. (2) Second on Cuthbertson's list were the *Nachtverrekijkers of Katogen*. These 'night telescopes or cat-eyes' were instruments with a large objective and a large field of view, but having a rather small magnification. They were mostly made of two drawtubes, the smaller of which had two convex lenses. Some specimens produced an inverted image, and Cuthbertson commented: 'they are of little use in the day, but at night rather good'. (3) In the third place Cuthbertson discussed the *Dag of Nacht verrekijkers* ('Day or night telescopes'), an instrument that was supposed to offer equal quality both at night and in daytime. This was, of course an impossibility, and these telescopes were in fact equally bad in both circumstances. Cuthberson therefore ironically called this telescope 'a twilight-telescope'. (4) Then there were the *Gemeen verrekijkers*, or 'Common telescopes', having only a single-lens objective. (5) Far better were the *Dollond of achromatische verrekijkers*. 'These are the best' was Cuthbertson's concise but clear comment. The specimens which were made with several brass drawtubes were also called 'military telescopes', having the advantage of collapsing into one very short tube, which was very convenient for travellers. (6) The *Zeemans verrekijkers* or 'Nautical telescopes' were also very popular, having long wooden tubes, with a rather large (achromatic) objective at one end and a brass eye-tube with four or five ocular lenses at the other. This kind of telescope was more cumbersome than the military telescope, but was its equal in use.

(7) Finally, the *Weeromkaatsende verrekijkers* or 'Reflecting telescopes' were mentioned, a completely different category of telescope, used for astronomical as well as terrestrial purposes. Cuthbertson's commercial conclusion was evident: 'it is very necessary to possess and use several types of telescopes'. And he produced, retailed, and sold them.

6 The dawn of professional astronomy

6.1 Precision instruments and other technological developments in late eighteenth-century observational astronomy

While the telescope had entered the domestic sphere of common life, in its scientific use further development had only just begun. In the final quarter of the eighteenth century the technical expertise of the scientific instrument makers reached a peak in the construction of new astronomical and geodetic instruments having a precise scalar division of a quality previously unheard of. This possibility of making measurements resulted in a quantifying spirit, touching many branches of natural science. In the 1770s English instrument makers such as Bird and Ramsden had revolutionised the manufacture of portable instruments, soon to be followed by French manufacturers such as De Mègnié and Lenoir. The first Dutch institution that followed this instrumental development was Franeker University, where in 1780 professor Jan Hendrik van Swinden ordered such a revolutionary equatorial telescope with a precision scale from the French instrument maker De Mègnié (now in the Boerhaave collection). In 1791 Van Marum followed this example by purchasing a portable equatorial telescope, made by the English instrument maker Jesse Ramsden, for Teylers Foundation.

Another important development had been the improvement of the reflecting telescope. In England William Herschel had succeeded in making a very large reflector, with which in 1783 he made the spectacular discovery of the new planet 'Georgium Sidus, later to be named 'Uranus'. Again it was Van Marum who wanted such a Herschel reflector. In 1790 he acquired a seven-foot Herschel reflector for Teylers Foundation. Because of the severe unrest on the European continent over the next two decades, this was the only Herschel telescope to reach the Netherlands.

6.2 Leiden Observatory at the turn of the eighteenth and nineteenth centuries

With political upheaval in Europe in around 1800 halting most scientific developments, this trend was also noticeable in Dutch institutions. Plans for the construction of a new astronomical observatory at Leiden University made in 1786, revised in 1794 and revived in 1803, never went further than the drawing board. New opportunities did not arise until the establishment, in 1815, of the new and enlarged Kingdom of the Netherlands. It became the deliberate policy of the new sovereign, William I, to

stimulate science and commerce, so when the new Leiden professor Cornelis Ekama submitted another memoir about necessary improvements to be made at the university's Observatory he was successful. In 1818 the observatory building was reconstructed, not as drastically as had previously been proposed (the observatory remained at the top of the Academy building), but at least it was again possible to perform astronomical observations on the redesigned platform. Ekama also received permission for a new costly telescope, a so-called large 'repeating circle', made by the French instrument maker Etienne Lenoir. This kind of precision instrument, with two revolving telescopes, was designed in 1785 by the French mathematician Jean-Charles La Borda and was based on an earlier theoretical concept developed by the German astronomer Tobias Mayer. In theory the revolving principle would significantly increase the accuracy of the positional measurements. The instrument could be used for both astronomical and geodetic purposes. In fact, over the years 1802-1811, General Kraijenhoff used several repeating circles in the course of his new triangulation of the Netherlands.

6.3 The tragic affair of the large telescopes of Roelofs and Rienks

In the years 1817-1828 Ekama was also responsible for the costly initiative of constructing several large reflecting telescopes for the astronomical observatories in Leiden and Brussels. These instruments were commissioned from Sied Rienks and his companion Arjan Roelofs, two Frisian farmer-philosophers who had turned to telescope-making, following the local tradition of making reflectors, started in the 1750s by the instrument makers Van der Bildt and Foppes. According to Ekama the products of Roelofs and Rienks were of such supreme quality that their large telescopes would easily 'surpass the giant telescopes of the famous Herschel in England' (see fig. 3). The project proved to be doomed from the start. The manufacture of parabolic telescope mirrors with a diameter of 55 cm was far beyond the capabilities of Rienks and Roelofs. As the project lacked any scientific supervision, it was only after the installation of the telescopes, in about 1828, that it became clear that these instruments, although of excellent exterior appearance, were completely unsatisfactory for astronomical observations. In 1848 the unused Leiden telescope was sold for scrap. The second telescope, originally destined for Brussels and later transported to Utrecht Observatory, was also dismantled. Of this second telescope only a few minor parts of the finder and the ocular are still preserved in the Utrecht University Museum.[46]

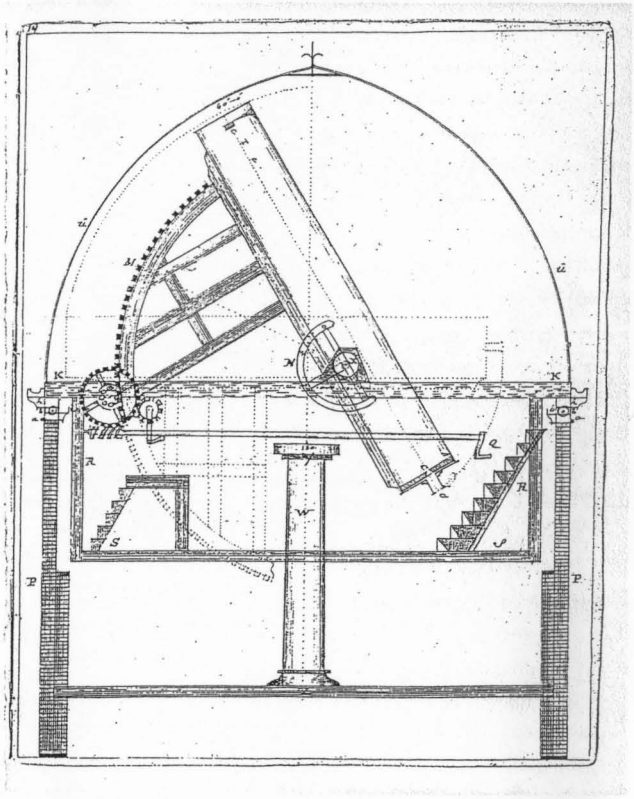


Fig. 3
Design for the large reflecting telescope by Roelofs and Rienks, constructed for Leiden Observatory in the years 1817-1828. Demolished 1848. Drawing in a manuscript with calculations regarding this telescope (Private collection).

7 A new mission for Leiden Observatory, 1837-1860

Dutch astronomy entered a new phase in 1837, when Frederik Kaiser (1808-1872) was appointed to the newly created position of Director of Leiden Observatory. In his youth Kaiser had been trained in astronomy by his uncle Jan Frederick Keyser (1766-1823) in Amsterdam. In 1826, at the intercession of the Utrecht professor Gerard Moll (a former pupil of his uncle), the young Kaiser became an assistant observer at Leiden Observatory. Trained on the job, Kaiser received an honorary doctorate in 1835 and was appointed two years later as Director of the Observatory, becoming professor of astronomy a short time later. Right from the start Kaiser devoted his life to a single purpose: to establish a modern, well-equipped astronomical observatory on Dutch soil with a solid research programme. For the first time in its existence the observatory became more than a place for demonstrating astronomical and mathematical principles. In addition to the old educational

task, real astronomical research became its second mission. In 1858, after 20 years of hard labour, Kaiser eventually succeeded in fulfilling this mission, the new 'research' observatory being opened in 1860.

Kaiser's starting point was his inaugural speech of 1838 in which on the one hand he described the poor state of the old observatory, whose dilapidated platform had become a severe threat to the roof of the Academy Building, but in which on the other he outlined his research programme. Well aware of the observatory's past and with a remarkably early sense of the importance of history, Kaiser paid tribute to the remnants of several old telescopes, having a length of some 'forty and fifty feet', whose 'inanimate bodies' were present in the observatory's attic in great numbers.[47] He even bought an obsolete reflector at an auction, for the sole reason that it had been one of the first telescopes of the famous Petrus van Musschenbroek. Discussing the recent past, Kaiser painfully analysed the reasons why Leiden Observatory had been languishing in 1838, in spite of the relatively large amount of money that had been spent on the reconstruction of the Observatory only a decade before. Boldly he concluded that on his arrival Leiden University had 'neither observatory nor instruments worthy of being called astronomical'.[48] In diplomatic terms Kaiser criticised his predecessors Ekama and Uijlenbroek for their decision to order – and install – the costly, but useless telescopes of Roelofs and Rienks. These 'monsters' had given a finishing stroke to Dutch institutional astronomy. It was only through some personal equipment that Kaiser had nonetheless been able to make some valuable contributions to observational astronomy. With this remark Kaiser was undoubtedly referring to his observations of Halley's Comet. In conclusion, Kaiser outlined his research programme and described the instruments that were necessary to perform it. In an attempt to seek a niche in observational astronomy, in which it would be possible to perform some valuable research, even at the Old Observatory building, having only minor instruments at his disposal, Kaiser chose precision astronomy as his subject, knowing that the determination of the exact locations in the heavens as well as on the earth would contribute to the verification of the geodetic longitude of many places.

In order to perform his self- imposed task, in 1838 Kaiser commissioned three telescopes of a new generation, two of which are described in this catalogue. These telescopes had state-of-the-art optics, produced by the Optical Institute at Munich, made famous by the German optician Joseph von Fraunhofer. The first instrument was a large telescope with a six-inch aperture, which is still serving astronomy today. The other instruments were smaller precision instruments. They had a divided scale made according to the most accurate technology and had a so-called 'broken lens' arrangement, which enabled an horizontal observation in line with the rotation axis of the instrument, regardless of the direction of the telescope.

In the 20 years between 1838 and the building of the new observatory in 1858 Kaiser succeeded in professionalising Dutch astronomical research. This new phase however, starting at this new observatory, for which many new instruments were ordered, is beyond the scope of this catalogue.

Huib J. Zuidervaart
Leiden, March 2007

1 Lipperhey's invention of the telescope was disputed by Jacob Metius of Alkmaar and an unnamed spectacle maker of Middelburg (probably Sacharias Jansen).
2 Cf. De Waard 1906; Van Helden 1977a.
3 Dutch lens grinders of the seventeenth century include Gerrit Matthysz van Stralen in Dordrecht (1628); Paulus Ruysch in Utrecht (1633); Hans Sachariassen in Middelburg (1633), [the son of Sacharias Janssen, one of the supposed inventors of the telescope]; 'Master Paulus' in Arnhem (1653) and Caspar Calthoff in Dordrecht (1655); Cf. De Waard 1945 and Rooseboom 1950.
4 E.g. Willebrord Snel (in Latin: Snellius), who corresponded about the properties of a telescope as early as 1610; Early users of telescopes in The Netherlands were Philippus Lansbergen; his pupil Martinus van Hove (in Latin: Hortensius) and the philosopher Isaac Beeckman, who in the early 1630s also learned how to grind lenses. Cf. Vollgraff 1914 and De Waard 1945.
5 Other scholarly work on telescopic lenses was done by Johannes Hudde, a burgomaster from Amsterdam, and by the philosopher Baruch de Spinoza, who was very interested in optics and used Hudde's work in his grinding and polishing of telescopic glasses. Spinoza also observed with Christaan Huygens.
6 Cf. Otterspeer 2000.
7 Cf. Haasbroek 1968.
8 The remaining part of Snellius's instruments (making up a list of some 15 mathematical instruments, including another 'quadrans ferreus amplissimus') was put up for auction with his library in March 1629. Cf. *Catalogus variorum & insignum, Willebrordi Snellii à Royen*, Lugduni Batavorum, 1629, 68-69.

9 AC I, Resolutien 1628-1637, 6 August 1632. Cf. Molhuysen I, 177. Snellius's first large quadrant remained in the possession of Golius. On 4 June 1668 it was sold at auction with Golius's library. Cf. *Catalogus bibliothecae Jacobi Golii*, Lugdunum Batavorum, 1668, 138: list of some 40 instruments, including 'Cl. Snellii quadrans, quem adhibuit in dimensuratione ambitus globi Terreni, cum requisitis'.

10 Cf. De Sitter 1933 and Heineman for the early history of Leiden Observatory.

11 Cf. Van Helden 1977b & 1994.

12 Vollgraff 1914.

13 Cf. *Catalogus oft register vande sonderling-heden ende wtgelesen sinnelickheden, ... die Christiaen Porrett, wijlen apotheker in zijn Cvnstcamer vergadert had*, Leyden (Jan Clasz van Dorp), 1628. See also: E.W. Moes in: *Leidsch Jaarboekje* 1905, 93-100.

14 No telescope is listed with the mathematical or other instruments mentioned in the auction sale catalogues of the following Leiden scholars: 1. Nicolai Goldmann, 'Mathematici' (1665); 2. David Stuart (1670); 3. Johannis Willaers (1670); 4. Petrus van Schooten 'Matheseos & Astronomiae ... Professor' (1680). 5. Anthony Hoevenaer, 'Instrumentmaaker' (Dec. 14th, 1695). However, one telescope is mentioned in the inventory of Hoevenaer's house, drawn up by notary J. Blocqueau on 14 October 1695. See: *Rapenburg*, no. 56, page 795: '1 verrekijker'.

15 This small telescope is mentioned in the inventory of the estate of the student Leonard van Sorgen (Notary Archive Leiden [NAL] 785, no. 103 (23-9-1644). Other deceased university students with telescopes were Fredericus Ludolphus van Metelen (NAL 412, no. 201 (26-11-1658); Abraham van Nispen (NAL 462, no. 25 (1668) and Jan Coufri (NAL 1051, no. 209 (1671). The Leiden public notary Hendrick Melchiorsz Brasser also owned a telescope (NAL 1050, no. 85 (1670). Courtesy of Prof. Paul Hoftijzer, Leiden.

16 *Catalogus variorum & insignum librorum ... Adriani Heereboord*, Lugduni Batavorum (Petri Hackii), 1661, last page: a 'telescopium, & alia supellex litteraria'. Also mentioned in his estate in NAL 864, no. 49. Heereboord's predecessor Franco Burgersdijk, the well-known Aristotelian, possessed no mathematical or philosophical instruments, according to the auction sale catalogue of his library (1637).

17 *Catalogus insignum & variorum librorum ... Florentii Schvyl*, Lugduni Batavorum (Daniel & Abraham Gaesbeck), 1671, 42: 'Telescopia'.

18 For the inventory of the house of Franciscus De le Boë Sylvius, see: Rapenburg, no. 31 [vol. 3] (1988), 339-340: '3 groote verrekijckers' in the attic, and '1 partij verrekijckers', stored in the 'distillation chamber'.

19 *Catalogus bibliothecae Jacobi Golii*, Lugd. Bat., 1668, 138, no. 16: 'Telescopia 2'.

20 Cf. Kechel 1653 and Bigourdan 1901.

21 *Catalogus Rarissimorum Librorum & Instrumentorum Mathematicorum, ... Samuelis Caroli Kechelii ab Hollensteyn*, Lugduni Batavorum (Cornelii Driehuysen), May 7th, 1668, 19-20. nr. 9: 'Tubus van 12 voeten', no. 10: 'Tubus van 6 voeten', no. 11: 'Tubus van 5 voeten', no. 12: 'Tubus van 2 voeten en een half'. See also no. 82: 'verscheyde geslepen glasen', no. 121: 'een houte instrument om de vlacte van de Son te observeeren' and no. 122: 'Een houte instrument om de Eclipsis te observeeren'. The two latter instruments probably were camera obscura's.

22 Cf. *Catalogus variorum & insignum ... librorum ... Christiani Melder*, Lugduni Batavorum (Jacob Voorn & Felix Lopez de Haro), September 28th, 1682, p. 67: 'Verrekykers N1,2'; Tubi tot verrekykers, N.1,2.3.'; Verscheyde doosen met geslepen glasen tot verrekykens, N.1,2,3,4,5,6,7,8.'; Noch verscheyde tubi en glasen tot verrekyckers behorende'.

23 AC I-7, 186, 8 August 1682.

24 Cf. Van der Aa 1712; Schroder 1725.

25 Cf. *Bibliotheca Volderina*, Lugduni Batavorum (Johannes van der Linden Sr & Jr and Johannes Voorn), 1709, [auctioned October 14th, 1709], page 95-96: '1 kleyne verrekijker; 1 maankijker; 1 pedestaal om een groote maankijker op te leggen'.

26 Zumbach's reputation as a teacher attracted the astronomer-to-be Johann Gabriel Doppelmayr (1677-1750), who visited Leiden, where he stayed at Zumbach's house, in 1701. In Leiden Doppelmayer also learned how to grind and figure telescope lenses. After a short visit to England, Doppelmayer returned to Leiden, where he spent another five months following Zumbach's astronomy lessons. Cf. Hans Gaab, 'Johann Gabriel Doppelmayr (1677-1750)', in: W.R. Dick & J. Hamel (eds.), *Beiträge zur Astronomiegeschichte*. Band 4 (Harri Deutsch, Frankfurt am Main, 2001 [= *Acta Historica Astronomiae*, vol. 13]), pp. 46-99.

27 Lotharius Zumbach de Koesfeld never gained an appointment at Leiden University, although in 1697 the curators put him first on the proposal list to Prince William III for professor of 'Duytse Mathematiek' [the mathematics instruction in the Dutch language for the training of surveyors and other lower mathematicians]. In 1701 he was again passed over for this position, although he did receive about a year's salary (315 guilders) for a book he had published. Cf. Molhuysen IV, 159 (18 May 1697); 189 (18 May 1701).

28 Molhuysen IV, 220, 222 (1 Feb. 1706). On 7 February De Volder advised in favour of Zumbach's proposals. Both inventories are printed in Molhuysen IV, 104*-108*. The inventory of the physics cabinet lists no telescopes.

29 Molhuysen IV, 225-226. The instruments at the observatory were cleaned and repaired by Coenraad Metz, an instrument maker from Amsterdam.

30 Von Uffenbach 1754, I, 2, 47, 63. Zumbach's appointment in Kassel was announced on 22 November 1707. Cf. Molhuysen IV, 234.

31 As the Huygens brothers in principle never parted with their telescopes, it was probably Huygens's friendship with De Volder that made this acquisition possible. In his will Christiaan Huygens bequeathed his manuscripts to Leiden University, appointing De Volder as one of the editors.

32 Von Uffenbach 1754, III, 434.

33 Jacques Bernard was vicar at the *Eglise Wallone* in Leiden. In December 1705 he had received an honorary doctorate. In 1706 at the 'voorspraak' of De Volder he was appointed Lector (junior professor) in philosophy and mathematics. In 1712 Bernard was promoted to ordinary professor in both fields. Cf. Von Uffenbach 1754, III, 495 and Molhuysen IV, 221, 259.

34 Molhuysen IV, 234 (Dec 7, 1707). As the 'opsiener' of the observatory Jan van Musschenbroek received a salary of 25 guilders a year. In 1723 he was succeeded by Cornelis Schagen until 1751, when Jacob Chevally was appointed keeper of the *Theatricum Astronomicum*.

35 During a visit to Van Musschenbroek's workshop Von Uffenbach noted in the entry 'Telescopia': 'Er macht sie gar schlecht, und sind die gröste von fünf bis sechs Schuh. Musschenbroek zeigte uns ein Objektiv von vierzehn Schuh, aber es war miserabel, ach nicht von ihm selbst gemacht', Von Uffenbach 1754, III, 434.

36 Desaguliers 1732, 185-186 & plate XII, fig. V.

37 Anonymous comment on a proposal by Louis Wurstenberguer of Kleve (Germany) on the production of 'all kinds of telescopic glasses and mirrors' (Noord-Holland's Archief, Haarlem, Archives of the *Hollandsche Maatschappij van Wetenschappen*, correspondence of 1752).

38 AC 70, notes Van Musschenbroek's purchase in August 1760: 'een achromaticq telescoop van Dollond' voor 36 / 17 / - bij Paauw', followed in 1762 by a '4 feet achromatic objective by Dollond'; cf. De Clercq, 1997, 157. Van Musschenbroek´s own achromats were: 'a telescope of six lenses, three foot long, in a mahogany wooden tube from Dollont' provided with a spare objective, and a pair of 'exquisite opera glasses from a new invention by Doullont his new method'. Cf. *Collectio* 1762, nos. 317-318.

39 Van Musschenbroek 1762, 335-336.

40 *Collectio* 1762, no. 332: 'a prism made up of 3 prisms composed of different glass, set in copper, serving to clarify the construction of Doullont's telescopes'.

41 Lulofs to university curators, 29 August 1768. Printed in Molhuysen VI, 5*-7*.

42 In his personal collection of scientific instruments, auctioned in May 1769, Lulofs also had an achromatic telescope. Professor Hennert of Utrecht University was allowed to bid for Lulofs's achromatic telescope to the limit of 250 guilders – at the time the average price for such a telescope – but failed to acquire the instrument. Utrecht Observatory had to wait until 1780 before such an amount was granted again for the direct purchase of an 'achromatic telescope, fitted to make astronomical observations'. This telescope was bought directly from Dollond for 281/16/14 guilders. Cf. Kernkamp 1940, 137, 139 and 609.

43 'Je n'y vis ni Astronome, ni instruments que l'on puisse ôter', in: De Lalande 1794. See also Otterspeer 2005, 149.

44 Cuthbertson 1794.

45 Hartsoeker 1699.

46 Utrecht University Museum, inv. nos. 56.01-56.04 (courtesy of Dr. J.C. Deiman, emeritus curator of the Museum).

47 Kaiser 1838, 7.

48 Kaiser 1838, 11.

A note on this catalogue

This 'Descriptive Catalogue of Telescopes from the Leiden Observatory and other telescopes in Museum Boerhaave' covers telescopic instruments used for astronomical, terrestrial and nautical purposes, dating roughly from between 1669 and 1860.
The first date is simple to argue: the oldest telescope in the Boerhaave collection was made in 1669 for the astronomical observatory of Leiden University. Founded in the year 1633, it was one of the first academic observatories in the world.
The closing date of this catalogue is also connected with the history of Leiden Observatory: in 1860 Frederik Kaiser, at that time the zealous director of this astronomical institution, opened a modern, newly equipped Astronomical Observatory at a new location in the 'Hortus Botanicus'. This event marked the beginning of a completely new era in Dutch astronomy, with several new telescopes and other instruments that deserve proper consideration at a later time.
Apart from this institutional reason, there are other arguments for this closing date. The practice of instrument making reached such a high degree of perfection in the latter half of the nineteenth century that the instruments made were incomparable to the earlier period.
The historical section of this catalogue focuses on the instruments whose history of use can be followed. Leiden Observatory has therefore had most attention, as in most cases little can be said about telescopes with other provenances.
Geodetic instruments – such as theodolites – or other instruments with minor telescopic sights – such as water levels or compasses – are not included in this catalogue, unless there is firm evidence of their use in an astronomical context.

A note about the appendix

To provide a proper historical context, in the appendix an overall picture is presented of all the telescopes and related objects (like telescopic glasses and stands) that are mentioned in the preserved inventories of Leiden Observatory in the period 1706-1860. For the specific inventories, see the literature. In addition a list of March 1743 is used, listing the instruments donated to the Observatory by Maria van Sol, widow of the late Samuel Jeremias Garama. For the list of instruments brought by Ekama from Franeker University in 1812, see Zuidervaart 2007.

A note on the entries

A standard entry is arranged as follows:

1 catalogue number
2 museum entry number
3 name of the object
4 (approximate) date of production. When a date is based solely on the author's expertise it is given in quarter centuries (e.g. 1750-1775). When dates *post* or *ante quem* are known they are given, for instance when an instrument is signed, indicating it has to have been made during the lifetime of its maker.
5 dimensions in centimetres: length (l), width (w); depth (d) or diameter (Ø). Dimensions are determined as follows:
   a with cylindrical objects: maximum length (l) and diameter (Ø).
   b all other objects are taken in the smallest position in which the instrument would fit into an imaginary rectangular box. If available, the stands are taken into account, standing with the telescope tube in a horizontal position.
6 signature (if any) or maker (if known)
7 provenance (former owner[s], date of transfer). If provenance is plausible but cannot be proven beyond any doubt, names are placed between brackets.
8 history and description
9 references

A note about old measures

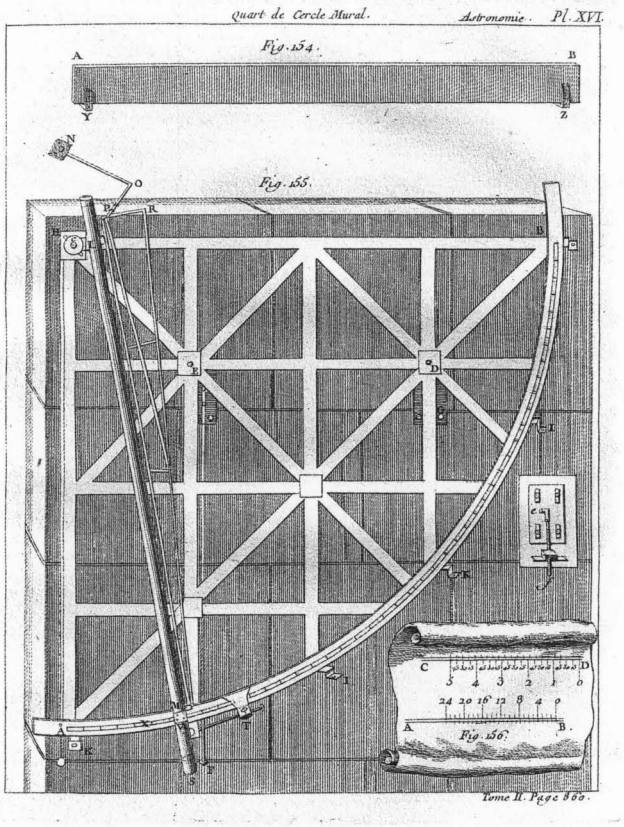
In the seventeenth and eighteenth centuries most measures were in feet and thumbs (translated as 'inches'). Most common in Holland was the Rhineland foot, which was divided into 12 'thumbs' (translated as 'inches').

Amsterdam foot	0.284 metres	Amsterdam inch	2.37 cm
English foot	0.304 metres	English inch	2.53 cm
Rhineland foot	0.314 metres	Rhineland inch	2.62 cm

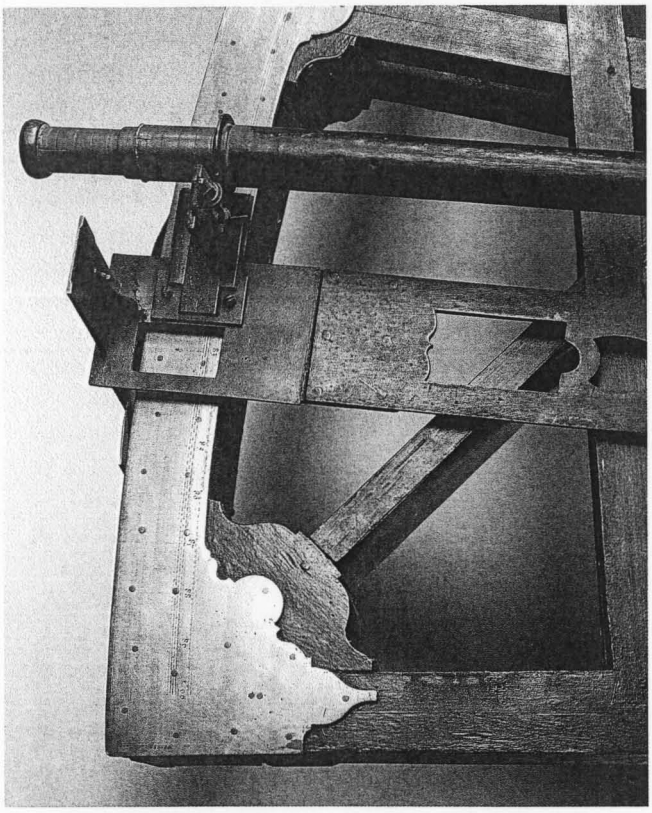
In the nineteenth century it became usual to give apertures in Paris measures:
1 Paris foot = 12 Paris inches = 12 Paris lines = 3.2484 metres, so 1 Paris line = 0.2256 cm
Cf. Oudemans 1888, 809

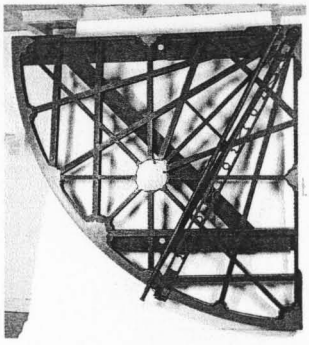
Astronomical quadrants & sextants with telescopic sights

The first telescopes at Leiden Observatory were finder telescopes, attached to a large mathematical instrument such as a quadrant or sextant. This use of the telescope merely as an auxiliary instrument reflects the initial low authority of the device as an individual philosophical instrument.



Mural quadrant with telescope.
Engraving from J. de Lalande, *Astronomie*, Paris (Desaint et Saillant), 1764.





1. 6500

Large wooden quadrant with a telescope

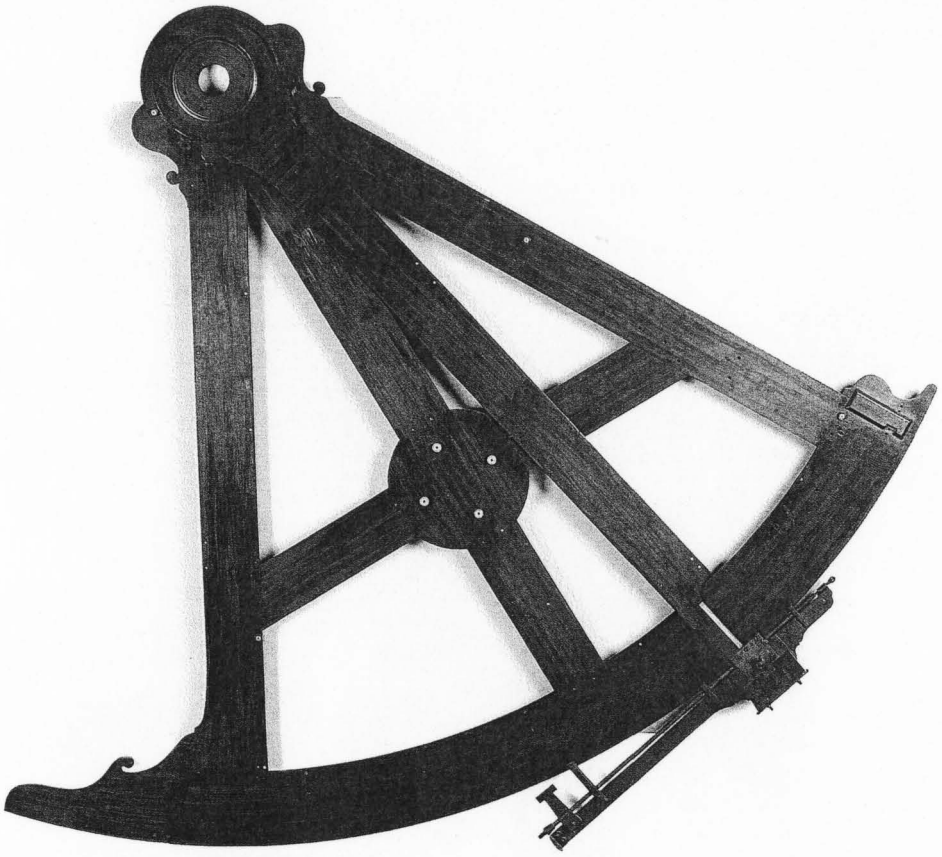
c. 1620 (quadrant); 1669 (telescope)
1211, Ø 5 (telescope)
By Willem Jansz. (Blaeu)
Provenance: Leiden Observatory, 1633-1978

In 1632 the curators of Leiden University paid professor Golius the sum of 125 guilders for a large astronomical quadrant he had bought three years before from the heirs of Willebrord Snellius, the late professor of mathematics. This acquisition led to the founding – in 1633 – of Leiden Astronomical Observatory. At the Observatory the quadrant was mounted on a strong vertical wooden pole that could be rotated around its axis in azimuth.

According to Vossius, the quadrant was made by Willem Jansz. Blaeu, probably in around 1620. During its stay at the observatory the quadrant was adapted a number of times by other instrument makers. The first alteration was made in 1656, when a revolving plate was added to the quadrant. This 20-inch azimuthal circle was ordered from the Leiden instrument maker Hendrick Sneewins. However, he died before the work was finished and the circle was eventually finished by Jan Davidt, another mathematical instrument maker from Leiden.

In 1669, at the request of the recently appointed mathematics professor Christaan Melder, the original Tychonic sight of the quadrant was replaced by a telescope, the large metal tube of which is still in place. This large tube is made of (red) copper, painted black, with two brass parts (1 13 cm). There are wooden fittings for objective and eyepiece. According to the 1793 inventory, these 'two glasses of the quadrant [...] in copper tubes' were kept in a drawer of a table elsewhere in the observatory. Now these optical parts are missing. A similar telescopic arrangement was designed in 1676 for a mural quadrant by Robert Hooke.
Other alterations were ordered in August 1682 by Melder's successor De Volder, which explains why, according to Uffenbach (1711), the – now missing – base of the quadrant was signed: 'Antonius Hoevenaer fecit Leidae'. The latter was working as De Volder's instrument maker.
Finally, in 1743, the acting professor Johan Lulofs ordered two new micrometers for the quadrant, after which he fixed the position of the quadrant in the plane of the meridian, using it as a mural quadrant. In this position Lulofs determined new coordinates for the Leiden Observatory, by measuring zenith distances of several stars crossing his meridian and comparing these results with other places in Europe.
In 1777 the quadrant was sketched in the travel journal of the Danish astronomer Thomas Bugge. It became obsolete as a usable instrument at the end of the 18th century.

Vossius 1650; Invent. 1706; 1793; 1868, A-4; Lulofs 1750, 476



2. 9724

Brass astronomical sextant, originally attached to a telescope

1685

h 145, w 166, d 18

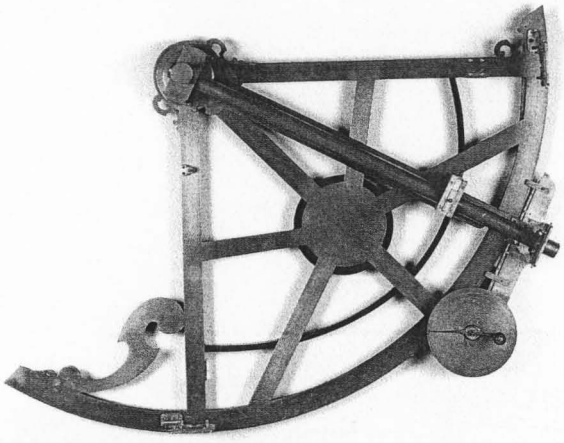
Signed: Coenraet Metz Fecit Amstelod[ami]

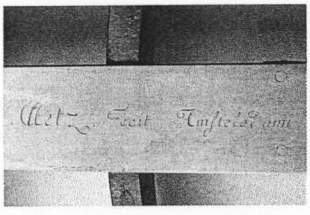
Provenance: Leiden Observatory, 1685-1935

In November 1685 De Volder submitted a request to the university curators for an instrument 'to measure the distances of the stars'. The instrument in question was this large, four-foot sextant, which was ordered from 'an able workman in Amsterdam'. The instrument did cost the sum of 1,050 guilders and was made by the instrument maker Coenraad Metz. The arrival of this sextant in 1686 required the enlargement of the observatory platform and the building of a second turret for its housing.

Originally this sextant had a finder telescope, which is now missing. According to the 18th-century inventories, the tubes of this telescope were stored in a cupboard, in a case covered with Russian leather. The instrument had three different objectives, which were stored with the other telescopic glasses elsewhere in the observatory.
The brass sextant has a scalar division of 60 degrees, divided into minutes by means of transversals at the edge. Fine tuning is possible with an endless screw.

AC I-7, 186; Invent. 1706; 1742; 1868, A-6





3. 9725

Brass quadrant, originally with two telescopes

1705-1724

I 74, Ø 30 (telescope)

Signed: Metz Fecit Amstelodami

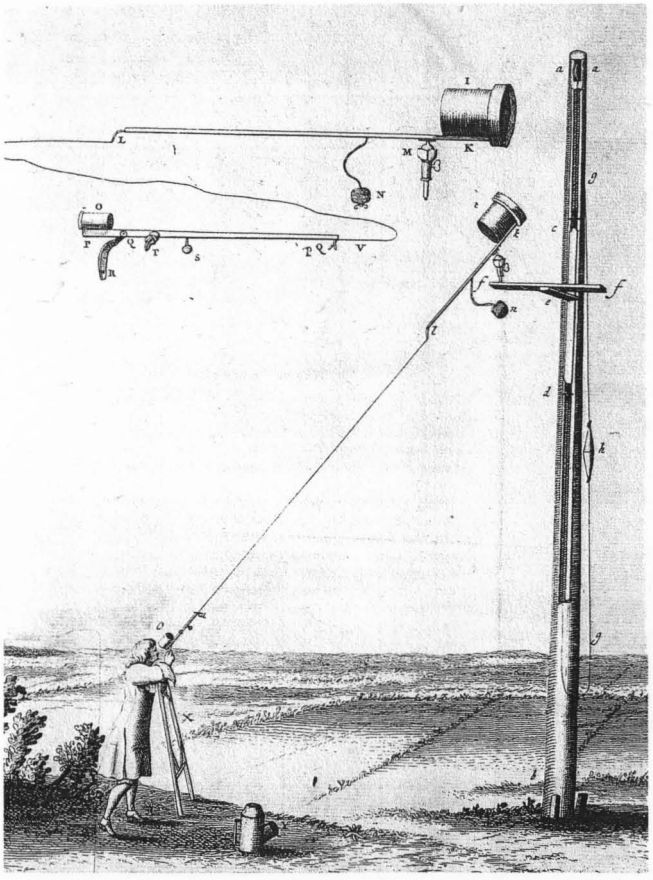
Provenance: Leiden Observatory, 1724-1931

This 'two-foot' brass quadrant (radius 69 cm), originally fitted with two telescopes, was ordered for Leiden Observatory at the request of Burchard de Volder (until 1706 professor of mathematics and philosophy). However, delivery of the instrument was delayed for some 20 years. In February 1724 W.J. 's-Gravesande, then professor of astronomy, informed the university's curators of the arrival from Amsterdam of the 'astronomical quadrant, which had 'so ingeniously' been made at the time of Prof De Volder, but which had never been completed and had not been delivered until now'. In November 1725 's-Gravesande showed the instrument to the curators, after some slight 'perfections' had been made. This remark probably refers to the (now missing) stand with 'gear work and counterweights, to fix the quadrant in all directions' made by Jan van Musschenbroek, who until 1723 had been keeper of the instruments of the '*Theatrum Astronomicum*'.

According to the 1793 Leiden Observatory inventory, there were two telescopes attached to this quadrant: one fixed and one movable. Only the movable telescope remains. It has a brass dust cap at each end. Only one lens of the originally compound ocular and the cross wires are present. The objective lens is missing. The scale of the quadrant is divided into 90 degrees, with transversals that allow a reading in minutes. The use of a worm gear with pointer – invented by Hooke – provides an even more precise reading down to 1/20 of an arc minute. Originally loose parts of the quadrant (such as screws, keys and a plumb line) were kept in a separate box made of oak.

Invent. 1798, nos. 1 & 6; 1868, A-7

Early astronomical telescopes and unmounted lenses



Christiaan Huygens and his tubeless telescope.
Engraving from C. Huygens, *Astrocopia compendiara tubi optici molimine liberate*, Den Haag (Arnoldum Leers), 1684.

The old Leiden Observatory inventories reveal that the early telescopes were assembled on the spot, every time they were used. Various glasses were installed in drawtubes, some made of cardboard, and others of iron plate. None of these 17th-century telescope tubes have survived, the last evidence of their existence being given by F. Kaiser in 1838 in his description of Leiden Observatory, stating that the 'dead bodies of telescope tubes of some forty and fifty feet in length were abundantly present in the Observatory's attic'.

Several telescopic lenses did survive however, a few actually being used at Leiden Observatory, others – like most of the Huygens glasses – being collected at a later date for reasons of historical importance.

All these early astronomical telescopes had only two glasses: a convex object glass with large focal distance and a convex ocular glass with a focal distance that resembled the optical diameter of the object glass. As was confirmed in 1699 in Hartsoeker's *Proeve der Deurzichtkunde*, for astronomical observations these telescopes were the very best, having only the minor disadvantage of placing the image upside down.

A. The Huygens collection

A very special collection at Museum Boerhaave is the collection of astronomical glasses made by the natural philosopher Christiaan Huygens (1629-1695) and his brother Constantijn (1628-1697). They became interested in grinding lenses in 1654. The year before they had ordered a number of telescopes, from a certain 'Master Paulus' in the Dutch city of Arnhem. But having obtained some practical information from other opticians, such as Caspar Calthoff of Dordrecht, the Huygens brothers decided to grind their own telescopic glasses.

In February 1655, just before he went to Paris, Christiaan Huygens finished a telescope with which he discovered the brightest of Saturn's satellites. The object lens of this telescope, engraved with an anagram testifying to this discovery, is now preserved in the Utrecht University Museum. There are two other lenses from this early period in the Boerhaave collection.

A second, more prolific period of telescope making started in 1681, following Christiaan's return to The Hague. In the years between 1682 and 1687 the brothers ground more than 40 object glasses. The greater part of this collection, containing 19 object glasses, is now preserved in Museum Boerhaave. As it was the brothers' habit to sign their object glasses with a diamond engraving as soon as they had finished the polishing process, most glasses can be dated very precisely.
With just a few exceptions the Huygens brothers kept all the telescopic glasses produced in their lifetimes for themselves. In 1691 Constantijn presented one of his 122-foot object glasses to the Royal Society in London. At probably around the same time Leiden Observatory acquired an astronomical clock and an aerial telescope, both designed by – and made for – Christiaan Huygens.

In about 1720 Constantijn Huygens Lzn., the son of Lodewijk, the youngest of the three Huygens brothers, drew up an inventory of all the telescopic objects still in the family. This was followed shortly afterwards by a draft auction catalogue drawn up by the instrument maker Jan van Musschenbroek. Although this presumed auction was never held, the two lenses with longest focal distance (170 feet and 210 feet) were sold to London, eventually to be presented to the Royal Society. Another object glass was acquired by the Leiden professor Willem Jacob 's-Gravesande, who had acted as an intermediary in the London sale. All the other telescopic objects remained in the Huygens family until 30 September 1754, when the entire collection was put up for auction, an annotated printed catalogue of which has been preserved. Nineteen glasses, the 17-foot telescope and the planetarium were bought by Suzanna Louise Van Wassenaer-Huygens, the only daughter of Constantijn Lzn Huygens. She had also inherited Christiaan's estate 'Hofwijk' in Voorburg. Following Suzanna's death, her assets were auctioned in 1786. On that occasion one of Suzanna's heirs, Alexandre Jerome Royer (1741-1809), bought nine of her object glasses. Together with some other lenses, which were probably bought by father Jean Royer (d. 1783) at the 1754 auction, he bequeathed the Huygens collection to Leiden University on 4 April 1809, together with some other Huygens memorabilia from his brother, the *antiquarian-avant-la lettre* Jean Theodore Royer (1737-1807).

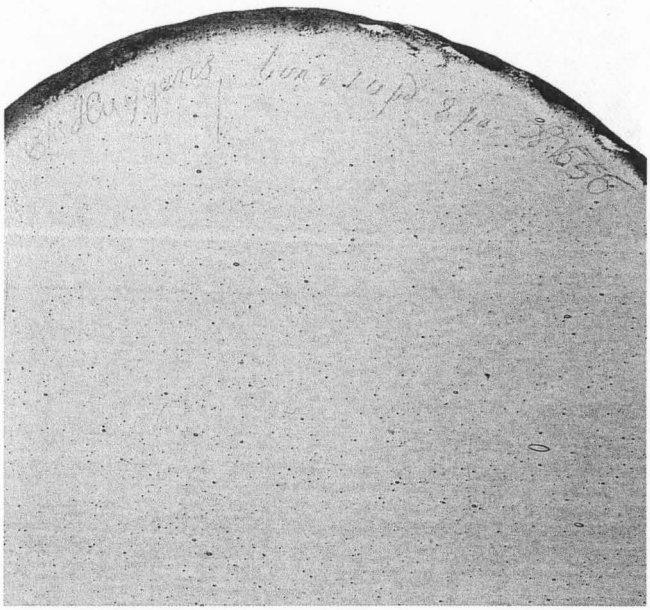
In Leiden the Huygens lenses were stored in the physics cabinet, in a specially made cupboard. Here these objects were studied for the first time as historical relics: in 1837 by Pieter Johannes Uylenbroek, in 1846 by Frederik Kaiser, in 1867 by Harting and in 1884 by Oudemans. In 1876 most of the Huygens glasses and the Huygens telescope were exhibited at the famous Special Loan Exhibition of Scientific Instruments at South Kensington, London. A few years later, in 1888, the Huygens lenses were transferred from the physics laboratory to the observatory, to be kept in the director's room with other obsolete telescopic lenses.

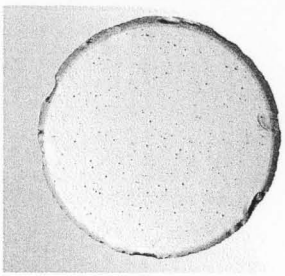
Since then the collection has been enlarged with four other Huygens lenses, which had surfaced from various collections. In 1929 the Huygens collection was exhibited at an exhibition held at Leiden Observatory to commemorate the 300th anniversary of Christiaan's birth. Two years later the Huygens collection was transferred to the newly founded *National Museum for the History of Science and Medicine* (todays Museum Boerhaave). Here the collection was catalogued by its first director, C.A. Crommelin in 1949. In 1995 all the available Huygens glasses were the subject of intensive study by Anne van Helden & Rob van Gent, who measured all kinds of optical parameters. In comparison they could identify with a high degree of certainty which glasses were ground from moulds used by the Huygens brothers.

Uylenbroek 1838; Kaiser 1846; Harting 1867; Oudemans 1884; Biedermann 1877; Catalogue 1929; Crommelin 1949; Van Helden & Van Gent 1995 & 1998

Abbreviations used in the descriptions of the Huygens glasses:

A	*Catalogus der Glaesen, c. 1720*
B	*List made by Jan van Musschenbroek, c. 1722*
C	*Auction sale catalogue, 1754*
H/M/(Obs.)	*Crommelin catalogue, 1949*





4. Object and ocular glass for an astronomical telescope of c. 12 feet

Provenance: Huygens family, 1656-1754; [J. Royer, 1754-1783]; A.J. Royer, 1783-1809; Leiden University, 1809-1931

a. 9185

Object glass of 10 feet 8 inches

1656
w 0.5, Ø 9.5
Signed on lens: Ch. Huijgens, lon. 10 pd 8 po.A 1656
Cover sheet 1: Objectivum cum | suo Oculare pro | Telescopio 10 pedum | 8 pollicum | C. Huygens fec | 1656
Cover sheet 2: N | 326 | Objectif van ~~10~~ 11 voet | ~~8 duymen~~ | de 10 pieds et 8 pouces | n° ~~44~~ 42 | Chrisst Huijgens
On the scale: 16
B 44, C 42, H 3-16

As the quality of this object glass is not particularly good, in 1846 Kaiser thought that the lens could not be genuine. However, being one of Huygens's first lenses, one would expect this lens to be of lesser quality. Measurements of its radius of curvature have shown it was ground on the same lap as a signed Huygens glass of similar focal length, made in 1655, now preserved at Utrecht University Museum. Van Helden & Van Gent have shown that the glass material used was supplied by the Bonnehomme brothers, owners of a *verrerie de christal* in Maastricht, in 1656.

Plano-convex lens made by Christiaan Huygens, using greyish glass. The lens has a contemporary given focal distance of 10 feet 8 inches (3.35 m), with a measured focal distance of 3.44 metres. The number '42' refers to the 1754 auction catalogue, when this object glass was sold for 4 guilders.

b. 9184

Ocular glass

1656
w 0.6, Ø 3.5
Signed on lens: Huygens oculair [po]ur [10] p 8 [p] 1656
Cover sheet: Ch. Huygens | 1656.
On the scale: 21
H 3-27

The glass has many air bubbles, which shows that in their earlier period it was difficult for the Huygens brothers to obtain glass of good quality. Mounted with the object glass this ocular gives a theoretical magnification of about 60 times, needing a tube of some 12 feet, probably made in two drawtubes. In a letter of 5 March 1659 Christiaan Huygens recommended tubes made of 'fer blanc', just like his own telescopes. He also included a drawing of the tripod support he had made for these telescopes. In 1656 Huygens made several telescope glasses for a 12-foot and a 23-foot telescope.

Biconvex lens made of whitish glass with a measured focal distance of 5.6 centimetres, which is about 2.1 Rhineland inches. According to Huygens's table of optimal object/eyepiece combinations, an object glass of 10 feet 8 inches needed an ocular glass with a focal distance of 1.7 inches.

Oeuvres II, 361364; XV, 11-16; Kaiser 1846; Van Helden & Van Gent 1995, 22; 1998, 73, 76-77

5. 9196

Campanine of c. 17 feet with an object glass of 12 feet

1683

I 129.5-530, Ø 10

Signed on the objective lens: 'Chr. Hugenius f[ecit]. | Ped. 12 Opt.'

Ocular tubes: '28, 29, 30'

Provenance: Huygens family, 1683-1786; [Royer, 1786-1809]; Leiden Observatory, 1809-1931

C 47, H 2, H 3-17/28/29/30

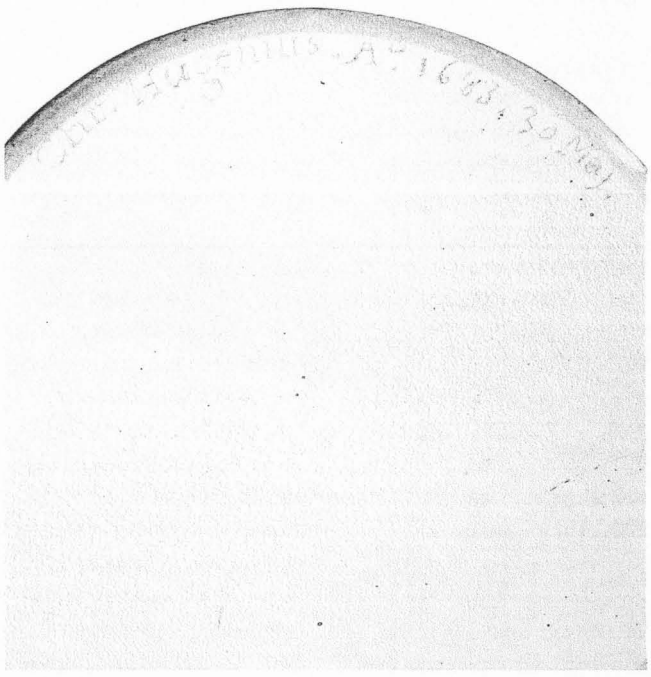
Sole remaining complete telescope by the Huygens brothers. They worked together on this telescope in the early part of 1683. From their letters it is known that the yellow-grey glass Christiaan used to grind the object lens was supplied by the English optician Christopher Cock. The three eyepiece lenses were ordered from 'Master Dirck', living in The Hague. In March 1683 Constantijn Huygens tested the telescope in the village of Dieren, by observing the clockwork on the towers of the neighbouring cities of Deventer and Zutphen. After having a few accidents with the original drawtube (having a length of 13 feet and 3¾ inches or 4.2 metres), Constantijn asked his brother to order new, somewhat longer and stronger, iron plate draw-tubes from Cornelis Langendelf, living in or near The Hague. These were made in April 1683, having a total length of 17 feet. Constantijn himself crafted a wooden tripod stand – now missing – for the instrument.

The provenance of this telescope is somewhat puzzling. In 1837 the early Huygens scholar Uylenbroek had found this Huygens telescope amongst the 'vast bulk of obsolete astronomical apparatus lying together in utter despair' in the attic of Leiden Observatory. Thus in 1846 the astronomer Kaiser supposed that the Huygens telescope had been at Leiden Observatory for 'perhaps longer than a century' and therefore had not been part of the 1809 Royer legacy. However, as the 17-foot long Huygens telescope is not mentioned in any of the observatory's 18th-century inventories, Kaiser's statement must be doubted. Indeed, the 1754 auction sale catalogue of the Huygens relics shows that the telescope was sold at that auction for 40 guilders, being described in the catalogue as no. 47: *Un Telescope d'environ 17. pieds monté dans un tuyau de fer-blanc, compose de cincq pieces.* At that auction the telescope was bought by Suzanna Louise Huygens, as is demonstrated by the list of her purchases, written in her copy of the auction sale catalogue. Almost all these items were acquired by her cousin A.J. Royer in 1786.
In conclusion, it is most probable that the telescope did enter the university as a Royer item, being transported to the observatory in about 1810 as the sole object still useful for astronomical observations. In 1846 for instance Kaiser used the Huygens telescope intensively for astronomical observations, being surprised by its very 'favourable' quality compared to other old telescopes.

The instrument consists of five iron-plated drawtubes, with a total of four lenses, giving it a magnification of c. 49 times. The front lens acts as the object glass, the other three forming a compound eyepiece. Of these, the rearmost is the actual eyepiece; the two interior lenses, mounted in a separate tube, have the function of inverting the image. By removing the tube with the two field lenses, the telescope becomes an astronomical telescope, with a smaller field of view, but with the same magnification. This kind of telescope, giving an upright image using convex lenses, was developed by the instrument maker Giuseppe Campani, which is why the Huygens brothers called such an instrument a 'campanine'.

The biconvex object lens (w 0.37, Ø 6.7) was made by Christiaan Huygens, having a contemporary given focal distance of 12 feet or 3.77 metres and a measured focal distance of 3.95 metres. The ocular glass (w 0.56, Ø 3.8) and the two field lenses (w 0.41-0.46, Ø 4.0) are made of yellowish glass. The ocular glass has a measured focal distance of 7.9 cm (or 3.0 inches); the two field lenses have a focal distance of 10.5 cm (or 4.0 inches).

Oeuvres IX, 413-420; XIII, 607; XV, 24; Kaiser 1846; Oudemans 1884; Catalogue 1929, fig.. 1; Engberts 1970, 96-97; Van Helden & Van Gent 1995, 20-21



6. 9109

Object glass of 13 feet

1683

w 0.4, Ø 6.7

Signed: Chr. Hugenius. Ao. 1683. 30 Maj. | Ped. 13.

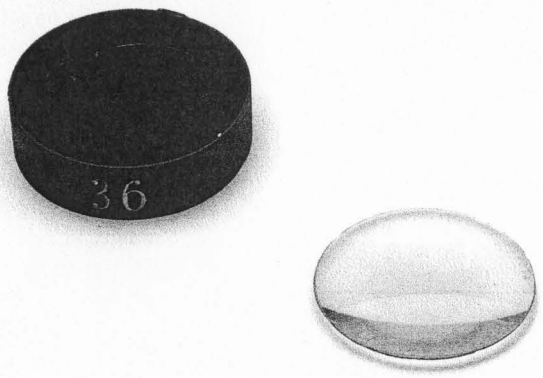
Provenance: Huygens family, 1683-1786; Anthony Dull Jansz, 1786-1837; Felix Meritis Amsterdam, 1837-1889; Physics Laboratory University of Amsterdam, 1889-1926

A III-2, B 31, C 27, M 22

Biconvex lens made by Christiaan Huygens, using yellow-grey glass. The lens has a contemporary given focal distance of 13 feet (4.1 m) and a measured focal distance of 4.1 metres. Of the inscription on the lens only the focal distance is in the handwriting of Christiaan Huygens. In 1754 the glass was sold for 18½ guilders as no. 27: *un autre [verre objectif] de 13 pieds avec son oculaire enchassé.*

In 1786 both glasses were bought by Anthony Dull Jansz, a wealthy member of the Amsterdam Society 'Felix Meritis', living on the 'Frankendaal' estate in Amsterdam. Dull made some extensive notes about his purchase. Having performed some experiments with the glasses, Dull concluded that the lenses needed 'a brass of tin tube' with four drawtubes, each 'having a length of about 3.5 feet'. After his death the two lenses were bought by the Felix Meritis physics department. The appendix of the 1835 inventory of scientific instruments of this society has the following entry: *Het objectief & het oogglas van een dertien voets kyker vervaardigd door Huygens, aangekogt in 1837 uit een gedeelte van het Legaat van A. Dull Jz: en zulks ter aandenking zo wel van de gever als van den grooten maker.* Following the dissolution of the society, most of its instruments were given to the University of Amsterdam. The eyeglass is now missing.

Oeuvres XV, 26; Felix Meritis Inventory 1835, no 27; Van Helden & Van Gent 1995, 23



7. 23827

Ocular glass for a telescope of c. 20 feet

1682-1687

w 0.5, Ø 3.3

Probably made by 'Meester Dirk' [van der Hoeven]

Cover sheet: N^{o} [~~179~~] ~~176~~ | 141 | Oogglas | voor en objectief van | 20 voeten | van 2¼ Duijm brantpunt | Een Oculair van 2¼ | duym brandpunt | goed voor een objectief van 20 Voeten | door Christiaan Huijgens N

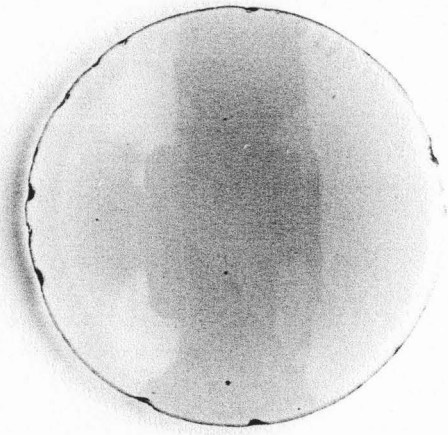
On the scale: 36

Provenance: Huygens family, 1656-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

H 3-36

Biconvex lens made of pinkish glass with a given focal distance of 2.25 inches (5.9 cm; measured 6.1 cm). According to Huygens's table, the measured focal distance implies that this ocular was suitable for an object glass of c. 18 feet.

Van Helden & Van Gent 1995, IV



8. 23831

Ocular glass for a telescope of c. 21 feet

1682-1687

w 0.5, Ø 3.5

Probably made by 'Meester Dirk' [van der Hoeven]

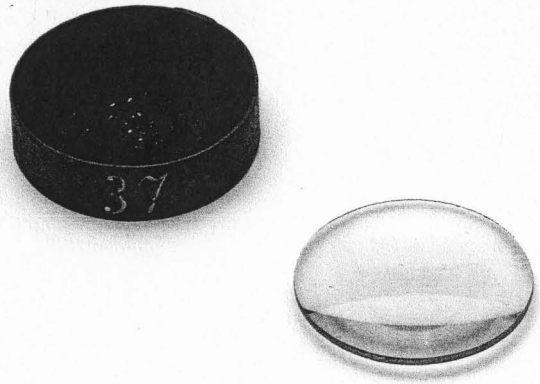
On the scale: 47

Provenance: Huygens family, 1656-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

H 3-47

Biconvex lens made of greenish glass with a measured focal distance of 6.5 centimetres, which is about 2.5 Rhineland inches. According to Huygens's table of optimal object/eyepiece combinations, the measured focal distance implies that this ocular was suitable for an object glass of c. 21 feet.

Van Helden & Van Gent 1995, IV



9. 23840

Ocular glass for a telescope of c. 25 feet

1682-1687

w 0.6, Ø 3.5

Probably made by 'Meester Dirk' [van der Hoeven]

Cover sheet: N^{o} 72 | omtrent 3 duym | Focus 2½ Duym Brantpunt | N^{o} ~~175~~ 140 | Voor een Objectief van 25 Voeten | Een Oculair van 2 ½ duijm brandpunt, goet voor een | objecttief van 25 voeten | door Christiaan Huijgens N

On the scale: 37

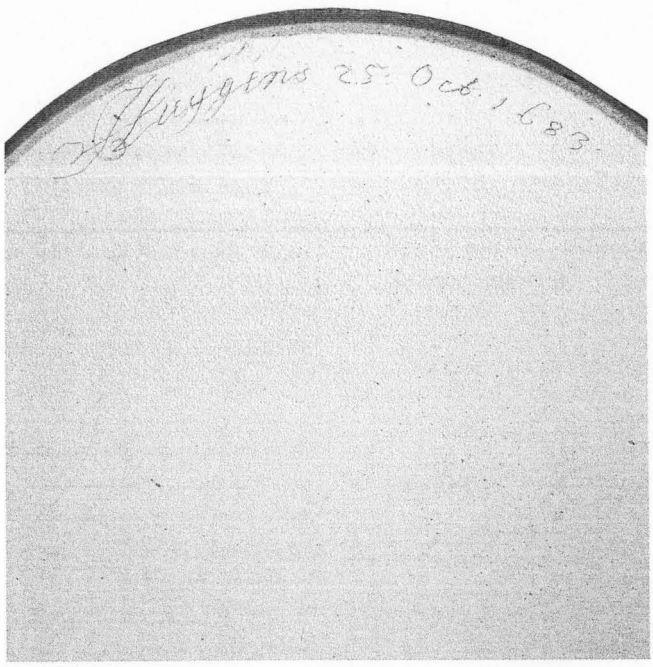
On the ring: 1660

Provenance: Huygens family, 1656-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

H 3-37

Biconvex lens of bluish glass with a focal distance of 2.5 inches (6.5 cm; measured 6.6 cm). According to Huygens's table of optimal object/eyepiece combinations, this implies the ocular was suitable for an object glass of c. 21 feet.

Van Helden & Van Gent 1995, IV



10. 9187

Object glass of 34 feet

1683

w 0.6 Ø 13.0

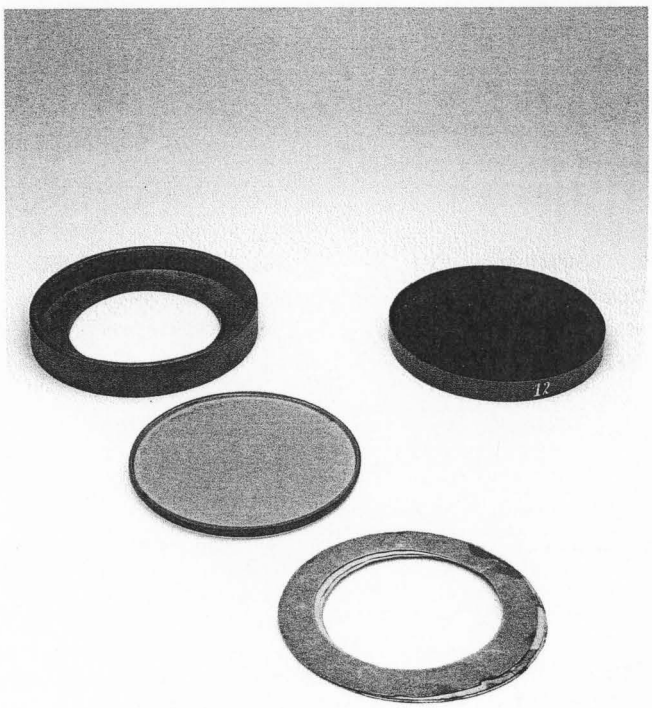
Signed: C Huygens 25. Ocb. 1683. | Ped 34.

Provenance: Huygens family, 1683-c. 1720; unknown, c. 1720-1920; Physics Laboratory University of Amsterdam, 1920-1926

A I-21, M 22bis

Biconvex lens made by Constantijn Huygens, using green-grey glass. The lens has a contemporary given focal distance of 34 feet (10.7 m) and a measured focal distance of 10.2 metres.
This 34-foot object glass is listed in the *Catalogus Der Glaesen tot de Verrekijkers* drawn up by Constantijn Lzn Huygens in about 1720. Soon after this catalogue was drawn up, the lens must have been removed, for it does not appear in the list compiled by Jan van Musschenbroek only a short time later. In the 1920s the lens emerged at the physics laboratory of the University of Amsterdam. Nothing is known of its whereabouts in the intervening years, apart from the fact that its associated eyepiece was lost.

Oeuvres XV, 26; Van Helden & Van Gent 1995, 26



11. 9195

Object glass of 34 feet

1683

w 0.7, Ø 11.6

Signed on the lens: C Huygens 13. nov. 1683.

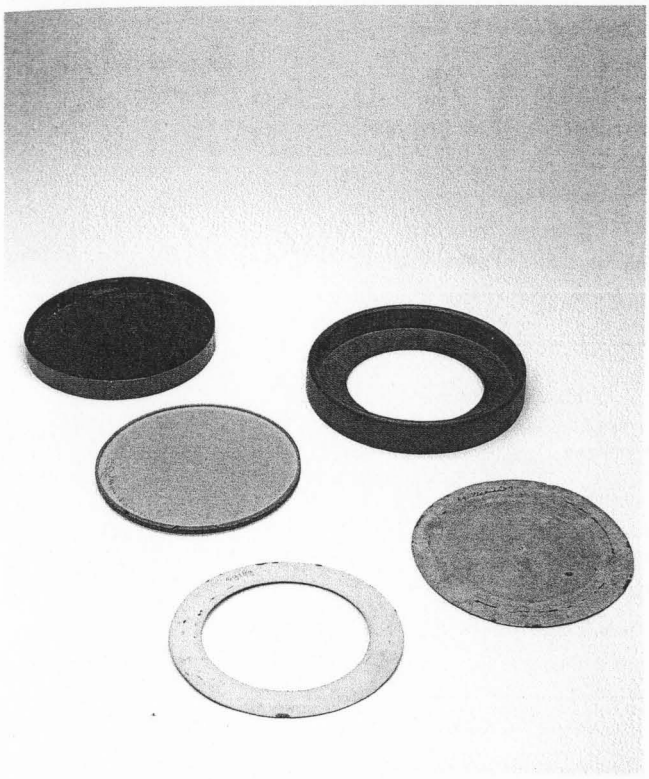
Diaphragm: 13 nov. 1683. | Ped. 34

Provenance: Huygens family, 1656-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

A I-23, B 23, C 20, H 3-12

Biconvex lens ground by Constantijn Huygens, using greyish glass supplied by an unknown Amsterdam merchant. In April 1683 Christiaan Huygens had compared this material with glass supplied by the London glass maker Christopher Cock, after which he concluded that glass obtained from Amsterdam was slightly clearer than the English glass. The lens has a contemporary given focal distance of 34 feet (10.7 m) and a measured focal distance of 10.2 metres. According to a list made by C.A. Crommelin, this lens was originally accompanied by a cover sheet reading *'13 Nov, 1683. | 118 . | Ped. 34'*. The glass was sold with its ocular (of c. 3 inches) for 16 guilders in 1754.

Oeuvres, VIII, 422 ; Van Helden & Van Gent 1995, 24-25; 1998, 72-73



12. 9189

Object glass of 34 feet

1683

w 0.6, Ø 11.6

Lens: C Huygens 14. nov. 1683.

Cover sheet: 14. nov. 1683. | (in pencil) Huigens

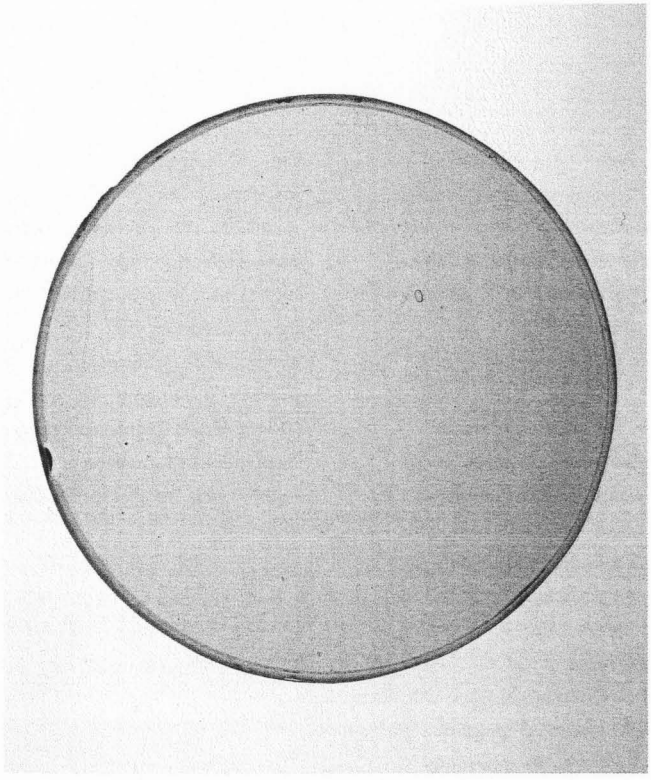
Diaphragm: 14. nov. 1683. | Ped 34.

Provenance: Huygens family, 1683-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

A 1-22; B 22, C 19, H 3-11

Biconvex lens made by Constantijn Huygens, using greenish glass. The lens has a contemporary given focal distance of 34 feet (10.7 m), with a measured focal distance of 10.1 metres. Like all other 34-foot object glasses, this lens was originally accompanied by a 3-inch ocular.

Van Helden & Van Gent 1995, 24-25



13. 9190

Object glass of 34 feet

1683

w 0.7, Ø 13

Lens: Ped. 34. Chr. Hugenius F.A^{o} 1683. 19 Nov.

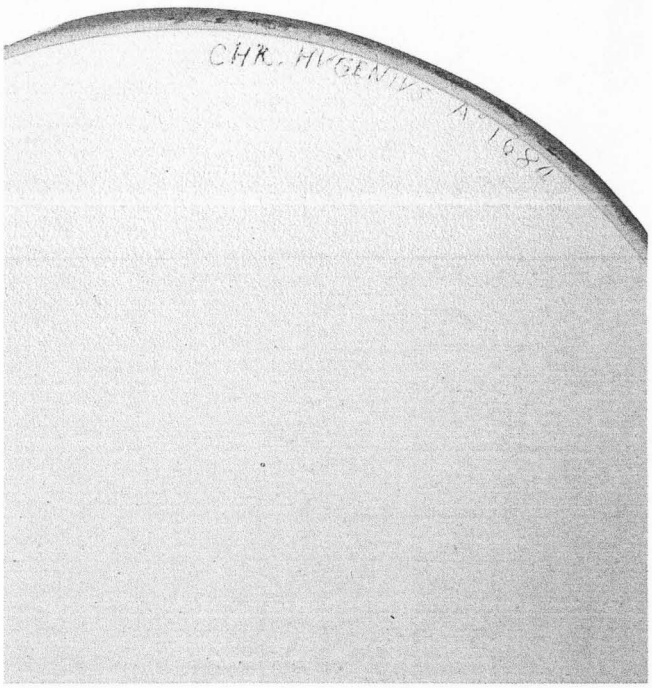
Cover sheet: Objectief-glas | van | 34 voet focus | gesleepen | door | Chr. Hugenius | 29 novb. 1683.

Provenance: Huygens family, 1683-c. 1722; W.J. 's-Gravesande, c. 1722-1742; Leiden Observatory, 1742-1931

A 1-19, H 3-14

Biconvex lens made by Christiaan Huygens, using greenish glass, supplied by a merchant living in Amsterdam. The lens has a focal distance of 34 feet (10.7 m; measured c. 10.1 m). In 1719 the Leiden professor W.J. 's-Gravesande assisted the Huygens family in preparing an inventory of all the Huygens instruments. Three years later he was an intermediary in the sale of two lenses to London, where they eventually ended up at the Royal Society. Probably on this occasion 's-Gravesande acquired a Huygens lens for his own cabinet. Following 's-Gravesande's death in 1742, the objective was bought by Leiden University, together with all the apparatus in his cabinet of scientific instruments. This *voorglas van een kijker door DH Huygens gemaakt* was transferred to the observatory, where it was stored with the other glasses.

Molhuysen IV, 311; V, 141; Kaiser 1846, 406-407; Catalogue 1929, afb. 4; Van Helden & Van Gent 1995, 24-25; 1998, 73; De Clercq 1997, 105*



14. 9110

Object glass of 34 feet

1684

w 0.6, Ø 13.0

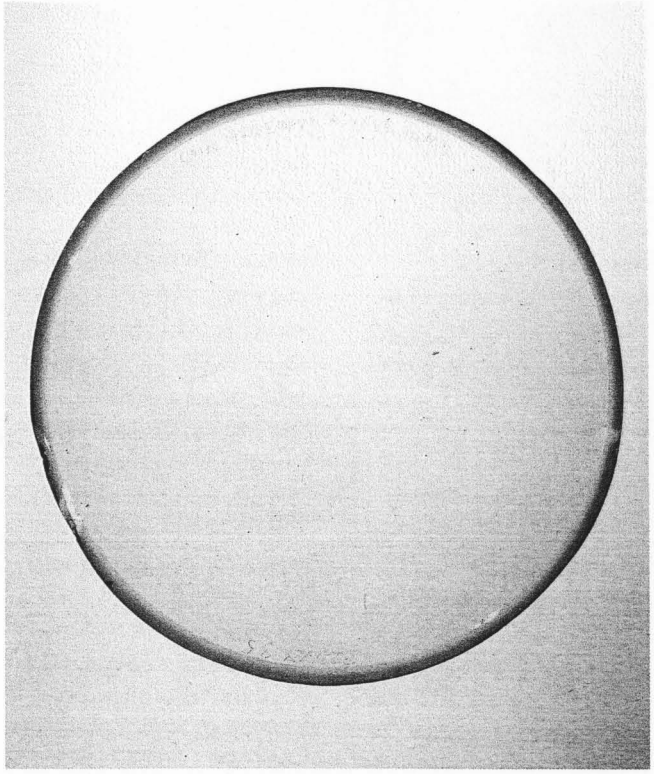
Signed: CHR. HVGENIVS. Ao. 1684. | PED. 34

Provenance: Huygens family, 1656-1754; [J. Royer, 1754-1783?]; A.J. Royer, 1783?-1809; Leiden University, 1809-1931

A I-20, C 21, H 3-15

Biconvex lens made by Christiaan Huygens, using bluish glass. The lens has a contemporary given focal distance of 34 feet (10.7 m), with a measured focal distance of 10.1 metres. From the *Catalogus der Glaesen* (c. 1720) it is known that this object glass was never mounted for actual use and did not have an accompanying eyeglass. It was sold for 12 guilders in 1754.

Van Helden & Van Gent 1995, 24-25



15. 9108

Object glass of 35 feet

1683

w 0.6 Ø 11.5

Signed on lens: CHR. HVGENIUS Ao. 1683. 10 Maj. | PEDVM 35.

Diaphragm: A^{o} 1683 | 10 Maji | Pedum 35

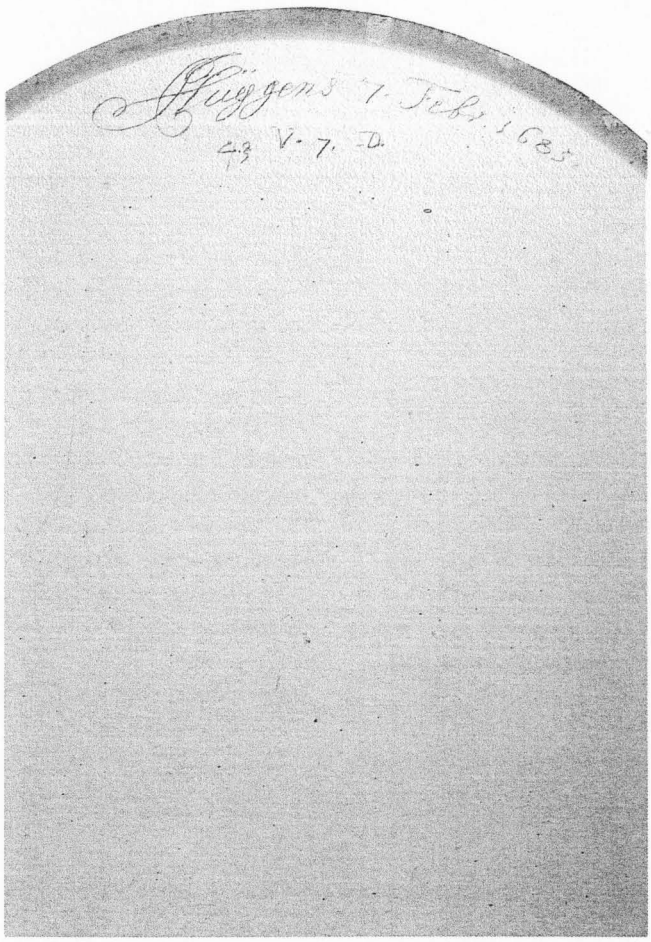
Provenance: Auction H.G. Bom, Amsterdam 1889; Leiden University, 1889-1931

H 3-13

Biconvex lens by Christiaan Huygens, using yellowish glass, which *glace de Venise* material had been supplied by the Leiden instrument maker Johan van Musschenbroek. According to Huygens' letter of 27 April 1683, he regretted the glass plaquette was too small to grind a 36-foot objective. He apparently succeeded in using the material for a lens with a focal distance of 35 feet (11.0 m).

As this lens is not mentioned in any of the inventories made by the Huygens brothers, the lens must have been parted from the family collection before the first list was drawn up in about 1720. On 2 December 1889 this *'antieke ronde glazen schijf, gemerkt Chr. Hugenius, Ao. 1683, 10 Maj. Pedum 35'* was offered for auction in Amsterdam, where it was bought for Leiden University.

Oeuvres VIII, 422; GAA: Catalogus 1889, no. 340; Verslag 1890, 7; Van Helden & Van Gent 1995, 26



16. 9193

Object glass of 43 feet and 7 inches

1685

w 0.7, Ø 14.5

Lens: C. Huijgens, 7. Febr. 1685 | 43 V. 7. D.

Cover sheet: [7.] Febr. 1685 | 117 | Ped 43 ½ .

Diaphragm: 7.Febr. 1685 | Ped. 43 ½ .

Provenance: Huygens family, 1685-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

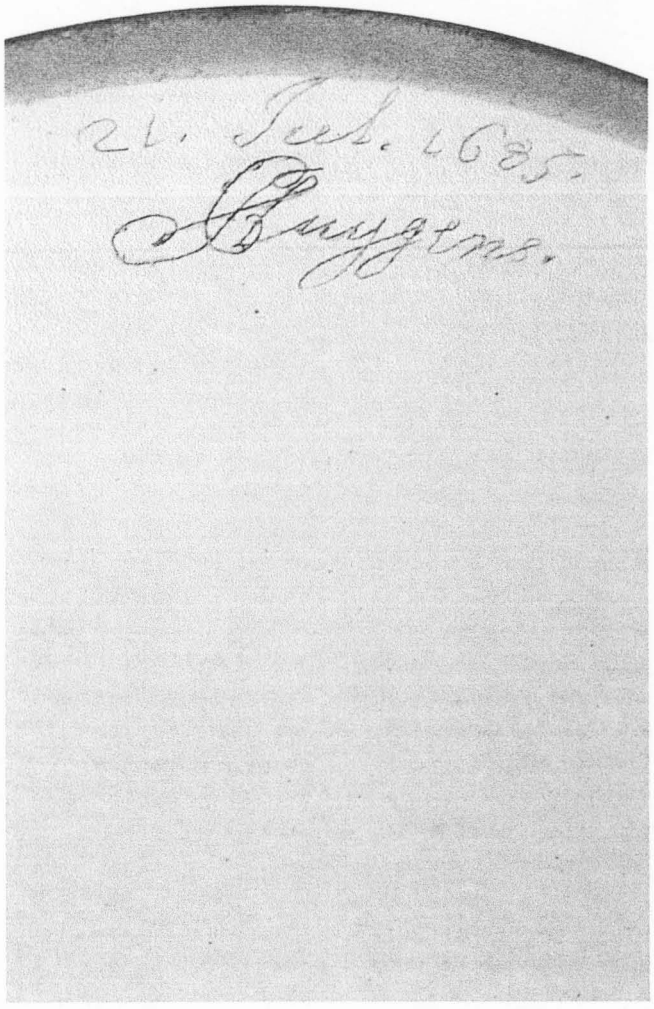
A 1-13, B 15, C 13, H 3-9

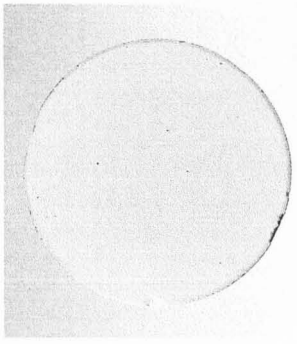
In order to avoid achromatic and spherical aberration, lenses of small curvature must be used. As a result these lenses have a long focal length. Consequently, the telescopes of the 17th century became longer and longer, with their tubes bending under their own weight. In 1684, in his *Astrocopia Compendiaria*, Christiaan Huygens proposed making telescopes without a tube. These, so-called *buysloze kykers* or tubeless telescopes, needed only an object glass on a console, which could be hoisted onto a mast, where this object lens was controlled by a string. An ocular on a tripod support completed this arrangement, in which both lenses had a ball-and-socket joint, providing the possibility of movement in any direction.
Starting in November 1683 Huygens made several observations with this kind of telescope, using object glasses from 34 feet (10.7 m) up to 122 feet (38 m). The latter arrangement needed a mast up to 33 metres in height. This length made the 'tubeless' telescope extremely sensitive to wind and therefore the aerial telescope was not very practical. So in September 1693 Christiaan abandoned his *Astrocopia Compendiarium* or tubeless telescope arrangement, returning to a large telescope tube with an old 44½-foot object glass, placing the centre of gravity of his nicely crafted four-sided wooden tube on a newly designed wooden stand.

Biconvex lens made by Constantijn Huygens, using dark grey glass, with a contemporary focal distance of 43 feet and 7 inches (13.7 m), with a measured focal distance of 14.3 metres. In 1754 the glass was sold for 24 guilders as no. 13: *Un Verre Objectif de 5 ½ pouces de Diametre pour un Telescope de 43 ½ pied avec son Oculaire, enchassé*. The ocular is now missing. The number 117 on the cover sheet probably refers to the 1786 auction catalogue.

On 11 February 1685 Christiaan Huygens used a 43-foot glass 'made by my brother' to observe the planet Saturn 'without a tube'. This was probably this object glass. Earlier, in 1699, he already had ground a 45-foot objective.

Oeuvres VI, 480; X, 478-480; 488; XV, 18-19, 145-146, 151, 160-161, 232-233; Van Helden & Van Gent 1995, 27





17. Object glass and ocular glass for an aerial telescope of c. 43/44 feet

Provenance: Huygens family, 1685-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

a. 9194

Object glass

1685

w 0.7, Ø 14.0

Lens: 21. Jul. 1685 | C. Huygens, Ped. 43

Cover sheet: 21. Jul. 16[85] | 116 | Ped [43.]

Diaphragm: 21. Jul. 1685 | Ped. 43. A I-14, B 16, C 14, H 3-10

On 27 June 1685 Constantijn wrote to his brother that he had made great effort to 'grind again an object glass of 44 feet', because his earlier lens (perhaps number 9193) contained too many veins. For this glass he used greyish English glass.

The lens has a contemporary given focal distance of 43 feet (13.5 m), with in fact a longer measured focal distance of 14.1 metres.

b. 23822

Ocular glass

1685

w 0.4, Ø 4.0

Probably made by Dirk van der Hoeven

On the scale: 35

H 3-35

In his letter of 27 June 1685 Constantijn asks his brother to bring some glass to 'the man [living] at the Achterom', [= Mr Dirk van der Hoeven], apparently to grind this eyeglass for the new '44-foot' objective he was in the process of grinding. Master Dirk used yellowish glass, with a measured focal distance of 10.5 centimetres, which is about 4.0 Rhineland inches.
According to Huygens's table of optimal object/eyepiece combinations, an object glass of 43 feet needed an ocular glass with a focal distance of 3.6 inches, which reasonably fits the measured distance.

According to an old list from Leiden Observatory, this ocular was originally accompanied by a sheet reading *Oculaire de 4 pouces pour 43? pieds | N^{o} 11 | 116*. The number 11 was probably misread for 14, which refers to both the 'Catalogus Der Glaesen' from about 1720 and to the auction catalogue of 1754, when this set was sold for 28 guilders.

Huygens, Oeuvres IX, 14; Van Helden & Van Gent 1995, 27

18. 9183

Ocular glass for a 'tubeless' telescope of c. 60 feet

1684-1687

I 15, Ø 5.5

Probably made by Dirck van der Hoeven

On the tube: 44

On a label: 27[and] 1671

Provenance: Huygens brothers, c. 1684-c. 1690; Leiden Observatory, c. 1690-1931

H 3-44

Together with the next item (cat. no. **19**) this eyeglass was mentioned in the 1742 Leiden Observatory inventory as *eenige stukken tot de machine uit de astrocopia compendiaria van Huygens* (or 'some pieces from the apparatus mentioned in Huygens's *Astrocopia Compendiaria*). Both eyepieces were acquired for Leiden Observatory, probably in the 1690s, at a time when Christiaan Huygens had returned to the Netherlands from Paris and the two brothers became engaged in activities other than grinding lenses. Round biconvex lens (Ø 4.8) of greenish glass with a measured focal distance of 11.0 cm (c. 4.2 Rhineland inches), mounted in an iron plate tube, painted black. According to the table of optimal object/eyepiece combinations, the measured focal distance implies that this ocular was suitable for an objective of c. 59 feet. Indeed, in a letter of 23 April 1685 Christiaan mentions an ocular glass of 4.5 inches that belonged to a 60-foot object glass.

Van Helden & Van Gent 1995

19. 9182

Ocular glass for an aerial telescope of c. 85-90 feet

I 12, Ø 6

1684-1687

Probably made by Dirck van der Hoeven

On the tube: 43

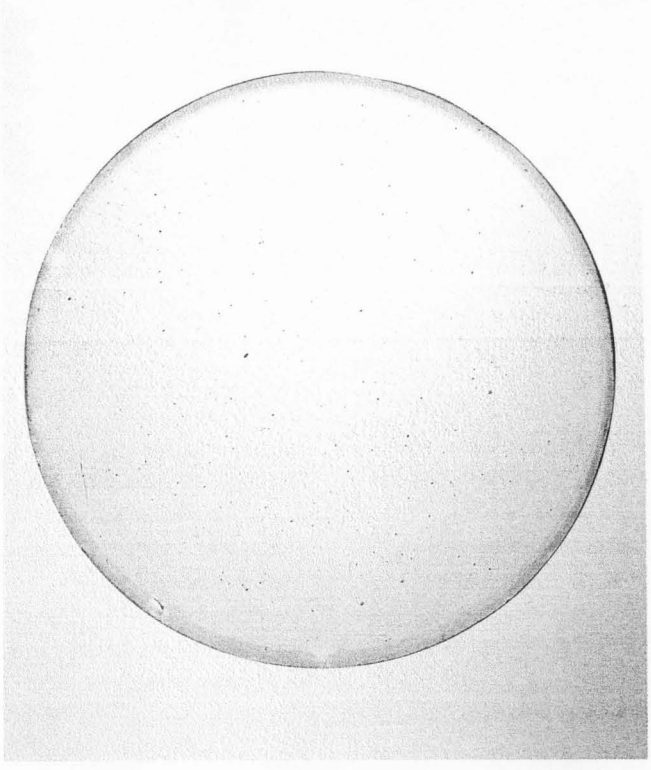
On a label: 26

Provenance: Huygens brothers, c. 1684-c. 1690; Leiden Observatory, c. 1690-1931

H 3-43

The correspondence of the Huygens brothers from the period 1682-1687 reveals that most oculars were ground by Dirck van der Hoeven living at the Achterom in The Hague, nicknamed the *schoorsteenveger* ['chimney sweep']. He worked with grinding scales delivered by the Huygens brothers. Round biconvex lens (Ø 5.6) of yellowish glass with a measured focal distance of 13.7 cm (c. 5.2 inches), mounted in an iron plate tube, painted black. According to Huygens's table of optimal object/eyepiece combinations, the measured focal distance implies the ocular was suitable for an object glass of c. 90 feet. However, in a letter of 23 April 1685 Christiaan Huygens mentions his desire to fit an 84-foot object glass with an eyeglass of 5.3 inches, so a smaller value was also used.

Oeuvres IX, 6; Kaiser 1846; Van Helden & Van Gent 1995, 32



20. 23838

Object glass of 62 feet

1687

w 0.8, Ø 14.8

Cover sheet: 14 Febr. 1687. | 113 | Ped 62.

Diaphragm: 14. Febr. 1687. | Ped. 62.

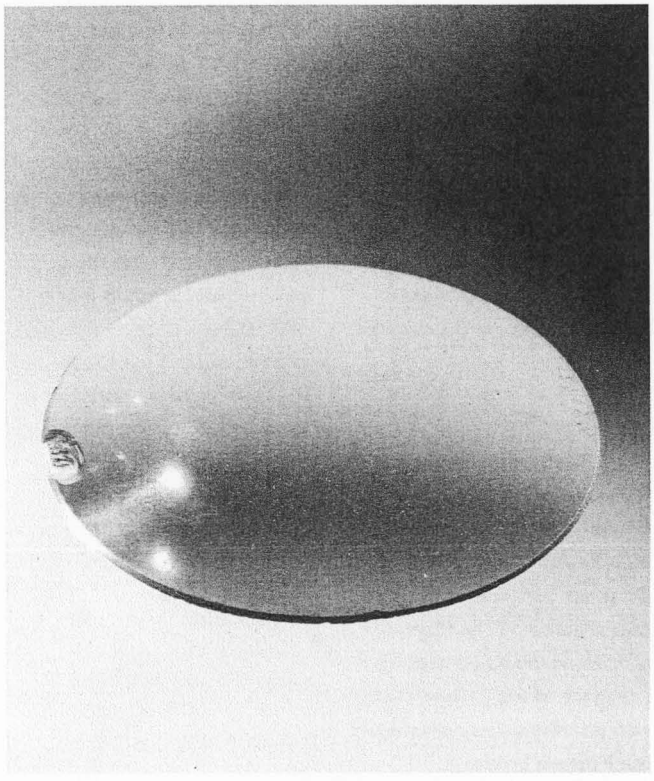
Provenance: Huygens family, 1687-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

A 1-9, B 12, C 10, H 3-8

Of all the Huygens object lenses preserved, this is the last one made. Father Huygens died just six weeks after the completion of this lens and after this event the brothers were never engaged in lens making again. The last lens mentioned in the Huygens papers, an object glass of 42 feet, ground on 31 March 1687 'on Spinoza's laps', has not been preserved.

Plano-convex lens made by Constantijn Huygens, using whitish glass. The lens has a contemporary given focal distance of 62 feet (19.5 m), with a measured focal distance of 19.7 metres. In 1754 the glass was sold for 31½ guilders.

Oeuvres XXII, 732; Van Helden & Van Gent 1995, 28



21. 23821

Ocular glass for a telescope of c. 83 feet

1680-1700

0.4, Ø 4.3

On the scale: 46

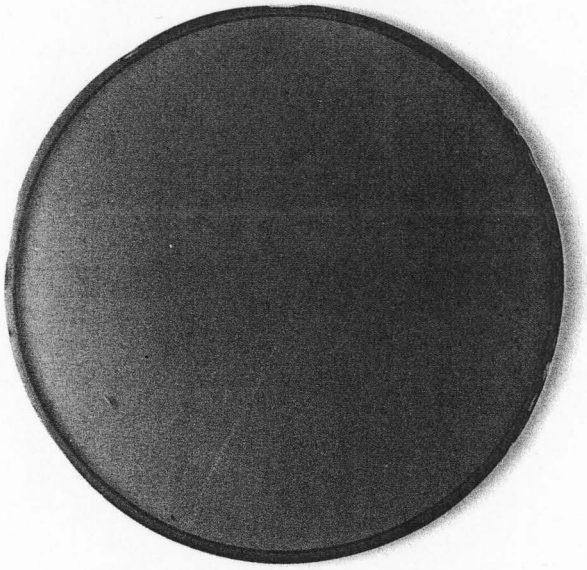
Provenance: Leiden Observatory, ?-1931

H 3-46

According to museum records, this eyeglass belongs to the Huygens collection, but as the glass was not ground from moulds made by the Huygens brothers, its provenance is uncertain.
However, according to Huygens's table of optimal object/eyepiece combinations, the focal distance of c. 5 inches implies that this ocular was suitable for an object glass of c. 83 feet, a measure frequently used by the Huygens brothers. The oldest *Catalogus der Glaesen* from 1720 mentions several *'glaesen voor verrekijkers van verscheijdene grootte'*.

Biconvex lens made of yellowish glass having a measured focal distance of 13.0 cm, which is about 5.0 inches.

Van Helden & Van Gent 1995, IV



22. 23845

Object glass of c. 85 feet

c. 1685

w 0.8, Ø 16.1

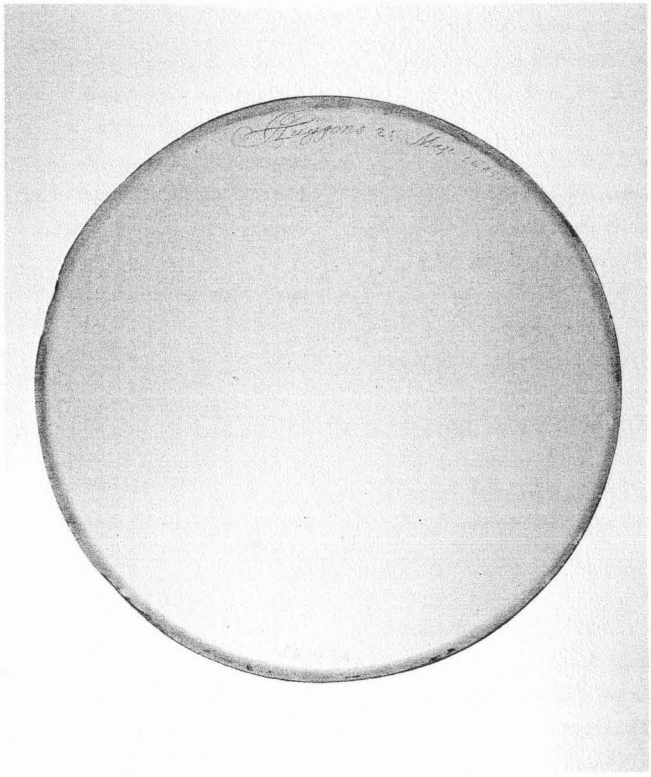
Provenance: Huygens family, 1685-1754; [J. Royer, 1754-1783?], A.J. Royer, 1783?-1809; Leiden University, 1809-1931

A II-8, B 39, C 35, H 3-5

By 8 September 1684 Christiaan Huygens was wanting to produce an object lens of about 86 feet. In 1685 two 84/85-foot glasses were ground, one by Constantijn (see next item, cat. no. **23**), the other by Christiaan. Perhaps this object glass is the 84-85 glass that Christaan Huygens reported on 23 April 1685 as having used to observe the heavens for three days at the request of some friends. On the occasion of these observations the lens was accompanied by a six-inch eyepiece. In August 1685 he writes that 'the glass of 85 feet deserves more work', so perhaps an earlier signature has been removed by a new polishing process.

Biconvex lens of green-greyish glass. The lens has no contemporary given focal distance, but has a measured focal distance of 26.9 metres, or in old measure about 85.6 feet. There is no accompanying cover sheet, nor diaphragm, but Van Helden & Van Gent have shown convincingly that the lens was made with the same moulds as other Huygens lenses.

Oeuvres IX, 6, 12, 18; XV, 153-154; Van Helden & Van Gent 1995, 29



23. 9188

Object glass of 85 feet

1685

w 0.7, Ø 16.1

Lens: C. Huijgens, 21 Maji 1685. | PED. 85.'

Cover sheet: 2[1] Maji 1685 | [in pencil] 85 v | iii | Ped 8[5].

Diaphragm: 21. Maji 16[8]5.

Provenance: Huygens family, 1656-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

A I-6, B 9, C 7, H 3-6

On 23 June 1685 Christiaan Huygens wrote to his brother that he had examined this glass, which he had found 'to be good'.

Biconvex lens made by Constantijn Huygens, using greenish glass. The lens has a contemporary given focal distance of 85 feet (26.7 m), with a measured focal distance of 27.6 metres. In 1754 the glass was sold for 36½ guilders as no. 7: *Un Verre Objectif de 6 pouces de Diametre, avec son Oculaire, pour un Telescope de 85 pieds, enchassé.*

Oeuvres IX, 12-13; Van Helden & Van Gent 1995, 29

24. 9192

Object glass for an astronomical telescope of 84 feet

1686

w 1.1, Ø 18.0

Signed: C. Huijgens, 19 Jun. 1686 | Ped. 84.

Cover sheet: [19 Jun.] 16[8]6. | 112 | Ped 84.

Diaphragm: 19.Jun. 1686. | Ped. 84.

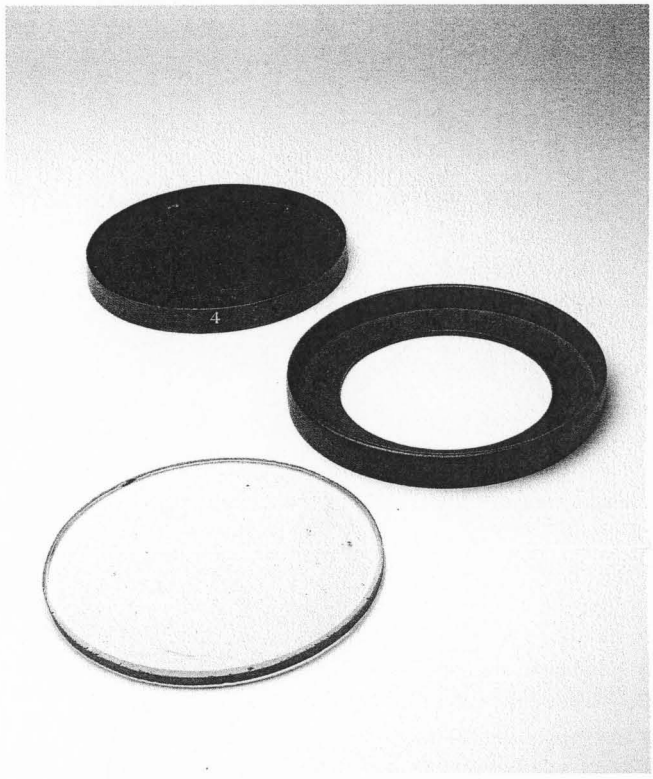
Provenance: Huygens family, 1686-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

A I-7, B 10, C 8, H 3-7

Biconvex lens made by Constantijn Huygens, using whitish glass. The lens has a contemporary given focal distance of 84 feet (26.4 m), with a measured focal distance of 26.2 metres.
In 1754 the glass was sold for 32 guilders as no. 8: *Un Verre Objectif de 7 pouces de Diametre, pour un Telescope de 84 pieds, avec son Oculaire, enchassé.*

The paper sheet of a six-inch ocular glass is also preserved, reading: *Oculaire de 6 p[ouce] | pour 84 pieds | No. 112* . This focal length is one inch more than prescribed in Huygens's table of optimal object/eyepiece combinations.

Van Helden & Van Gent 1995, 29



25. 23839

Object glass for an astronomical telescope of c. 85 feet

1686

w 0.9, Ø 17.8

Lens: [1]8 Juli 1686

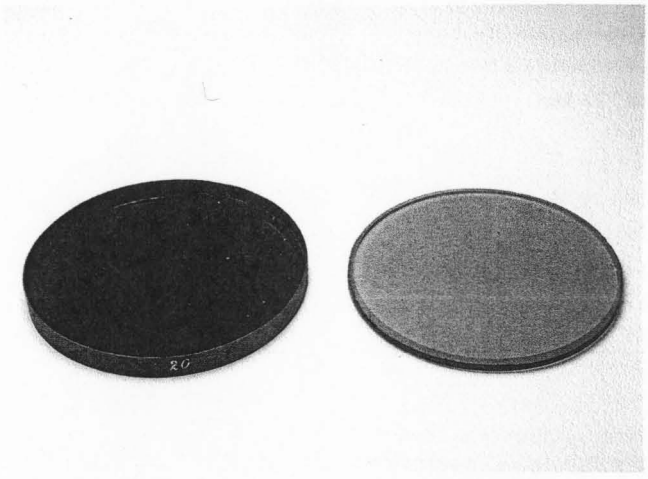
Cover sheet: Objectif] de 85 pieds. [8]5 voeten | 18 Junij 1686 | No ?? 34.

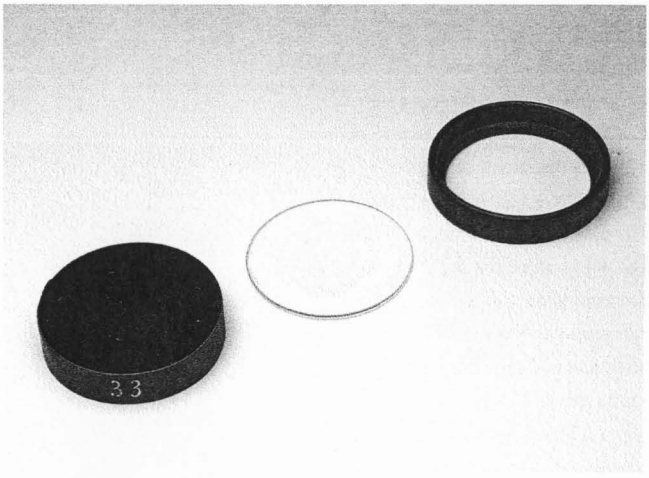
Provenance: Huygens family, 1686-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

A II-7, B 38, C 34, H 3-4

Biconvex lens made by the Huygens brothers, using white-greenish glass. The lens has no contemporary given focal distance, but has a measured focal distance of 26.6 metres, or in old measure about 85 feet. The number 34 refers to the 1754 auction catalogue, when the glass was sold for six guilders as: *Un Verre Objectif de 7 pouces de Diametre, pour un Telescope de 85 pieds, sans Oculaire*. The difference in date between the lens and the cover must be attributed to a writing error.

Van Helden & Van Gent 1995, 29





26. Object glass and eyeglass for an astronomical telescope of 120 feet

Provenance: Huygens family, 1686-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

a. 23844

Object glass

1686

w 0.9, Ø 18.7

A II-4 & 6, B 5-7, C 4-5, H 3-20

Biconvex lens made by the Huygens brothers, using green-greyish glass. The lens has a contemporary given focal distance of 120 feet (37.7 m; measured 39.0 m). There are two cover sheets in the handwriting of Constantijn Huygens Lzn that may go with this lens, the first reading: *120. Pieds. | 29e Januarij 1686 | No 6 4 110* and the second: *120. Pieds. | 1e Febr 1686 | No 4 5 109*. The first erased number corresponds to the *Catalogus der Glaesen* made in about 1720. The second erased number is from the 1754 auction catalogue and the last number probably refers to the – now missing – 1786 auction catalogue of Suzanna Huygens. In 1754 the two glasses were sold for 39 and 41 guilders.

b. 23832

Ocular glass

1686

w 0.7, Ø 6.4

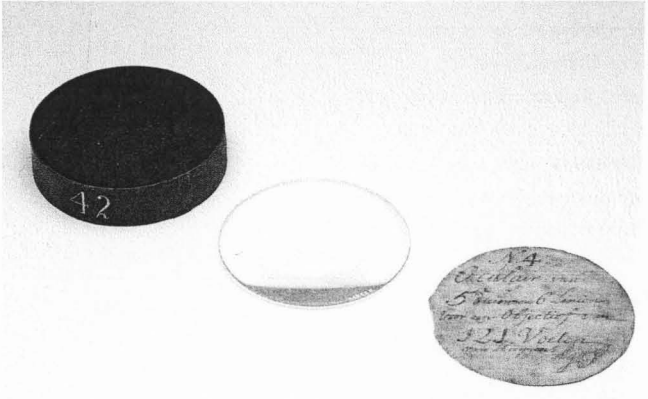
Cover sheet: [Ocu]lair van 6 ½ [duym. Tot] 120 voet [| N⁰ 64 | 110 | oculair pour 120 pieds].

On the scale: 33

H 3-33

On 4 April 1686 Constantijn Huygens wrote to his brother that he desired an eyeglass for his 120-foot objective with a somewhat larger diameter than they usually chose. Indeed, this biconvex eyepiece of whitish glass has a larger diameter (6.4 cm) than the eyeglass cat. no. **17a** (4.0 cm). The eyepiece has a given focal distance of 6 inches (15.7 cm; measured 16.3 cm).

Van Helden & Van Gent 1995, 30



27. 23834

Ocular glass for an aerial telescope of 120-122 feet

1686-1687

w 0.7, Ø 6.1

Cover sheet: N⁰ 4 | Oculair van | 5 duimen 6 linien | voor een Objectief van | 121 Voeten | van Huygens | Obje

On the scale: 42

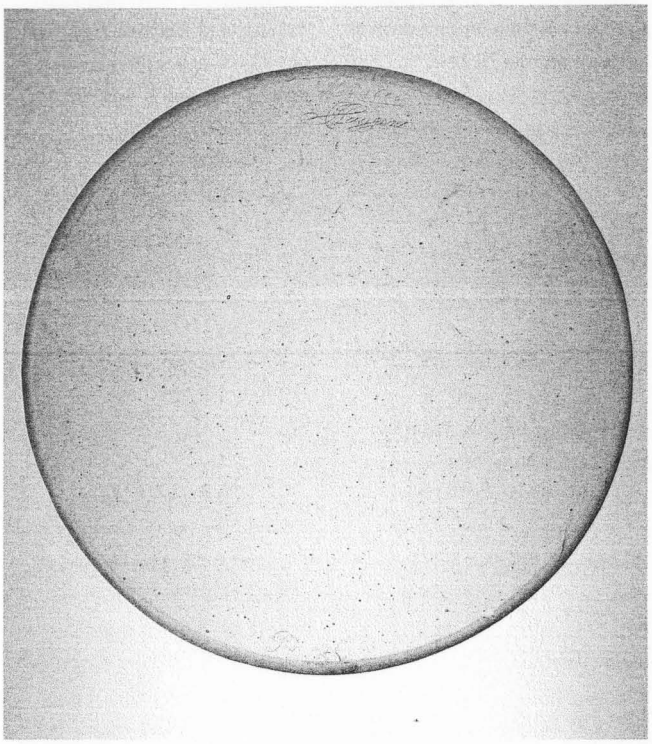
Provenance: Huygens family, 1686-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

H 3-42

As the Huygens brothers never ground an object glass of 121 feet, this eyeglass probably functioned as a spare ocular for the 120-foot object lens (cat. no. **260**).

Biconvex lens made of whitish glass with a contemporary given focal distance of 5.3 inches (13.9 cm) and a measured focal distance of 13.7 cm.

Van Helden & Van Gent 1995, IV



28. 9186

Object glass of an astronomical telescope of 122 feet

1686

w 1.3, Ø 19.7

Lens: 10. May 1686 | C Huijgens | Ped. 122.

Cover sheet: Maji [...] | ~~108~~ | No 178 | Ped. 122.

Diaphragm: 10. May 1686.

On the scale: I

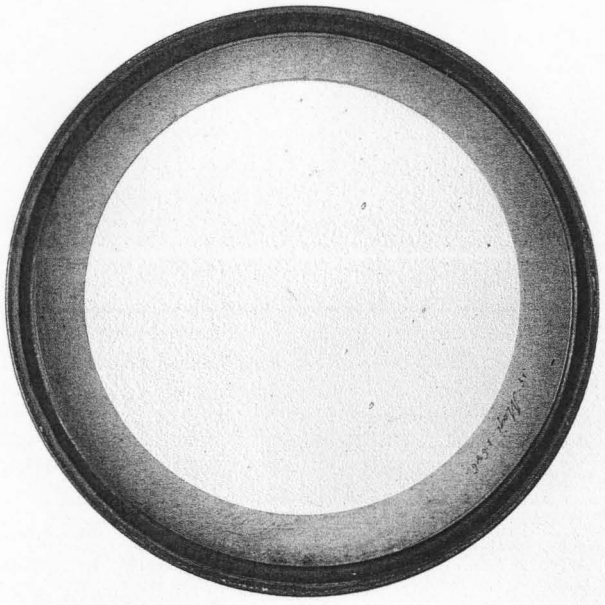
Provenance: Huygens family, 1686-1786; unknown, 1786-?; H. Veder, ?-1894; Leiden University, 1894-1931

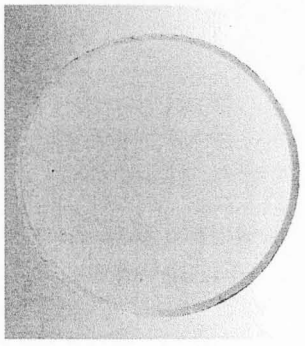
A 1-3, B 3, C 1, H 3-1

On 6 April 1686 Christiaan Huygens wrote to his brother that after his leave he had tried his 'two glasses, one of 122 and the other of 85 feet, which I have found to be good'. He only had some trouble with the erection of the mast, necessary for the aerial telescope arrangement. Shortly afterwards Constantijn also made three 122-foot object glasses. These lenses are all preserved, one (dated 4 June 1686) being at the Royal Society in London, the other two being preserved in Museum Boerhaave. As far as we know only Christiaan made astronomical observations with a 122-foot aerial telescope. Christiaan observed the planet Jupiter on at least two occasions during the month of May 1686.

Biconvex lens made by Constantijn Huygens using colourless glass, fitted in a metal scale. The lens has a contemporary given focal distance of 122 feet (38.8 m), with a measured focal distance of 39.4 metres. In the 1754 auction this object glass was sold with its eyeglass for 38½ guilders as no. 1: '*Un Verre Objectif de 7½ pouces de diametre, pour un Telescope de 122 pieds avec son Oculaire, encasse dans un Cercle de fer-blanc*'. In 1894 the object glass was presented to Leiden Observatory from private ownership.

Oeuvres X, 51, 159-160; Van Helden & Van Gent 1995, 31





29. Object glass and ocular glass of an astronomical telescope of 122 feet

Provenance: Huygens family, 1686-1786; A.J. Royer, 1786-1809; Leiden University, 1809-1931

a. 9191

Object glass of 122 feet

1686

h 1.0, Ø 19.3

Lens: 15. May 1686. | C Huygens. | Ped. 122.

Cover sheet: 15 Maji 1686 | [...] | 107 | Ped 122

On the scale: 2

A 1-4, B 4, C 2, H 3-2

Round biconvex lens ground by Constantijn Huygens, using greenish glass supplied by a London-based merchant. The lens has a contemporary given focal distance of 122 feet (38.8 m), with a measured focal distance of 39.1 metres. In 1754 this glass was sold for 37 guilders.

b. 23833

Ocular glass of tubeless telescope of 122 feet

1686

w 0.5, Ø 5.9

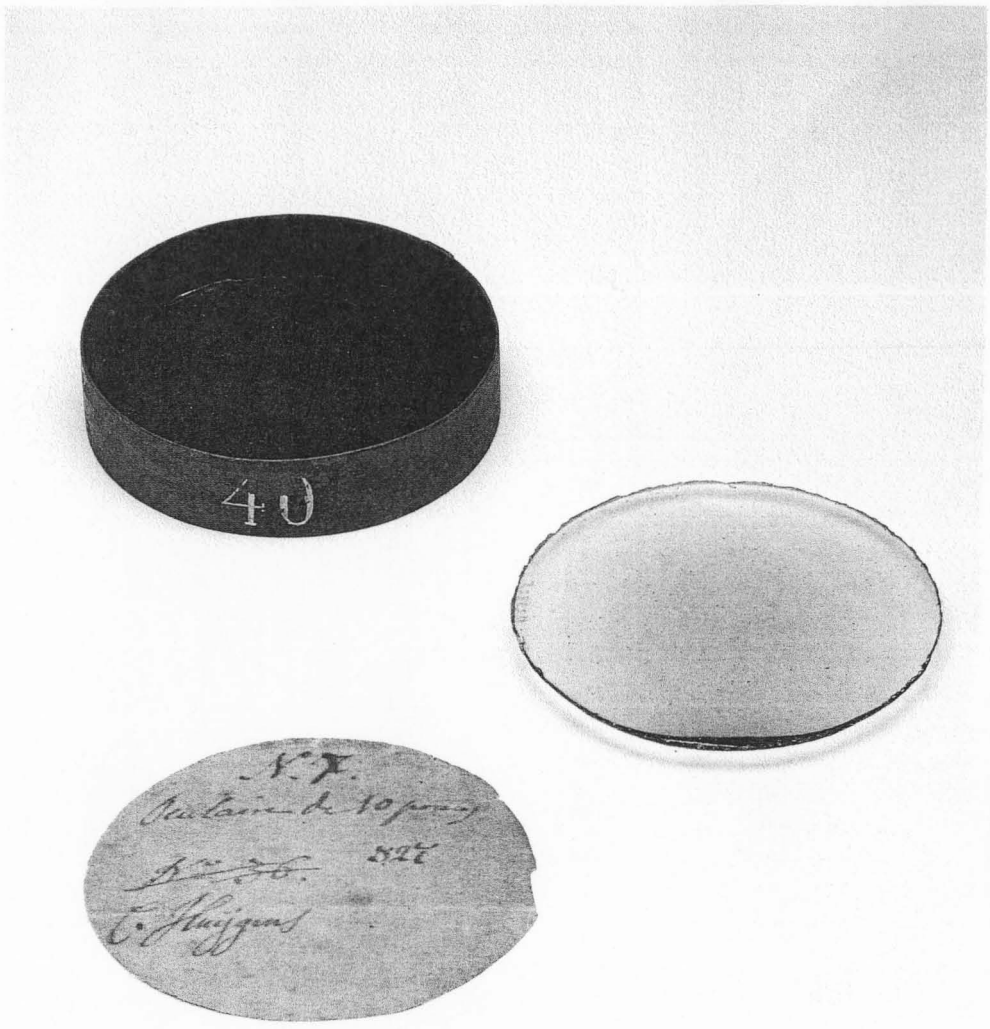
Cover sheet: N.1. | Oculair van 7 ½ duim | voor een Telescoop | van 122 voeten, van | d. Hr Christiaan Huigens.

On the scale: 31

H 3-31

Round biconvex lens of yellowish glass, with a contemporary given focal distance of 7.5 inches (19.6 cm) and a measured focal distance of about 21.0 cm. According to Huygens's table of optimal object/eyepiece combinations, an object glass of 122 feet would need an ocular glass with a focal distance of 6.1 inches.

Kaiser 1846; Van Helden & Van Gent 1995, 31 & IV



30. 23825

Ocular glass for a telescope of c. 325 feet

c 1680-1700

w 0.56, Ø 6.9

Cover sheet: N^{o} 7 | Oculair de 10 pou[ce], 327 | ~~N^{o} 36~~ | C. Huijgens.

Provenance: Leiden Observatory, ?-1931

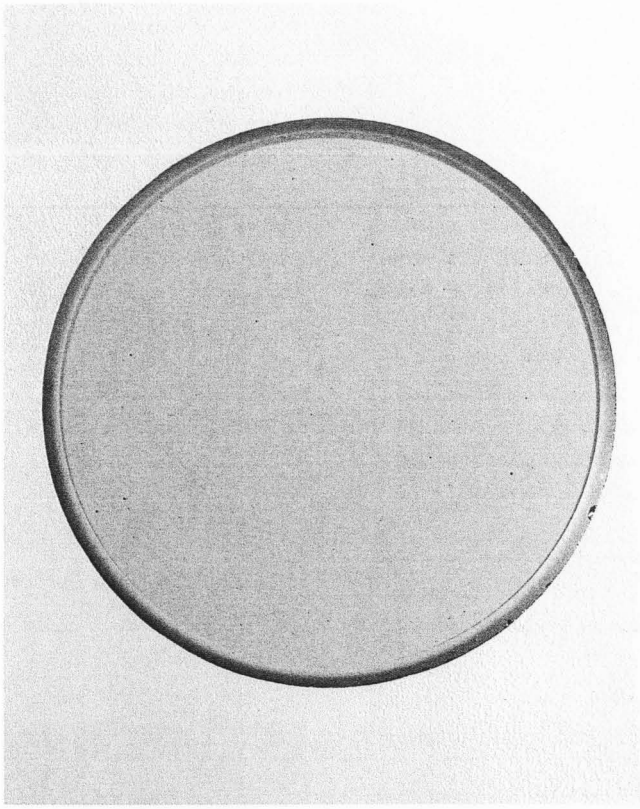
C 36?, H 3-40

Biconvex lens roughly made of grey glass with a measured focal distance of 26.0 cm, which is about 9.9 inches. According to Huygens's table of optimal object/eyepiece combinations, the focal distance of c. 10 inches implies that this ocular was suitable for an object glass of c. 325 feet. However, the object glass with the largest focal length ground by the Huygens brothers was 210 feet, so perhaps this glass was unfinished or it served other purposes.

According to tradition, the lens was part of the Huygens collection, although Van Helden & Van Gent have demonstrated that the curvature of this eyeglass does not match those of other Huygens oculars, so a positive identification cannot be given. However, according to the preserved cover sheet, the glass was part of number '36' of the 1754 auction of Huygens lenses, described as: *Un grand Verre Objectief avec son Oculaire, enchassé'*. The set was sold at the time for 7 guilders.

Van Helden & Van Gent 1995, IV

B. Other glasses for astronomical telescopes



31. Object and ocular glass for an astronomical telescope of c. 16 feet

Provenance: Leiden Observatory, ?-1931

a. 23823

Object glass

c. 1700

w 0.46, Ø 6.7

On a paper sheet: 25

H 3-25

Biconvex lens made of greenish glass, with a measured focal distance of 4.76 metres, which is about 16 feet. A metal scale was made at Leiden Observatory at a later date. Perhaps this object glass was one of the objective lenses mentioned in the 1793 Leiden Observatory inventory: '*8 objectiefglasen van 7½ tot 16 voet brandpunt*'.

b. 23828

Ocular glass

c. 1700

w 0.12, Ø 4.5

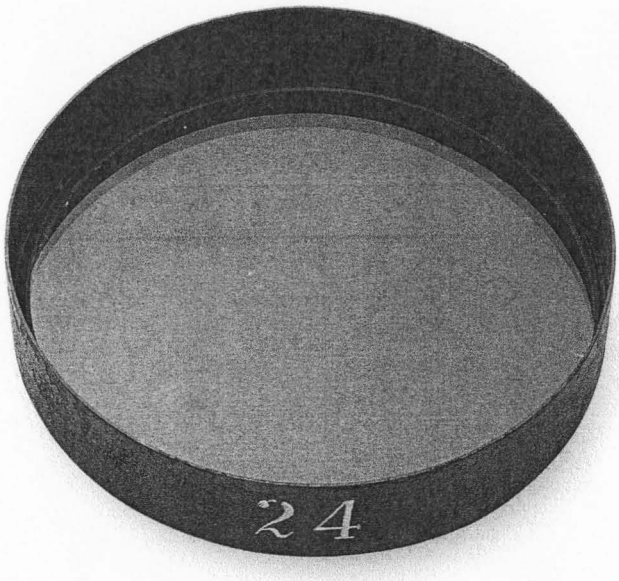
On the scale: 39

H 3-39

According to Huygens's table of optimal object/eyepiece combinations, an object glass of 16 feet needed an ocular glass with a focal distance of 2.2 inches, which reasonably fits the measured distance.

Biconvex lens made of greenish glass with a contemporary given focal distance of two inches and a measured focal distance of 5.7 centimetres, which is about 2.3 Rhineland inches. An accompanying note reads: *Huygens | Oculair | van 2 duimen | brandpunt | Voor een objectief | van 16 voeten* or in English: 'Objective with a focal distance of two inches for an objective of 16 feet'.

Van Helden & Van Gent 1995, IV



32. 23826

Object glass for an astronomical telescope of c. 20/21 feet

c. 1700

w 0.35, Ø 7.5

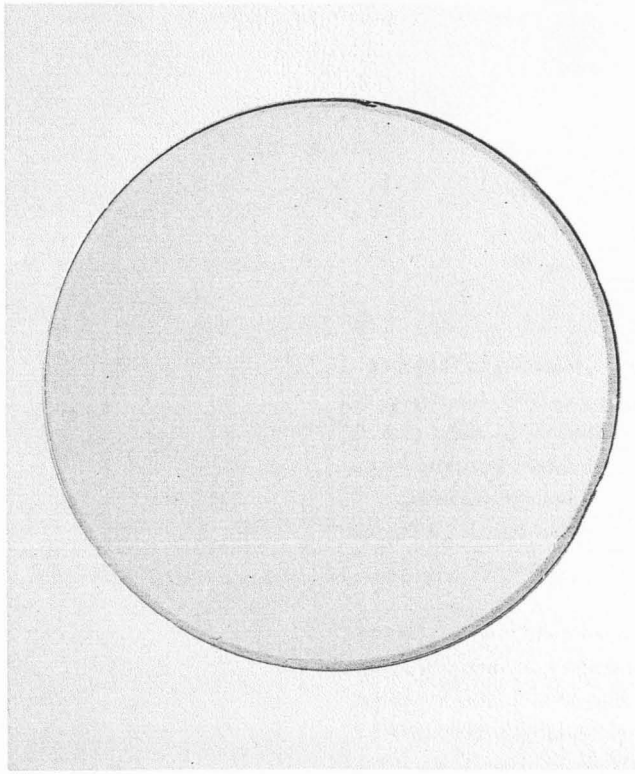
Provenance: Leiden University, c. 1700-1931

H 3-24

Biconvex lens made of pinkish glass, with a measured focal distance of 6.32 metres, which is about 21 feet. A metal scale marked with the number '24' was made at Leiden Observatory at a later date. According to an old list, the lens was originally accompanied by a mahogany standard.

Perhaps this is the object glass of 20 Paris feet (or 6.5 metres) that 's-Gravesande bought for 15 guilders in 1727 at the auction of the telescopic glasses of Nicolaas Hartsoeker. This glass grinder always used the Paris foot. The same year 's-Gravesande ordered some glass material from England, which was used by Arnold Marcel of Dordrecht to grind 12 new eyeglasses. Together these lenses could have been used for the '*buijs van 22 voet, in een schuivende, als in een koker*', which is mentioned in the 1793 Leiden Observatory inventory.

Hartsoeker 1727, no. 32-33; AC-I-45; Van Helden & Van Gent 1995, IV



33. 23824

Object glass for an astronomical telescope of c. 24 feet

c. 1700

w 0.35, Ø 9.5

On the scale: 22

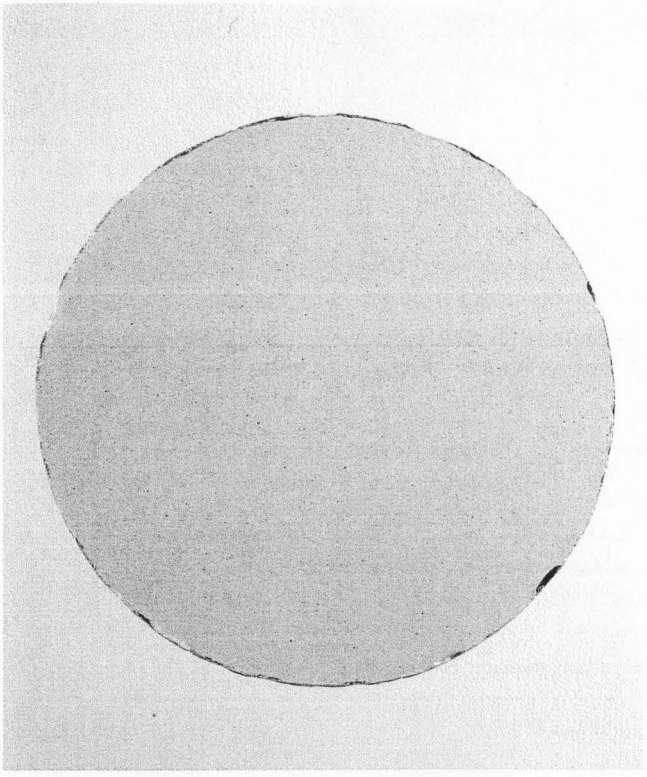
On a label: 19

Provenance: Leiden Observatory, c. 1700-1931

H 3-22

Biconvex lens made of yellowish glass having a measured focal distance of 7.24 metres, which is about 24 feet. Perhaps this object glass is one of the lenses belonging to the long iron tubes used at Leiden Observatory since 1683. The lens could have been used for the *blikke kijker hout onderlegt van omtrend 25 voeten*, which is mentioned in the 1742 Leiden Observatory inventory.

Van Helden & Van Gent 1995, IV



34. 10773

Object glass for an astronomical telescope of c. 25/27 feet

c. 1700

w 0.43, Ø 11.6

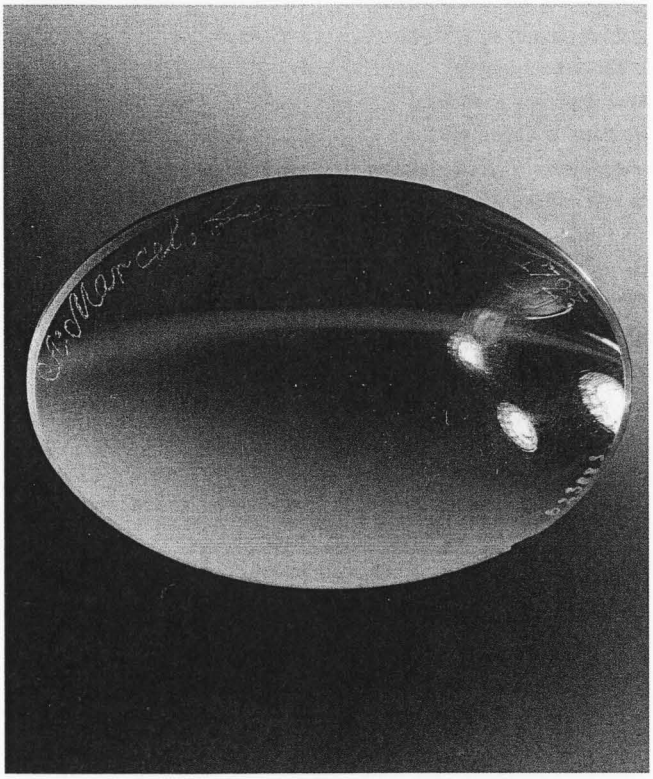
Provenance: Leiden Observatory, c. 1700-1931

H 3-23

Biconvex lens made of greyish glass with a measured focal distance of 8.25 metres, which is about 27.5 Rhineland feet or about 25 Paris feet.

Perhaps this is the object glass of 25 Paris feet (8.12 m) that 's-Gravesande bought for 29 guilders in 1727 at the auction of the telescopic glasses of Nicolaas Hartsoeker. This glass grinder always used the Paris foot. The same year 's-Gravesande ordered some glass material from England, which was used by Arnold Marcel of Dordrecht to grind 12 new eyeglasses. Together these lenses could have been used for the *houte buys [...] tot een kijker van 30 voet*, which is mentioned in the 1742 Leiden Observatory inventory.

Hartsoeker 1727, no. 29-30; AC-I-45; Invent 1742; Van Helden & Van Gent 1998, IV



35. 23883

Ocular glass for an astronomical telescope of c. 30 feet

1723

w 0.88, Ø 5.1

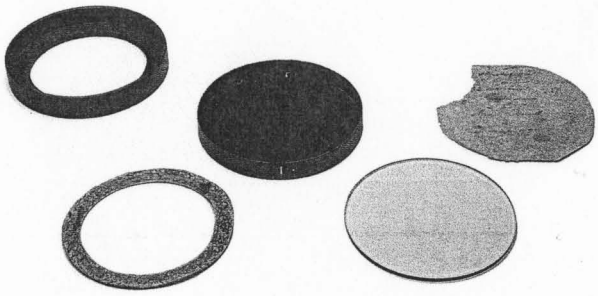
Signed: A. Marcel, fecit in Dord 1723 | 3.D:

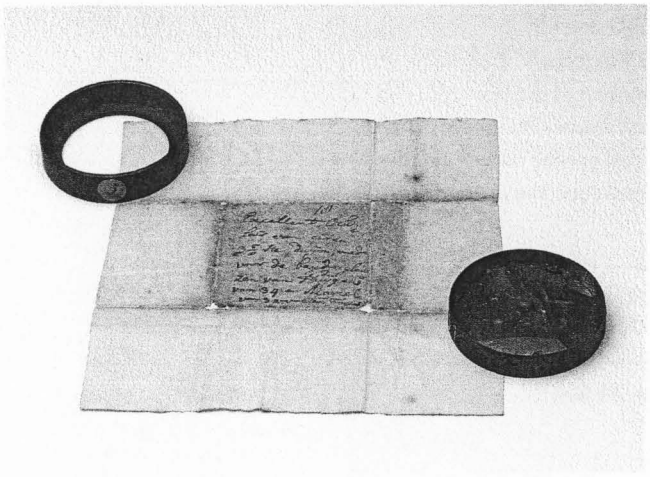
Provenance: Leiden Observatory, 1724-1931 45 (Obs.)

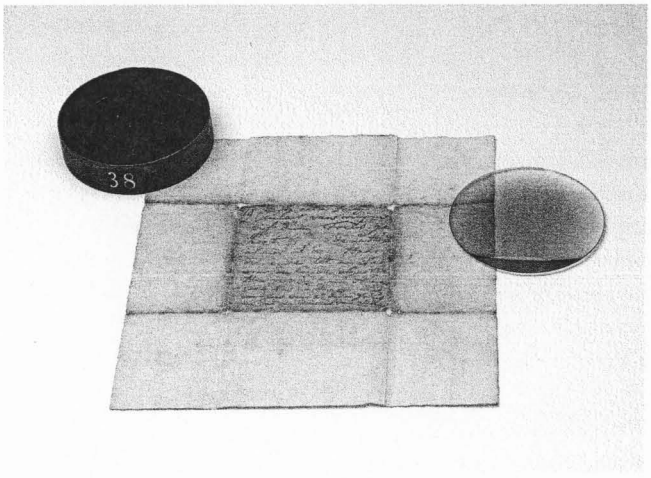
Arnold Marcel (1672-1748) was a silversmith in the city of Dordrecht. Like his cousin, the microscopist Anthony van Leeuwenhoek, Marcel was also active as a natural philosopher. He published on magnetic experiments and lectured for a group of scientific dilettantes.

This telescopic eyeglass of 'white-greenish' glass has a given focal distance of three inches (7.85 cm; measured 7.82 cm). The lens was probably bought by 's-Gravesande in 1724, when he received permission to repair some telescopes at the Leiden Observatory. In 1727 's-Gravesande ordered some English ocular lenses, which were ground by Marcel to fit in the observatory's telescope tubes. According to Huygens's table of optimal object/eyepiece combinations, an eyeglass of three inches would be suitable for an objective glass with a focal distance of c. 30 feet. This measure fits with the largest telescope tube mentioned in the 1742 inventory: 'Een blikke buis tot een kijker van 30 voet oud en verroest'.

AC I-45; Van Helden & Van Gent 1995, IV







36. Set of object & ocular glasses for an astronomical telescope of 32-35 feet

Provenance: Leiden Observatory, c. 1890-1931

The three lenses 23882, 23829 and 23835 have the same provenance. They were probably bought in 1889, together with Huygens lens 9108, at the auction house of H.G. Bom in Amsterdam, mentioned in the catalogue as 'Drie diverse lenzen'.

a. 23882

Object glass

1732

w 0.51, Ø 11.6

Lens: Arnold Marcel Fecit in Dordregt 1732 | 32 voet

Cover sheet: Objectief-glas | van | 32 voet focus gesleepen | door | Arnold Marcell | in | Dordregt 1733 | 17

On the scale: 19

On the ring: 12

19 (Obs.)

Biconvex lens made of greyish glass by Arnold Marcel of Dordrecht, with a contemporary given focal distance of 32 feet (10.0 m) and a measured focal distance of 9.41 metres.

b. 23829

Pieces of a broken ocular glass

c. 1750

Ø 5.6

Cover sheet: 18 | Excellent Ocu | lair van circa | 3 duijm, mede voor de beijde glazen van Huijgens van 34 en Marcel | 32 voeten Focus

On the scale: 41

On the ring: 5a

H 3-41

Broken pieces of a biconvex lens made of reddish glass with a contemporary given focal distance of c. 3 inches (7.8 cm). The handwriting of the text on the sheet is the same as that of the next lens, cat. no. **36c**. The Huygens lens referred to is probably cat. no. **15**, which actually has a focal distance of 35 feet. According to Huygens's table of optimal object/eyepiece combinations, an object glass of 34 feet needed an ocular glass with a focal distance of 3.2 inches, which reasonably fits the given distance.

c. 23835

Ocular glass

c. 1750

w 0.74, Ø 6.3

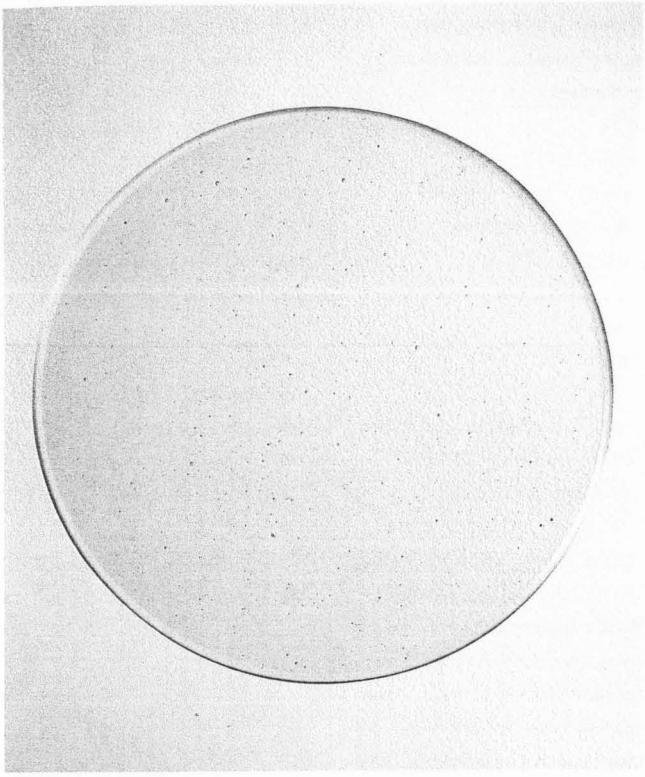
Cover sheet: 19 /N.[B.] extra fraaij | Oculair van ruijm | vijf duim Focus ge | kogt bij de La Haije | alhier in den Haag | dienende tot oogglas | voor de beide objectieven | Hoe zeer dat van Huigens | wel kan verdragen een | oogglas van 2,5 duim focus | en dat van Marcel van 3,5 duim

On the scale: 38

H 3-38

Biconvex lens made of greenish glass with a contemporary given focal distance of 5 inches (13.1 cm) and a measured focal distance of 13.9 cm. The translation of the sheet is: 'Especially fine ocular glass with a focal distance of five inches, bought here at De la Haije in The Hague, to be used for both objectives, although the Huygens lens can use an eye glass of 2.5 inches focus, and the Marcel lens an eyeglass of 3.5 inches'. De la Haye was an optical workshop in The Hague, active in the 1760s.

Catalogus 1889, no. 343; Rooseboom 1950; Van Helden & Van Gent 1995, IV



37. 23841

Object glass for an astronomical telescope of 36 feet

c. 1700

w 0.76, Ø 14.2

Signed: [T] T R

Signed on the scale: 21

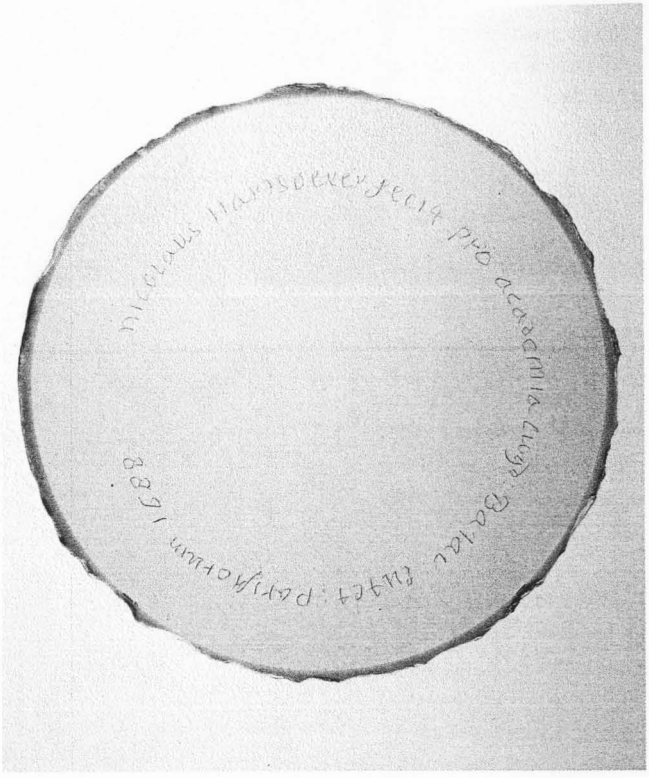
Provenance: Leiden Observatory, ?-1931

H 3-21

This object glass could be one of the lenses fitted to one of the long iron tubes used at Leiden Observatory since 1683.

Biconvex lens made of green-white glass with a measured focal distance of 10.7 metres, which is about 36 feet. According to the museum archive, the number '17' was once noted on the storage ring.

Van Helden & Van Gent 1998, IV



38. 9197

Object glass for a large astronomical telescope of c. 50 feet

1688

w 0.87, Ø 16.7

Signed: Nicolaas Hartsoeker fecit pro academia lugd. Batav lutet parisiorum 1688

Provenance: Leiden Observatory, 1688-1931

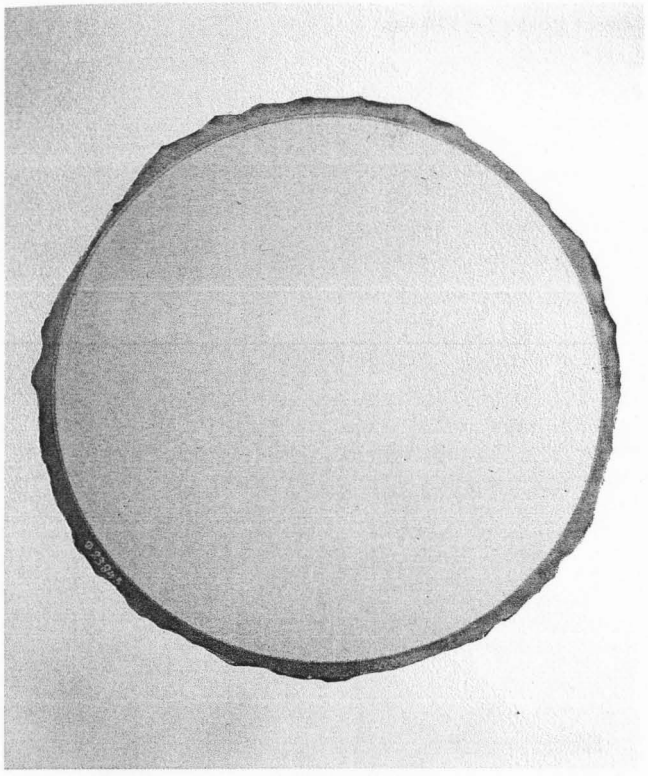
38 (Obs.)

Telescopic lens of about 50 feet, made for Leiden University by Nicolaas Hartsoeker in 1688. In March 1689 the glass was examined by Christiaan Huygens, when De Volder showed it to him during a visit to Leiden. At that time the lens had a mounting of red morocco leather with some gilt tooling, about two fingers wide. According to Huygens, the lens was made of good material, but he had not been able to test the lens properly with an ocular. He had placed the object glass in the gallery of De Volder's house, after which he had observed the image of the bricks in the houses on the other side of the [Rapenburg?] canal.

Without mentioning Hartsoeker's name the lens was included in De Volder's 1706 observatory inventory. Hartsoeker's 50-foot lens was recorded as a remarkable piece at Leiden Observatory in the travel diaries of Von Uffenbach, Ferrner and Bugge in 1711, 1759 and 1777. According to the 1793 inventory, the Hartsoeker objective was stored in a tin can. The focal distance of the 'greenish' glass was measured in 1995 by Van Helden and Van Gent as 16.8 metres, or 51.7 Paris feet (the old measure Hartsoeker used).

It is stated in the auction catalogue of Hartsoeker's glasses of 1727 that these large object glasses were used in 'tubeless' telescopes, in a way strongly resembling Huygens's *Astrocopia Compendiarium*. This aerial arrangement is illustrated together with a large tube telescope on the title page of Hartsoeker's *Proeve der Deurzichtkunde*, printed in 1699.

Oeuvres, IX, 313; Van Helden & Van Gent 1995, IV



39. 23843

Object glass of c. 50 feet

c. 1700

w 0.75, Ø 16.5

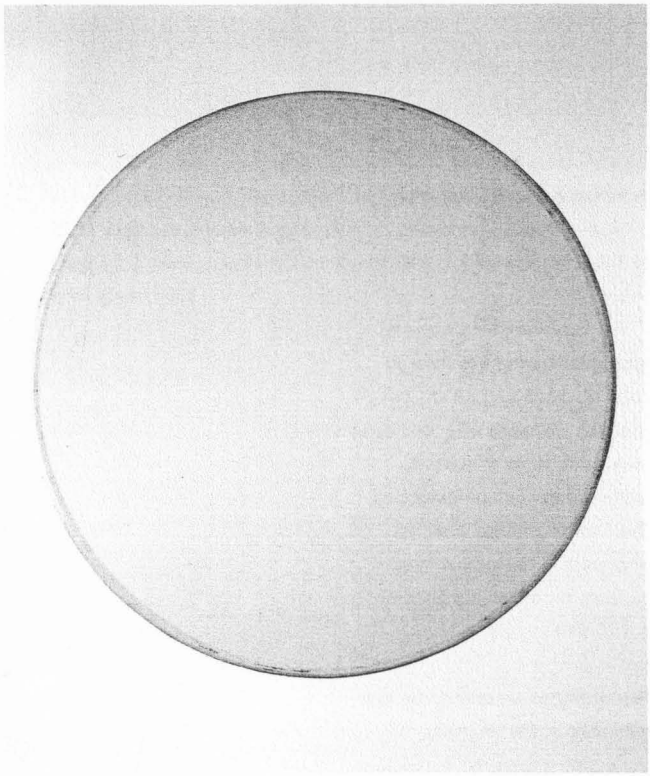
Provenance: Leiden Physics Cabinet/ Kamerlingh Onnes Laboratory, ?-1931

M 22A

Plano-convex lens made of white glass having a measured focal distance of 16.9 metres, which is about 54 Rhineland feet, or 52 Paris feet. Perhaps this lens can be identified as the *Groot Objectief glas, wiens focus [is] 50 voet* ' (or: 'large object glass, with a focus of 50 feet'), which entered the Leiden physics cabinet in 1742 from the estate of W.J. 's-Gravesande. If so, it could be the object lens of 51 Paris feet, which was auctioned in 1727 from Hartsoeker's assets. At this auction 's-Gravesande bought three object glasses (of 20, 25 and 60 feet focus) for Leiden University, but it is conceivable that he also bought a glass for his personal cabinet.

In the physics cabinet 's-Gravesande used lenses with large focal distances to demonstrate Newton's rings: a colour effect which arises when flat and slightly curved surfaces are pressed together.

Hartsoeker 1727, no. 25; Van Helden & Van Gent 1995, 24 & IV; De Clercq 1997, no. 134



40. 23842

Object glass of c. 130 feet

c. 1700

w 0.71, Ø 18.5

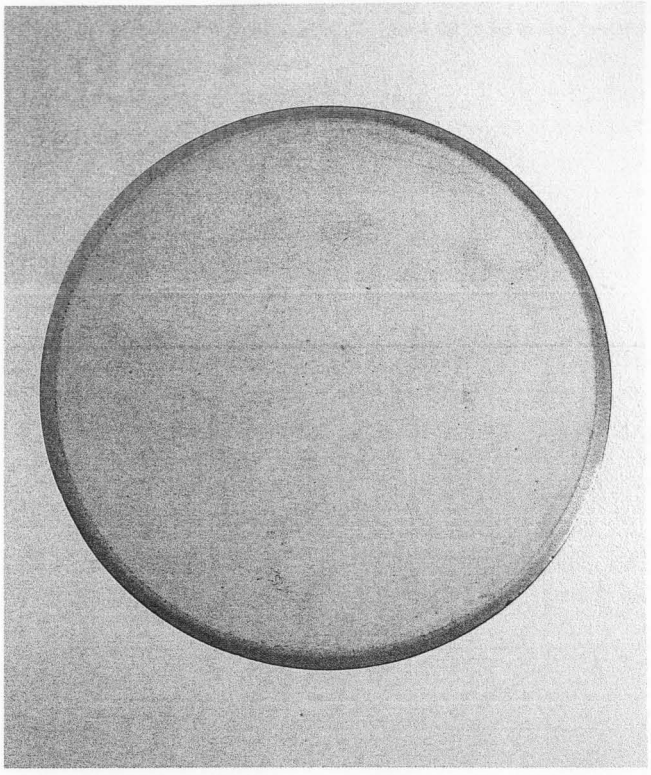
On the scale: 3

Provenance: Leiden University, ? -1931

H 3-3

Biconvex lens made of bluish glass with a measured focal distance of 41 metres, which is about 130.6 Rhineland feet. According to a list made in the early years of the museum, the lens was accompanied by a cover sheet, now missing, reading in red crayon *'Een objectief van C. Huygens met zijn oculair* [and in ink] *'Een objectief met zijn oculair van Christiaan Huygens'*. A label on the wooden storage ring was marked with the number '15'. However, as the glass was not ground from moulds made by the Huygens brothers, its provenance is uncertain.

Van Helden & Van Gent 1998, IV



41. 19382

Object glass of c. 170 feet

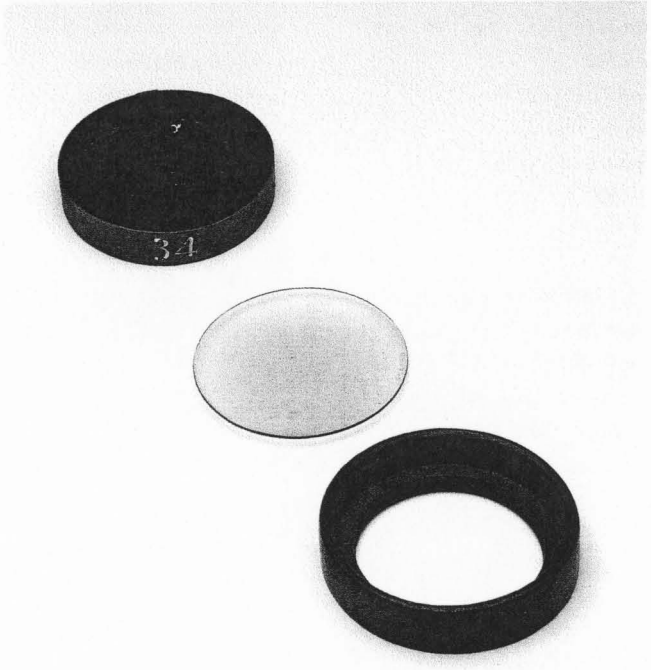
c. 1700

w 0.46, Ø 12.5

Provenance: unknown, probably Leiden Observatory, ?-1931

Biconvex lens made of colourless glass with a measured focal distance of 53 metres, which is about 169 feet. Although the Huygens brothers did make 170-foot object glasses, according to Van Helden & Van Gent this glass was not ground from moulds made by the Huygens brothers, so its provenance is uncertain.

Van Helden & Van Gent 1995, IV



42. 23830

Ocular glass for an aerial telescope of c. 190 feet

c. 1700

w 0.42, Ø 5.1

On the scale: 34

Provenance: Leiden Observatory, ?-1931

H 3-34

Biconvex lens made of grey glass having a measured focal distance of 19.8 cm, which is about 7.6 inches. According to Huygens's table of optimal object/eyepiece combinations, the measured focal distance implies that this ocular was suitable for an object glass of c. 190 feet.

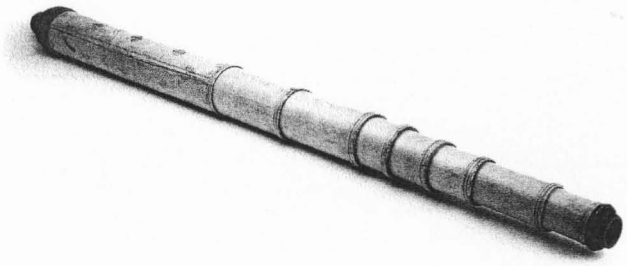
According to tradition, the lens was part of the Huygens collection. However, Van Helden & Van Gent have demonstrated that the curvature of this eyeglass does not fit those of other Huygens oculars, so a positive identification cannot be given.

Van Helden & Van Gent 1995, IV

Refractors with cardboard or vellum drawtubes

Portrait of an unknown man with a refracting telescope. Painting by J. Greenwood, Boston, 1760. (Rijksmuseum Amsterdam).

The magnification of terrestrial telescopes depends on the focal ratios of objective and eyepiece. This fact, combined with the requirement that to minimize the chromatic and spherical aberration it is needed to use lenses with a small curvature (and in consequence large focal distances), made telescopes rather lengthy. To make such an instrument portable and easy to store, draw tubes were invented. At first these draw tubes were made of cardboard or vellum, often decorated with gold tooling, or covered with marble paper, leather or ray-skin. Later in the 18th century a combined brass-and-wood arrangement became more popular.



43. 9985

Large reverse taped refracting telescope

1675-1700

167-240; Ø 4.6-7.5

Provenance: Stödel & Goudsmit, 1963

Large cardboard telescope, probably of English origin. The outer tube is covered with white parchment paper, with gold decorative tooling. The frames of the objective, eyepiece and other small parts are made of dark brown wood. The telescope consists of eight drawtubes, each step with a smaller diameter towards the objective (75-70-67-63-60-56-51-46 mm). This 'reversed form' is typical of telescopes of English origin in the late 17th century. The decorative tooling also points to an English provenance. The length necessary for use is indicated by pencil point on each tube. The optics are only partly preserved: a simple objective (Ø 4.0) and a simple ocular (Ø 3.2) at the wide end of the instrument. The original broken lens has been replaced by flat glass. Fragments of the original ocular lens are preserved in a separate box.

Turner 1966, 99-128; Engberts 1970, 95-96

44. 13707

Terrestrial telescope

1700-1743

122-61, Ø 2.5-3.1

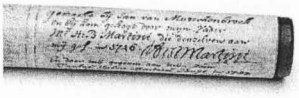
Signed: I MANN FECIT

Provenance: M.D. van Hest, 1929

The instrument maker James Mann (d. 1756) played a minor part in the controversy about the invention of the achromatic telescope. In 1758 the patent for the invention had been granted to John Dollond, but his opponents claimed he had been only second after the 'true' inventor Chester Moore Hall. The latter had in about 1730 contracted two different glass grinders to make a crown convex lens and a flint concave lens according to precise specifications. One of them had been James Mann. As Mann had hired the same subcontractor as the other optician (Edward Scarlett), Hall's 'secret' had been revealed, as it was realised that the two pieces went together. However, as Sorrenson has demonstrated, this story does not stand up to reality. So Mann remains only a minor technician in the history of science. In 1743 he went into an apprenticeship with James Ascough, signing their instruments 'Mann & Ascough'.

Telescope in four segments of green cardboard (one segment covered with grey ray skin). Original objective (Ø 1.2) replaced by flat glass, simple ocular with two field lenses. The screwable dust cap is missing.

Engberts 1970, 87; Turner 1966, 127; Clifton 1995, 177; Sorrenson 2001



45. 28470

Terrestrial telescope

1712-1716

131.5-71, Ø 4

Bought by Jan van Musschenbroek

Provenance: Martini family, c. 1712-1997

Telescope bought by Henricus Bernardus Martini (1693-1776), probably when he matriculated as a student at Leiden University (1712). Four years later he left Leiden as a Juridical Doctor, returning to his home town of 's-Hertogenbosch, becoming a successful magistrate. In 1746 the telescope was handed over to his son Antonius Martini on the occasion of his own matriculation at Leiden University. It seems that this habit continued in the family through nine generations. In 1997 the telescope was bequeathed to Museum Boerhaave by the last in the line of succession, Jhr. P.H.A. Martini Buijs (1914-1997).

According to the handwritten inscription on the outer tube, this telescope was made in Leiden by Jan van Musschenbroek, whose workshop offered telescopes for sale, from at least 1711. As the tooling on the tubes is identical to that on English telescopes of the first quarter of the 18th century, there must be doubts about whether Van Musschenbroek really made this telescope. Perhaps the instrument was only a retail, although it is possible that Jan van Musschenbroek made the lenses. The catalogue of Van Musschenbroek's workshop that was auctioned in 1749 contained several tools for the grinding and polishing of lenses.

The telescope consists of four reverse taped drawtubes made of cardboard, covered in vellum and tooled with gold, which are fitted with brass lens mounts with a screwable dust cap. There are four asymmetric biconvex lenses, forming a three-lens inverting eyepiece (Ø 2.0) and an object glass with a screwable dust cover.

The following inscription testifies to the handover to the successive heirs: *'gemaakt bij Jan van Musschenbroek en bij hem gekogt door myn vader Mr H.B. Martini, die denzelven aan mij gaf in 1746 A. M.(?) Martini en door mij gegeven aan mijn zoon Paulus Hubert Martini Buijs in 1783. // die dezelve aan mij gaf in 1820 A. A. Martini Buijs en door mij gegeven aan mijn zoon Paulus Hubert Andries Martini Buijs in 1850 // en door mij gegeven aan mijn zoon Antoni Adriaan Martini Buijs in 1886 P.H.A. Martini Buijs // Door mij gegeven aan mijn zoon Paulus Hubert Andries in 1914 A.A. Martini Buijs'* [// indicates the beginning of a new hand].

De Clercq 1997, 37-45; De Clercq & De Mooij 2002

46. 8889

Terrestrial telescope

1740-1771

156-172, Ø 3.7-4.5

Signed on the exterior tube: BLASIO BURLINI PROFESSOR VENEZIA ARCHIMEDE

Provenance: A.W.M. Mensing, 1935

In 1885 the well-known Amsterdam auction house of Frederik Muller & Company employed the merchant Anton Mensing (1866-1936), who took over the company in 1899. During his life as an auctioneer Mensing collected a large quantity of scientific instruments, a collection that was intended for auction in 1924, but was eventually sold in parts to a number of museums, such as the Rijksmuseum voor de Geschiedenis der Natuurwetenschappen in Leiden and the Adler Planetarium in Chicago.

On the exterior tube of this telescope from the Mensing collection there are four identical stamps with the (barely legible) signature of Biagio Burlini (1709-1771) and his Italian workshop 'Venezia Archimede'.

The telescope tube has four segments of marbled green cardboard, stamped with patterns. Rings and frames are made of brown and black varnished wood. The objective lens (Ø 2.8) and dust cap are missing. The ocular has two field lenses and a dust cover slide.

Engberts 1970, 85; Koperen Kabinet, 50; Lualdi 1999

47. 32072

Terrestrial telescope

1750-1800

130-78, Ø 4.2

Provenance: M.D. van Hest, 1929

This telescope, made by an unknown instrument maker, has an outer tube of pink cardboard and inner tubes of white parchment paper. The telescope consists of four drawtubes (Ø 4.2-4.0-3.7-3.5). The outer tube is decorated with some black drawings, mostly of plants. The cover is slightly damaged. The fittings are made partly of grey and black horn, and partly of black wood. The dust covers are made of brass.

A brass shutter can be screwed onto the objective (plano-convex, Ø 3.0). The eyepiece tube also has a dust cover slide. It contains a separate tube (I 11) with just one lens, but it probably contained a reversing system with two lenses, which is now missing.

Engberts 1970, 86

48. 13705

Terrestrial telescope

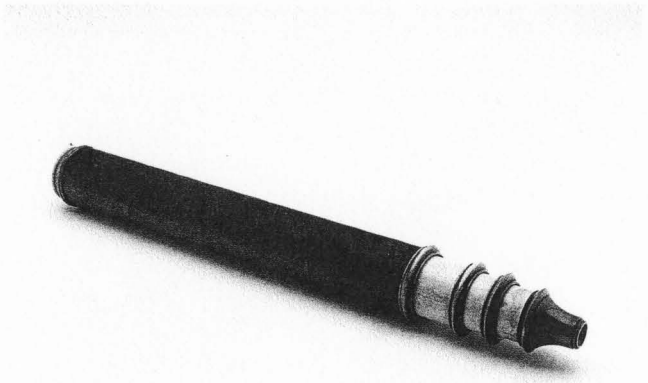
c. 1750

151-161, Ø 4

Provenance: Purchased with assistance of the Leiden University Fund, 1927

Hand-held telescope, probably of German origin. The instrument has six drawtubes made of cardboard partly covered with black linen, richly decorated with leaf and flower motifs. At some places the paint has worn off, as a result of which an older Latin manuscript has become visible, which has been used for constructing the drawtubes. The fittings are made of brown wood. The objective is replaced by flat glass. Simple ocular with field lenses (at the end of the third and fourth tubes). The screwable dust cap and the diaphragm at the end of fifth tube are missing.

Engberts 1970, 84-85



49. 8908

Terrestrial telescope

1700-1800

133- 99, Ø 2.7- 3.6

Provenance: M.D. van Hest, 1929

Hand-held refractor with four drawtubes of white cardboard with black leather (imitation sharkskin) on the outer tube, with frames and rings of horn. Simple objective (Ø 1.4) and simple ocular with two field lenses. The screwable dust caps are missing.

Engberts 1970, 87

50. 13706

Terrestrial telescope

1700-1800

129- 80, Ø 3.3

Provenance: Leiden University, Physics Laboratory, pre 1880-1931

This 18th-century telescope originates from the Leiden Cabinet of Physics, but cannot be identified in the contemporary records. In the 1880s it was listed as a *'Verrekijker bestaande uit 4 kokers groen'*.

The drawtubes of this telescope are made of green cardboard, which are fitted with ivory fittings and frames. A screw cap can be fitted on the eyepiece. The objective, which would have a diameter of 1.3 cm, is missing and has been replaced by flat glass. The eye lens is also missing. Two field lenses have been preserved in the smallest tubes.

Engberts 1970, 85-86; De Clercq 1997, 132, referring to 1880s list, no. 265

51. 8919

Night telescope

1759?

I 30-47, Ø 6.5

Provenance: Leiden University, 1759?-1931

Most likely this telescope is the 'Katoog of Nagtkijker with 4 glasses', acquired for the Leiden Cabinet of Physics for 13 guilders in 1759 from Louis Thornburry, a tradesman in The Hague. Another 'Katoog' with three lenses, bought from William Tottie, a brass founder from Rotterdam, the same year is now missing.

A 'Kat-oog' (Cat's eye) was a 'Night telescope', possessing a large objective, a large field of view and a rather small magnification. These kinds of instrument produced reversed images, which is remarkable for a terrestrial telescope, but usual for these night telescopes. According to a contemporary statement, they were of little use in daytime, but rather good at night.

This two-draw refracting telescope is made of cardboard (in part painted green) and unpainted thin wood, covered with black leather. The instrument has four lenses. The objective tube holds a biconvex objective (Ø 5) and is closed by a wooden screw cap. The eyepiece tube has a brass sliding cover and holds a double field lens (two separate tube segments screwed together, each with a biconvex lens of Ø 5) and a biconvex eyepiece lens (Ø 1.8).

AC I-51; Engberts 1970, 87-88; De Clercq 1997, 132

52. 9740

Terrestrial telescope in an 'Optical Cabinet'

1750-1775

I 17.5-38, Ø 2.5-3.0

Signed on the middle tube: DOLLOND I LONDON

Provenance: R. Escher, Leiden, 1926; Van Seters Collection, Amsterdam, 1926-1957

In the early 1920s the naturalist and historian of science Wouter Hendrik van Seters (1891-1976) started a collection of antique optical instruments. In 1957 he sold the most interesting part to the 'Rijksmuseum voor de Geschiedenis der Natuurwetenschappen', amongst them this so-called 'optical cabinet'.

The 'optical cabinet' (a combination of different optical instruments brought together in a single storage box) was a marketing invention of the London instrument maker Benjamin Martin (1705-1782). The square wooden case (h 6, w 15, d 37) contains three optical instruments: a compound drum microscope (inv. no. 9739), a solar microscope (inv. no. 9740-b), both made by Martin, and a refracting telescope made by his colleague Dollond.

This telescope consists of three drawtubes made of green cardboard partly covered with ray skin. The instrument has a simple objective (Ø 1.4) with shutter and a compound ocular with a dust cover slide.

Engberts 1970, 94; Millburn 1986, 54; Fournier 2003, 85 & 162

53. 8935

Terrestrial telescope

1750-1800

l 28.5-102, Ø 2.9-4.5

*Signed on 4th tube: *DOLLOND LONDON*

Provenance: Mrs. M.G. Kalff-Goedkoop, 1935

Refracting telescope made by the well-known Dollond workshop, with five drawtubes made of green cardboard, covered with green ray skin. It has polished brass rings and fittings. The instrument has a simple biconvex objective (Ø 3.3) with screwable dust cap and a compound ocular with a shutter.

Engberts 1970, 89-90

54. 8933

Terrestrial telescope

1725-1775

l 29-91.5, Ø 2.8-4.0

Provenance: Dr. J.C.M. Timmermans, 1933

Refracting telescope made in five segments of green cardboard and grey-green ray skin. The instrument has a simple objective (Ø 3.4) with a field lens at the end of the fourth cylinder and a compound ocular with a shutter. The ocular cap and the screwable sun glass are missing. The telescope resembles the previous telescope (cat. no. **53**).

Engberts 1970, 89

55. 8894

Terrestrial telescope

1775-1800

l 31.5-83, Ø 2.8-4.0

Provenance: Dr. J.A. Koch, 1933

This refracting telescope consists of four drawtubes of white cardboard, the outer tube covered with black shark skin, having rings and frames made of brown painted wood and horn. The instrument has a simple objective (Ø 2.1) and compound ocular with two field lenses. The dust covers of objective and ocular are missing.

Engberts 1970, 91

56. 8912

Terrestrial telescope

1750-1800

I 133-187, Ø 3.4

Provenance: Burgers Collection, 1946

The collector Johannes Marinus Burgers (1862-1946) of Arnhem was a dilettante of science, who occasionally lectured at the local physical society 'Wessel Knoops'. He probably started collecting scientific instruments, especially optical instruments, in the 1890s. Following his death in 1946, his two sons, both professors at Delft University, gave the bulk of their father's collection to the 'Rijksmuseum voor de Geschiedenis der Natuurwetenschappen'.

This instrument consists of four drawtubes made of cardboard. The objective tube is covered with brown leather. It has rings and frames of brown painted wood and horn. The instrument has a simple objective (Ø 1.8) with shutter and an ocular with two field lenses.

Engberts 1970, 92-93; Koperen Kabinet, 58

57. 8895

Terrestrial telescope

1700-1800

I 31-86, Ø 2.8-3.5

Provenance: Groenendijk Collection, Amsterdam, 1957

In 1957 Museum Boerhaave acquired some 120 scientific instruments from the collection of the Amsterdam family Groenendijk, amongst them this terrestrial telescope. The collection was started by Nicolaas Groenendijk, who acquired his interest in the instrument cabinet of the Amsterdam Society 'Felix Meritis' in the 1860s. According to tradition, Groenendijk bought several of these instruments following the dissolution of the Society in 1889. However, it is not known if this telescope was one of them.

This refracting telescope has four drawtubes made of cardboard: the outer tube covered with brown imitation sharkskin, and the three inner tubes with green paper. The instrument has a simple objective (Ø 1.2) with a brass dust cover slide and an ocular with two reversing lenses (incomplete) with a mounting made of bone.

Engberts 1970, 93-94; Koperen Kabinet, 54

Small (pocket) refractors

Portrait of Willem George Frederik (1774-99), Prince of Orange-Nassau as a child, having a small pocket refractor in his right hand.
Painting by an unknown artist, Northern Netherlands, c. 1775. (Rijksmuseum Amsterdam).

In the early 18th century the telescope entered the domain of the bourgeois citizen. Domestic uses of the telescope were developed, such as the pocket telescope, a commodity that could be used at the opera or other theatrical performances. Most of these small refractors – and later reflectors too – were unsigned, so little is generally known about their producers. These types of small telescope have a rather modest magnification.

58. 8936

Pocket telescope

1700-1725

l 7.5-11, Ø 3.4-4.0

Provenance: Burgers Collection, 1946

This instrument consists of two drawtubes made of white ivory and green cardboard. It has a simple objective (Ø 4.0) and a simple ocular.

Engberts 1970, 117-118

59. 8892

Pocket telescope in cylindrical box

1725-1750

l 5.5-7.5, Ø 2.9-5.0

Provenance: Burgers Collection, 1946

This very small refracting telescope has two drawtubes made of cardboard. The objective tube is covered with red ray skin, the eyepiece tube is painted green, decorated with a gilt flower and a star in a moon crescent. The frames are made of black wood (probably ebony). The telescope has a simple objective (Ø 2.5) and a simple ocular. It can be kept in a cylindrical cardboard box (l 7, Ø 4), covered with black paper on the outside and with red plush on the inside.

Engberts 1970, 117

60. 8906

Small refracting telescope

1739

l 16, Ø 2.0

Stamped with points in leather housing: ANO 1739

Provenance: Thijs Mol, 1951

Small telescope, probably of Dutch or German origin. It has a brass tube mounted with dark brown leather, stamped with a flower pattern (tulips) and a heart. It also has a simple objective (Ø 2.0) with a dust cover slide. The original eyepiece is missing and has been replaced by a piece of flat glass.

Engberts 1970, 119-120

61. 8922

Pocket telescope

1750-1775

l 6-10.5, Ø 1.9-2.8

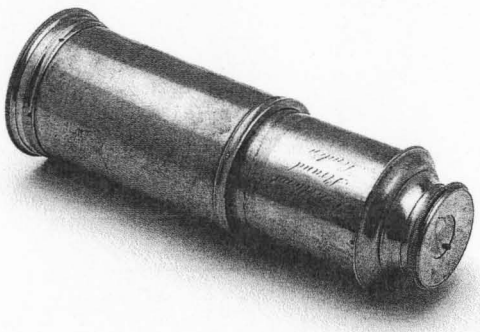
Signed: Martin, London.

Provenance: 'Kweekschool van de Broeders der Onbevlekte Ontvangenis' [= Seminary of Brothers of Immaculate Conception], Maastricht, 1951

The English instrument maker Benjamin Martin (1705-1782) was one of the most prolific producers of scientific instruments in the 18th century. His catalogues of instruments list several hand-held telescopes, of which this is one of the smaller copies.

Small hand-held refracting telescope made in three segments of brass. The instrument has a simple objective (Ø 3.0) and a simple (incomplete) ocular with two eyeglasses, facilitating two different magnifications.

Engberts 1970, 119; Millburn, 1986, 33



62. 8898

Pocket telescope

1752-1766

l 8.5-12.5, Ø 3.5

Signed on the eyepiece tube: P. Dollond Strand London

Provenance: Leiden University, 1931

The instrument maker Peter Dollond (1731-1820) worked at this adress between 1752 and 1766. When and how this small specimen of his craftsmanship came into the Leiden Cabinet of Physics is unknown.

Such simple two-draw brass refractors were often used as an opera glass. When drawn out, the signature on the eyepiece tube (Ø 3.2) becomes visible. It is fitted with a biconvex objective and a plano-convex eyepiece lens. The field lens is missing. The objective is protected by a dust cover slide.

Engberts 1970, 110-111; Clifton 1995, 87; De Clercq 1997, 131

63. 8896

Pocket telescope

1750-1800

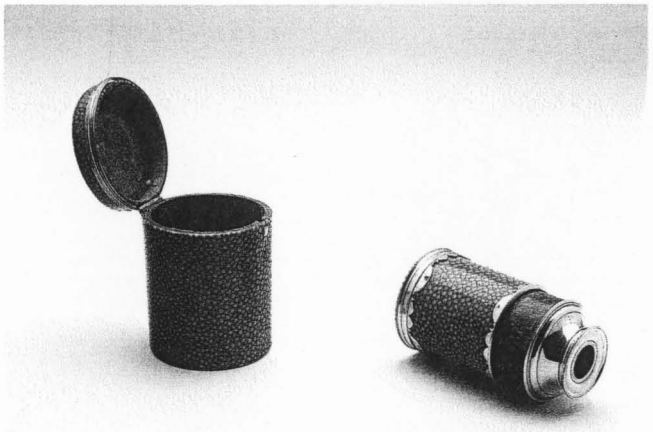
l 5.5-8, Ø 2.8

Signed: Dollond London

Provenance: Ds. C.B. Heyn, 1945

Very small refractor in two brass segments (the original leather cover of the outer tube is missing). The instrument has a simple objective (Ø 2.3) and a simple ocular, both without a dust cover.

Engberts 1970, 115



64. 8904

Pocket telescope with storage cylinder

1750-1800

l 6.5-10, Ø 4-4.2

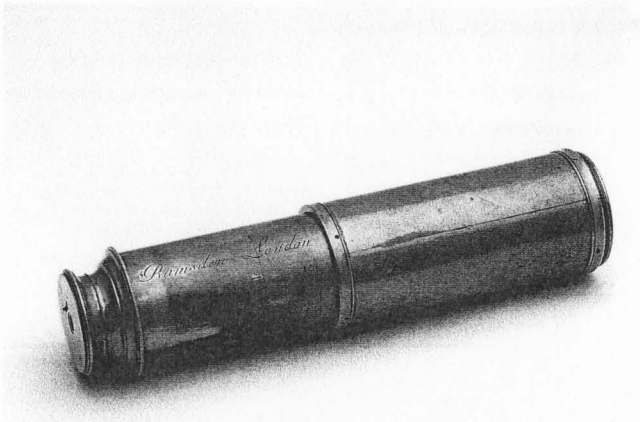
Signed in a cartouche on the eyepiece tube: DOLLOND LONDON

Provenance: unknown, 1935

Small telescope tube made of two tin-plated brass drawtubes covered with red cardboard (stamped with gilt patterns) and green ray skin. Simple objective (Ø 4.2; loose) and simple ocular (damaged) with silver mounting.

The storage cylinder (l 8, Ø 5.5) is covered with red plush and green ray skin.

Engberts 1970, 111



65. 8932

Small refracting telescope

1762-1800

I 11-17, Ø 3.4-3.8

Signed: Ramsden London

Provenance: Mrs. Dr. B. Immink, 1949

Jesse Ramsden (1735-1800) was one of the leading English instrument makers in the final quarter of the 18th century. He was married to Sarah Dollond, daughter of John Dollond.

Small hand-held refracting telescope with two brass drawtubes. The instrument has a simple objective (Ø 3.3) and a simple ocular with two eyeglasses (marked 1 and 2), facilitating two different magnifications. The dust cover of the objective is missing.

Engberts 1970, 118-119; Clifton 1995, 227

66. 8890

Pocket telescope

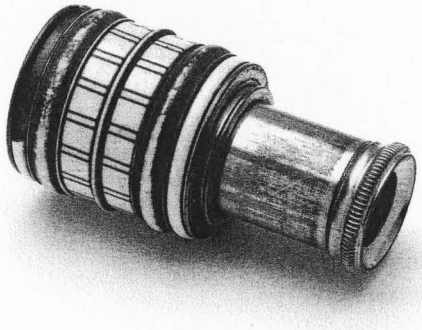
1750-1800

I 5-9.5, Ø 2.1-4.0

Provenance: Posthumus, The Hague, 1929

Small refracting telescope consisting of an objective tube elegantly made of turned ivory (cracked) and two drawtubes of (partly silvered) brass (Ø 2.1 and 2.5). The frames are made of brass. The instrument has a simple objective (Ø 3.3) and a simple ocular.

Engberts 1970, 112



67. 8920

Pocket telescope

1750-1800

I 5-9.5, Ø 2.2-3.5

Provenance: Prof. Dr. B.G. Escher, 1934

Small refracting telescope made in three segments of brass and painted ivory, with a red-coloured inlay. The instrument has a simple objective (Ø 2.5) and a simple ocular.

Engberts 1970, 114-115

68. 8899

Pocket telescope in case

1762

1 8.8, Ø 3.5

Signed on the inside of the cover: x H v Deyl Jans Leiden 1762 x [tail of the number 'six' erased]

Provenance: G.A. Brongers, 1950

Earliest known refracting telescope by Harmanus van Deijl Jansz (1738-1809), according to the signature made in Leiden in 1762. At that time Harmanus was probably working as an apprentice at the workshop of the well-known instrument maker Jan Paauw. Harmanus was the son of the Amsterdam instrument maker Jan van Deijl (d. 1801), who in 1762 assisted the Amsterdam mathematician and brass founder Carl Ulrich Bley in the construction of the first achromatic telescope in the Netherlands. Later in life Jan van Deijl and his son Harmanus produced many achromatic telescopes. After about 1800 Harmanus switched to the construction of achromatic microscopes.

Small brass telescope with dust cover slide. Simple objective with screwable cap. The ocular is missing. The leather case is decorated with a blind tooled motif in 13 vertical rows. The number 07936 and the mark GLD 3/6 (barely legible) are written on the inside of the cap.

Zuidervaart 2004

69. 8911

Achromatic pocket telescope

1769

115.5-24, Ø 1.9-3.3

Signed: Jan van Deyl and Zoon inv. et fec. Amsterdam, 1769

Provenance: W. de Mey, The Hague, 1960

Achromatic pocket telescope made by Jan and Harmanus van Deijl.

The instrument consists of two segments: a brass objective tube (l 14; Ø 3.3) with achromatic objective (Ø 2.1) and dust cover, and a brass eyepiece tube (l 11; Ø 1.9) with ocular and field lens. The eyepiece tube is meant to be stored in the objective tube. Before using the instrument, the ocular must screwed onto the objective tube. With this operation a telescope is formed with a total length of 24 cm.

Engberts 1970, 94-95

70. 8882

Achromatic pocket telescope in cylindrical case

1765-1775

115.5-24, Ø 1.9-3.3

Signed: Jan van Deyl and Zoon inv. et fec. Amsterdam

Provenance: Dr. J.A. Koch, 1933

Achromatic pocket telescope made by the Van Deijl workshop.

The instrument has the same dimensions and usage as the preceeding instrument, cat. no. **69**.

The telescope can be kept in a cylindrical case (l 17, Ø 4.5), covered with black leather on the outside and green plush on the inside.

Engberts 1970, 91-92

71. 8840

Achromatic pocket telescope

1776

16.5-9.0; Ø 1.9-2.1

Signed: Jan van Deyl and Zoon Fecit Amsterdam Ao 1776

Provenance: Burgers Collection, 1946

Very small achromatic pocket telescope made by the Van Deijl workshop in 1776. The instrument has two brass drawtubes, the first with an achromatic objective (Ø 1.9) with screwable dust cover and the second with a simple ocular, also with dust cover. The instrument can be kept in a light brown cylindrical case made of palm wood (l 8.5; Ø 3.3).

Engberts 1970, 116

72. 8934

Pocket telescope

1775-1800

15.5-8.5, Ø 3

Provenance: M.D. van Hest, 1930

Small refracting telescope made in two segments of mahogany and brass. The instrument has a simple objective (Ø 2.2) and simple ocular.

Engberts 1970, 113

73. 8909

Pocket telescope

1775-1825

17.5-10, Ø 2.2-3.0

Provenance: M.D. van Hest, 1929

Small refracting telescope made in two segments of ivory and green cardboard, decorated with gilt figures. The instrument has a simple objective (Ø 2.0) with dust cover and a simple ocular with a dust cover slide.

Engberts 1970, 112-113

74. 8938

Pocket telescope with storage cylinder

1775-1800

14-11, Ø 2.0-3.5

Provenance: Burgers Collection, 1946

Small refracting telescope made in four brass segments, the outer one covered with black leather. The instrument has a simple objective (Ø 2.8) and simple ocular. It can be kept in a black cardboard storage cylinder.

Engberts 1970, 118

75. 8918

Small telescope

1775-1800

19-13, Ø 3.2-3.5

Provenance: Burgers Collection, 1946

Small refracting telescope made in two brass segments. The instrument has a simple objective (Ø 2.9) and a simple ocular with two eyeglasses (marked 1 and 2), providing the possibility of two separate magnifications. The dust cap is missing.

Engberts 1970, 116

76. 8923

Small refracting telescope

1775-1825

I 15.5, Ø 1.6-2.5

Provenance: M.D. van Hest, 1929

Small refracting telescope made of brass and dark brown turned walnut wood. The instrument has a simple objective (Ø 1.9) and a simple ocular with dust cover slides.

Engberts 1970, 113-114

77. 8900

Pocket telescope

1775-1800

I 5-7, Ø 2.5-3.5

Provenance: Mrs. E.C. van Hest, 1941

Very small refracting telescope with bone fittings and two cardboard segments covered with black leather and green parchment. The instrument has a simple objective (Ø 2.8, cracked) and a simple ocular.

Engberts 1970, 115

78. 8937

Pocket telescope

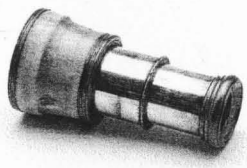
1775-1800

I 6-11, Ø 2.6-4.8

Provenance: J.G. van Tricht, vicar of Delft, c. 1800; C.E. van Manen, Java, 1951

Very small refracting telescope with three drawtubes made of gilt brass and bone. The instrument has a simple objective (Ø 3.9) and simple ocular.

Engberts 1970, 112



79. 8915

Pocket telescope

1800-1820

I 5-9, Ø 2.3-4.0

*On the ocular tube: NûB [D]OUBLÉ (the û has a * in the centre).*

Provenance: C.E. van Manen, 1951

Very small refracting telescope in three segments made of tin-plated copper and ivory (cracked). The instrument has a simple objective (Ø 3.3) and a simple ocular.

Engberts 1970, 114

80. 8891
Pocket telescope
1800-1850
13.8-8.5, Ø 1.9-4.0
Provenance: Leiden University, 1931

Very small refracting telescope, made in four segments. Outer tube made of (now broken) ivory, inner tubes and fittings made of brass. Simple objective (Ø 2.6); simple ocular. The instrument is of such a delicate construction that it was probably made just for fun, not for practical use.

Engberts 1970, 111

81. 8930
Pocket telescope
1800-1900
18.5-17, Ø 1.6-3.0
Provenance: M.D. van Hest, 1941

Small refracting telescope with three brass drawtubes (the first painted black). The instrument has a simple objective (Ø 2.0) and a simple ocular.

Engberts 1970, 120

82. 8921
Pocket telescope
1800-1825
18.5, Ø 1.8-2.0
Provenance: Van Seters Collection, 1957

Small refracting telescope with a tube made of ivory. The instrument has a simple objective (Ø 1.6) and simple ocular. On the outside of the telescope tube the inscription 'M 81a' can be read.

Engberts 1970, 120

83. 8926
Pocket telescope
1800-1825
13-10, Ø 1.6-5.0
Provenance: Burgers Collection, 1946

Curious small refracting telescope with a tube made of eight segments of tin-plated copper, which can be put together into the shape of a solid cylinder. Drawn out the instrument has a conical outline. The outer tube is plated with ivory and is decorated with a flower vase motif. The telescope has a simple objective (Ø 4.0) and simple ocular.

Engberts 1970, 117

84. 9032

Pocket telescope

19 cm, Ø 4.5

Provenance: Unknown

Very small refracting telescope.

85. 8907

Small terrestrial telescope

1800-1900

114-37, Ø 1.5-3.0

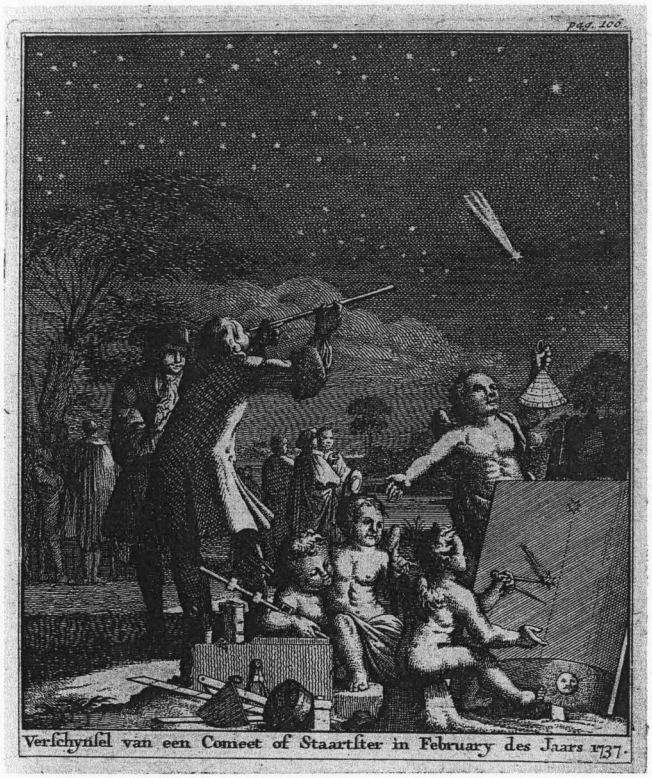
Provenance: Mrs. J. van der Meer - van de Baan, Eefde, 1967

This hand-held terrestrial telescope is made of brass and consists of four drawtubes (the outer one covered with black leather). The achromatic objective (Ø 2.0) has a brass solar cap (incomplete). The compound ocular can be closed with a dust shutter.

Engberts 1970, 109

Hand-held refractors with wooden objective tube

Hand-held telescopes with long wooden tubes were very popular for intensive daily use, as they were less sensitive to wear.
These instruments had been made since the early 18th century, mostly with just one brass drawtube, and were equipped with an ocular ranging from very simple to more complex. After 1760 these telescopes were also equipped with achromatic object glasses.



The observation of a comet with a hand-held telescope in 1737.
Engraving from *Europische Mercurius*, Amsterdam (Dries van Damme), 1737.

86. **8901**

Telescope objective for a nautical telescope

1731

h 2, Ø 6

Signed: tot Amsteldam by Gerard van Keulen 1731

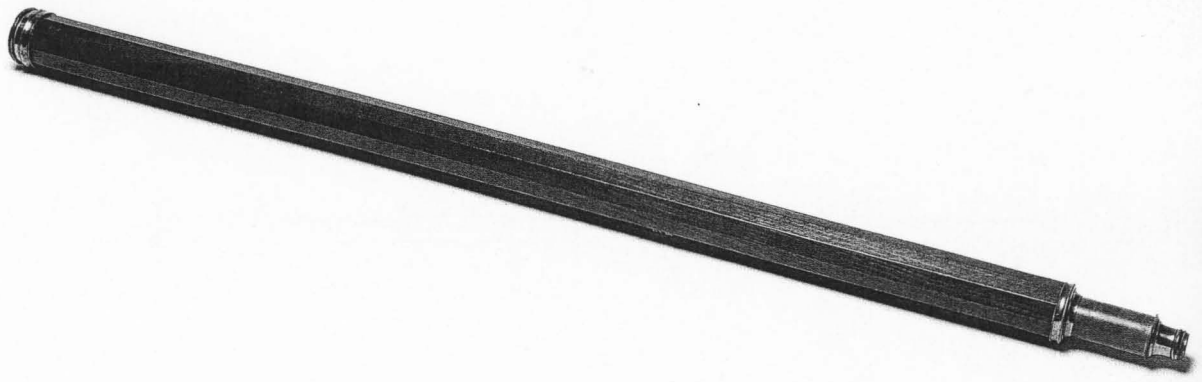
Provenance: G.A. Brongers, 1950

Although telescopes had been used at sea since the latter half of the 17th century, in 1731 the *Verenigde Oost-Indische Compagnie* (the Dutch East India Company) started to include some small telescopes with 'kopere bussen' (with copper fittings) in the standard equipment for its ships. None of these early nautical telescopes have been preserved. However, as the Van Keulen firm was one of the major suppliers of the VOC and as this convex objective lens is dated '1731', it is tempting to suppose that this lens was part of this important VOC order.

Gerard van Keulen (1704-1726) was a member of the well-known Amsterdam firm Van Keulen, which during the period 1680-1885 produced an impressive stock of maps, books and scientific instruments relating to the art of navigation. As Gerard van Keulen died in 1726, at first sight it is curious that the objective lens bears the date '1731'. However, the habit of dating instruments after the maker's death was common practice at the Van Keulen workshop. It seems that only after their sale were instruments engraved with a date, giving their buyer the impression of purchasing a new instrument.

This convex objective lens of greenish glass is mounted in a brass ring with a cable brim at its front. According to the holes in the mounting, the objective lens was originally fitted with four screws on a telescope.

Mörzer Bruyns 1989



87. 11894

Terrestrial - Nautical telescope

1750-1800

196-115, Ø 5

Signed on the shutter: Dollond LONDON

Provenance: Leiden University, 1931

In 1797 the Leiden Cabinet of Physics contained: A 'Tubus Terrestris of Dollond', in a cylindrical box of mahogany, long 3 feet and with a diameter of 1¾ inches.

The decagonal objective tube (l 93) of this telescope is made of mahogany and holds a biconvex objective. Into it slides a brass eyepiece tube (l 25, Ø 3), which contains four lenses. The dust cover sliding over the objective bears the engraved signature of the maker.

Engberts 1970, 82-83; De Clercq 1997, 131

88. 19935

Terrestrial - Nautical telescope

1750-1800

l 96-109, Ø 4.5

Made by Dollond

Provenance: Bought with the support of the Leiden University Fund, 1927

Similar telescope as the previous number (cat. no. **87**) with a slightly longer decagonal objective tube (l 96) made of mahogany. The brass ocular tube has a field lens (Ø 1.8) and can be covered with a dust cover slide. The shutter of the objective is missing. On this shutter was engraved 'Dollond. London'.

Engberts 1970, 83

89. 8913

Terrestrial - Nautical telescope

1750-1800

l 34-57, Ø 4.4

Provenance: J.G. van Tricht, vicar of Delft, c. 1800; C.E. van Manen, 1951

This hand-held telescope has an octagonal objective tube made of oak (l 34; Ø 4.4) and a brass ocular tube (l 23; Ø 2.5). The instrument has a simple objective (Ø 1.4) and an (incomplete) compound ocular. Both dust cover slides are missing.

Engberts 1970, 83-84

90. 11889

Terrestrial - Nautical telescope

1760-1774

l 66-75, Ø 6.5

Signed on eyepiece: NAIRNE LONDON

Provenance: 'Kweekschool van de Broeders der Onbevlekte Ontvangenis' [= Seminary of Brothers of Immaculate Conception], Maastricht, 1951

This hand-held telescope predates the year 1774, when the instrument maker Edward Nairne (1726-1806) went into an association with his colleague Thomas Blunt, signing their instruments 'Nairne & Blunt'.

The instrument consists of two drawtubes: a mahogany objective tube and a brass ocular tube (Ø 5.2). The cracked and damaged wooden tube has two holes, probably made for the attachment of this telescope to a stand. The eye tube has rack-and-pinion focusing equipment. The instrument has a simple objective with a dust cover slide and an incomplete compound ocular.

Engberts 1970, 93

91. 31354

Nautical telescope

1791

l 57-169, Ø 6.0

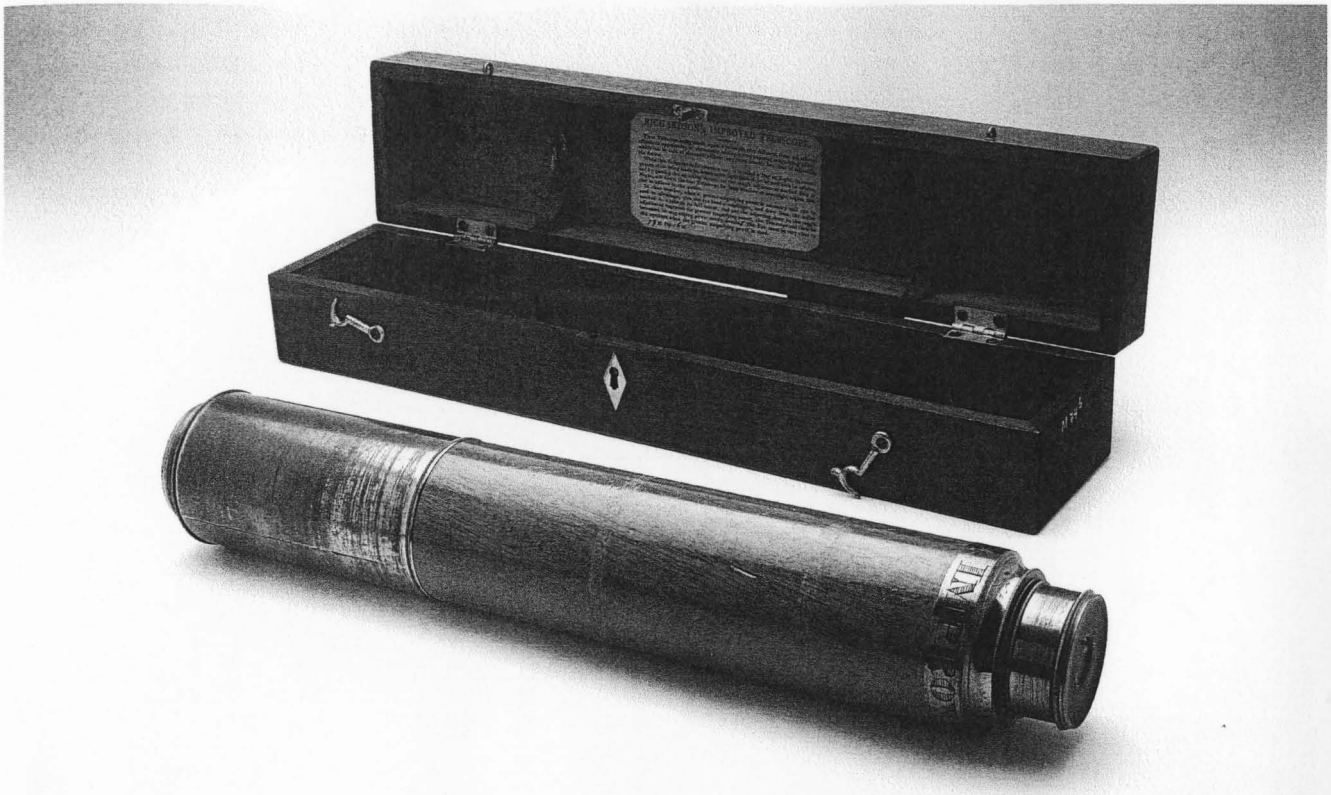
Signed: Jan van Deijl & Zoon Fecit Amsterdam Ao 1791

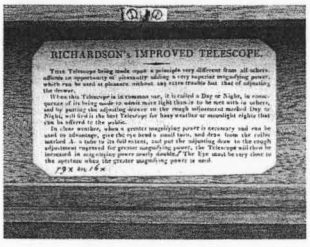
Provenance: P.J. Treffers, 1930

This achromatic nautical telescope is one of the last achromatic telescopes to be made by the Van Deijl workshop, which ended its telescope production in about 1795 owing to the shortage of continental flint glass.

The instrument has a reddish mahogany objective tube (Ø 6) and a brass eyepiece drawtube (Ø 2.5). The achromatic objective has a doublet consisting of a biconvex front lens and a concave back lens. Both original dust covers are missing.

Engberts 1970, 88





92. 8883

'Day or Night' telescope with box

1775-1835

1 38-96, Ø 3.7-4.9

Signed on ocular: Richardson | LONDON | Adjustment for greater Magnifying Power | for Day or Night

*Signed on tube: IMPROVED TELESCOPE**

Provenance: Mr and Mrs Idenburg-Siegenbeek van Heukelom, Batavia, 1935

A manual attached to the inside of the mahogany storage box (h 8, w 40, d 6) explains that this instrument was called a 'Day or Night-telescope', because the objective was designed to admit more light than most other telescopes. The user would 'find it the best telescope for hazy weather or moonlight nights that can be offered to the public'. This kind of telescope was introduced in 1754 by the London instrument maker J. Ascough; the name 'Day or Night telescope' suggested that these instruments offered equal quality at night as well as in daytime. They became quite popular, despite the fact that in practice these telescopes were equally bad in both circumstances.

This device was made by an optician called 'Richardson', who claimed to have improved the instrument. In the manual the claim is made that his telescopes were 'made upon a principle very different from all others', resulting in 'a very superior magnifying power'. There is no explanation of what the claimed improvement was; perhaps it concerned the two magnifications (nine and 16 times). Clifton lists six optical instrument makers operating in London in about 1800, the first being Matthew starting in 1742, followed by four bearing the name John and one with the name George, the last dying in 1835.

The telescope has three drawtubes made of wood and brass. The simple objective (Ø 4.0) has a brass dust cover slide. The compound ocular (marked 'A') has two field lenses and a shutter.

Engberts 1970, 90-91; Clifton 1995, 231-232

93. 8885

'Day or Night' telescope

1775-1825

148-88, Ø 6.0

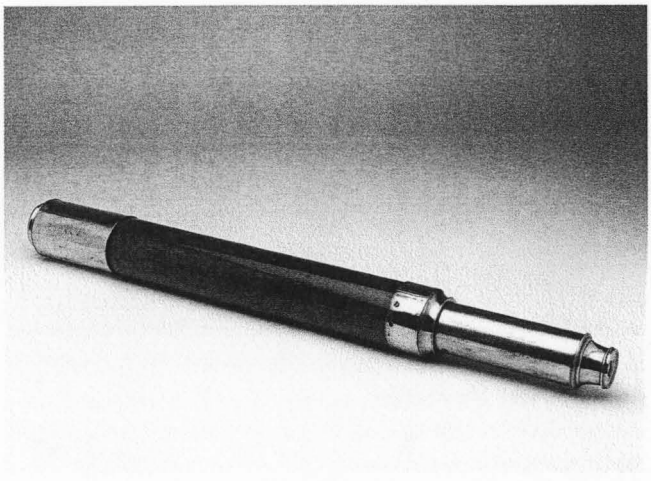
Signed: Dolland London Day or Night

Provenance: Burgers Collection, 1946

This telescope – and the next (cat. no. **94**) – bears the signature 'Dolland', resembling the name of the well-known firm of optical instrument makers Dollond. However, a telescope maker by the name of 'Dolland' has hitherto been unknown. Someone has probably tried to fake the well-known 'Dollond' brand, probably to sell a telescope of lesser quality.

The hand-held telescope is made of two brass segments, the outer tube covered with black linen. The dust cap of the achromatic objective (Ø 3.7) is missing. The compound ocular has a dust cover slide.

Engberts 1970, 106



94. 8886

'Day or Night' telescope

1775-1825

150-89, Ø 5.5

Signed: Dolland London Day or Night

Provenance: Burgers Collection, 1946

This hand-held telescope is made of two segments, the objective tube with achromatic objective (Ø 3.8) being made of reddish mahogany and the eye tube with compound ocular and dust cover slide of brass.

Engberts 1970, 106-107

95. 9451

'Day or Night' telescope

1825-1850

151-91, Ø 5.5

Signed: Harris & Son, London, Day or Night. No 316

Provenance: Bureau for the Verification of National Naval Instruments, 1939

Telescope made by the workshop of Harris & Son in London, which flourished from 1802 until about 1846. The firm was founded by Thomas Harris (fl. 1767-1837) who worked with his son William (1797-1846).

This telescope has two drawtubes (each 48 cm), the objective part made of wood, the ocular tube made of brass. The simple objective (Ø 4.0) has a sun cap and dust cover; the compound ocular has a shutter.

Engberts 1970, 82; Clifton 1995, 126

96. 31355

'Day or Night' telescope

1825-1850

l 51-90, Ø 6.0

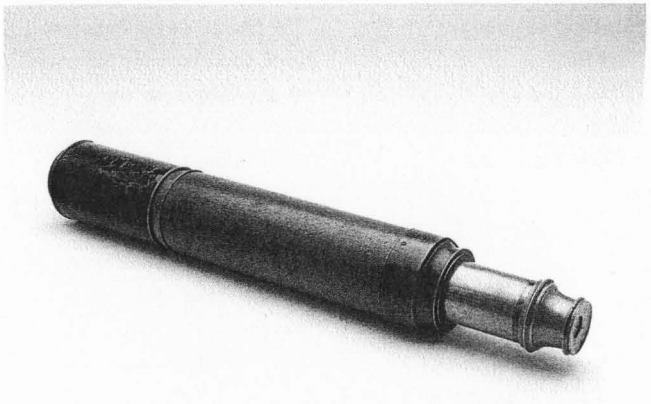
Signed: T Harris & Son, London, DAY, or NIGHT

Provenance: Dr. J.A. Koch, 1933

Telescope made by the same workshop of Thomas Harris & Son as the previous number (cat. no. **95**).

The telescope has two draw-tubes, the objective part made of red-brown wood, the ocular tube made of brass. The simple objective (Ø 4.0) has brass fittings and dust cover; the compound ocular has a dust cover and shutter.

Engberts 1970, 102; Clifton 1995, 126



97. 8902

'Day or Night' telescope

1800-1850

l 37.5-91, Ø 3.8-6.0

Signed: Jones London Day or Night.

Provenance: Mrs E.C. van Hest, 1941

In this period Clifton mentions more than 50 instrument makers based in London bearing the name 'Jones'.

Telescope made in three segments, the objective part made of red-brown oak, the other tubes made of brass. The simple objective (Ø 3.0) has brass fittings and a dust cover slide. Compound ocular with brass sun cap, painted black.

Engberts 1970, 105; Clifton 1995, 152-155

98. 8884

'Day or Night' telescope

1800-1850

l 51-89, Ø 5.8

Signed: J. SMITH LONDON Day or Night

Provenance: Mrs J. Renes-Bluemink, The Hague, 1937

For the first half of the 19th century Clifton refers to several London-based 'opticians', bearing the name 'James or Joseph Smith'.

This hand-held telescope is made in two segments. The main tube is made of brown-red oak (l 58) with a simple objective (Ø 3.7) whose dust cap is missing. At the objective end a hollow brass tube (l 11.5) can be pulled out to eliminate disturbing sun rays. The brass eye tube (l 47) has a compound ocular with a dust cover slide. The screw thread of the ocular tube is damaged.

Engberts 1970, 104; Clifton 1995, 255-257

99. 8928

Nautical telescope

1784-1840

l 27-62.5, Ø 2.6-5.0

Signed on ocular tube: Spencer Browning & Rust London

On a label: 60.2

Provenance: Bureau for the Verification of National Naval Instruments, 1939

This telescope was made by the optical workshop of 'Spencer Browning & Rust', which was operational in London during the period 1784-1840.

The telescope consists of three segments made of mahogany and brass. The instrument has a simple objective (Ø 2.8) with dust cover slide and a compound ocular with cross wires (the horizontal thread of which is missing). A brass screwable cap with slide protects the eye tube.

Engberts 1970, 100

100. 8929

Nautical telescope

1784-1840

l 27-62.5, Ø 2.6-5.0

Signed on the ocular tube: Spencer Browning & Rust London

On a label: 60.1

Provenance: Bureau for the Verification of National Naval Instruments, 1939

This telescope is almost identical to the previous one (cat. no. **99**) with the same dimensions and usage.

The Dutch 'Verificatiebureau voor de Rijkszeeinstrumenten' (= the 'Bureau for the Verification of National Naval Instruments') was founded in 1858 and was housed at Leiden Observatory. Its first director was Frederik Kaiser, assisted by his son Pieter Jan Kaiser, who became the second director of the institute in 1872.

Kaiser 1894; Engberts 1970, 100; Clifton 1995, 261

101. 6952

Nautical telescope

1809-1857

l 48-95, Ø 5.5

Signed: MARINE. J.M. Kleman & Zoon, Koninklijke Instrumentmakers

Provenance: Bureau for the Verification of National Naval Instruments, 1939

Refracting telescope made by the firm of J.M. Kleman, which was operational in the period 1781-1857. The indication '& Zoon' (= 'and son') was added in 1809.

Telescope made of mahogany (l 29.5) and brass. It has a simple objective (Ø 3.8) with dust cover slide. Compound ocular (Ø 4.3). This instrument was made for the Dutch Navy ('Marine'). It is signed with two crossed anchors within a circle and the letter 'Z' (= 'Zeemacht', the Dutch expression for 'Naval Forces').

Engberts 1970, 99-100; Maclean, 1976

102. 11890

Nautical telescope

1826-1839

l 75.5-89, Ø 4.0-6.0

Signed on the ocular tube: Merz, Utzschneider und Fraunhofer in München

Provenance: Bureau for the Verification of National Naval Instruments, 1939

Nautical telescope, made by the Munich 'Optical-mechanical Institute' of Joseph von Utzschneider, which after 1826 was run by Georg Merz, who bought the company in 1839, having used the late Fraunhofer's name as a guarantee of the workshop's high quality over those years.

Telescope made of pear wood and brass. The wooden tube is cut out over two-thirds of its length, probably for the attachment of the telescope to a stand, which however is now missing. The instrument has an achromatic objective (Ø 4.7) with dust cap and a compound ocular with a dust cover slide. The instrument is marked below the signature with a coat of arms representing two crossed anchors within a circle of leaves and the letters 'NM', which stands for 'Nederlandsche Marine', or 'Dutch Navy'. A contemporary label with the number '60 s' refers to an old inventory number.

Engberts 1970, 98-99

103. 11891

Nautical telescope

1826-1839

175-88, Ø 3.9-5.5

Signed on the ocular tube: Merz, Utzschneider und Fraunhofer in München

Provenance: Bureau for the Verification of National Naval Instruments, 1939

Just like the previous number (cat. no. **102**), this telescope was produced especially for 'NM', the 'Nederlandsche Marine' or the Royal Dutch Navy. The coat of arms with two anchors is somewhat smaller.

Refracting telescope made of walnut and brass. The instrument has an achromatic objective (Ø 4.7) and a compound ocular (with a broken dust cover slide). The objective lens is broken and the cover of the objective dust cap is missing.

Engberts 1970, 99

104. 11908

Nautical telescope

1826-1839

175-88, Ø 4.0-6.0

Signed on the ocular tube: Merz, Utz[schneider u] Fraunhofer in Mü[nchen].

Provenance: Bureau for the Verification of National Naval Instruments, 1939

Marked below the signature with a coat of arms representing two crossed anchors within a circle of leaves, completed with the letters 'N[M]', the 'Nederlandsche Marine' or the Royal Dutch Navy.

Refracting telescope made of brass covered on the outer cylinder with black leather, with two leather straps for carrying the instrument. The instrument has a simple objective (Ø 4.8) and a compound ocular with dust cover slide. The objective dust cap is missing.

Engberts 1970, 99

105. 11888

Nautical telescope

c. 1850

197-122, Ø 7.5

Provenance: Bureau for the Verification of National Naval Instruments, 1939

Refracting telescope made of brass covered with black leather, with two leather straps for carrying the instrument. The instrument consists of a slightly conical objective tube (Ø 5.8-6.5) and a brass ocular drawtube (Ø 3.2). It has an achromatic objective (Ø 6.0) with movable sun cap and dust shutter. The incomplete compound ocular also has a dust shutter.

Engberts 1970, 97-98

106. 8887

Nautical telescope

1850-1900

150-104, Ø 4.0-5.5

Provenance: Burgers Collection, 1946

Refracting telescope with three segments made of brass, painted black. The outer tube is covered with black leather, with two leather straps for carrying the telescope.

The instrument has an achromatic objective (Ø 4.8) and a compound ocular (bumped and incomplete). The screwable sun cap is missing.

Engberts 1970, 107-108

107. 8888

Nautical telescope

c. 1850

l 51-76, Ø 4.5-5.5

Provenance: O.F. Muller von Czernicki, 1936

Refracting telescope with two segments made of brass, the outer one covered with black leather (torn). The instrument has an objective (Ø 4.3) with a dust cap and a compound ocular.

Engberts 1970, 103

108. 9206

Terrestrial telescope

1825-1875

l 26-81, Ø 5.0

Signed: W. Heynen Opticien de la Cour, a la Haye

Provenance: Sotheby's-Mak van Waay, 1988

The optical firm of A.W. Heynen was operational in The Hague from at least the 1850s. The company was based on the Noordeinde in the 1880s. They were probably only retailers of instruments made abroad.

This brass refracting telescope has four drawtubes, the outer tube being covered with black leather. The instrument has an achromatic objective (Ø 4.5) with dust cover and an extendable sun cap. The compound ocular has a dust cover slide.

109. 8931

Refracting telescope with compass

1825-1875

l 15-38, Ø 1.8-3.3

Provenance: Mrs J.H. Springer, 1941

Refracting telescope with four segments made of mahogany and brass. The instrument has a simple objective (Ø 2.8) and a compound ocular with a dust cover slide. The cover of the objective contains a compass (Ø 3.3) divided into eight parts, marked: N-NE-E-SE-S-SO-O-NO. This notation proves the French origin of the instrument. The deviation of magnetic north is indicated as 21° to 22° North west.

Engberts 1970, 105

110. 8893

Terrestrial telescope

1825-1875

l 38-96, Ø 6.0

Provenance: G.A. Spoelstra, unknown date.

Refracting telescope with three drawtubes made of mahogany and brass. The instrument has an achromatic objective (Ø 3.9) with a dust cover slide and a broken compound ocular with shutter and sun cap. The eye tube has a screwable dust cap with shutter.

Engberts 1970, 102-103

111. 8925

Terrestrial telescope

1850-1860

l 34-82.5, Ø 2.5-4.5

Signed: J. Molteni Paris

Provenance: W. Schoor, Leiden, 1929

The telescopes of the French instrument maker J. Molteni were introduced into the Netherlands in the 1850s. In their modest range of the market they offered great quality at 'amazingly low prices'. This achromatic telescope (l 34-82.5, Ø 2.5-4.5) has four segments, made of wood and brass, with an achromatic objective (Ø 4.8) and a compound ocular. The objective dust cap is missing.

Kaiser 1853, 657; Kaiser 1854; Engberts 1970, 101-102

112. 9452

Achromatic nautical telescope with astronomical eyepiece

1825-1850

192-101, Ø 4.0-5.2

Signed: Plössl in Wien

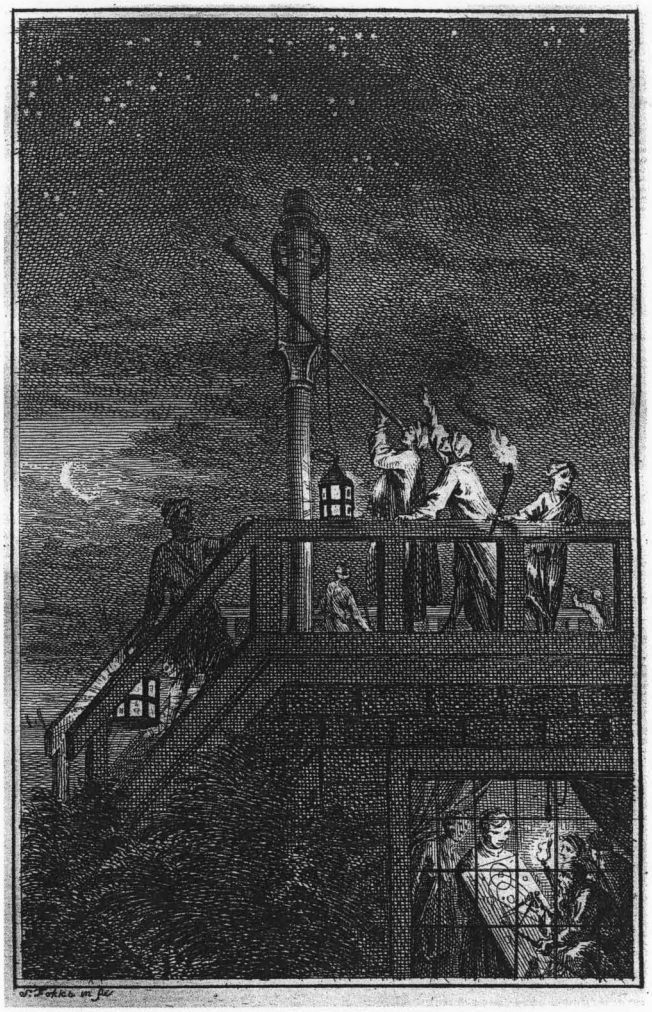
Provenance: Leiden Observatory, pre 1854-1931

In the first half of the 19th century the optical workshop of S. Plössl in Vienna became highly competitive with the Optical Institute of Merz in Munich, making telescopes of similar high quality, but being cheaper. The only problem in the 1840s was that the delivery of a Plössl telescope once ordered took a very long time.

This nautical telescope with a tube of mahogany (with craquelure) and brass fittings has no support. The achromatic objective (Ø 5.0) is made of three lenses. The dust cap is missing. The telescope has two compound oculars, one with a dust cover slide. The second – incomplete – ocular is kept in a pillbox marked: 'Astr. Ocular of the Plössl Telescope no 10'. Such an 'astronomical eye tube' was available at the time for 4 to 6 Dutch florins. It made the telescope more suitable for astronomical observations. Visible on the telescope tube is the inscription 'D.10.', referring to an old inventory number.

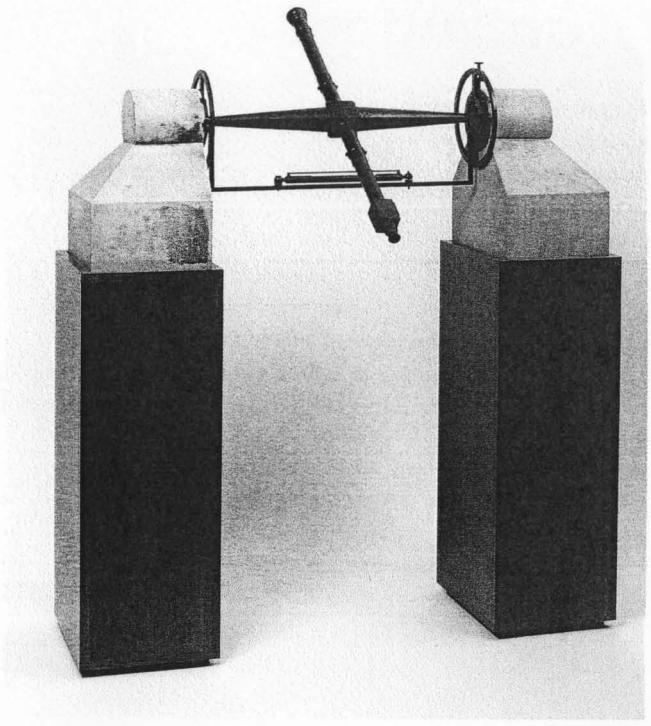
Kaiser 1845, 479, 483-487; 1853, 652 & 655-656; Invent. 1854, no. 30; 1868, E-10; Engberts 1970, 101

Refracting telescopes on support



Depiction of an unknown private observatory with a refracting telescope on a support.
Engraving by the Amsterdam artist Simon Fokke, from J. Hervey, *Godvruchtige Bespiegelingen over den Nacht, Den Starrenhemel en den Winter*, Amsterdam, 1756.

For astronomical use telescopes had to be equipped with a support. Which one was to be chosen depended on the desired use. Transit telescopes only had a movable axis in the plane of the meridian. More popular were the azimuthal stands, which were the simplest to make and allowed observation in all directions. More convenient for longer observation of the same object were the equatorial supports, in which the turning axis of the telescope was placed in a parallel position with the earth's axis, with the result that a heavenly object could be observed for a longer time.



113. 9621

Transit telescope

1740

h 40, w 115, d 83

Signed: J. Sisson LONDON

Provenance: Leiden Observatory, 1739-1933

AC-I, 110; Invent. 1868, A-11; Engberts 1970, 73-74

This transit telescope was bought from Jan van Musschenbroek by W.J. 's-Gravesande for 469 guilders in 1740. The instrument was made by the London-based instrument maker Jonathan Sisson (1690-1749). By placing the instrument on the meridian and observing the meridian passages of a star with known coordinates, it could be used for checking the time of the observatory's clocks. In the 1750s the telescope was used by Johan Lulofs with his famous experiments to determine the proper length of a seconds pendulum.

The brass telescope is attached to a horizontal axis that pivots in a vertical plane between two lime stones (h 40, w 30, d 25) resting on – newly made – wooden pillars. Attached to the axis (l 65) are two revolving circles (Ø 28), one of which has a scalar division whose pointer is missing. The telescope (l 83, Ø 3) has a plano-convex objective (Ø 3.0) with simple biconvex ocular (Ø 2.5). Placed behind the eyepiece is a rectangular reticule, with an adjusting mechanism whose key is missing. A water level (l 26) is placed on a brass bar between the revolving circles. One sight on the telescope tube is missing, as is the screwable dust cap of the eyepiece.

114. 22457

Refractor on large tripod

1750-1800

h 171, w 94, d 74

Signed: DOLLOND - LONDON

Provenance: Fam. Koch, 1933

Refracting telescope made by the well-known Dollond workshop in London. Its founder John Dollond (1706-1761) became very famous as the inventor – in 1758 – of the achromatic telescope. Peter Dollond (1730-1821) capitalised on his father's success by enlarging his firm of instrument makers to one of the best known in London. The firm has a long record of making outstanding optical instruments.

Telescope with a wooden objective tube (l 74, Ø 5-6; cracked in several places) and a brass ocular tube (l 21, Ø 3) on a large folding azimuthal tripod, length 144 cm (wooden part) and 22 cm (brass part), with a diameter of 16 cm. Originally the eyepiece could be drawn out by a rack-and-pinion construction, but this mechanism is out of order. The optics of the compound ocular are only partly preserved.

Engberts 1970, 54-55

115. 11915 & 15005

Refractor on small tripod

c. 1775

l 73.5-118, Ø 6.0-7.0

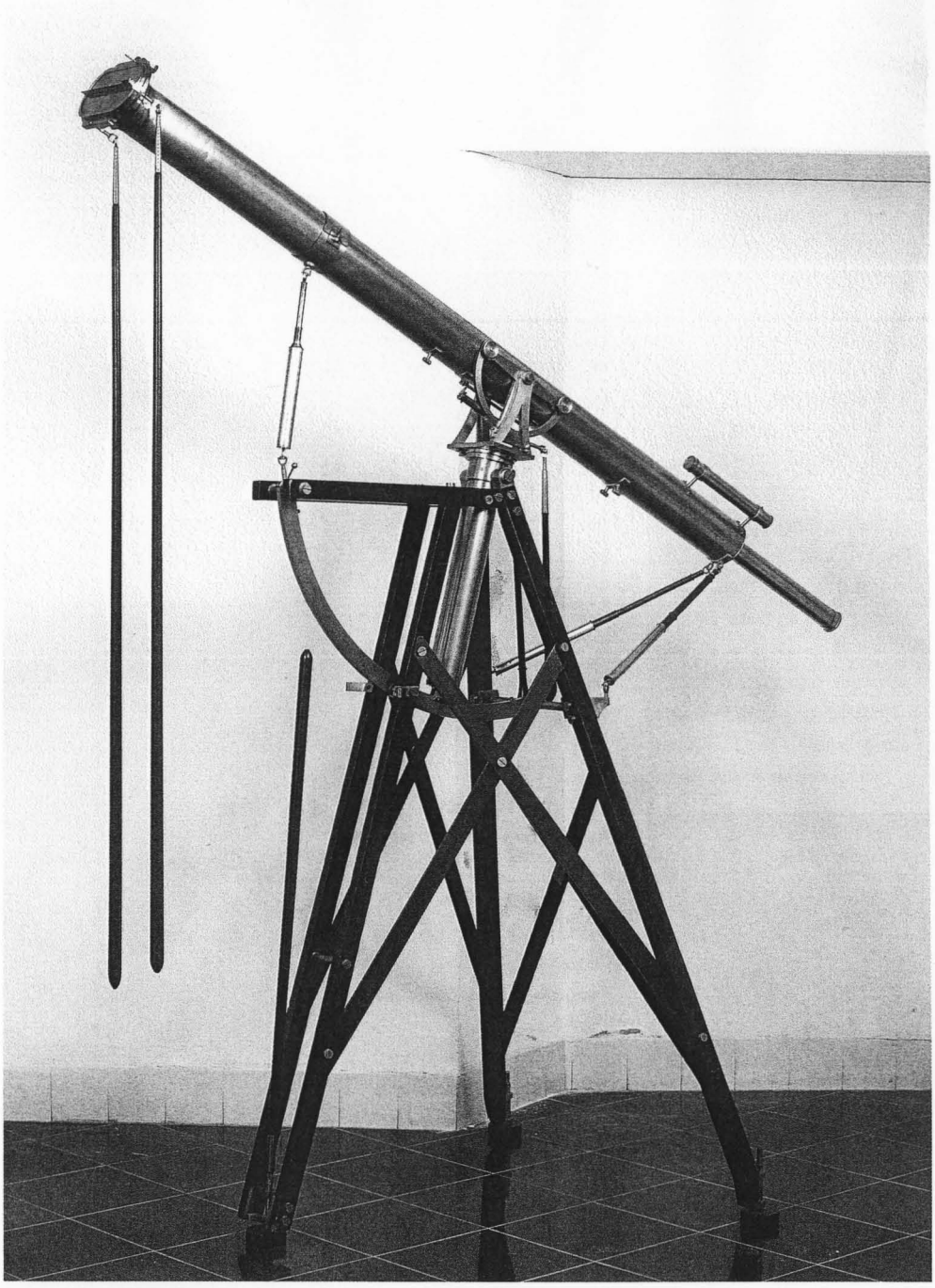
Signed on the end of the tube: DOLLOND LONDON.

Provenance: J.H.C. Lisman, Leiden, 1931

Refracting telescope made by the well-known Dollond workshop in London. The telescope has a mahogany objective tube and a brass ocular drawtube (l 46, Ø 3.0), mounted on a brass azimuthal tripod stand. The instrument has a simple objective (Ø 5.1) with a screwable dust cap and a compound ocular.

The foldable brass azimuthal tripod (h 37.5, w 31, d 31) has its own museum number (15005).

Engberts 1970,.54



116. 8699

Large achromatic lens telescope with heliometer and micrometer

1765-1775

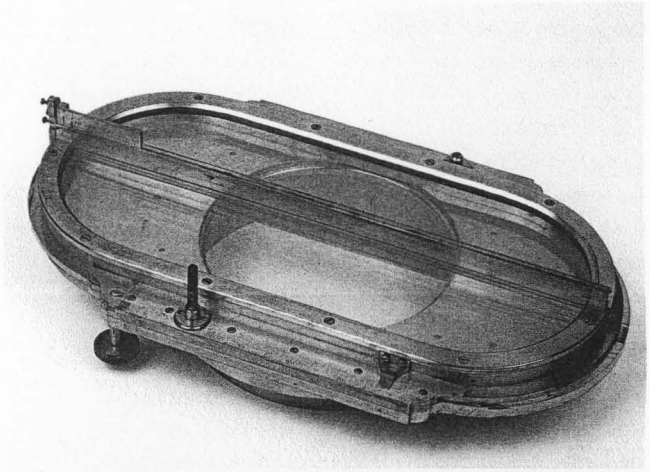
h 174.5, w 202.5, d 89

Signed around the eyepiece:
*DOLLOND * LONDON*

Provenance: Sotheby's, 1985

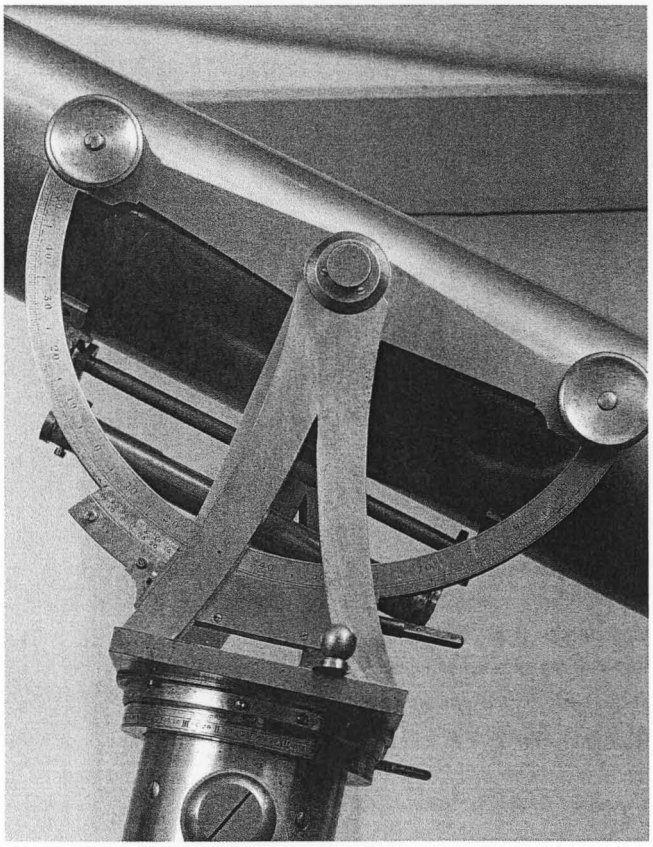
The achromatic refractor was a major improvement of the telescope. Although the achromatic principle (the annulment of colour shifting by combining two lenses with different refracting indices) had already been discovered by Chester Moore Hall in 1731, the invention itself only became known in 1757 after the patent was granted to John Dollond in London. As a result, until 1774 his son Peter Dollond was the only instrument maker in Great Britain allowed to produce achromatic telescopes.

This large telescope is one of the rare examples of a large achromatic astronomical telescope of the first generation. The brass tube (l 167, Ø 10) stands on a high wooden tripod with an equatorial mounting and adjustable polar height, with fine tuning on both axes. This variable mounting enables the use of this telescope at every degree of latitude. The achromatic objective (Ø 9.5) has a dust cap. A heliometer objective can be placed in front of the objective (see the accessories below). The telescope has several compound oculars. Attached to the tube is a brass finder (l 26, Ø 3.5) with a simple objective and a compound ocular.



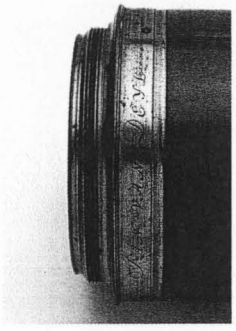
The large wooden storage box (h 27.5, w 195, d 18) has brass handles. It contained various accessories, such as spare oculars, colour filters, a heliometer objective and a micrometer.

The heliometer objective is an accessory to the Dollond achromatic telescope described above. The arrangement has two D-shaped lenses, to be set in front of the objective tube, for measuring the angular distance between two heavenly bodies.



The micrometer is according to Bradley. In this instrument the distance between two parallel threads can be varied by means of an adjustment screw. This arrangement facilitates the precise measurement of small angular distances between stars in a different way from the heliometer objective.

Sotheby's Oct. 1985, no. 236; Dekker 1978; Brooks 1991



117. 3468 & 15037

Large achromatic telescope on wooden support

1776

h 157, w 108, d 67

Signed: Jan van Deyl & Zoon Fecit Amsterdam Ao 1776

Stand probably made by Jan Kampman and Adam Steitz

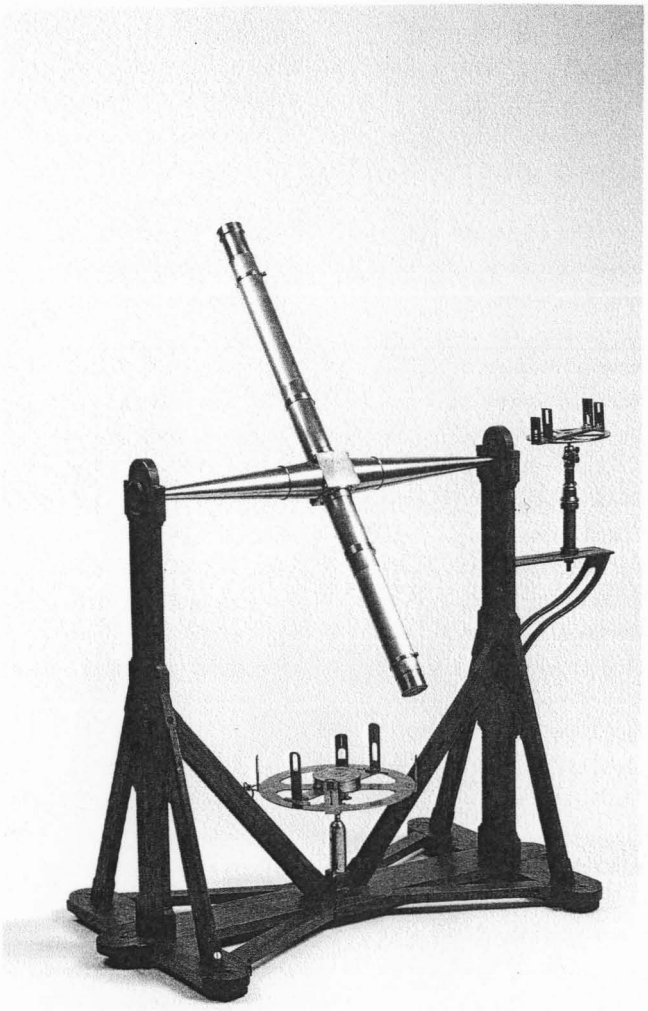
Provenance: Nico Israel, Amsterdam, 1959

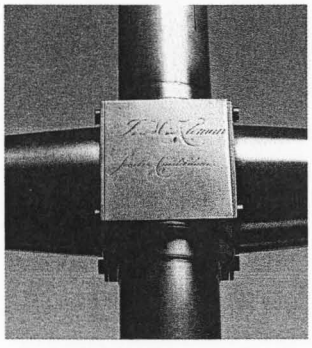
This instrument is one of the rare examples of a large achromatic telescope made Jan van Deijl, who had made achromatic telescopes of high quality since 1763. A very similar instrument with an identical stand, dated 1781, is at Teylers Museum, Haarlem. That instrument was bought in the renowned Ebeling sale of 1791. The catalogue for this auction states that Van Deijl had made only two copies of such a large achromatic telescope. The mahogany tripod in the Ebeling sale was made by Jan Kampman from Amsterdam, with the brass alt-azimuth mounting and other brass parts made by Adam Steitz, also from Amsterdam.

Walnut tube (l 90 , Ø 10) with frames of brass at both ends, resting in a cradle, mounted on a large azimuthal tripod of brown varnished mahogany. Such a wooden tube was designed to insulate from the cold, which was thought to prevent the condensation of moisture on the lenses. It has an achromatic objective (Ø 7.4) with dust cover (with its own number 15037). The inscription: '*Vergroot 68 maal*' (= magnifies 68 times) can be read on the inside of the compound ocular tube.

The stand has a small brass quadrant (radius 14, no graduation) and some other minor brass details. Some axles are made of steel. On the tripod a vertical hexagonal hollow column has been mounted. Within this column a hexagonal wooden bar (l 109) can be moved up and down and set tight with a wooden screw. Two butterfly screws fix the cradle of the telescope to the quadrant. The straps of leather on the cradle make it possible to attach different telescope tubes.

Ebeling 1791, no. 392 & 393; Turner 1973, no. 264; Engberts 1970, 57-58





118. 22458

Achromatic transit telescope on support with two Dutch circles

1800-1809

h 87, w 114.5, d 50

Signed on transit instrument: J.M. Kleman fecit Amsterdam

Signed on larger circle: J.M Kleman & Zoon fecit Amsterdam

Signed on small circle: Richer à Paris

Provenance: T.A. Polée, Doorwerth, 1944

In September 1808 Louis Napoleon, King of Holland, proclaimed the Observatory of Utrecht University to be his 'Royal Observatory'. As a consequence plans were made to rebuild the observatory and the Amsterdam firm of instrument makers J.M. Kleman was commissioned to make some new astronomical instruments at the King's expense. By 1809 some of these instruments were already finished, amongst them an 'achromatic transit telescope for the Royal Observatory at Utrecht', being shown at an exhibition of industrial products in Amsterdam. In August 1810 however the instruments were still awaiting delivery at Kleman's workshop. As a result of the annexation of the Kingdom by Napoleonic France, Utrecht Observatory had to be financed by Utrecht city council again, resulting in the total cancellation of all preceding plans.

As a transit telescope is a typical observatory instrument, while this apparatus represents the only known transit telescope by Kleman (made according to its signature some time before 1809), it is tempting to suppose that this instrument was originally destined for the Royal Observatory at Utrecht. According to tradition, the instrument was actually used by General Kraijenhoff in about 1810, in the course of his major triangulation of the Netherlands. This would fit with the above supposition, as Kleman must have sought another useful purpose for this already finished instrument.

The transit instrument is placed on an oak support (101 x 58). The present device obviously has an arrangement made up at some later date from three different instruments: the transit telescope and two geodetic circles, added for the alignment of the instrument into the plane of the meridian. The first 'Dutch circle' (Ø 29) was also made by Kleman (in the period after 1809, when the indication '& Zoon' was added to the workshop's signature). The other circle (Ø 16.5) was made by the French instrument maker Jean Francois Richer (1743-c. 1820) of Paris. The brass telescope tube (l 99, Ø 5) is fastened perpendicular to the axis. It consists of four parts, held together by hoops. It has a biconvex objective (Ø 4.0) with a dust cover. The eyepiece (l 15.5, Ø 4.5) can be drawn out and has a compound ocular. A dark orange screen can be placed in front of the ocular by means of a small brass lever. The remains of a reticule are visible. The hollow horizontal axis (l 75) has a conical shape on both sides, its diameter varying from 7.5 to 2.0 cm.

Kernkamp 1940, 393, 414, 495; Engberts 1970, 71-73; Maclean 1976, 5; Deiman 1987, 185

119. 26115

Binocular achromatic telescope on tripod stand

c. 1800

l 81, w 21, h 81

Provenance: Van der Mey, 1971

Rare binocular telescope, unsigned, but probably of English origin. Such binocular achromatic telescopes became a novelty in the late 1770s, but remained rare on the market. In the Netherlands an achromatic binocular telescope was developed by the philosopher Frans Hemsterhuis (1721-1790) and was made in very small quantities by the Van Deijl workshop. In 1792 such a Van Deijl binocular was bought for Teylers Museum. A binocular Dollond telescope is in the Utrecht University Museum.

The telescope has achromatic objectives with compound eye tubes, with fine tuning for adjustment of the distance between the eyes and the image. Each telescope tube (l 81, Ø 6) can be covered with a dust cap. A scale division can provide vernier readings. The instrument can be fitted on a mahogany tripod stand (l 18, Ø 5.2) with brass fittings and clamps. It has some minor defects.
The instrument is kept in a contemporary mahogany storage box (h 8, w 83, d 22.5), which contains two spare ocular tubes (l 21.5, Ø 3). The cover of the box is marked with a burning mark representing a crowned 'W', suggesting a Royal descent ('Willem I'?).

Turner 1973, no. 265

120. 22460

Achromatic lens telescope on tripod stand

1826-1839

h 192, w 96-107, d 17

Signed: Merz Utzschneider u. Fraunhofer München

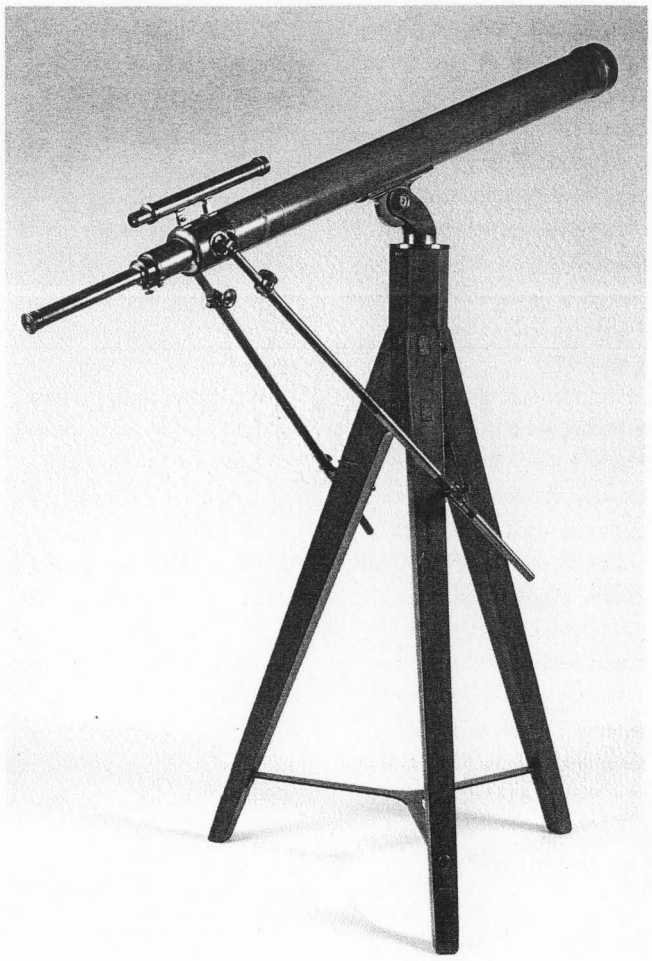
Provenance: W.H. de Beaufort, 1976

Achromatic telescope, made by the Munich 'Optical-mechanical Institute' of Joseph von Utzschneider, which after 1826 was run by Georg Merz, who bought the company in 1839, having used the name of the late Fraunhofer as a guarantee of the workshop's high quality until 1839. In the 1840s such a telescope required an investment of some 220 Dutch guilders.

Telescope tube (l 96-107, Ø 8-2.5) of mahogany and brass on large wooden azimuthal tripod stand (wooden part: l 172; brass part: l 16, Ø 17). The telescope has an achromatic objective (Ø 6.0) with dust cap and a compound ocular. Attached to the tube is a finder (l 15.5, Ø 2) with cross wires.

A wooden storage box (h 20, w 85, d 12) covered with blue marbled paper contains two spare eye tubes, four compound oculars, two sun filters and two brass attachments for the support.

Kaiser 1845, 482; Brachner 1986; Riekher 1990; Pelzers 1996



121. 3469

Large achromatic telescope on tripod stand, used in several astronomical observations

c. 1820

h 156, w 186 , d 87

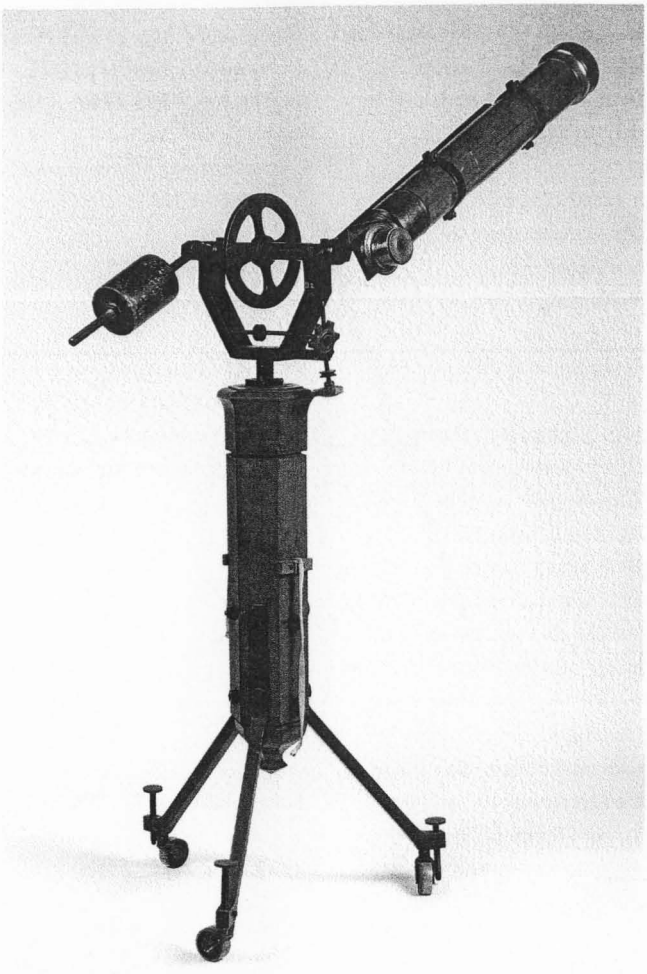
Signed: Utzschneider und Fraunhofer in München

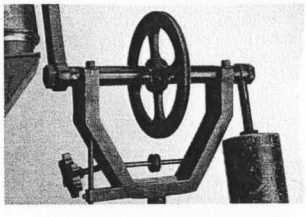
Provenance: J.B. Stoop, Amsterdam (c. 1820), inherited by the De Beaufort family, remaining there until 1967

Achromatic telescope of superb quality, made by the 'Optical-mechanical Institute' founded in Benediktbeuern in 1809, which moved to Munich in 1819 and was run until 1826 by Joseph von Utzschneider and Joseph von Fraunhofer (d. 1826). In 1835 the Leiden astronomer Frederik Kaiser borrowed this telescope from its first owner, the Amsterdam banker Jan Bernard Stoop (1781-1856), for the observation from the attic of his Leiden home of the return of Halley's Comet. In 1861 the telescope was again borrowed by a professional astronomer, Dr. F.W.C. Krecke of the Utrecht Astronomical Observatory 'Zonnenburg'. Following Krecke's departure in 1866, the telescope was returned to the Stoop family. In 1874 the telescope was borrowed for a third time, on this occasion by the Utrecht astronomer Dr J.A.C. Oudemans. He was leader of the Dutch astronomical expedition to Réunion to observe the famous transit of Venus. However, bad weather prevented a successful observation. Back in the Netherlands the telescope returned to the Stoop residence 'De Treek' near Maarn. Here the instrument remained until 1918, when it was inherited by Dr L.F. de Beaufort (1879-1968). It was on his behalf that the instrument was offered to the museum in 1967.

Telescope (l 146, Ø 9.5-11.5) made of mahogany and brass on a wooden azimuthal tripod stand. The instrument has an achromatic objective (Ø 9.6) with dust cover and a compound ocular. Attached to the tube is a brass finder (l 36, Ø 3) with simple objective and compound ocular. According to the descriptions of Kaiser and Oudemans, the instrument was originally accompanied by a circular micrometer, which is now missing.

Kaiser 1836; Verslag 1874, 10-11; Engberts 1970, 63-64; Brachner 1986; Hooijmaijers 2003





122. 9965

Achromatic 'Comet Searcher' on an equatorial stand

1826-1839

h 142, w 122, d 55

Signed on brass tube: Merz, Utzschneider und Fraunhofer in München

One ocular signed: C. Kellner. Wetzlar

Provenance: Leiden Observatory, c. 1840-1935

In his inaugural lecture of 1838 Frederik Kaiser listed a 'comet searcher on an equatorial stand' as one of the instruments that Leiden Observatory still needed. Shortly afterwards he adapted this telescope made by the 'Optical-mechanical Institute' in Munich into such a 'comet searcher'. To this end the telescope was placed on a heavy iron bearing after Kaiser's own design, with counterbalances that lightened its use. A second feature in this arrangement was the reflecting prism combined, which in every position of the telescope fixed the observer's line of sight in a horizontal position. After 1850 the eyepiece was replaced with an 'orthoscopic ocular', with a large field of view invented – and made – by the optician C. Kellner (1826-1855) of Wetzlar.

A similar, but somewhat smaller 'comet searcher' mentioned in the 1854 & 1868 inventories, coming from the same workshop and also with a bearing after Kaiser's design, is now lost. It was probably this 'comet searcher' that was sent to the famous international exhibition of scientific apparatus at South Kensington in London in 1876. On its return to Leiden this instrument appeared to be severely damaged, so it was probably abandoned.

The telescope has a wooden tube (l 79, Ø 10), an achromatic objective, a dust cap and a reversing prism. The heavy azimuthal tripod mounting has a counterbalance with fine tuning. Several small accessories are kept in a wooden box, including four compound ocular tubes. One of these is the Kellner ocular, which was characterised in 1868 as 'a very remarkable and curious comet-ocular'. One of the achromatic objectives and the original Merz prism were stolen from the museum in 1943. The mark 'D2' on the instrument refers to an old inventory number.

Kaiser 1838, 57; 1853, 652; Invent. 1854, no. 23; 1868, E-2; Biedermann 1877, 397; Verslag 1876, 10; 1877, 12-13; 1879, 8; Oudemans 1888, 778; Engberts 1970, 65-67

123. 13711

Dialytic lens telescope on stand with storage box

1838

h 69, w 70, d 42

Signed: Plössl in Wien

Provenance: Leiden Observatory 1838-1931

The 'dialytic lens telescope' was proposed by J.J. Littrow in 1830. In this kind of telescope the achromatic objective was split into two parts: the concave crown glass was placed at the end and the convex flint glass was set in the middle of the tube. With this arrangement only a small piece of flint glass had to be used, avoiding the extremely high price of the large pieces of flint glass that would otherwise be necessary. However, this arrangement required a very precise alignment of the lenses, the reason why these kinds of telescopes – which were only made at the workshop of Plössl in Vienna – were soon abandoned.

In 1838 Leiden Observatory bought the first 'dialytic lens telescope' 'with an aperture of 36 lines' [= 8.1 cm]. In the 1868 inventory Frederik Kaiser remarked that this telescope, which was originally made for an unnamed astronomer in Leipzig, 'was not particular good'. Another dialytic lens telescope by Plössl with an 'aperture of 26 lines' [= 5.9 cm], described by Kaiser as 'a very nice telescope' and rated by Oudemans as being 'of excellent quality' in 1888, is now lost.

Brass telescope tube (l 70, Ø 7.5) on ditto tripod mounting (azimuthal, with fine tuning on both axes. Achromatic objective (Ø 8.1) with cap and correction lens (Ø 4.2). The wooden handle for the horizontal adjustment of the instrument has been broken. The wooden storage box (h 26.5, w 90, d 13) with submerged handles contains five compound oculars (four of which are numbered I to IIII) and some other accessories. Attached inside the storage box is a label with instructions for the use of these instruments, ranging from an aperture of 26 lines to 41 lines.

Littrow 1830; Kaiser 1853, 640; Invent. 1854, no. 25; 1868, E-4; Oudemans 1888, 771; Engberts 1970, 67-69

124. 3470

Small achromatic refractor on folding tripod

1819-1826

h 49, w 71, d 27

Main telescope signed: Utzschneider u. Fraunhofer in München

Finder made by E. Wenckebach

Stand made by Lerebours

Provenance: Leiden Observatory, c. 1840-1931

This achromatic telescope with a contemporary aperture of 27 lines [= 6.1 cm] was bought for Leiden Observatory in the early 1840s. The instrument was made by the 'Optical-mechanical Institute', based in Munich and run until 1826 by Joseph von Utzschneider and Joseph von Fraunhofer (d. 1826). The 1868 inventory reveals that the finder was made by the Amsterdam instrument maker E. Wenckebach and that the stand was constructed by Lerebours, after a design by F. Kaiser.

This telescope has a mahogany tube (l 71, Ø 5.5-6.5), fitted with brass, standing on a brass folding tripod (azimuthal), with wooden adjustment handles on both axes. The main objective (Ø 6.1) has a dust cover. The eye tube (l 35; Ø 2.3-3.2) is in two segments, containing four lenses, one being severely damaged. The brass finder (l 18, Ø 2.0) has a simple objective and a compound ocular.

Kaiser 1845, 482; Invent. 1854, no. 27; 1868, E-6; Engberts 1970, 69-70; Brachner 1986

125. 13669

Brass refractor on tripod stand with storage box

1853

h 57, w 145, d 33

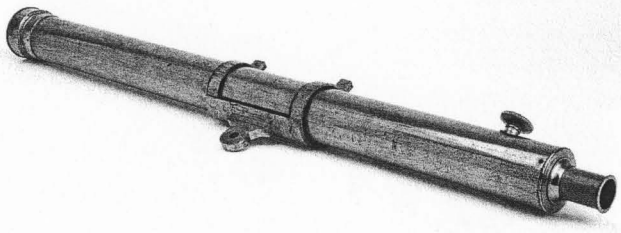
Signed on the hinge of the stand: Molteni Frs. à PARIS

Provenance: Leiden Observatory, 1853-1931

Frederik Kaiser bought this telescope after hearing of Molteni's products from P.J. Kipp, director of a Delft instrument firm. Having made some observations with seven different Molteni telescopes, Kaiser reported with enthusiasm about the great qualities of these modest products, which were available at 'amazingly low prices'. The 1868 inventory: 'A telescope by Molteni, with an aperture of 34 lines [= 7.7 cm] on a brass mounting without fine tuning. As the objective was bad, Mister G.A. Steinheil has replaced it with his excellent objective, number 378'.

Brass telescope (main tube: l 108, Ø 8; eye tube: l 50, Ø 4.2) with dust cap on a brass azimuthal tripod. The achromatic objective is missing. Three compound eyepieces can be placed in the eye tube (two with sun filters, one with a dust cover slide). The oak storage box (h 25, w 115, d 14) has simple iron mounting. Telescope tube, stand and storage box are all marked 'D 8'.

Kaiser 1853, 657, 662-664; 1854; Invent. 1854, no. 28; 1868, E-8; Engberts 1970, 70-71



126. 11920

Refracting telescope

1853

w 92, Ø 7

Signed: MOLTENI FRÈRES. PARIS

Provenance: Leiden Observatory, 1853-1969

Brass telescope tube (l 76, Ø 7) with cap. All the optical components are missing. According to the 1854 and 1868 Leiden Observatory inventories, this telescope 'with an aperture of 27 lines' [= 6.1 cm] was attached to a stand made by E. Wenckebach in the 1840s, which is now missing.

Kaiser 1845, 488; 1854; Invent. 1868, E-9; Engberts 1970, 124

127. 10503

Refracting telescope

1853

l 40-113, Ø 3.2-6.5

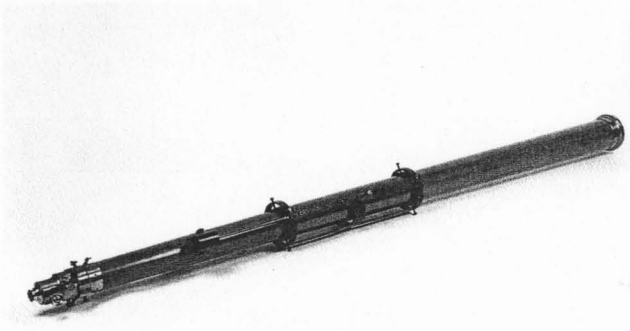
Attributed to J. Molteni, Paris

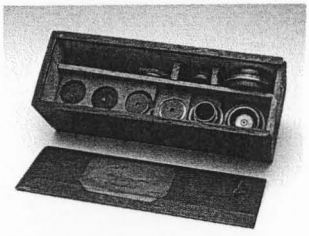
Provenance: Leiden Observatory, 1853-1969

The 1868 Leiden Observatory inventory mentions two small 'Zugfernrohre' by Molteni, with astronomical oculars mounted on a wooden stand 'which I have recommended for dilettantes'. This telescope is probably one of these entries. The wooden stand is now missing.

Telescope in five drawtubes made of brass, the outer tube painted in a dark brown colour. It has a solar and dust cap at the objective end and a shutter at the ocular end. All the optical components are missing. A label on this telescope reads: 'Kijker van Molteni', with the numbers 'D [31] 16' (the 31 being erased).

Invent. 1854, no 32; 1868, E-17; Engberts 1970, 125





128. 13710

Large achromatic telescope on iron mounting

1856

h 12, w 266.5, d 12

By Steinheil in Munich

Provenance: Leiden Observatory, 1856-1933

This large walnut telescope was ordered for Leiden Observatory in 1856 from the workshop of Carl August Steinheil (1801-1870), which had been founded in Munich only the year before. In 1868 this impressive instrument was described as: *A telescope by C.A. Steinheil, with an objective of 4 inches aperture and 9 feet focus, which annihilates completely the secondary spectrum. To this telescope belongs an iron stand, which enables the usage of the instrument at different windows of the great hall in the [new] observatory. The tube can obtain a fine tuning through the usage of a gear work which lengthens or shortens the oblique rods of the stand. To this telescope belongs also a long axis, which enables a parallactic arrangement.*

The instrument was used in 1874 by P.J. Kaiser during the Dutch expedition to Réunion for the observation of the transit of Venus. On that occasion the telescope was equipped with a helioscopic ocular by Merz, with polarisation filter and a photographic camera. However, a cloudy sky hindered proper observation of the transit. On its return to Leiden Observatory the crown glass lens appeared to be broken. In the process of preparation for the observation of the second transit of Venus, on Curaçao in 1882, this broken objective was replaced by another made by H. Schröder. On this occasion some other changes were made to the instrument: a partly reflecting prism was attached for lessening the intensity of the sunlight; two wedge-shaped pieces of coloured glass were put in front of the two achromatic objectives, the ocular tube was provided with a new set of cross wires and a firm wooden tripod stand was made for the telescope, on which it was movable with crossbars in the horizontal and vertical directions.

Telescope (l 266.5, Ø 8.5-12; cracked) with wooden objective tube and brass eye tube on an iron mounting with counter-balances. The achromatic objective, the finder and the dust cap are missing. Belonging to this telescope is a storage box, with label 'D1 ocularen of Steinheil' containing six compound oculars and some other accessories, including two diaphragms, which are marked '1890'. According to the museum records, this instrument was signed 'Steinheil in München. No. 222. Dr. H. Schröder'. This signature was probably inscribed on the – now missing – objective lens.

Invent. 1868, E-1; Verslag 1874, 10; 1875, 8; 1882, 18-19; Oudemans 1905; Engberts 1970, 64-65; Franz 2001

129.

Telescope and Mount

Provenance: Deventer Natuur- en Scheikundig Genootschap, to be placed in the Deventer HBS, 1867-1974

a. 20731 & 17795

Achromatic telescope on tripod stand

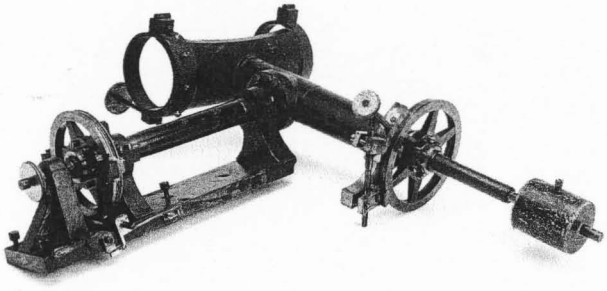
1819-1839

h 90, w 133, d 45

Signed on the base of the main tube: Utzschneider u. Fraunhofer in München

To celebrate its 50th anniversary in 1867 the 'Natuur- en Scheikundig Genootschap' in Deventer permitted itself the indulgence of buying a good quality telescope. But at a price of 611.50 Dutch guilders this secondhand brass telescope exceeded the original budget. However, the outstanding quality of the telescope and its maker was praised at a meeting on 19 December 1867, so the purchase was granted permission.

Brass telescope (tube: 1 120; Ø 10) on a rather small brass azimuthal folding tripod.
A set of late 19th-century oculars, signed 'HASTRO' were accessories to this telescope. They were registered with the separate inventory number 17795.



b. 17701

Equatorial mount for a telescope

1825-1867

h 62, w 51, d 18

This mount made of brass and steel, with a lead counterweight, was designed for the attachment to a standing wall of a telescope with a diameter of 9 cm. The instrument has two brass circles (Ø 11.5), the first with a scalar division ranging from 0 to 24, the second with a scalar division of two times 0-180 degrees. This mount was bought in 1867, together with the Utschneider & Fraunhofer telescope mentioned above. It was evidently an accessory added to the telescope at a much later date.

Van Helden 2002, no. 191& 191a

130. 11895

Achromatic lens telescope

1826-1839

l 94-105, Ø 5.4-7.5

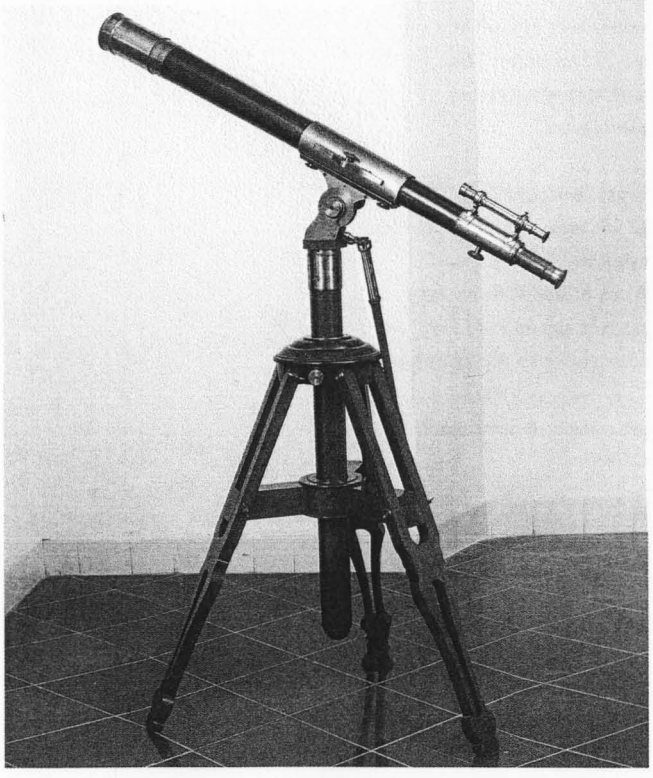
Signed: Merz Utzschneider u Fraunhofer in München

Provenance: Van Stockum's Antiquariaat, 1954

Telescope made by the Munich 'Optical-mechanical Institute' of Joseph von Utzschneider, which after 1826 was run by Georg Merz, who bought the company in 1839 having kept the name of the late Fraunhofer as a guarantee of the workshop's quality for all those years.

The telescope is made of pear wood and brass. It has an achromatic objective (Ø 5.8) whose dust cap is missing. The compound ocular can be moved by a rack-and-pinion arrangement. The telescope had to be placed in the cradle of a stand, which is now missing.

Engberts 1970, 108-109



131. 3467

Large achromatic lens telescope on stand

c. 1840

h 143.5, w 119, d 77

Signed: Reballio & Zoon Opticien à Rotterdam

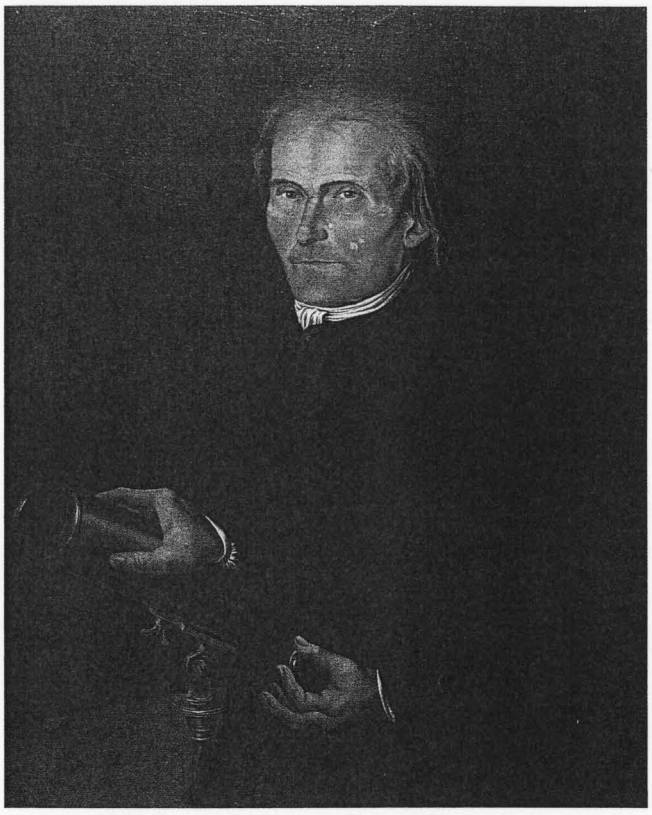
Provenance: A. van der Meer, 1962

This instrument makers firm was founded in 1763 and has lasted five generations until c. 1925. As most artisans of Italian descent, at the beginning the Reballios specialised in meteorological instruments. This telescope is one of the few examples from the period in which they called themselves 'opticians'. As the Dutch telescope industry had come to a standstill during this period, it seems likely that this excellent high-quality instrument is retail, made by some unknown (French?) instrument maker. This hypothesis seems to be confirmed by the fact that a similar telescope is recorded with the false French spelling 'A. Rébaillo & Zoon, Opticiens Rotterdam'.

Walnut telescope tube (l 119-167, Ø 6-9.5) with several brass fittings on a solid, adjustable wooden azimuthal stand, with fine tuning on both axes. It has an achromatic objective (Ø 8.0) with dust cover slide. Three large compound ocular tubes. Brass finder (l 22.5; Ø 2) with simple objective with cap and compound ocular with cross wires.

Engberts 1970, 59-61; Bolle 1983, note 203

Reflecting telescopes

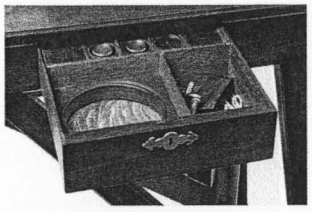


Portrait of the Franeker telescope maker Jan van der Bildt (1709-1799).
Painting by J.J. de Boer, probably Franeker, 1791 (Museum Martena Franeker).

In the early 1730s a new type of telescope came onto the market. Soon the reflecting telescope was available in three types:

1 the Newtonian design, having a main concave mirror, a flat secondary mirror and an eyepiece, establishing an upside-down image, suitable for astronomical observations.
2 the Gregorian design, having a main concave (in theory parabolic) mirror with a hole in the centre and a secondary concave (in theory elliptic) mirror, located on the optical axis at a distance slightly greater than the sum of the focal lengths of the two mirrors. An eyepiece in the line of sight of the tube establishes an upright image, suitable for 'earthly objects' as well as astronomical observations.
3 the Cassegrain design, having a main concave (in theory parabolic) mirror with a hole in the centre and a convex (in theory hyperbolic) secondary mirror, located on the optical axis just after the primary focal point.

An eyepiece in the line of sight of the tube also establishes an upright image suitable for terrestrial and astronomical observations. Compared with the Gregorian design, the Cassegrain type has the advantage that with the same tube length a longer focal length (and therefore magnification) can be achieved. However, in the 18th century it was far easier to make a concave mirror with the necessary optical requirements than a convex one, so the Gregorian type remained the most popular for a long time.



132. 9699

Newtonian reflecting telescope on a table support

c. 1733

h 112.5, w 153.5, d 57

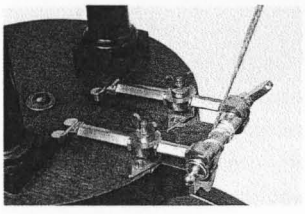
By E. Scarlett, London

Provenance: [P. van Musschenbroek 1733-1762; M.J. Diodati 1762-1784]; Unknown, 1784-1838; Leiden Observatory, 1838-1931

This so-called 'five-foot' Newtonian telescope probably belonged to professor Petrus van Musschenbroek, who gave a detailed and illustrated description of the instrument in the second edition of his *Beginsels der Natuurkunde* (1739). In this book Van Musschenbroek reveals that his telescope was made by the London instrument maker Edward Scarlett. Correspondence with J.Th. Desaguliers confirms that this Scarlett telescope was bought in 1733. After Van Musschenbroek's death the telescope was auctioned at Leiden in 1762. The instrument was bought for 185 guilders by Martijn Jacob Diodati, a wealthy preacher from The Hague. In 1784 the telescope is mentioned in the inventory of Diodati's assets before it was auctioned again, its new owner being unknown however. In the early 19th century the instrument came back onto the market and was acquired by F. Kaiser as an important historical instrument for Leiden Observatory. In an autographic note Kaiser stated: 'This telescope [described by Van Musschenbroek] has such a perfect resemblance to the one which I bought in 1838 at an auction for 30 guilders, that I have no doubt at all that it is the same'.

Telescope with an octagonal wooden tube (l 133, Ø 14.5) with wooden dust cap, lying in a cradle on a wooden azimuthal table support. The finder on the tube (still mentioned in the 1838 auction catalogue) is now missing. The main mirror has a diameter of 13 cm. The secondary mirror is oval in shape (2.6 x 1.8). The eye tube (l 6, Ø 2) has a simple ocular. The supporting table (h 90, w 58, d 40) has three legs resting on small wheels. The drawer in the table contains two diaphragms, one dust cover with a slide, a crank and a few minor spare parts.

Desaguliers to Van Musschenbroek, Nov. 27, 1733 (Arch. MB 138-h); Van Musschenbroek 1739, 628-635 & Pl. XXI.3; Collectio 1762, no. 405; Diodati Inventory 1784; Catalogus Librorum 1838, 61; Invent. 1868, E-21; Autographic note by Kaiser in Arch. MB 571; Engberts 1970, 15-17



133. 8165

Gregorian reflecting telescope on wooden support

1736-1739

h 53.5, w 77, d 30

Attributed to E. Scarlett, London

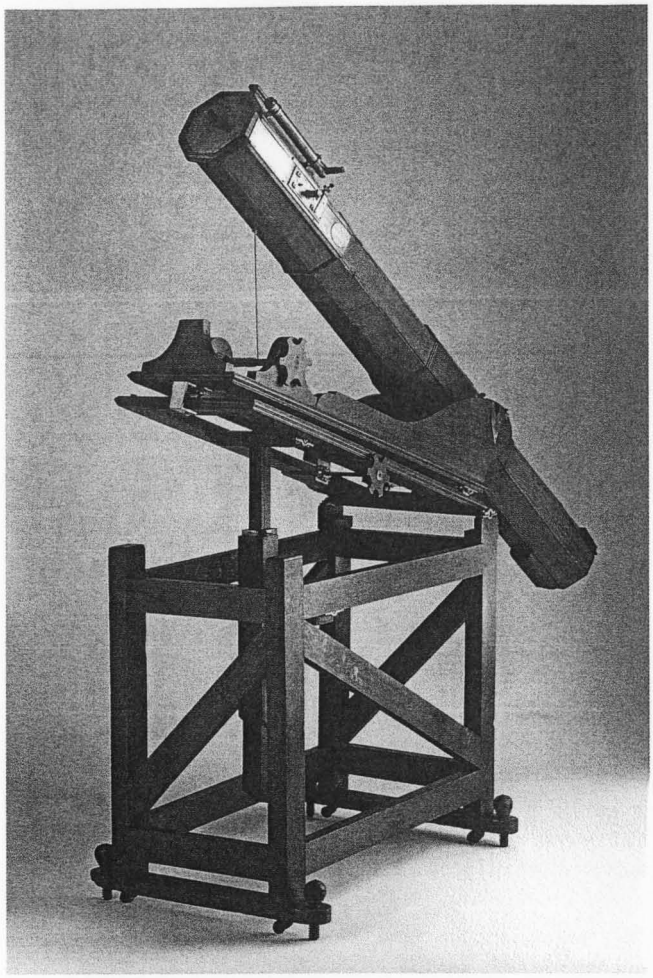
Provenance: [P. van Musschenbroek, c. 1736-1762; J.M. Diodati, 1762-1784]; Leiden Observatory, c. 1820-1931

According to Engberts, this telescope was the personal property of the Leiden professor Petrus van Musschenbroek, who gave a detailed and illustrated description of this instrument in the 1739 edition of his popular textbook on physics. In Van Musschenbroek's picture we see the telescope mounted on a tripod, instead of the present wooden support, so at first glance it seems the support was added at a later date. However, the 1762 auction catalogue for Van Musschenbroek's instruments says that this telescope has two supports: one for use in the open air, and a smaller one for use inside on a table. This must be the present support. According to this 1762 catalogue, 'the whole apparatus' was made by E. Scarlett. At this auction the telescope was bought for the sum of 101 guilders by Martijn Jacob Diodati, a wealthy preacher from The Hague, who also bought Van Musschenbroek's Newtonian Scarlett telescope.

In the 1868 Leiden Observatory inventory Kaiser described the telescope as 'an old, but pretty good two-foot reflector', neither constructor nor provenance of which he knew. As Kaiser joined the Observatory in 1826 and the telescope is not mentioned in the inventory of 1798, this telescope must have been acquired by the Observatory somewhere between 1798 and 1825.

Gregorian telescope, with a brass objective tube (l 65, d 9.5), containing a main mirror (Ø 8.0) and a secondary mirror (Ø 1.7), which can be closed by a screwable dust cap. The tube is lying in a wooden cradle on a mahogany cylindrical support with an azimuthal bearing. The eyepiece is a compound ocular. The telescope has no finder but a simple sight.

Van Musschenbroek 1739, 634-635 & Tab. XXII.2; Collectio 1762, no. 401; Invent. 1868, E-20; Engberts 1970, 23-24



134.

Newtonian telescope

Provenance: Leiden Observatory, 1736-1931

a. 9620

Large Newtonian reflecting telescope on wooden support

1736

h 227, w 251, d 80.5

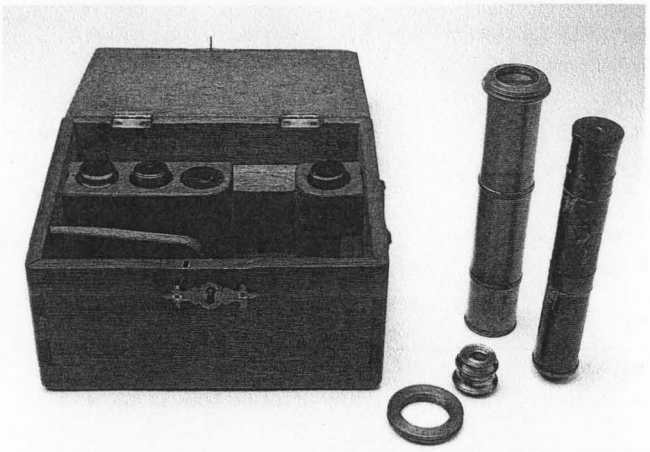
Signed: George Hearne London.

This so-called 'eight-foot telescope' was made by George Hearne of London, one of the earliest commercial constructors of reflecting telescopes. Hearne was introduced to the art of making telescopic mirrors by John Hadley.

This instrument was purchased for Leiden Observatory by W.J. 's Gravesande in 1736 at a price of 862 guilders. The instrument was imported by the Leiden instrument maker Jan van Musschenbroek, who submitted an invoice for 55 guilders for installing the instrument. In about 1750 Hearne's main mirror had become dull, so at the request of professor Johan Lulofs a replacement mirror was made by the Franeker instrument maker Jan van der Bildt. Lulofs described this mirror as being 'of unparalleled' quality. According to the Swedish astronomer Ferrner (1759), another spare mirror had been made by the English instrument maker James Short, but in comparison Ferrner preferred Van der Bildt's mirror. Both mirrors are mentioned in the 1793 Leiden Observatory inventory, but one of them is now missing. In 1862, at the request of professor Kaiser, a spherical silvered glass mirror was made for the instrument by C.A. von Steinheil, which is also now missing. In 1777 the Danish astronomer Bugge reported that professor Wynpersse told him the Hearne-telescope was unable to perform observations at a height of more than 30 degrees above the horizon, for reasons of instability of the wooden support of the instrument.

The reflecting telescope stands on a wooden azimuthal support. The octagonal wooden objective tube (l 251, Ø. 24) contains a main mirror (Ø 20), an oval secondary mirror (4.5 x 3.0) and can be closed with a wooden dust cover. The distance between the mirrors (c. 215) can be altered by hand. The ocular is fixed in a rectangular copper mounting (9 x 5.2), which is adjustable. A brass finder (l 31, Ø 3.5, with incomplete optics) is fixed on the wooden tube. The support of the telescope consists of a wooden framework (l 120, w. 60, h. 98), on which an inclined cradle has been placed bearing the tube. The inclination of the cradle can be varied slightly.

According to the Leiden Observatory inventories of 1742 (no. 32), 1793 (no. 7) and 1798 (no. 6), the Hearne telescope was accompanied by a number of accessories and spare parts, some of which are now lost – such as a small brass quadrant for measuring altitudes – and some of which – described below – are still present.



Wooden box (h 18.5, w 22.5, d 11.5), marked 'A 10', containing two tubes with oculars and five loose oculars (two of which are marked 105 and 168). In the inventories of 1793 and 1798 these objects are described as: *To the eye mirror with the biggest hole belongs a copper eye tube with its glasses and a sunglass. Also a green parchment eye tube with copper fittings and three convex glasses for the earthly objects. To the eye mirror with the smaller hole belongs four different eye-tubes, each with its eye-glass of different magnitude.*

Round tube of brass (h 16.5, Ø 16.5), marked 'A 10', with two spare secondary mirrors (5.5 x 3.5 & 3.0 x 2.0). In the inventories of 1793 and 1798 these objects are described as: *Two inclined flat metal eye-mirrors, each attached to a copper plate that fits into the side of the [large] tube; together in a copper box.*

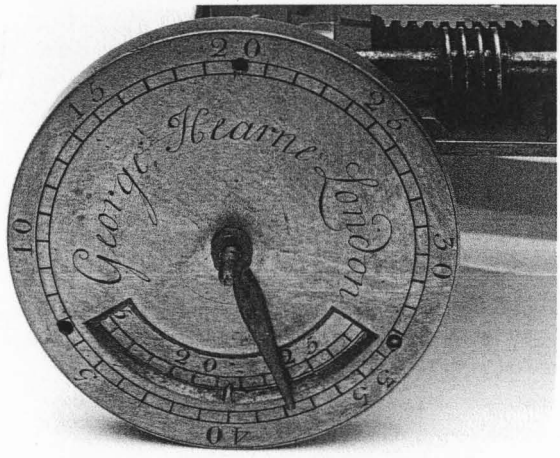
b. 18960

Micrometer

1736-1742

h 6, w 11.5, Ø 7

Signed: George Hearne, London



Micrometer made after the design by James Bradley, English Astronomer Royal, belonging to the large reflecting telescope.
This micrometer was first mentioned in the 1742 Leiden Observatory inventory. A few years later (in 1751) Lulofs rates this micrometer as 'very good'. The 1798 inventory contains a note that the micrometer is 'partly defective'. Originally the micrometer was housed in a small wooden box, together with the oculars. This box could be placed in a larger one made of oak.

AC I-46, no.r 113; AC I-110; Invent. 1742, no. 32; 1793; 1868, A-10; Lulofs to Klinkenberg, 19 May 1751 (Arch. KNAW, inv. no. 31); Allamand to De Courtanvaux, 4 July 1769; Engberts 1970, 13-14; Brooks 1991

135. 11873

Small Gregorian reflecting telescope

1737

h 20, w 23, d. 8.5

Signed: JAMES SHORT EDINBURGH 1737 23/137

Provenance: G.A. Brongers, Heemstede, 1950

This is one of the early telescopes made by James Short in Edinburgh (Scotland) shortly before his move to London in 1737. Short had started producing reflecting telescopes five years earlier. In contrast to most other British instrument makers, Short only produced mirrors. Thanks to this specialisation he enjoyed unequalled fame. Short often combined his mirrors by choosing the best combination from a selection of mirrors on a trial-and-error basis. Short referred to this method as 'marrying the specula'.
In the signature '23' refers to the number of telescopes made after this design; 137 is the serial number, referring to the total number of telescopes he had made at that time.

The telescope can be mounted with a brass column (l 9) on a mahogany box (h 8.5, w 19, d 7; cracked cover) in which the instrument can also be stored. The brass objective tube (l 16, Ø 4.5) can be closed with a dust cap and contains a main mirror (Ø 3.6) and a secondary mirror (Ø 1.1). The eye tube (l 6.5, Ø 1.7) has a compound ocular.

Engberts 1970, 38-39; Turner 1969

136. 8201

Cassegrain reflecting telescope on tripod stand

1741

h 64, w 75, d 31

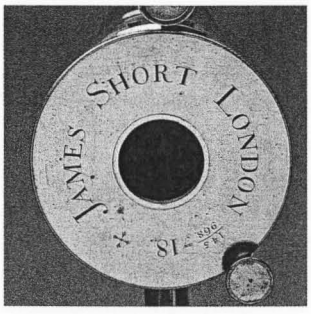
*Signed: JAMES SHORT LONDON 1741 3/ 290 = 24**

Provenance: Dr. J.A. Koch, 1933

Two-foot reflector made by James Short in 1741, just two years after his move to London. The number '3' in the signature refers to the number of telescopes made at that time after this design, implying that this is probably one of the first Cassegrain-type telescopes Short made. The number '290' refers to the total number of telescopes already made; '24' is the focal length in inches.
Such an instrument was sold at the time for the price of 35 guineas. It is highly likely that the telescope was originally accompanied by several other secondary mirrors and eye tubes, facilitating a Gregorian arrangement and other magnifications as well (see the next item).

Reflecting telescope with a Cassegrain arrangement on a brass azimuthal tripod with fine tuning on both axes. The brass objective tube (l 65.5, Ø 12.5) contains main mirror (Ø 10.5), convex secondary mirror (2.8) and can be closed with a dust cap. The eye tube (l 10 Ø 2.7) has a compound ocular. A brass finder (l 28, Ø 2.0) is attached to the main tube.

King 1955, 85; Turner 1969; Engberts 1970, 33-34



137. 11874

Gregorian and Cassegrain reflecting telescope on tripod stand with case

c. 1755

h 54.5, w 71, d 31

*Signed: JAMES SHORT LONDON 145/968 = 18.**

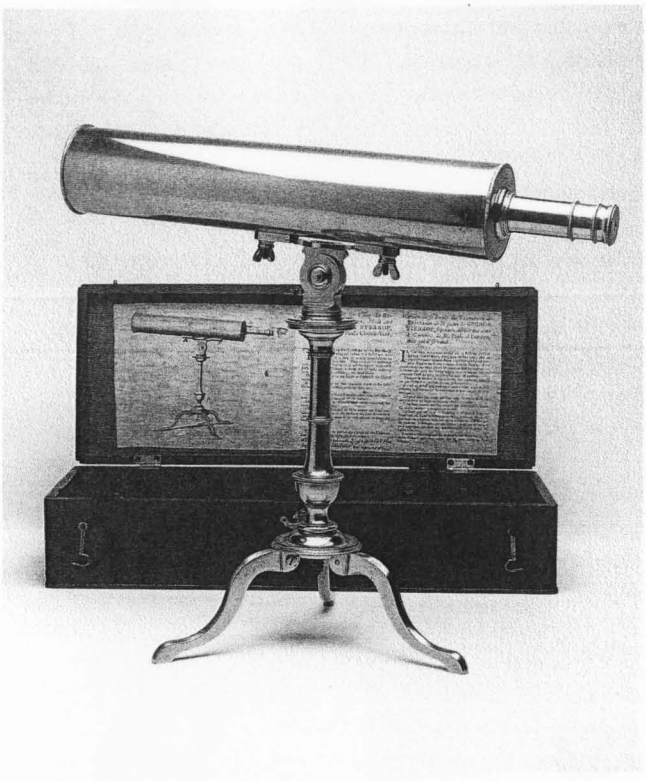
Provenance: Jan Hisser, Middelburg, c. 1833-1853; Mrs. M.G.A. de Man, Middelburg, pre 1898-1928; Bought, with the support of the Physical Society 'Diligentia', The Hague, 1928

Reflecting telescope made by James Short. The number '18' represents the focal length of this particular model in inches, '145' refers to the number of 18-inch telescopes made at that time and '968' is the serial number giving the total number of telescopes produced. According to Turner's reconstruction of the production of Short's telescopes, this instrument was probably made in 1755.

The mahogany storage case (h 30, w 69, d 20) with original brass mounting contained several notes from former owners. According to a written instruction dated September 1833, the telescope belonged to a certain J. Hisser, who had observed with it 'from here' the large clock in the town of Goes. Archival records show that the only person fitting this name was the merchant Jan Hisser (d. 1853), who lived in nearby Middelburg. According to Hisser, the telescope was the best he had ever seen in its category, 'surpassing all the others in purity, field of view, clearness and magnifying power'. He had used the instrument several times to observe Saturn's rings and Jupiter's bands. As a similar Short telescope was auctioned in Middelburg in 1832, together with other astronomical instruments of the late Jan Pieter Fokker (1755-1831), former 'Astronomist' of the Batavian Republic, it is tempting to suppose that this was his instrument. In 1798 Fokker had installed an astronomical observatory in the Abbey of his home town Middelburg, which was operational until at least the year 1805.

Brass reflecting telescope on a brass azimuthal tripod with fine tuning on both axes. The objective tube (l 61.5, Ø 10.5) contains a main mirror (Ø 10) and a secondary mirror (Ø 2.3) and can be closed with a dust cap. The eyepiece (l 9, Ø 3) has a compound ocular. A finder (l 29, Ø 2.0) with simple objective and ocular is attached to the main tube. Seven other secondary mirrors, one of which can be used to change the telescope into a Cassegrain arrangement, are stored in four tin cans. Two other eye tubes with compound oculars are also present.

Turner 1969; Engberts 1970, 28-29; Arch. MB 552



138. 8150

Reflecting telescope on tripod stand with wooden case

1747-1748

h 38, w 42, d 20

Signed: George Sterrop MAKER

Provenance: bought c. 1928

This Gregorian telescope can be stored in an oak case (h 17, w 44, d 10) containing an engraved label that is a short manual in English and French entitled: 'Directions for using the Re-Flecting Telescope, made and sold by George Sterrop, Optician, in St. Paul's Church-Yard, London'. George Sterrop was a well-known instrument maker who lived at this address from 1747-1748. He died in 1756.

Reflecting telescope on a brass azimuthal folding tripod. The brass objective tube (l 34, Ø 6.5) has a main mirror (Ø 6) and secondary mirror (Ø 1.6) and can be closed by a dust cap. The eye tube (l 8, Ø 2.5) has a compound ocular with screwable sun filter. The butterfly nut of the stand is missing.

Engberts 1970, 27-28; Clifton 1995, 266

139. 8156

Gregorian reflecting telescope

1738-1757

h 37, w 37, d 23

Signed: Made by G: ADAMS at Tycho Brahe's Head in Fleet Street LONDON.

Provenance: Mak van Waay, Amsterdam, 1962

Reflecting telescope made by George Adams the elder (1734-1772), who worked at Tycho Brahe's Head in Fleet Street between 1738 and 1757.

The instrument rests on a brass folding tripod with a lion's head crafted at the knee of every leg. A ball-and-joint socket arrangement regulates the fixing of the telescope. The brass objective tube (l 46, Ø 7.2) is covered with black leather and contains a main mirror (Ø 5.5) and a secondary mirror (Ø 1.4). Its screwable dust cap is missing. The eye tube (l 8.5, Ø 2) has a compound ocular with screwable sun filter.

Engberts 1970, 47; Millburn 2000

140. 8157

Gregorian reflecting telescope on tripod stand

1738-1773

h 39, w 55.5, d 26

Signed: J. URINGS, LONDON

Provenance: W. Roos, Rotterdam, 1938. Bought with the financial support of D.H. van Dam

Reflecting telescope, probably made by John Urings II, who worked from 1738 until 1773. He was the son of instrument maker John Urings I, who operated in London from 1709 until 1751. Only the son is known to have made and sold telescopes.

Brass objective tube (l 47, 8) with main mirror (Ø 7.0), secondary mirror (Ø 2.0) and dust cap. Eyepiece (l 8.5, Ø 2.8) with compound ocular. Its screwable sun filter is missing.

Engberts 1970, 35; Clifton 1995, 285

141. 8152

Gregorian reflecting telescope

1756-1777

h 35.5, w 45.5, d 23

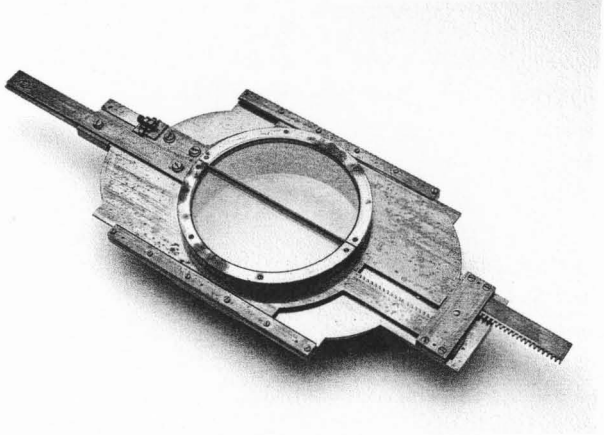
Signed: 'B. MARTIN, Fleet Street, LONDON'

Provenance: Van Stockum's auctions, The Hague, 1955

Brass reflecting telescope on folding tripod stand made by Benjamin Martin (1705-1782), who worked at Fleet Street from 1756 until 1777. During this period he sold these 'one-foot-telescopes' for the price of £5/5/0.

The objective tube (l 36, Ø 7.5) contains a main mirror (Ø 6) and secondary mirror (Ø 1.4) and can be closed with a dust cap. The eyepiece (l 8.5, Ø 2.3) has a complex ocular with screwable sun filter. The top of the stand and the knees of the tripods legs are decorated with triangles (one missing). At the bottom of the original wooden storage box (h 18, w 48, d 10) the old owner's inscription 'BT' can be read.

Engberts 1970, 22-23; Millburn, 1976; Millburn 1986, 31 (no. 39); Clifton 1995, 181



142. 8159 & 6131

Gregorian reflecting telescope with heliometer objective

1760-1780

h 52, w 75, d 30

Signed on the tube: P. Dollond London

Provenance: Leiden Observatory, 1890-1931

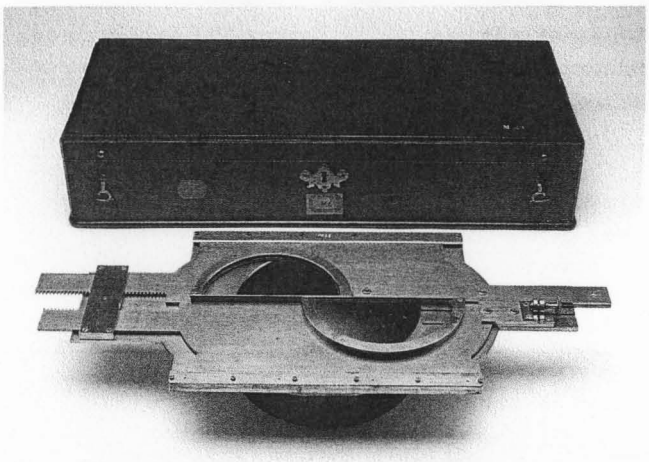
In 1890 the *Verslag* of Leiden Observatory mentions the enrichment of the historical section of its instruments with a Huygens lens (9108) and 'a heliometer made by Dollond'. The latter most probably refers to this combination of reflecting telescope and heliometer objective. In 1931 both telescope and heliometer objective were acquired from Leiden Observatory, being registered at the museum as two different instruments (A-35 and A-16). However, as (1) the heliometer objective fits precisely on the Dollond telescope and as (2) no other Dollond reflector is mentioned in the inventories of the Observatory and as (3) there is no other way of knowing that the unsigned heliometer objective was made by Dollond, there is hardly any alternative but to conclude that these two instruments form a pair.
On 2 December 1889 this *'sterk aanhalende koperen spiegeltelescoop door P. Dollond te Londen, met dubbele beweging, koperen drievoet en bijbehorende heliometer, in mahonieh[outen] kist'* was offered for auction in Amsterdam, where it was bought for Leiden University, together with the Huygens lens 9108, and probably also the glasses 23882 , 23829 and 23835.

A similar two-foot Dollond reflector with pairing heliometer was once the personal property of Frederik Kaiser and was used at Leiden Observatory in 1845.

Telescope with brass tube (l 67, Ø 10.5), main mirror (Ø 10), secondary mirror (Ø 2.3) and dust cap standing on a brass column (h 20) resting on a foldable tripod with azimuthal revolving arrangement. Fine tuning over both axes is possible using two ivory adjustment keys connected to a semicircular gear work (Ø 12). No scalar division. The ocular tube (l 7.5, Ø 3) has a compound ocular. Attached to the tube is a brass finder (l 25, Ø 2.0) whose objective is missing.

The mounting of the heliometer objective (h 4.3, w 37.5, d 13.2) is made of brass. At one end the brass frame can be fixed to the telescope tube. The double convex long-focus objective is split into two halves, which can be moved along the direction of the division by means of a rack-and-pinion arrangement. With a heliometer the angular distance between two stars (or the diameter of the sun) can be measured by moving the heliometer until the two images coincide. The angle can be read using a vernier on a scale with a length of 5.5 inches divided with a precision of 1/500. The adjustment sticks are missing.

Kaiser 1845, 494; Invent. 1854, part 2, no. 1; Catalogus 1889, no. 308; Verslag 1890, 7; Engberts 1970, 24-25; Turner 1973, no. 258; Brooks, 1991; Clifton 1995, 87



143. 6130 & 12802

Heliometer objective with wooden box for a – now missing – Dollond reflector

1765-1768

l 50, w 20, d 7

According to provenance made by P. Dollond, London

Provenance: Johan Maurits Mohr, Batavia, 1768-1775; Jan Hooijman, Batavia; 1776-1789; Society Felix Meritis, Amsterdam, 1787-1889; Amsterdam Physics Laboratory, 1889-1926

This heliometer objective is one of the few surviving instruments of the illustrious astronomical observatory of the Reverend Johan Maurits Mohr in Batavia [now Jakarta], which was built and equipped between 1765 and 1768 and had already been dismantled following an earthquake in 1775. It was most likely part of the first shipment of scientific instruments sent to Batavia in 1765. After Mohr's death his instruments were bought in Batavia by the vicar Jan Hooijman, who transported them to Amsterdam for repairs. After more than 10 years in an attic of the Amsterdam merchant Hendrik van Akker, Mohr's instruments were used in 1787 to equip the newly founded astronomical observatory of the Society for Arts and Sciences 'Felix Meritis' in Amsterdam. Inventories of the scientific instruments of this Society list a large 4½-foot Gregorian telescope with heliometer objective made by Dollond, London. It is likely to be this reflector, which is depicted in plaster at the Felix Meritis building. The heliometer objective and the telescope were frequently used at Felix Meritis, e.g. for the observation of the solar eclipse of 1851. After the dissolution of Felix Meritis in 1889 its instruments were scattered among several institutions of the University of Amsterdam. The fate of the telescope is not known. Its heliometer objective went to the Amsterdam Physics Laboratory. In 1926 it was given to the National Museum for the History of Science and Medicine.

The objective is made of brass and glass. The long focal lens is split into two halves, which can be moved along the direction of the division by means of a rack-and-pinion arrangement. At one end the brass frame can be fixed to a telescope with a tube diameter of 16.6 cm. Angles can be read using a vernier on a scale with a length of eight inches divided with a precision of 1/500. The adjustment sticks are missing.

The original mahogany storage box (h 10.5, w 52.5, d 22.5) has the museum number 12802. This box has two old labels with the signatures 'F.M.' ['Felix Meritis'] and is marked with old inventory numbers '387' and 'M 23'.

Van der Voort 1851; Brooks, 1991; Zuidervaart & Van Gent 2004

144. 8164

Gregorian reflecting telescope with small altitude quadrant

1775-1800

h 58, w 80, d 34

Signed: Dollond London

Provenance: Anton P. Taubman, The Hague, 1953

At the top of the support this nicely crafted Chippendale-styled telescope made by the Dollond workshop is decorated with sea animals. The altitude can be determined from a remarkable decorated quadrant (radius 28.5 cm) by using a plummet. The scale division of the quadrant is two times 0-90 degrees.

The telescope has a brass objective tube (l 69, Ø 12), with main mirror (Ø 9), secondary mirror (Ø 3) and dust cap on a brass azimuthal tripod with fine tuning on both axes. The adjustment can be made with ivory handles. Two compound oculars (l 10, Ø 3.9) are available. A brass finder (l 19.5, Ø 2.5) is attached to the main tube.

Engberts 1970, 41-42

145. 8030

Gregorian reflecting telescope on tripod stand

1770-1790

h 30, w 43, d 19

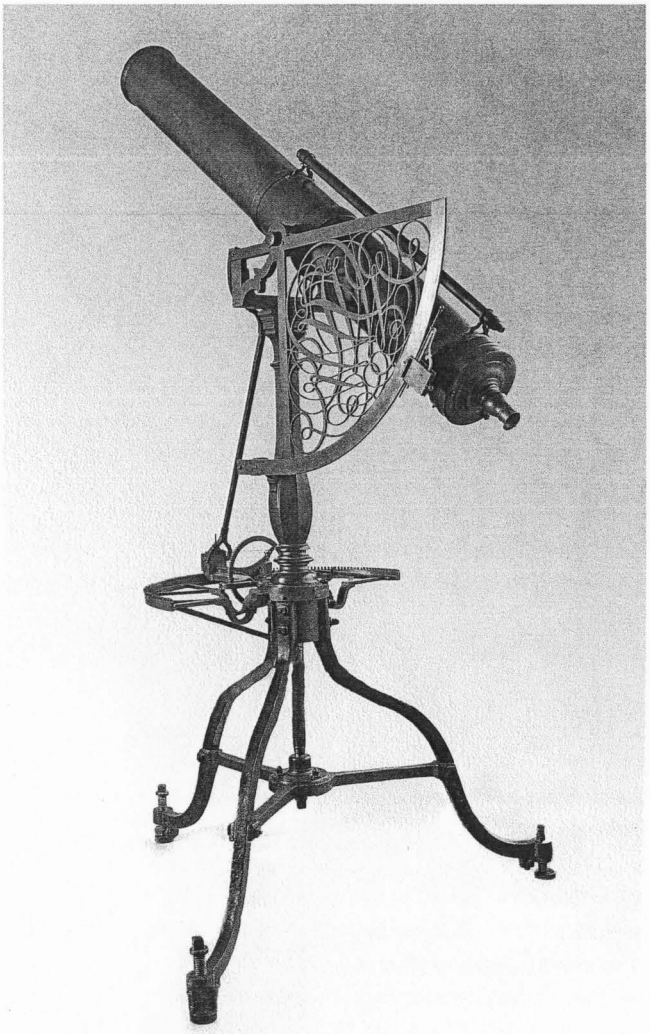
Signed around the eyepiece: Chevallier. Ing.r M bre de l'Athenée des Arts. à Paris.

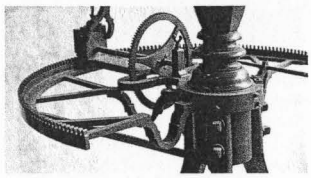
Provenance: Sotheby's, 1984

Gregorian telescope, probably by Louis Vincent Chevalier (1734?-1804), who made and sold mirrors, lenses and telescopes. Three of his sons were also opticians: Louis, & Nicolas-Marie had short careers, Jacques Louis Vincent (1771-1841) worked for his father, left for the army and returned in 1803-4 to start his own manufacturing business.

Gregorian reflecting telescope, the objective tube (l 35, Ø 7) with green leather binding and French-style tooled gilt decoration, focusing to the secondary mirror by rack and pinion and a long shank, supported by a bracket above a universal ball joint, turned brass column and folding tripod base. The eyepiece (l 7.5, Ø 2.5) has a compound ocular.

Cat. Sotheby's, Sept. 1984, no. 228





146. 9651

Large Cassegrain and Gregorian reflecting telescope on tripod stand

c. 1742

h 250, w 225, d 162

Designed and partly made by Jacobus van de Wall of Amsterdam. His monogram is depicted on the quadrant. The (now missing) mirror was cast by Ulrich Bley from Amsterdam

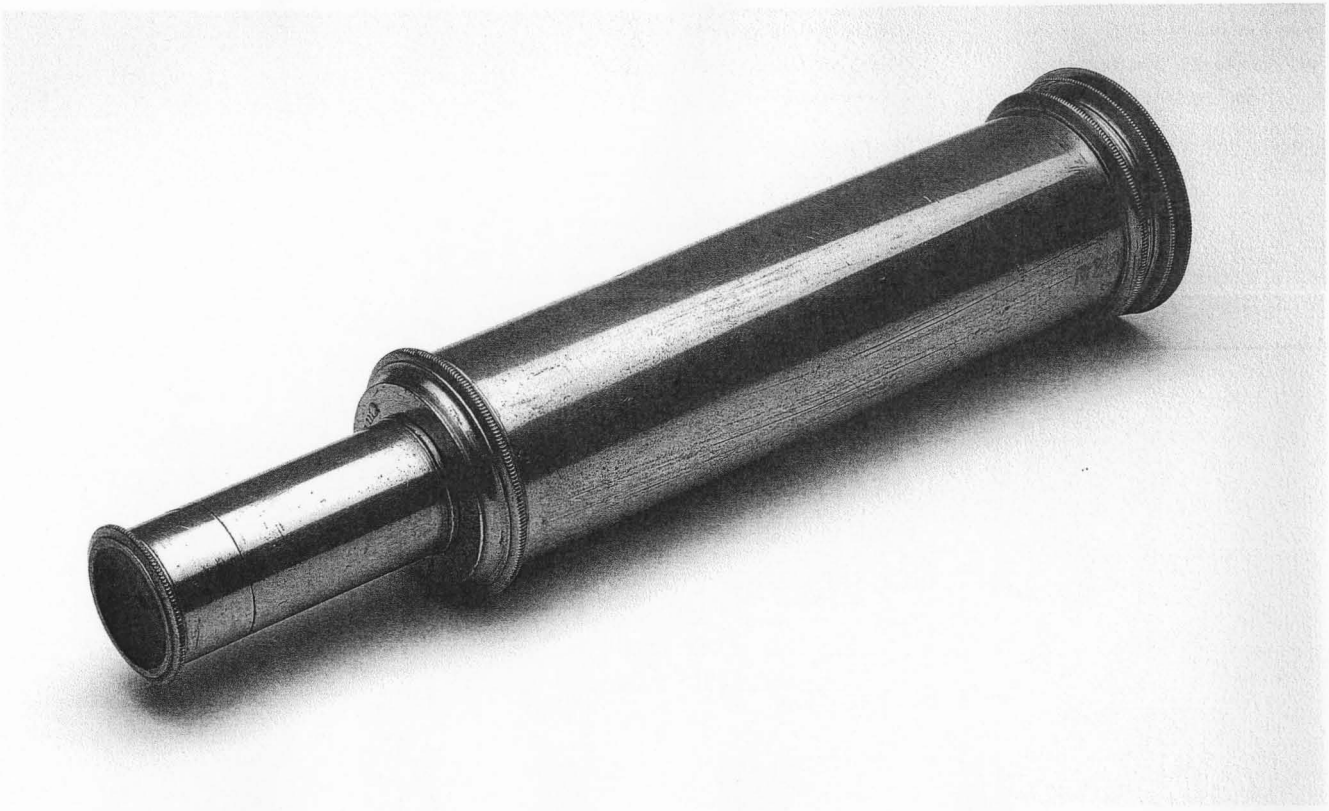
Provenance: J. van de Wall, Amsterdam, c. 1742-1782; Leiden Observatory, 1782-1989

Large reflecting telescope made in about 1742 by Jacobus van de Wall (1700-1782), an Amsterdam merchant who was driven by an optical and perhaps purely mechanical interest. The mirrors – now missing – with a focal distance of eight feet were cast by Carl Ulrich Bley, an artisan who also played a pioneering role in the development of the Dutch achromatic telescopes made by Van Deijl. According to Van de Wall, the mirrors of this telescope had been made of an alloy of 32 parts copper to 13½ parts tin. Van de Wall's own astronomical observatory (erected in about 1758) was visited by astronomers such as Ferrner, De Courtanvaux, Pingré, Messier, Lalande and Bugge. Van de Wall also showed them still larger mirrors with a focal distance of 20 feet, however this telescope was never finished. Other, smaller reflecting telescopes made by Van de Wall have not survived or are not recognised as such. This telescope, then still the largest reflector in the Netherlands, was bequeathed to Leiden University in 1782. However, it was never used properly, although the quality of the instrument was highly regarded by astronomers such as Hennert, Van Beeck Calkoen and Kaiser.

Dark copper telescope on a heavy azimuthal tripod bearing, making a triangle with the floor with sides of 162 cm. The bearing has a steel axis, which bears the telescope. A finder telescope (l 108 Ø 4) is placed on the main tube (l 215, Ø 23). However, all the optical parts of both main and finder telescope are missing. The stand has a gear work for fine tuning on both axes. A horizontal semicircle of 52 cm radius has a divided scale ranging from -90° to +90°; an altitude quadrant of 73 cm radius has a scale from 0° to 90°. Pointers allow reading to an accuracy of 5'.

Originally this telescope had the following accessories: four large main mirrors, 12 Cassegrain mirrors and one Gregorian mirror in a copper box, three eye tubes for various magnifications, a two-foot enlargement tube for the Gregorian arrangement, and some diaphragms. The telescope has been on semi-permanent display at Leiden University's Oort building since 1998.

Ferrner 1759, 373-375; Hennert 1770; Bugge 1774; Invent. 1793; 1868, A-19; Kaiser 1868, XIV; Zuidervaart 2003; Zuidervaart 2004



147. 8879

Small hand-held Gregorian reflecting telescope

c. 1750

h 4, w 19, d 3.3

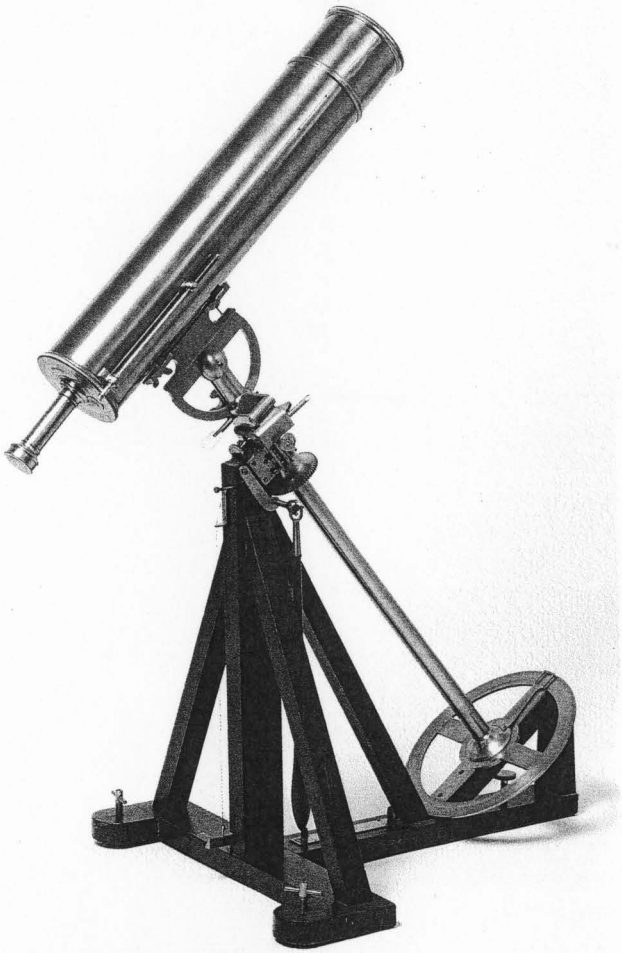
Signed: H[K]. PRINS Fecit Amsterdam.

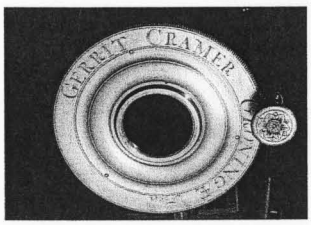
Provenance: Bought with support of the Physical Society 'Diligentia' The Hague from W. Roos, Rotterdam, 1928

Only known reflecting telescope signed by Hendrik Prins (1696-1762), an instrument maker who acquired quite some fame for his thermometers and barometers. He was an apprentice of the well-known 'weatherglass maker' Daniël Gabriël Fahrenheit (1686-1737), who had constructed some reflecting telescopes as early as 1712.

Brass hand-held Gregorian reflecting telescope. The objective tube (l 14, Ø 3.3) contains a main mirror (Ø 3.2) and a secondary mirror (Ø 0.9) and can be closed with a dust cover. The eye tube (l 5.5, Ø 2) has a compound ocular with a dust cap. The secondary mirror is fitted in a screwable mounting with long screw thread for the adjustment of the image.

Engberts 1970, 48; Zuidervaart 2004, 412 & 445





148. 9700

Reflecting Gregorian telescope on parallactic mount

c. 1750

h 85, w 72.5, d 53

Signed on telescope tube: GERRIT CRAMER GRONINGAE Fecit.

Signed on side of main mirror: Van der Bildt

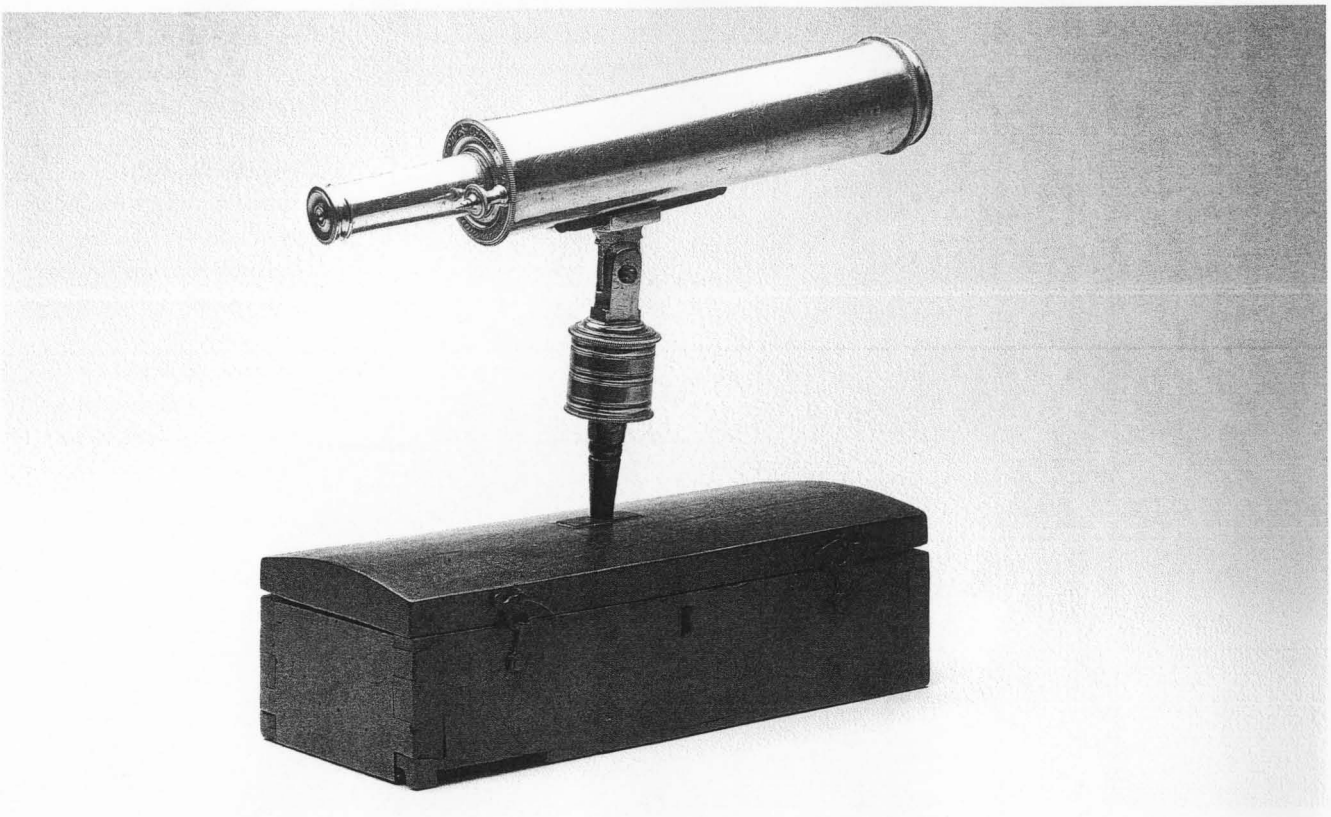
Provenance: J.H.C. Lisman, 1928

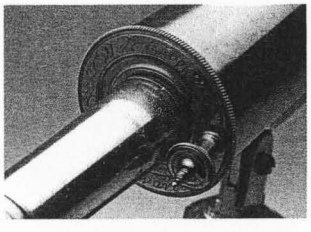
This reflecting telescope has an exceptional equatorial stand with a fixed polar height of c. 53 degrees (suitable for the Northern Netherlands). The instrument is a joint product of Gerrit Cramer (1707-c. 1755) of Groningen and Jan van der Bildt (1709-1791) of Franeker. In 1745, following the appointment of the Swiss-born philosopher Samuel Koenig as scientific adviser to the Leeuwarden court, it became a deliberate policy of the Stadholder William IV to support talented geniuses from the northern provinces. Scientific instrument makers such as Cramer, Van der Bildt and Foppes benefited by this policy: Cramer provided the Stadholder with a luxurious microscope, Van der Bildt made a pneumatic pump as well as several reflectors and Foppes delivered an ingenious 'surveying machine' to the Prince's cabinet.

This telescope has a brass objective tube (l 50, Ø 11) with main mirror (Ø 9.0) and secondary mirror (Ø 2.0). The tube has a large dust cover that extends the tube by 9.5 cm, necessary because the secondary mirror sticks out of the tube. The eye tube (l 11, Ø 2.5) has a compound ocular with dust cap. The shutter is decorated with a cable edge. Some adjustment screws are engraved with a pattern of flowers.

The telescope rests on a wooden equatorial stand with fine tuning on both axes. The adjustment can be made with keys having ivory handles. A divided circle (Ø 26.5) is placed at the base of the instrument with a pointer parallel to the tube, having three different scales: two times 0-180° (subdivided into 15'), four times 0-90° and 24 hours. A geared bow (Ø 7) divided with a scale 0-90° (subdivided into 15') can provide a vertical reading. At the base a water level is missing.

Engberts 1970, 29-31; Zuidervaart 2004





149. 8160

Gregorian reflecting telescope on case

1750-1770

h 24, w 25.5, d 10

Signed: W Foppes Leeuwarden

Provenance: Pharmaceutical Laboratory, Leiden University, 1931

Wytze Foppes (1707-1778) of Leeuwarden was one of those 'men from the provinces' whose 'genius' had been brought to the attention of the Frisian Stadholder. In 1751 Prince William IV commissioned Foppes to construct two ingenious surveying instruments with telescopic sights (one of them is now in the Museum Boerhaave collection). This order from the Prince encouraged Foppes to become a mathematical practitioner. In 1753, on the occasion of the transit of Mercury, Foppes presented himself as a 'geometrical' constructor of microscopes and telescopes. His telescopes resembled those of Short and Van der Bildt.

Small brass reflecting telescope with objective tube (l 19, Ø 4.5), main mirror (Ø 4), secondary mirror (Ø 1.2) and screwable cap. The eye tube (l 6.5, Ø 2) has an (incomplete) compound ocular. The mahogany storage box (h 10, w 24, d 7) can be used as an azimuthal stand of the telescope. The inside of the case is covered with red velvet, stamped with a pattern.

Engberts 1970, 32-33; Zuidervaart 1995, 179-180

150. 8154

Gregorian reflecting telescope on tripod stand

1745-1760

h 38, w 42.5, d 20

Signed: I. VAN DER BILDT FRANEKER

Provenance: Burgers Collection, 1946

Jan Pietersz van der Bildt (1709-1791) started out as a general instrument maker, constructing an air pump for Franeker University in 1743. In later years in Leeuwarden he assisted Samuel Koenig with demonstrations of experimental physics at the Stadholder's court. At that time König characterised Van der Bildt as 'a poor boy, with a lot of genius, who at a day in the future can make excellent pieces of work on everything on which he tries to make an application'. In about 1746 Van der Bildt decided to specialise in the construction of reflecting telescopes. It is estimated that he constructed some 550 telescopes, with tube lengths varying from one to seven feet.

Brass reflecting telescope on brass azimuthal tripod stand. The objective tube (l 35, Ø 7) is covered with black leather, decorated with raised circles. It contains a main mirror (Ø 6) and secondary mirror (Ø 2) and can be closed with screwable dust cap. The eye tube (l 7, Ø 2) has a compound ocular.

Engberts 1970, 45-46; Zuidervaart 2004

151. 8198

Gregorian reflecting telescope

1745-1760

h 57.5, w 62, d 32

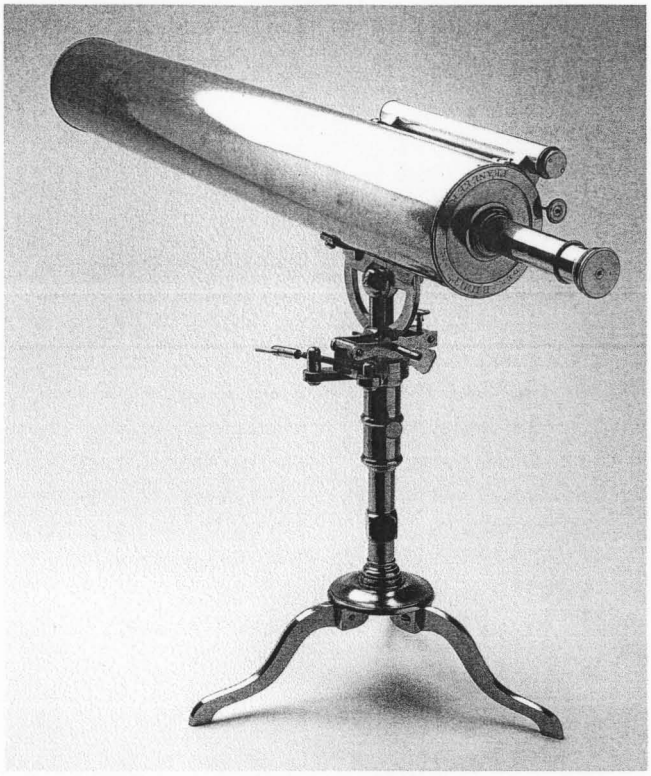
Signed: I. van der BILDT. FRANEKER

Provenance: Dr. C.A. Crommelin, 1929

In his early days Jan van der Bildt signed his telescopes with 'I van der Bildt', later he changed this signature to 'J. van der Bildt'. In around 1768, after a huge row with his sons 'Jan Junior' and 'Lubbertus', who had both started making similar but inferior reflectors, Jan van der Bildt 'the elder' started to number his telescopes, the lowest number known being 316, the highest 536 (both in the Louwman collection, Wassenaar).

Brass reflecting telescope on a brass tripod (azimuthal, with fine tuning on both axes – one of the ivory handles is missing). The objective tube (l 50.5, Ø 11.5) contains only the main mirror (Ø 10.5). The secondary mirror and the dust cover are missing. The eye tube (l 10, Ø 2.6) has a compound ocular.

Engberts 1970, 25-26



152. 8202

Gregorian reflecting telescope

1745-1760

h 57, w 79, d 32

Signed: I. van der BILDT FRANEKER

Provenance: Burgers Collection, 1946

At some point in the past the tube of this telescope was enlarged, probably to house a speculum of larger focal length. The original length of tube was 65.5 cm, which means that in old Dutch measures this was originally a '27-duims-telescope'. Following enlargement the focal length rose to $2^2/_3$ feet. It is possible that this enlargement was made by Van der Bildt himself. In 1773, in a letter to a business companion, he described a change of specula in four of his earlier telescopes. And mention is made of a Gregorian reflecting telescope made by Dollond in the 1789 Amsterdam Ebeling collection catalogue, the original mirrors of which were replaced by others made by 'J. van der Bildt, the elder'. The catalogue claims the instrument was 'very much improved by this operation'.

Brass reflecting telescope on brass tripod stand (azimuthal, with fine tuning on both axes). The objective tube (l 79, Ø 11) has a main mirror (Ø 10), secondary mirror (Ø 3.0) and a dust cover. The eye tube (l 13.5, Ø 3.5) has a compound ocular. Attached to the objective tube is a brass finder (l 24.5, Ø 2.5) with simple objective, simple ocular and a shutter.

Engberts 1970, 36-37; Zuidervaart 2004

153. 8158

Gregorian reflecting telescope on tripod stand

1760-1770

h 40, w 34, d 22

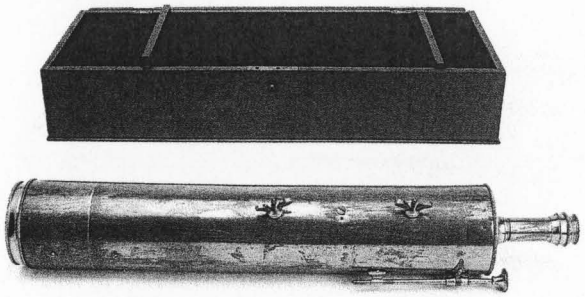
Signed: J. van der BILDT FRANEKER

Provenance: Mrs E.C. van Hest, 1941

It was probably in around 1760 that Van der Bildt modernised the spelling of his name from 'Ian' (or 'I') to 'Jan' (or 'J'), of which this telescope gives an example.

Brass reflecting telescope on brass azimuthal folding tripod stand. The objective tube (l 34, Ø 7) contains the main mirror (Ø 6.5) and the secondary mirror (Ø 2.0). The dust cover is missing. The eye tube (l 7, Ø 2) has a compound ocular with sun filter.

Engberts 1970, 35-36



154. 20341

Gregorian reflecting telescope with mahogany case

1760-1770

l 46, Ø 7.5

Signed: J. van der BILDT FRANEKER

Provenance: Deventer Atheneum, which became the Deventer HBS in 1845, pre 1828-1980

This Van der Bildt telescope with its mahogany case is mentioned in the inventory of the Deventer Athenaeum. A similar 'good looking telescope of J. van der Bildt, long 18 inches in a mahogany case' was auctioned in 1819 with the scientific instruments of the late Deventer professor Ladislaus Chernac. As this telescope fits the description, it is possible that it is the same instrument.

At some point in its history the speculum of this telescope has been changed. The tube has been rather crudely enlarged by 6 cm, enabling the use of a speculum of greater focal length.

This brass Gregorian reflecting telescope is kept in a mahogany case (h 19.5, w 51.5, d 10.5). The cover of the storage box and the tripod stand for the telescope are missing. The objective tube (l 8, Ø 7.5) contains a main mirror and a secondary mirror. The eye tube (l 7.5, Ø 3) has a compound ocular with a red sun glass.

Ebeling 1789, nos. 417 & 418; Chernac 1818, no. 28; Dompeling 1828, no. 90; Van Helden 2002, no. 192

155. 8155

Gregorian reflecting telescope on tripod stand

1760-1770

h 39.5, w 48, d 21

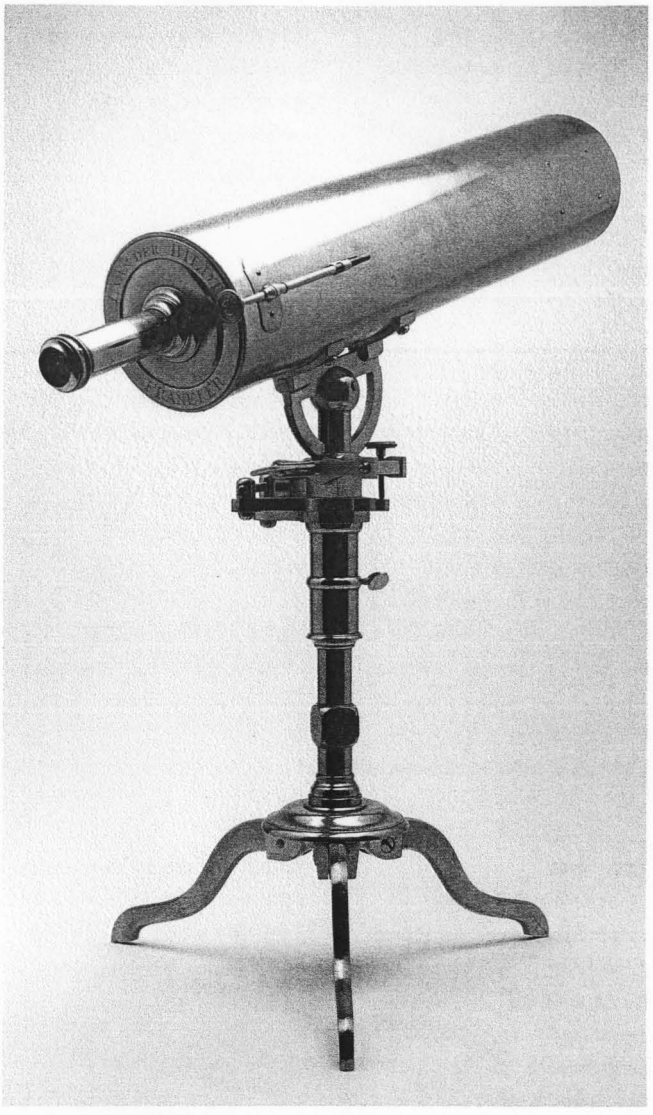
Signed (upside down): J. VAN DER BILDT, FRANEKER

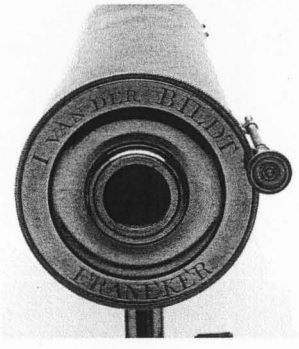
Provenance: Burgers Collection, 1946

The general appearance of this telescope (and the way the signature has been placed) differs from other telescopes signed by Van der Bildt. It could be an indication that the instrument is a retail into which Van der Bildt merely placed a mirror.

Brass reflecting telescope on a nicely decorated brass tripod stand. The objective tube (l 39.5, Ø 6.8) contains a main mirror (Ø 6) and a secondary mirror (Ø 2.3) and can be closed with a flat dust cover. The eyepiece (l 8.5, Ø 2.4) has a compound ocular with a red sun glass.

Engberts 1970, 37





156. 9964

Gregorian reflecting telescope on tripod stand

1760-1770

h 45, w 55, d 26

Signed: J:VAN DER BILDT. FRANEKER.

Provenance: J.H.C. Lisman, 1928

In 1754 Jan van der Bildt had been appointed 'keeper of the physical instruments' of Franeker University. In that capacity he made some equipment for professor Antonius Brugmans, who on this occasion praised Van der Bildt as an 'astute artisan', who could make instruments of such quality, 'that one could not expect of another instrument maker'. This nicely crafted telescope reflects these lauded skills.

Brass reflecting telescope on a brass folding tripod stand, having geared fine tuning on both axes. The objective tube (l 44.5, Ø 8.5) contains a main mirror (Ø 7.5) and a secondary mirror (Ø 2.0) and can be closed with a dust cap. The eye tube (l 10, Ø 3) has an incomplete compound ocular with a red screwable sun filter.

Engberts 1970, 31-32

157. 7365

Gregorian reflecting telescope on tripod stand with wooden case

c. 1774

h 39, w 34, d 23

Signed: 'J. VAN DER BILDT. Franeker. No. 350'

Provenance: A. Spijkman, Amsterdam, 1953

Early copy of a numbered Van der Bildt telescope. It was probably in about 1768 that Van der Bildt started to number his telescopes, to distinguish them from those made by his sons Jan Junior and Lubbertus.

Brass reflecting telescope on a brass tripod stand. The objective tube (l 34, Ø 7) has a main mirror (Ø 6), a secondary mirror (Ø 2.0) and a (damaged) dust cap. The eyepiece (l 7, Ø 2.3) has a compound ocular and a red sun glass. The instrument can be stored in a late 19th-century mahogany box (h 18, w 47, d 11) with brass handles.

The instrument is on semi-permanent display at Castle Groenevelt in Baarn.

Engberts 1970, 39-40

158. 25789

Gregorian reflecting telescope on tripod stand with case

c. 1775

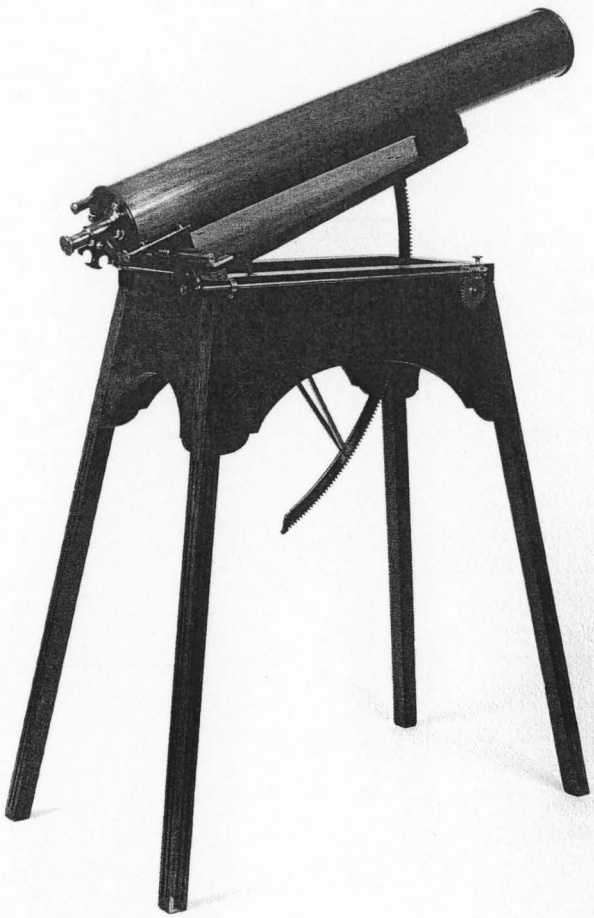
h 52.5, w 58, d 30

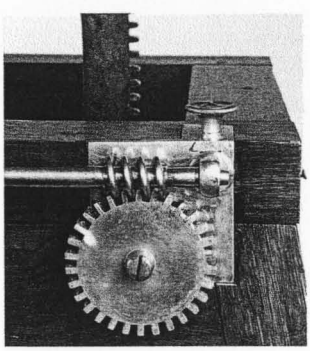
Signed: J VAN DER BILDT FRANEKER No 354

Provenance: Auction H. Bom, Amsterdam, 1929

Numbered reflecting telescope on brass foldable tripod made by Jan van der Bildt in Franeker.
The brass objective tube (l 49; Ø 9) contains a main mirror (Ø 8.0) and a secondary mirror (Ø 3.4) and can be closed by a dust cap. The eyepiece (l 7, Ø 2.5) has a compound ocular with sun filter.
On its base the azimuthal tripod stand is marked in white ink with the inscription '1950 n. 3'.

The instrument can be stored in an oak box (h 27, w 98, d 19) (not original?), with a paper label of the Amsterdam auction house Bom & Zoon. It contains a small pillbox with some screws, a cardboard box (h 13, w 13, d 4) with three compound oculars of various sizes and two sun filters (neither fitting on the telescope) and a black painted tin box (h 8, w 7, d 13) with two spare convex secondary mirrors (Ø 2.1 and 2.4).





159. 9718

Large Gregorian reflecting telescope on a table support

1760-1770

h 139, w 131, d 65

Signed: I. van der BILDT

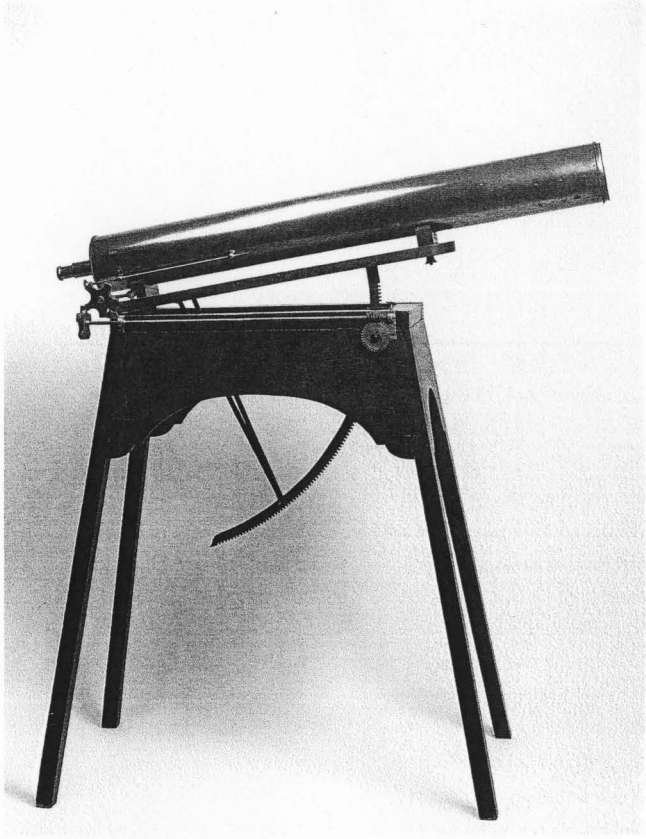
Provenance: Leiden University, c. 1900-1931

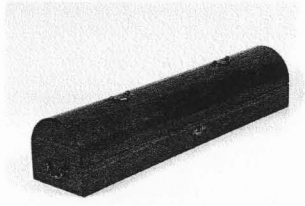
Rare example of a large four-foot Van der Bildt telescope. Van der Bildt started producing larger telescopes in the 1760s, one of them being a 'Newtonian reflector of five feet' made in 1767 for King Frederick of Prussia. However, he had in 1750 already produced a replacement speculum for the Leiden eight-foot Hearne reflector, a mirror that was praised at the time as being of 'unparalleled' quality. According to Scheltema, the largest telescope Van der Bildt ever sold was in the cabinet of the Amsterdam merchant Ernestus Ebeling. This seven-foot telescope is mentioned in the auction sale catalogue of 1789. It had a Gregorian and a Cassegrain outfit, very rare for a Van der Bildt telescope.

It is not known how or when this telescope came into the Physics Cabinet at Leiden University. The instrument is not listed in the inventory drawn up in the 1880s. In the 1920s there were two van der Bildt reflectors in the Physics Laboratory: this large one and a smaller copy, marked with the serial number '530'. The latter telescope was lost during bombing in the Second World War on 11 December 1944.

The brass objective tube (l 119, Ø 15) rests in a cradle on a heavy four-legged oak support. As usual the distance between the main mirror (Ø 14) and the secondary mirror (Ø 3.2) can be altered by means of an adjusting screw. The eyepiece (l 111, Ø 3.5) is made in two segments and contains an incomplete compound ocular, with an orange sun glass. Attached to the tube is a small finder (l 18, Ø 2.5) with simple objective and ocular. Using an arrangement of three large worm wheels made of brass and steel (the largest having a radius of 56 cm), the orientation of the cradle can be adjusted in both the vertical and horizontal planes.
A tin box contains two other secondary specula.

Cat. Ebeling (1789), no. 420; Invent. Leiden Physics Lab. c. 1880 (Arch. MB 17b); Van der Bilt 1941; Engberts 1970, 20-21; De Clercq 1997, 206; Zuidervaart 2004





160. 22459

Large Gregorian reflecting telescope with case

c. 1780

h 137.5, w 136.5, d 64

Signed: J van der BILDT FRANEKER

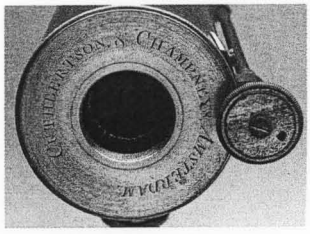
No 416

Provenance: J.J. Taudin Chabot (c. 1900); J.W. van Zuilekom, Arnhem, 1956

Rare example of a large 'four-foot telescope' by Van der Bildt made, according to its signature and numbering, at a later date than the telescope described in the previous entry (cat. no. **159**). A similar telescope with storage case was auctioned in The Hague in the cabinet of J.J. Cau in 1838.

The brass objective tube (l 125, Ø 14.5) with a dust cover rests in a cradle (l 82) on a heavy four-legged oak support (h 115), forming a rectangle of 106 x 60 cm on the ground. The orientation of the tube can be adjusted in both the vertical and horizontal planes with large worm wheels. A quadrant (radius 55) is present for reading the altitude of the instrument. As usual the distance (c. 115) between the main mirror (Ø 13.5) and the secondary mirror (Ø 3.3) can be altered by means of an adjusting screw. All the optics of the eyepiece tube (l 11, Ø 3.5) are missing, as is the finder. The large wooden case (h 28.5, w 142, d 31) has a nicely crafted convex cover with brass fittings. It contained a handwritten manual (c. 1900) and an address card from the firm of instrument makers 'P.J. Kipp & Zonen, W.J. Giltay opvolger' in Delft, with the address of former owner J.J. Taudin Chabot of Rotterdam (1903) and Wurttemberg (1904).

Scheltema (1823), 239; Engberts 1970, 21-22;



161. 9046

Gregorian reflecting telescope on tripod stand with case

c. 1770

h 32, w 45, d 25

Signed on the back plate: CUTHBERTSON, & CHAMPNEYS, AMSTERDAM.

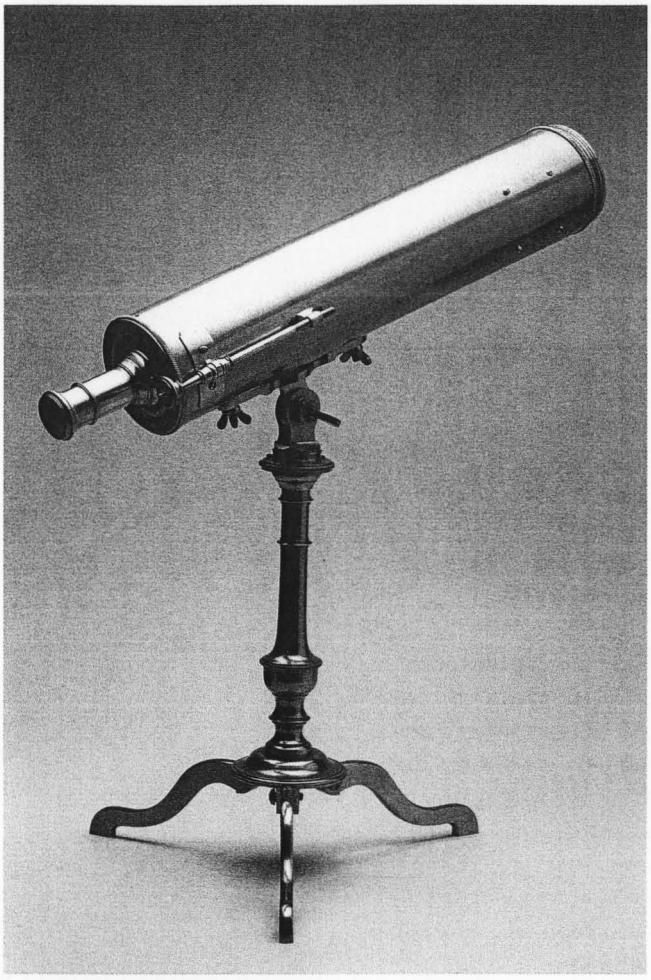
Provenance: Christie's London, 1987

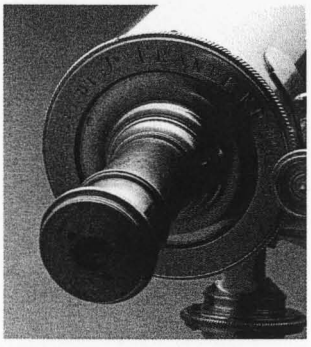
In 1768, in the year before the second transit of Venus, the English instrument makers John Cuthbertson and his tutor and recent father-in-law James Champneys settled in the Netherlands, providing a direct link with the English scientific instrument market. This meant serious competition for the telescopes of the Van der Bildt family. Soon there was scarcely any price difference between telescopes made in the Netherlands and English retail. In 1773 Van der Bildt charged between 200 and 250 guilders for a two-foot telescope. According to the price list published by Cuthbertson that same year, he could deliver such a reflecting telescope for 220 guilders.

James Champneys had been one of the London instrument makers who tried to break Dollond's patent for the achromatic telescope, but in vain. In 1766 he was convicted for infringing this patent, which eventually led to his bankruptcy. This was probably the reason why he joined Cuthbertson in his move to the Netherlands. In 1770 they advertised together, but soon afterward Champneys must have died. In the years that followed John Cuthbertson became one of the leading Dutch instrument makers, acquiring quite some fame as the constructor of air pumps and electrical plate machines. He returned to England following the French invasion of Holland in 1795. His brother Jonathan Cuthbertson stayed in Rotterdam, publishing a manual on telescopes in 1794.

Brass telescope with rod focusing on brass azimuthal folding tripod stand. The objective tube (l 36, Ø 7) contains a main mirror (Ø 6.5) and secondary mirror (Ø 1.2). The dust cap is missing. The eyepiece (l 8, Ø 3.3) has a compound ocular. The instrument can be kept in a mahogany storage case (h 18, w 46, d 9) with brass plaque, covered on the inside with red velvet. A former owner's mark can be read on the wooden edge: *'637 J.C. H. L.R. f.'*

Hackmann 1973; Christie's 1987, lot. 282; Clifton 1995, 75





162. 8148

Gregorian reflecting telescope with case

c. 1775

h 39, w 42, d 22

Signed: J. van der BILDT Jnr Franeker No 63

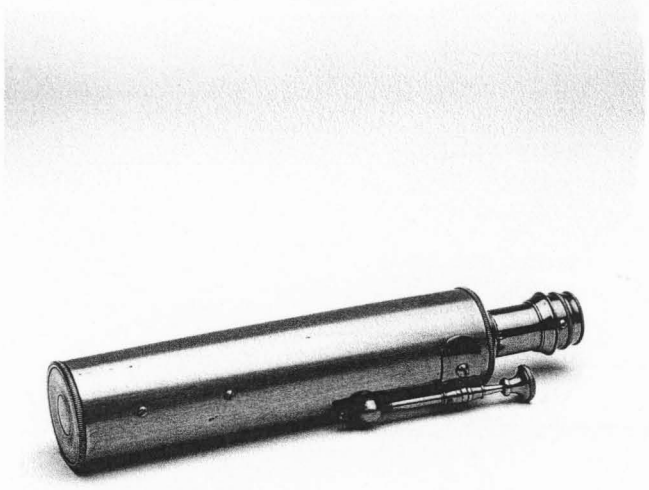
Provenance: Posthumus, The Hague, 1929

Telescope made by Jan van der Bildt *the younger* (1736-c.1780), son of Jan van der Bildt *the elder*, working – like his younger brother Lubbertus – independently of his father from about 1768. Little is known of the life of these two sons. In 1755 Jan van der Bildt Junior matriculated as a student at Franeker University. Following his marriage in 1762, he was convicted on several occasions for fighting and perjury. Jan Junior was operational until about 1780.

Numbered telescopes of 'Jan van der Bildt Junior' are known ranging from no. 20 (Eisinga planetarium Franeker) to no. 63 (this telescope). One copy is known having an engraved date ('1776') instead of a number (SG Prof. Zeeman, Zierikzee).

Brass telescope with dust cap on brass folding tripod stand. The objective tube (l 36, Ø 7.5) contains a main mirror (Ø 6.5) and a secondary mirror (Ø 2.0). The eye tube (l 6.5, Ø 2.3) has a compound ocular, the dust cover slide of which is missing. The instrument can be kept in a wooden storage case (h 18, w 48, d 10) covered on the inside with green paper.

Engberts 1970, 32; Rooseboom, 30-34



163. 8881

Hand-held Gregorian reflecting telescope

1770-1780

h 3, w 19.5, d 5

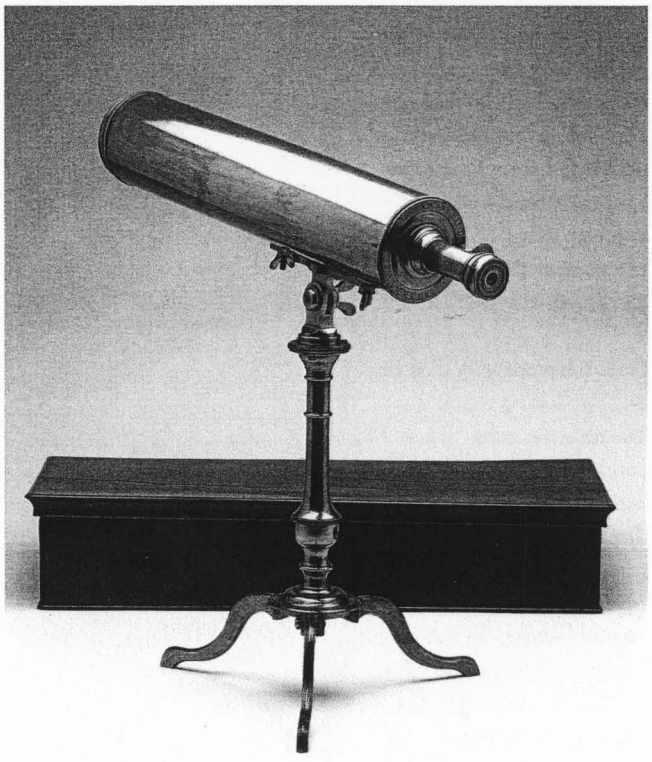
Signed: L. van der BILDT. FRANEKER

Provenance: A. van de Sande Bakhuyzen (heir of the former director of Leiden Observatory), 1931

Small hand-held reflector made by Lubbertus van der Bildt (1738-c.1780), working independently of his father from about 1767, when he was mentioned in the archives as a 'microscope maker'. He was married in 1760.

The brass objective tube (l 15, Ø 3.5) contains a main mirror (Ø 3.0), a secondary mirror (Ø 1.4) and a dust cap. The compound ocular has a sun filter.

Engberts 1970, 48; Zuidervaart 2004



164. 8153

Gregorian reflecting telescope on tripod stand with case

1770-1780

h 39, w. 43, d. 21

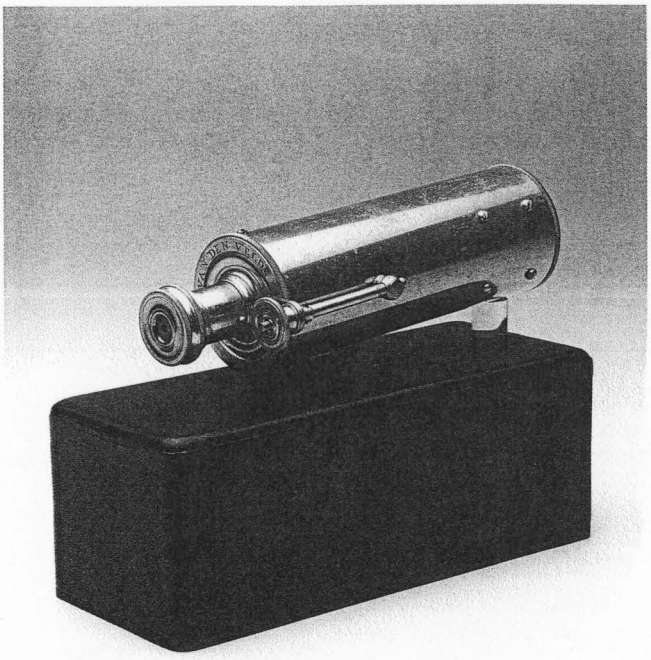
Signed: L. VAN DER BILDT FRANEKER

Provenance: Mrs A. Haga, 1953

Like his father and elder brother 'Jan Junior', Lubbertus van der Bildt started to put a serial number on his telescopes, probably after a family quarrel in about 1768. Scheltema – having spoken to Van der Bildt's daughter Rinske – suggested that the two sons had dissociated themselves from their father having constructed telescopes of inferior quality. Serial numbers of Lubbertus are known, ranging from no. 83 (Louwman collection, Wassenaar) to no. 139 (Eisinga planetarium, Franeker).

Brass reflecting telescope on brass folding tripod stand. The brass objective tube (l 35, Ø 7.5) contains a main mirror (Ø 6.5), a secondary mirror (Ø 2.0) and dust cap. The eyepiece has a compound ocular with sun filter. Some minor parts are missing. The instrument can be kept in a mahogany storage box (h 18, w 47, d 10) with a crack in the cover.

Engberts 1970, 40-41



165. 8161

Small hand-held reflecting telescope with case

c. 1780

h 7, w 10, d 5

Signed: I. VAN DEN VELDE

Provenance: Publishing company v/h Brill N.V., Leiden, 1961

In 1768 Idsaard Gerbens van de Velde was mentioned as a 'telescope maker' in Franeker, probably being at that time an apprentice of Jan van der Bildt the elder. With his colleague telescope builder Sybrandt Taekes van de Vliet he enjoyed the support of professor Jan Hendrik van Swinden, who had taken it upon himself 'to help these two craftsmen, my good friends, in advice and deeds'. According to Van Swinden, Van de Velde 'made excellent telescopes'. In about 1780 Van de Velde moved to Haarlem as a general instrument maker.

Brass Gregorian telescope (tube length 10, Ø 3.5) with main mirror (Ø 3), secondary mirror (Ø 1.3), compound ocular and dust cap. The instrument can be kept in a mahogany box (h 5.5, w 14, d 5).

Engberts 1970, 42; Zuidervaart 2004, 40 & 44

166. 26441

Gregorian reflecting telescope on tripod stand

c. 1800

h 38, w 44, d 22

Signed: B:E: van der Bildt

Provenance: Bought with the support of the Leiden University Fund, 1927

Bauke Eisma van der Bildt (1753-1831) was an apprentice of his grandfather Jan van der Bildt the elder. Between 1786 and 1806 he worked as an instrument maker at Buiksloot in the neighbourhood of Amsterdam. In 1806 he returned to Franeker, being appointed keeper of scientific instruments at Franeker University.

Brass Gregorian telescope on folding tripod stand. The objective tube (l 36, Ø 7) contains a primary mirror (Ø 6) and a secondary mirror (Ø 2) and can be closed by a dust cover. The eyepiece has a compound ocular.

Van der Bilt 1941

167. 28471

Gregorian reflecting telescope with case

h 37, w 36, d 23

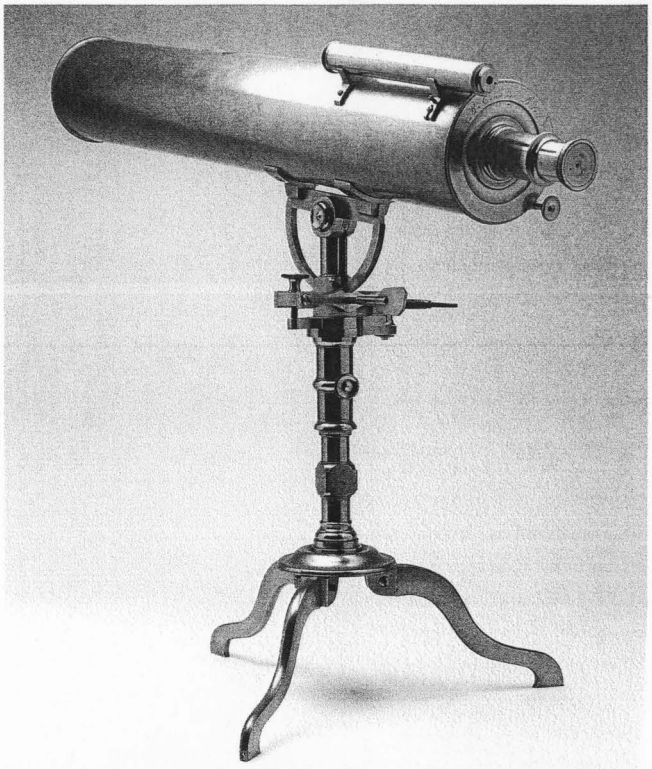
Signed: B.E. van der Bildt

Provenance: H. Hen, c. 1810; Burgers Collection, 1946

Brass reflecting telescope on a brass folding tripod stand made by Bauke Eisma van der Bildt. The objective tube (l 36, Ø 7) contains a main mirror (Ø 6), a secondary mirror (Ø 2.3) and a dust cap. The eyepiece has a compound ocular. The instrument can be kept in a mahogany storage case (h 18, w 46, d 10), which contains a rectangular tin box with a spare secondary mirror marked: '70 maal' [= magnification 70 times].

Attached to the inside of the cover is a paper label testifying to the sale of the telescope by another instrument maker: *'HENDRIK HEN. Maakt and Verkoopt alle soorten of Optische- Mathematische- & Physische Instrumenten, als: Octante, Verrekykers, fyne Brillen, Barro- en Thermomeeters in de Kalverstraat by de R.C. Kerk de Papegaay. No 35, in de Groene bril'.*

Engberts 1970, 37-38



168. 8167

Reflecting telescope with Gregorian and Cassegrain arrangement

1800-1825

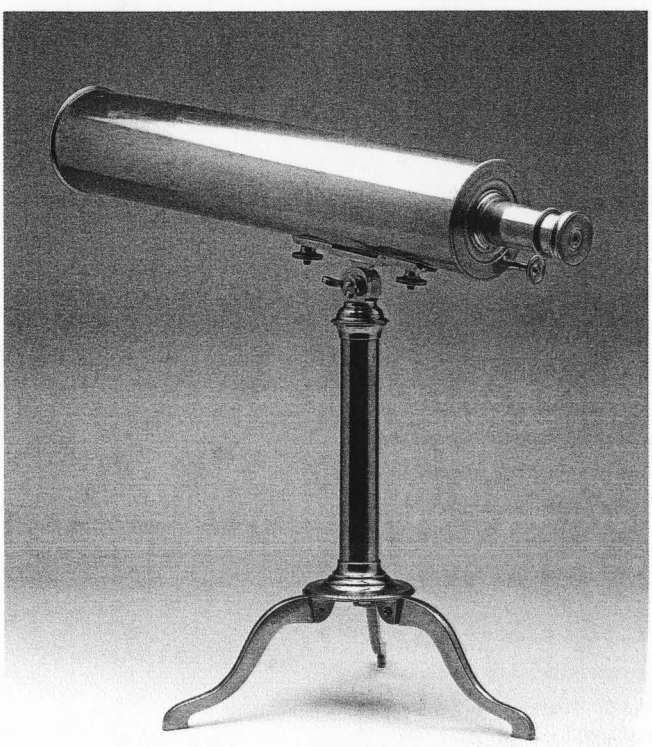
h 56, w 62, d 34

Signed: B.E. van der Bildt

Provenance: Laboratory of Technical Physics, Delft, 1934

Brass reflecting telescope on a folding tripod stand made by Bauke Eisma van der Bildt. Placed at the top of the vertical column is an undivided semicircle for geared fine tuning on both axes by means of two adjustment keys. The objective tube (l 62, Ø 10.5) has a main mirror (Ø 9), a secondary mirror (Ø 3) and a dust cap. The eyepiece (l 8 Ø 3.2) has a compound ocular. A brass finder (l 19, Ø 2.2) with cross wires is attached to the main tube. Stored in tin cans are three spare secondary specula, two concave mirrors (Ø 2.1) and a convex mirror (Ø 2.8), also facilitating a Cassegrain arrangement of the telescope.

Engberts 1970, 51-52



169. 8149

Gregorian reflecting telescope on a tripod stand

1800-1825

h 38, w 36, d 23

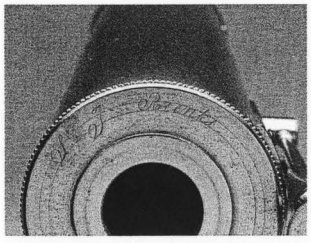
Signed: Jn. Roosenboom Fecit Amsterdam.

Provenance: E.A. Ates, Amsterdam, 1967

The instrument maker Jan Rooseboom (d. 1811) originating from Buiksloot (near Amsterdam) was probably an apprentice of Bauke Eisma van der Bildt. As a 'mathematical instrument maker' Rooseboom also made sextants. He had a shop near the 'Schrijerstoren' in Amsterdam, where he also sold navigational maps and books.

Brass Gregorian telescope on a brass tripod stand. The objective tube (l 36, Ø 7.5) has a main mirror (Ø 6), a secondary mirror (Ø 2) and a dust cap. The eyepiece (l 6.5, Ø 2.5) has a compound ocular.

Engberts 1970, 53



170. 8151

Small Gregorian reflecting telescope on tripod stand

1800-1825

h 34.5, w 32.5, d 19.5

Signed: S:J: Rienks

Provenance: Acquired in 1941 by C.A. Crommelin from the 'Koper inlevering' at Wageningen [= the surrender of all brass and copper objects in the possession of civilians, by order of the German occupation forces in the Netherlands]

In 1817 the national government of the Netherlands commissioned the instrument maker Sieds Johannes Rienks (1770-1845) and his theoretical companion Arjan Roelofs (1754-1828) to construct two large telescopes for the astronomical observatories in Leiden and Brussels. They had to be of such superb quality that they would 'surpass the giant telescopes of the famous Herschel in England'. It transpired however that the project was doomed right from the start. The manufacture of parabolic telescope mirrors with a diameter of 55 cm was far beyond the capabilities of the makers. The project also lacked any scientific supervision. Following the completion of these telescopes in about 1828, it transpired that the instruments, although of excellent exterior appearance, were completely unsuitable for the intended astronomical observations. Both telescopes were dismantled in the 1850s.

Although Rienks failed as the constructor of these giant telescopes, some of his smaller telescopes were of reasonable quality. This small reflector on a brass folding tripod stand is decorated with a pearl-shaped edge, characteristic of Rienks's work. The objective tube (l 26.5, Ø 6) contains a main mirror (Ø 5; with crack) and a secondary mirror (Ø 2). The dust cover is missing. The eye tube (l 6, Ø 2) has a compound ocular.

Van der Bilt 1951; Engberts 1970, 52

171. 8166

Newtonian reflecting telescope

1826-1845

h 67.5, w 70, d 32

Signed: S:J: Rienks. Leyden

Provenance: E.A. Ates, Amsterdam, 1966

Newtonian reflector, nicely crafted by Sieds Johannes Rienks, who worked as an instrument maker from 1798 and who settled in Leiden in 1826.

In 1809 Rienks made a four-foot reflecting telescope, which was used by professor Ekama in Franeker and Leiden and which was eventually bought for Leiden Observatory. A similar telescope was bought for Ghent University in 1820, followed in 1827 by a four-foot telescope for the new Astronomical Observatory in Brussels. The Leiden and Ghent copies were placed on an wooden azimuthal table support, whereas the Brussels reflector had a brass equatorial tripod stand. This two-foot telescope resembles the one made for Brussels, which is still preserved at the Observatoire Royal de Belgique. An almost identical two-foot telescope is preserved at the Eisinga Planetarium, Franeker.

Brass tube (l 63, Ø 13) with screwable cap on brass tripod with fine tuning on both axes. Main mirror (Ø 12) and oval secondary mirror (3.3 x 2.1). Ocular tube (l 7.5) with simple ocular and dust cap. Brass finder with sight (l 21, Ø 2.3) with reversing mirror and simple ocular. With the characteristic pearl-shaped edge, often used by Rienks.

Van der Bilt 1950 & 1951; Engberts 1970, 19-20; Van Boxmeer 1996, 77-80

172. 8147

Newtonian reflecting telescope

1775-1825

h 51, w 42, d 26

Probably made by Rienks

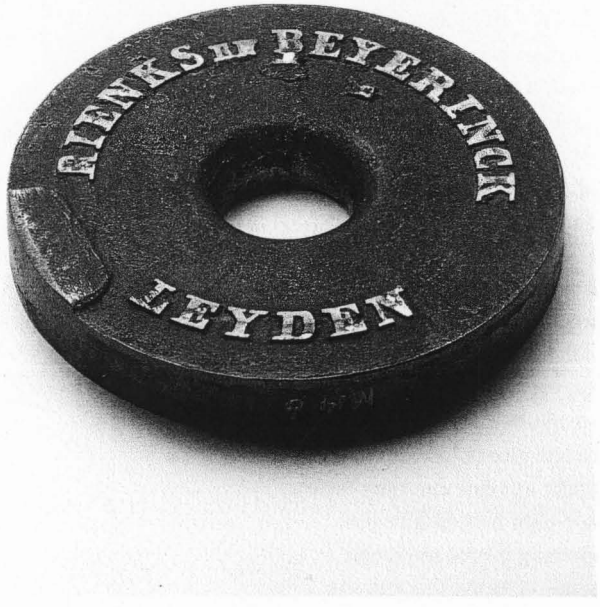
Provenance: Leiden Observatory, ?-1961

Unsigned Newtonian telescope, but with the characteristic pearl-shaped edge so often used by the Dutch instrument maker Sieds Johannes Rienks. The tripod is evidently made by another instrument maker. The wooden parts of the stand were made at a later date.

The 1868 Leiden Observatory inventory mentions 'two small telescopes by Rienks with little value'. Perhaps this was one of them.

This brass telescope (l 39, Ø 8.5) lies on a wooden cradle (l 23), connected to a ball-and-socket joint on a brass azimuthal tripod. One of the dust covers of the tube is missing. The main mirror (Ø 8.5) is damaged. The flat secondary mirror has an oval shape (2.3 x 1.6). Simple ocular.

Invent. 1868, E-19; Verslag 1885, 9; Engberts 1970, 14-15



173. 12234

Telescopic mirror

1829-1845

h 1.6, Ø 11.5

Signed on the back of the mirror: Rienks en Beyerinck; Leiden

Provenance: G.J.Zaalberg van Zelst, 1933.

Reflecting mirror for telescopic use, made by Rienks in cooperation with Beijerink during his stay in Leiden. The signature was produced during the mirror casting process. The diameter of the hole in the mirror is 3 cm.

Rooseboom 1950, 30

C. Unsigned reflectors

174. 8842

Small Gregorian reflecting telescope with case

1750-1800

h 3, w 17, d 3

Provenance: Van Seters Collection, 1957

Brass hand-held Gregorian telescope with an objective tube (l 11.5, Ø 3) covered with white ray skin. The tube contains a main mirror (Ø 2.5), a secondary mirror (Ø 0.8) and a dust cover. The eyepiece has a compound ocular. The storage case (h 5.5, w 19, d 4) is covered with black shark skin.

Engberts 1970, 50

175. 8163

Small Gregorian reflecting telescope on tripod stand

1750-1800

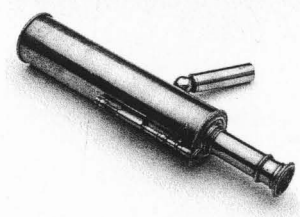
h 15, w 18, d 10

Provenance: Groenendijk Collection, Amsterdam, 1957

Brass Gregorian telescope on a brass folding tripod stand. The objective tube (l 13, Ø 3) is covered with red ray skin and can be closed with a dust cap. It contains a main mirror (Ø 2.5) and a secondary mirror (Ø 0.8). The eye tube (l 5, Ø 1.4) has a compound ocular. The number '969' (or its inverse '696') is marked in the cradle.

Kabinet 1994, 54

Engberts 1970, 46-47; Koperen



176. 8216

Small Gregorian reflecting telescope

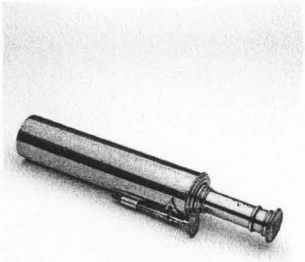
1750-1800

h 10, w 18, d 3

Provenance: B.G. Escher, 1933

Brass Gregorian telescope mounted on a rod (l 4 cm) for the adjustment of a – now missing – tripod stand. The objective tube (l 13, Ø 3.0) contains the main mirror (Ø 2.5) and secondary mirror (Ø 0.8) and can be closed with a dust cap. The eye tube (l 0.5, Ø 1.4) has a compound ocular.

Engberts 1970, 26-27



177. 8880

Small Gregorian reflecting telescope

1750-1800

h 4, w 18, d 3

Provenance: Geodetic Institute, Delft, 1934

Brass hand-held Gregorian telescope. The objective tube (l 13, Ø 3.0) contains the main mirror (Ø 2.5) and secondary mirror (Ø 1.0). The dust cap is missing. The eye tube has a compound ocular.

Engberts 1970, 49

178. 8841

Small Gregorian reflecting telescope with case

c. 1800

h 4, w 14, d 3.5

Provenance: Burgers Collection, 1946

Brass hand-held Gregorian telescope. The objective tube (l 13, Ø 3.0) is covered with green ray skin and contains a main mirror (Ø 2.5) and a secondary mirror (Ø 1.0). The dust cap is missing, as is the eye tube. A wooden storage case (h 5, w 20, d 4.5) is covered on the outside with black leather and on the inside with green plush.

Engberts 1970, 49

179. 32073

Small Gregorian reflecting telescope on box

1750-1800

h 18,5, w d 4,6

Provenance: Posthumus, The Hague, 1929

This small reflecting brass telescope is mounted on a folding column (l 11 cm) with a screw thread with which it can be attached inside a wooden storage box (h 9, w 20, d 6). The objective tube (l 17; Ø 4) is covered with white and red coloured ray skin and can be closed with a screwable dust cover. The distance between the main mirror (Ø 3.5) and the secondary mirror (Ø 0.8) can be altered by an adjusting screw. The brass compound ocular (l 6.0; Ø 1.6) has a red sun glass. The eyepiece has a plano-convex field lens (Ø 1.4). A somewhat wider tube can be pushed onto the eye tube, with a diaphragm (Ø 0.1) and a dark red screen for solar observations.

Engberts 1970, 43-44

180. 8162

Gregorian reflecting telescope on tripod stand

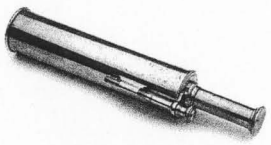
1750-1800

h 18, w 26, d 10.5

Provenance: J. van Bennekom, 1930

Brass telescope on a folding tripod stand. The objective tube (l 18, Ø 5) is covered with black leather and can be closed with a cap. The main mirror is missing. The secondary mirror has a diameter of 1.2 cm. The eyepiece (l 7, Ø 2) has a compound ocular with screwable sun filter.

Engberts 1970, 44-45



181. 8217

Gregorian reflecting telescope

1750-1800

h 3, w 18.5, d 4

Provenance: J.P. Bertram, 1965

Brass hand-held telescope. The objective tube (l 19, Ø 3) contains a main mirror (Ø 2.5) and a secondary mirror (Ø 0.8) and can be closed with a dust cap. The eyepiece has a compound ocular.

Engberts 1970, 50-51

182. 11872

Gregorian reflecting telescope on a tripod stand

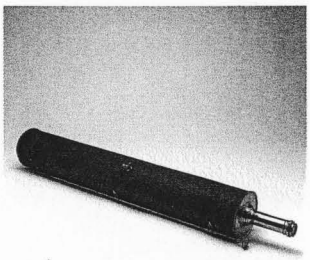
c. 1780

h 36.5, w 43, d 20

Provenance: Van Stockum's antiquariaat, 1959

Brass telescope mounted with a ball-and-socket joint on a folding tripod stand. The objective tube (l 35, Ø 7) is nicely covered with light red ray skin (damaged). It contains a main mirror (Ø 6) and a secondary mirror (Ø 1.5) and can be closed with a screwable dust cap. The eye tube (l 8 Ø 2) has a compound ocular with a sun filter.

Engberts 1970, 43



183. 11916

Reflecting telescope without stand

1750-1800

l 81, Ø 9.5

Provenance: Heineken Brewery, 1938

Brass telescope originally with a – now missing – tripod stand. The objective tube (l 65, Ø 9.5) is covered with black ray skin. It contains a main (now loose) mirror (Ø 8) and a secondary mirror (Ø 2) and can be closed with a screwable dust cover. The eyepiece (l 12, Ø 2.7) has a compound ocular with screwable dust cap. One butterfly nut is missing.

Engberts 1970, 45

184. 17551

Metal mirror for a reflecting telescope

1800-1875

w. 2, Ø 15.5

Provenance R.H.B.S, which became the Hegidius Scholen gemeenschap, Deventer, 1974

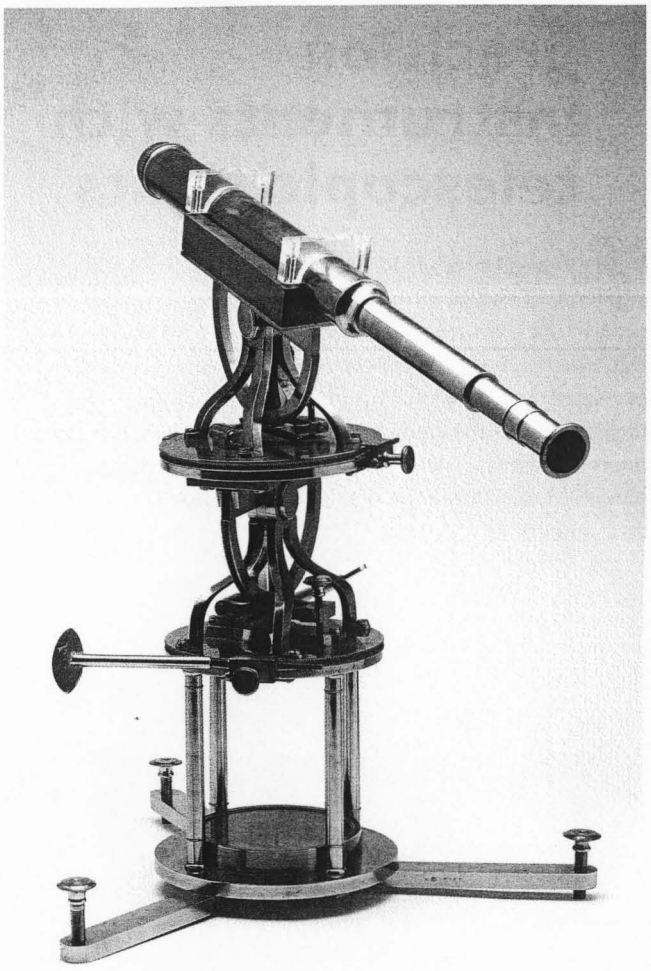
Stored in a wooden box without a cover (h 6.5, w 28, d 22) is a concave mirror, probably for a large reflecting telescope, having a diameter of 15.5 cm. The mirror is kept in a tin can. Four wooden eyepiece tubes are also stored in the box, although they seem to have no connection with the mirror. The box is marked with a paper label reading 'L 67'.

Van Helden 2002, no. 193

Astronomical precision instruments with telescopic sights

In the final quarter of the 18th century the technical expertise of the scientific instrument makers reached a peak in the construction of new astronomical and geodetic instruments, having a precise scalar division of a quality previously unheard of. This possibility of making measurements resulted in a quantifying spirit, touching many branches of natural science. This development narrowed the difference between astronomical telescopes and geodetic theodolites.

Leiden Observatory in 1828, with the reconstructed platform and dome made ten years earlier for the reflecting telescope of Roelofs and Rienks. In 1826 the astronomer Frederik Kaiser started at this site as a plain observer. In 1838, after his appointment as the Observatory's director, Kaiser introduced precision astronomy in the Netherlands with a new set of instruments. This process towards precision was completed in 1860 with the instalment of a new Astronomical Observatory at one of Leiden's bastions. Lithograph by Leendert Springer, Leiden, 1928. (Regional Archive Leiden).



185. 6161

Universal equatorial telescope

c. 1800

h 43.5, w 48.5, d 32

Signed: G. Hulst van Keulen Amsterdam

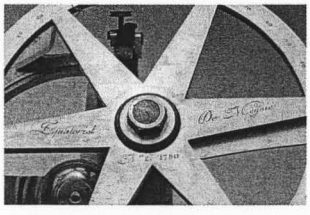
Provenance: Leiden Observatory, c. 1800-1931

Gerard Hulst van Keulen (1733-1801) was a member of the well-known Amsterdam firm Van Keulen, which produced an impressive array of maps, books and scientific instruments relating to the art of navigation during the period 1680-1885. From 1779 onwards he was the only partner left in the firm. Being inspired by the precision instruments made abroad, Hulst van Keulen also started to produce precision instruments, such as sextants and repetition circles. In 1792 the States of Holland granted him a patent for an improvement of the dividing machine for the scalar division of mathematical instruments, invented in 1770 by the English instrument maker Ramsden. This universal equatorial telescope is probably a product of this machine. The instrument is the only copy known to be made by Hulst van Keulen. The instrument is not mentioned in the 1798 inventory, so the apparatus must have been acquired in the period 1799-1801, when Jan Frederik van Beeck Calkoen was professor of astronomy at Leiden. The maker, Gerard Hulst van Keulen, was his uncle, being married to his aunt Anna Hendrina Calkoen in 1769.

In about 1800 the universal equatorial telescope represented state-of-the-art technology, but a growing insight into the nature and influences of observational errors soon made the instrument obsolete. In his inaugural address of 1838 F. Kaiser declared that the 'universal-aequatorial-instrument was disapproved for the completion of accurate observations'.

This telescope (l 48.5; Ø 3.5), with a compound ocular and an incomplete simple objective, has a complicated stand, which includes equatorial as well as azimuthal adjustments. The vertical semicircles have a scalar division of two times 90 degrees; the horizontal circles have a division of two times 80 degrees. There is a compass (Ø 11) at the bottom of the stand. The original clamps of the cradle have been replaced by modern ones made of perspex. Two of the adjustment keys are missing.

Kaiser 1838, 51; Invent. 1868, A-25; Mörzer Bruyns 1989, 61-71



186. 10671

Equatorial achromatic telescope

1780

h 32, w 91.5, d 31

Signed: Equatoriel De Mégnié No. 1. 1780.

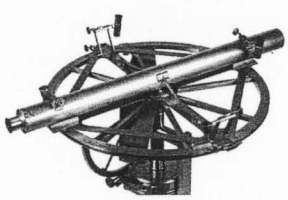
Provenance: Franeker University, 1780-1812; Leiden Observatory, 1812- 1821; Franeker Athenaeum, 1821-1843; Royal Academy of Civil Engineers (later Delft Geodetic Institute), 1843-1934

This precision telescope made by the French instrument maker Pierre Bernard de Mégnié was ordered for Franeker University in June 1779 by professors Jan Hendrik van Swinden and Nicolaas Ypey. The French astronomer De Lalande was intermediary for its delivery. Lalande had recommended this 'lunette achromatique placee sur une machine parallatique' for the convenience with which the instrument could be used to observe 'eclipses, conjunctions, satellites and comets'. The price paid was 'un peu plus de 1200 livres'. The telescope arrived in Franeker at the end of 1780.
In 1812, following the closure of Franeker University by Napoleon, professor Cornelis Ekama, having been transferred from Franeker to Leiden University, took the equatorial with him, for use at Leiden Observatory. In 1819 in Leiden this very instrument was the subject of an acclaimed prize essay written by Benjamin Kam, a theology student who had attended Ekama's astronomy lessons. Two years later Ekama was forced to return the instrument to the newly founded Franeker Athenaeum. Following its arrival in Friesland it was established that 'the beautiful and costly telescope by De Mégnié' was in very bad shape. In 1843, following the closure of the Franeker Athenaeum, Mégnié's equatorial – like most of the instruments – was sent to the Royal Academy of Civil Engineers in Delft, where it was eventually deposited in the Geodetic Institute.

De Mégnié's instrument is one of the first examples of equatorial mounting in a modern conception. It overcame the limits of previous parallactic mountings by attaching the telescope to the axis of declination, at the opposite end to the declination circle. In this way the telescope could be pointed at all heights.

The brass telescope (l 91.5, Ø 5.0-6.0) is mounted in a cradle on a nicely crafted brass equatorial mounting that had to be fixed on a table before use. The ocular tube (Ø 2.7) can be adjusted by means of a rack-and-pinion construction. The biconvex objective (Ø 5.0) can be closed with dust cap. It has a simple ocular with sun filter. The polar height can be adjusted with a semi-circle by means of fine tuning with a worm gear over both axes. The ivory handles are partly incomplete. Precise readings can be made on both circles (Ø 21) with a vernier. The number '1' on the instrument indicates that this was the first instrument De Mégnié made in the year 1780.

Kam 1819; Engberts 1970, 55-56; Zuidervaart 2007



187. **26089 & 16168**

Large repetition circle

1818

signed: Lenoir à Paris

h 147, w 50, d 50

Provenance: Leiden Observatory, 1819-1933

In April 1816 professor Cornelis Ekama was granted permission to buy a large repetition circle from the Paris instrument maker Etienne Lenoir (1744-1832). The instrument was delivered in March 1819 for the sum of 2,180 Dutch guilders. In 1823 Ekama praised the accuracy of the instrument. However, shortly afterwards the heavy instrument was severely damaged. In 1826, when F. Kaiser entered the observatory as assistant observer, he found the instrument in a useless state. One of the two telescope objectives was broken and the edge of the large circle was bent, severely affecting the scalar division of the instrument. In 1861 Kaiser used one of the two Lenoir telescopes as a finder telescope for the 7-inch-Merz refractor, which was delivered for the new Leiden observatory. In 1919 this Merz-telescope was given to the Bosscha Observatory in Lembang (Indonesia). In Lembang the Merz-telescope still serves practical astronomy today, however without its 'original' Lenoir 'finder' (Courtesy Prof. Bambang Hidayat, Lembang 2005).

The large repeating circle (Ø 53) can rotate in any plane. It is mounted at one end of a steel axis placed 109 cm above ground level. Placed at the other end of the axis is a counterweight (Ø 14.5, w 4) to balance the instrument. Placed around the counterweight is a rack-and-pinion arrangement for the fine tuning of the altitude of the instrument. A small quadrant (also with a rack-and-pinion arrangement and a scalar division) allows the instrument to be placed in an equatorial position. Mounted at the centre of the divided circle is a telescope with a large objective tube (l 72, Ø 5.5) and a smaller eyepiece tube (l 2.5, Ø 3). The objective is missing, as is the second telescope. Placed at the scalar division of the large circle (0-360 degrees) were four small microscopes for reading the verniers (divided 0-40), one of which is now missing.
The mainly brass instrument can rotate in a fork bearing (h 21.5, w 19) placed on a heavy vertical column (h 85), with a somewhat conical shape (Ø 4.5-10). Placed at the base is a smaller divided circle (Ø 25; division 0-360 degrees), with a gearing arrangement for the fine tuning of the azimuth adjustment (one part missing) and a vernier for reading the divided scale. The feet have three large screws for the horizontal levelling of the instrument, constituting a triangle with sides of 48 cm.

A wooden box (l 80.5, w 22.5, d 13), with label 'Lenoir, Ingenieur pour les instruments a l'usage des sciences' (no. 16168) probably was used for storing one of the telescopes. It could house two tubes with diameters of c. 5.5 and 3 cm.

AC 69-71 (1816-1819); Ekama 1823, 29; Kaiser 1838, 15; Invent. 1854, no. 18; 1868, A-26; Bennet 1987

188. 10813

Small repetition circle

1800-1832

signed: Lenoir à Paris

h 30, w 27, d 27

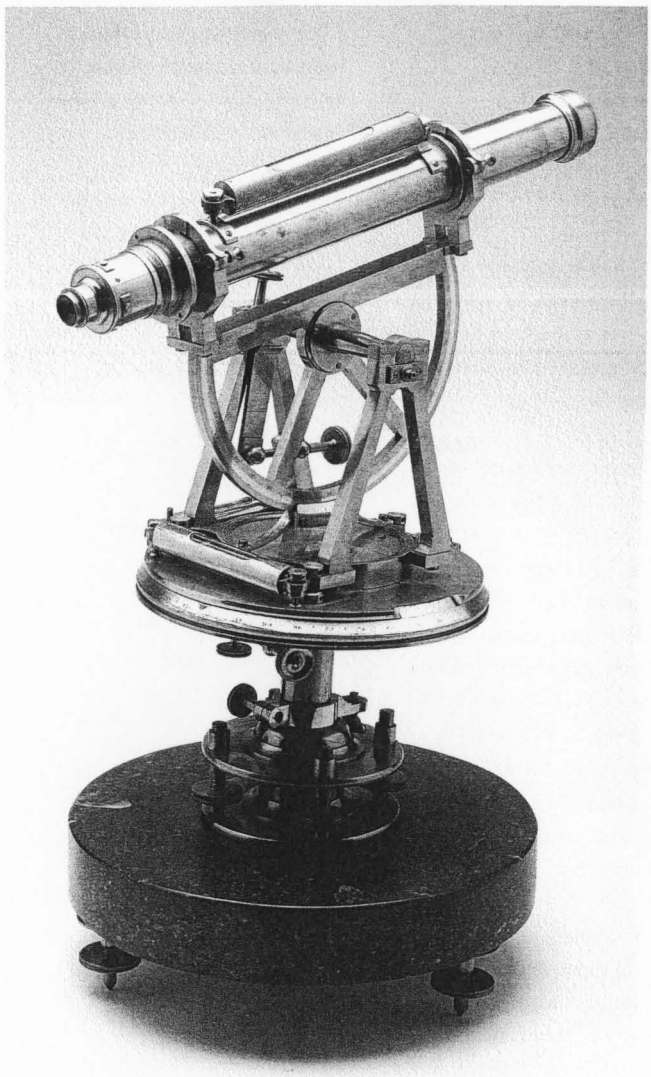
Provenance: Astronomical Institute Amsterdam, 1950

Small repetition theodolite, used for instruction purposes at the Astronomical Institute of the University of Amsterdam.

This small repeating circle is based on the same principles as the previous large circle by Lenoir. The repeating principle was invented in 1785 by the French mathematician Chevalier la Borda on a theoretical basis developed in the mid-18th century by the German astronomer Johann Tobias Mayer. It required the continuous measurement of an angle measured with the two telescopes without returning the instrument to its zero starting point. In the end the accumulated angle has to be divided by the number of measurements. In theory this angle is far more precise than the interpolation of a single measurement.
In contrast to La Borda, who used one telescope and a mirror, Lenoir mostly equipped his repetition circles with two telescopes. These instruments could be used for astronomical as well as geodetic purposes.
In the years 1802-1811 these reflecting circles by Lenoir were used by the Dutch General Kraijenhoff during the first accurate triangulation of the Netherlands.

This brass instrument rests on a horizontal tripod to which a horizontal circle (Ø 15.5) is attached, having a scalar division from two times 0 to 180 degrees. A vertical column (h. 17) bears a second divided circle (Ø 17). In the centre a bearing holds the upper telescope (l 26.5, Ø 2). The other similar telescope is placed under the circle. A gearing provides the fine tuning of the instrument.

Bennet 1987, 165



189. 8199

Theodolite, transformed into a transit telescope

1826-1832

h 44.5, w 40, d 40

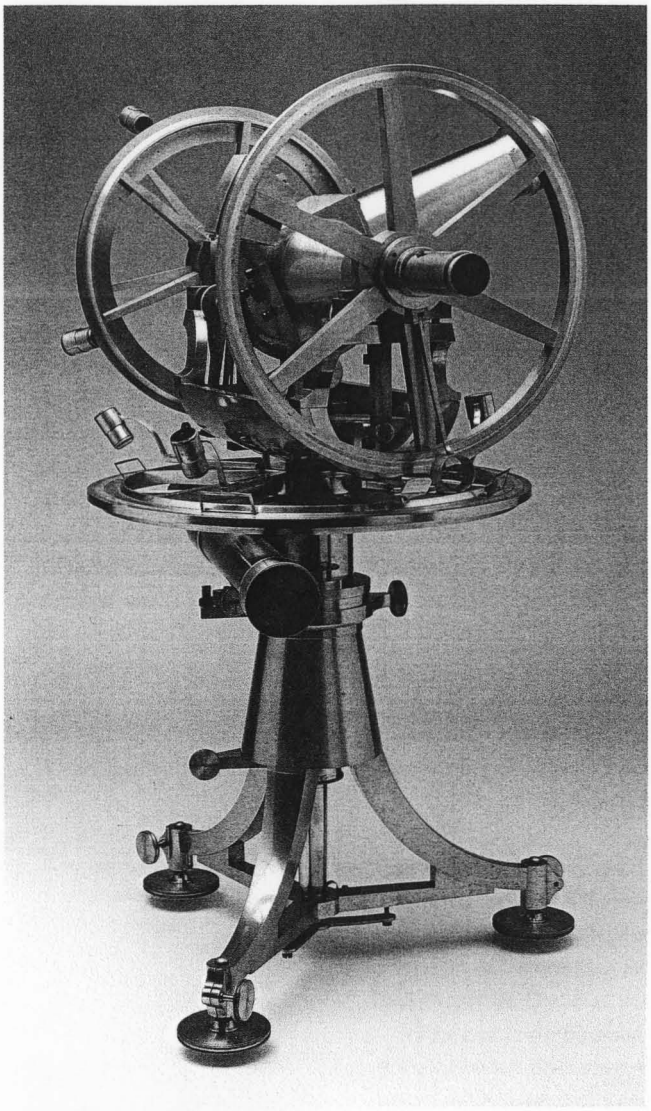
Signed: Troughton & Simms London

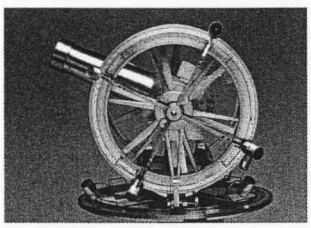
Provenance: Leiden Observatory, 1832-1933

In 1832 the Dutch government gave this theodolite and levelling device with two telescopes to the Leiden Observatory, where the Amsterdam instrument maker E. Wenckebach transformed it into a portable transit telescope. The instrument was adapted for astronomical use by placing the upper telescope on a separate stand, with a large prism being placed in front of its objective. In this way the telescope could be used as a transit instrument, having a level on it to control its horizontal position in the plane of the meridian.
The original instrument was made by the English firm of instrument makers Troughton & Simms, operational since 1826 and remaining in business under various names until 1988.

The telescope (l 37, Ø 3.5)), with a contemporary aperture of '13 lines' [= 3.3 cm], is attached to a vertical semicircle (Ø 19) with a divided silver scale (two times 90 degrees), revolving on a horizontal circle (Ø 19.5) with a divided silver scale (0-360 degrees) and a vernier reading (0-20 degrees), standing on a vertical column on a horizontal marble circular plane (h 4.3, Ø 26), which can be adjusted with three levelling screws. Two missing levels and a levelling screw were crafted in 1955.

Kaiser 1838, 57; Invent. 1854, no. 6; 1868, C-5; Kaiser 1868, XXI; McConnell 1992





190. 12822

Universal instrument

1824-1838

h 55, w 41, d 28

Signed on the objective: Utzschneider u. Fraunhofer in München

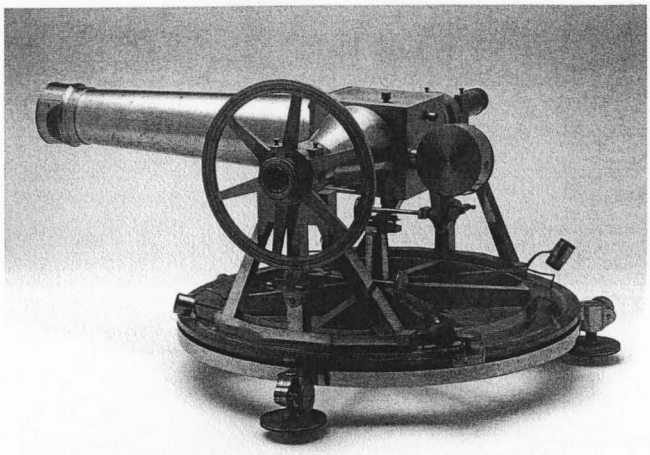
Provenance: Leiden Observatory, 1838-1935

In 1838 Kaiser described this universal instrument as 'an apparatus with which one can measure horizontal and vertical arcs with equal accuracy and that can be used as a transit-instrument'. Most 'universal instruments' used a 'broken lens arrangement', invented in about 1820 by Traugott Leberecht Ertel (1778-1858), in which a prism reflects the light from the objective into the hollow axis of the telescope. The eyepiece placed at the end of the axis allows a horizontal view regardless the position of the telescope tube. This relieved the observations and contributed to the accuracy of the measurements.

The precision instrument is a joint product of the Mathematical-Mechanical Institute and the Optical Institute, both based in Munich. The first workshop was founded in 1802 and run by Ertel from 1820. The second workshop was separated from the first in 1809, owned by Von Utzschneider and run by Joseph von Fraunhofer. Following the latter's death in 1826, Georg Merz ran the firm. According to the signatures, the optical parts of this instrument were made between 1819 and 1826. The Ertel firm started advertising for such universal instruments in 1824, offering them until the end of the century. A handwritten description by Ertel entitled *'Erlauterungen zu einem Universal instrument'* goes with this instrument.
In 1875 the instrument was refurbished for instruction purposes. In 1944 the apparatus was severely damaged when the museum was bombed, but it has recently (in 2005) been restored.

A vertical conically-shaped tripod rests on three adjusting screws. This tripod bears a hollow conical column (l 10, Ø 6-9), on top of which a hollow cylinder (h 5.5, Ø 5) can rotate around the vertical steel axis of the stand. A horizontal 'alhidade' circle (Ø 27) is connected to this movable cylinder. Located below this azimuth circle is a rectification telescope (l 28, Ø 3), having a simple objective (Ø 3.5) with dust cap (ocular missing). A second movable circle (Ø 25) bearing the telescopic arrangement is positioned concentrically to the first circle. The azimuth displacement of the two circles to each other can be measured by means of an inlay silver scalar division with vernier readings on the outer circle, to be read with four reading microscopes. Located on top of the inner horizontal circle is a cradle, which holds the horizontal hollow axis (l 28) of the telescope, placed between two vertical circles (Ø 20.5). The telescope tube (l 20, Ø 4-5) with achromatic objective (Ø 3.4) is located in the middle of this axis.

MB Arch 391; Kaiser 1838, 51-57; Invent. 1868 C-2; Verslag 1876, 10; Engberts 1970, 77-79



191. 8200

Portable transit instrument

1834-1838

h 51, w 35, d 28

Signed on the azimuth circle: Ertel & Sohn in München

Signed on the objective: Utzschneider u. Fraunhofer in München

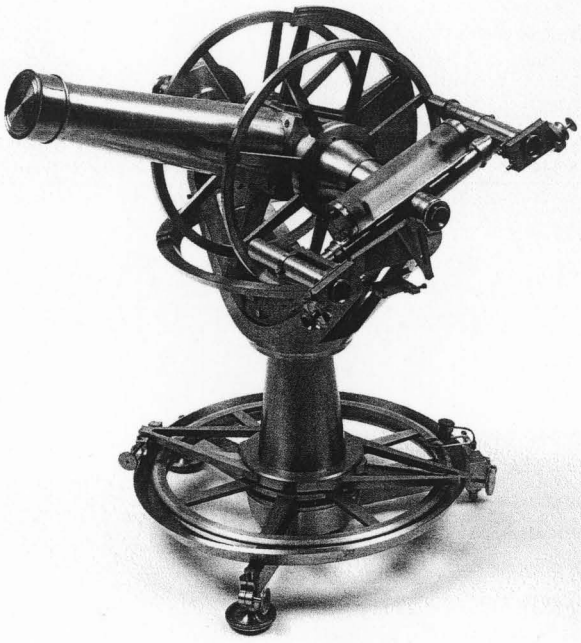
Provenance: Leiden Observatory, 1838-1935

Like the previous universal instrument this smaller device is a joint product of Ertel's Mathematical-Mechanical Institute and the Optical Institute, both of Munich. The first company signed its products 'Ertel & Sohn', starting in 1834 when Georg Ertel joined the firm. According to the signature on the objective, the optics were made in the period between 1819 and 1826.

These two precision devices were the first instruments ordered by F. Kaiser following his appointment as director of the Leiden Observatory. Ertel delivered the apparatus in August 1838. Before installing the instruments Kaiser made some arrangements to the observatory building, providing a well-grounded floor for the instruments separate from that of the observer. The first measurements on the polar height exceeded Kaiser's expectations.

Three adjusting screws bear a horizontal circle (Ø 34), in the centre of which a vertical rod is placed. Around this rod a hollow conical bus can rotate and placed at the lower end of it is a second horizontal circle (Ø 30), with a silvered scalar division and four vernier readings. Placed at this movable circle are two heavy triangular bearings, which provide the support for a horizontal axis, in the middle of which the telescope tube (l 35, Ø 4.5-6), the deviating prism and a counterweight are located. Attached to one end of the axis is a compound ocular. Attached to the other end of the axis is a vertical scaled circle (Ø 14.5), with a scalar division for reading the inclination. The telescope that was described in 1868 as having an aperture of 19 lines [= 4.8 cm] has an achromatic objective (Ø 5) with a dust cap. Originally the instrument was covered with a wooden box.

Kaiser 1838, 27-28, 51-54, 62-63; Invent. 1868, C-3; Engberts 1970, 79-82



192. 10680

Universal Instrument

1853

h 58, b 50, d 44

Signed: A. & G. Repsold Hamburg. 1853.

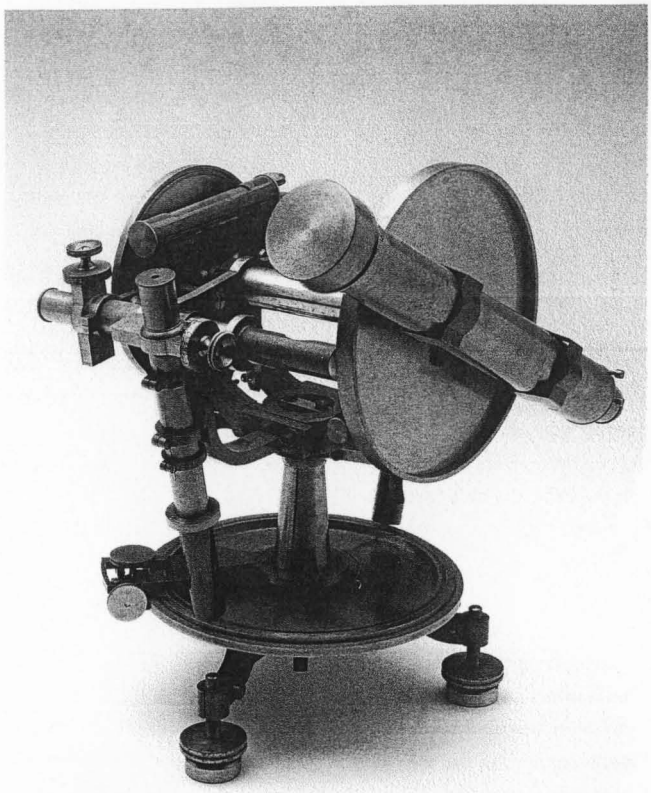
Provenance: Leiden Observatory, 1853-1931

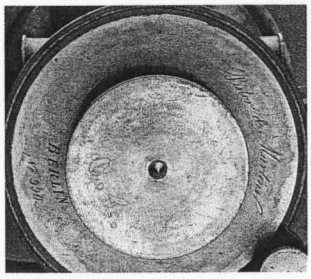
Three generations ran the Hamburg firm of Repsold, starting in around 1799 with Johann Georg Repsold, who was succeeded in 1831 by his sons Adolf (1806-1871) and Georg (1804-1885), the constructors of this instrument. The Repsold firm came to an end in 1919.

This universal instrument was ordered for the Leiden Observatory by F. Kaiser in 1851, after testing a similar Repsold apparatus for the Dutch East Indies. This instrument was also described and illustrated by Oudemans. As the universal instrument required the sum of 2,000 guilders, the grants for the years 1849-1851 had to be combined, providing a sum of 1,440 guilders. A special grant of 600 guilders allowed the purchase of the instrument, which was delivered in 1853. The instrument was for example used in 1875 for measurements on the refraction of the atmosphere, and in 1895 for geodetic purposes by the 'Rijkscommissie voor de graadmeting'.

Like most universal instruments this device has a so-called 'broken lens arrangement', in which a prism deviates the light of the telescope into the hollow axis, allowing a horizontal observation in every position of the telescope tube. Three adjusting screws bear a horizontal tripod to which an immovable horizontal circle (Ø 35) is attached. A movable hollow column (Ø 7-13) can rotate around the vertical axis of the stand. Placed at the lower end of the column is a second horizontal circle (Ø 32), with a silvered scalar division. The other end of the column bears the horizontal axis, in the middle of which the telescope tube (l 31, Ø 7) is placed, with an ocular (now incomplete) at one end of the axis. Attached to the cradle of the axis are two immovable vertical scaled circles (Ø 27) that fit with a movable semicircle attached to the telescope, for reading the inclination. Originally the instrument was used with two micrometer-microscopes (partly preserved), which allowed a vernier reading with an accuracy of single arc seconds. The telescope that was described in 1868 as having an aperture of 21 lines [= 4.7 cm] has a simple objective (Ø 5.0) with a dust cap. A wooden storage box (h 59, w 68, d 49), marked C1, has steel handles in a brass mounting.

Kaiser 1851; Oudemans 1852; Invent. 1868, C-1; Verslag 1875, 9; Verslag 1896, 12; Engberts 1970, 74-77





193. 5917

Small universal instrument

1858

h 32, Ø 30

Signed: Pistor & Martins Berlin, no 990.

Provenance: Leiden Observatory, 1858-1982

In 1848 the Dutch government commissioned F. Kaiser to equip a geodetic expedition to the Dutch East Indies (now Indonesia) with proper astronomical instruments.
As the leading German workshops of Ertel and Repsold were too busy to meet Kaiser's demand for a quick delivery of the necessary portable universal instruments, he was forced to seek elsewhere. In this process the Berlin-based company of Pistor & Martins was commissioned to construct these instruments, made however after their own design, without the usual 'broken telescope'. After testing the instruments and comparing them with other universal instruments made by Ertel and Repsold, the Pistor & Martin devices were shipped to the East Indies. This smaller portable universal instrument – in fact little else than a theodolite – was commissioned shortly after these experiences and was used at Leiden Observatory solely for educational purposes.

The apparatus was described in the 1868 inventory as *a universal instrument by Pistor & Martins, delivered in 1858, with a telescope at the end of its axis of 12 Lines [= 2.7 cm] aperture. The circles have a diameter of 5 inches [= 12.7 cm], and every circle has two mikrometer-mikroscopes for the reading of the scales.* The original 'heavy iron stand' is now missing. The mark 'C 4' on the instrument refers to an old inventory number.

The workshop of Carl Philipp Heinrich Pistor (1779-1847) was founded in Berlin in about 1813. In the mid-1830s he entered into an association with Martins, forming a firm that existed until 1873.

Kaiser 1851, 102-134; Invent. 1868, C-4

Miscellaneous

194. 11893

Walking stick with a telescope

1800-1900

h 90, Ø 3

Provenance: Groenendijk Collection, 1957

Walking stick (l 90, Ø 1.3-3.0) made of light brown bamboo and brass. The upper part of the stick contains a small telescope (l 30-55, Ø 1.6-3.0) in three segments of bamboo and brass, having a simple objective (Ø 2.0) and a compound ocular with reversing lenses. The tube can be closed with a screwable brass cap. In 1838 a similar walking stick made by Steinberg, London was in the instrument collection of J.J. Cau in The Hague.

Cau 1838, no. 74; Engberts 1970, 123

195. 17721

Artificial horizon facilitating telescopic altitude measurements

1800-1850

h 16, w 13, d 21

Signed: Dollond London

Provenance: Deventer Natuur- en Scheikundig Genootschap, to be placed in the Deventer HBS, 1867-1974

This brass container with inclined glass windows was filled with liquid mercury, resulting in a perfect horizontal mirror. This reflecting surface made it possible to measure the altitude of a celestial body above the horizon even when the horizon itself was invisible or obscured. The angle between the object and its image could be measured and divided by two, its result being the desired altitude.

Van Helden no. 190

Literature

Aa, Van der 1712

[Pierre van der Aa], *Les delices de Leide, une des célèbres villes de l'Europe, qui contiennent une description exacte de son antiquité... Le tout enrichi de tailles douces*, Leiden, 1712.

Biedermann 1877

Rudolf Biedermann, *Bericht uber die Ausstellung Wissenschaflicher Apparate im South Kensington Museum zu London, 1876. Katalog der Ausstellung*, London, 1877.

Bigourdan 1901

G. Bigourdan (ed.), *A-G. Pingré: Annales célestes du dix-septième siècle*, Paris, 1901.

Bennet 1987

J.A. Bennet, *The Divided Circle. A History of Instruments for Astronomy Navigation and Surveying*, Oxford, 1987.

Bilt, Van der 1941

J. van der Bilt, 'Over den Frieschen teleskopenbouwer Jan Pytters van der Bildt (1709-1791)', in: *Hemel en dampkring*, 39 (1941), 122-136.

Bilt, Van der 1950

J. van der Bilt, *De grote spiegelkijkers van Roelofs en Rienks : een episode uit de geschiedenis der Leidse en Utrechtse sterrewachten (1821-1846)*, Leiden, 1951.

Bilt, Van der 1951

J. van der Bilt, 'Over de kleine kijkers en de microscopen van Sieds Johannes Rienks', in: *Hemel en Dampkring*, 1951, 181-191.

Bolle 1983

Bert Bolle, *Barometers in beeld*, Lochem, 1983.

Brachner 1986

Alto Brachner, *Die Münchener Optik in der Geschichte: Entstehung, Unternehmungen, Sternwarten, Lokalitäten, Ausbreitung*, München, 1986.

Brooks 1991

Randall C. Brooks, 'The Development of Micrometers in the Seventeenth, Eighteenth and Nineteenth Centuries', in: *Journal for the History of Astronomy*, 22 (1991), 127-173.

Campen, Van

J. van Campen, *De Haagse jurist Jean Theodore Royer (1737-1807) en zijn verzameling Chinese voorwerpen*, Hilversum, 2000.

Catalogus Librorum 1838

Catalogus Librorum [...] quorum omnium auctio 14 maiji MDCCCXXXVIII, Leiden (H.W. Hazenberg), 1838.

Catalogus 1889

Catalogus van eene kolossale kollektie instrumenten en gereedschappen, waarvan de publieke verkooping zal plaatshebben op Maandag 2 December 1889, en twee volgende dagen, telkens des avonds te zes ure, in het verkooplokaal van H.G. Bom, Warmoesstraat 35, Amsterdam, Amsterdam, 1889 (GA Amsterdam, sign. VC 21).

Catalogue 1929

C.A. Crommelin & J.A. Vollgraff, *Catalogue de l'exposition à l'Observatoire de Leyde, 13-18 Avril 1929*, Amsterdam, 1929.

Clercq, De 1997

Peter de Clercq, *The Leiden Cabinet of Physics: a descriptive catalogue*, Leiden (Museum Boerhaave), 1997. (Communiation no. 271).

Clercq, De & De Mooij 2002

Peter de Clercq & Charles de Mooij, 'A hand-held telescope from the Musschenbroek Workshop', in: *Bulletin of the Scientific Instrument Society*, no. 65 (2002), 15-17.

Clifton 1995

Gloria Clifton, *Dictionary of British Scientific Instrument Makers 1550-1851*, London, 1995.

Christie's 1987

Scientific and Medical Instruments, London (Christie's), Nov. 1987.

Collectio 1762

Collectio exquisitissima instrumentorum, [..], vir celeberrimus Petrus van Musschenbroek, Leiden (P. Luchtmans), 1762.

Crommelin 1949

C.A. Crommelin, *Descriptive catalogue of the Huygens collection in the Rijksmuseum voor de Geschiedenis der Natuurwetenschappen (National Museum of the History of Science)*, Leiden, 1949. (Communication no. 70).

Cuthbertson 1794

Jonathan Cuthbertson, *Verhandeling over de Verrekykers. Behelsende, eenige dwaalingen van de onkundige daar over. Hoe of men zy stellen en gebruiken moet. Welke geschikt is tot byzondere gebruiken. Manier om de vergrootende vermoogen, en volmaaktheid te vinden. En hoe of men weeten kan welke de beste is &c, &c.*, [n.p. = Rotterdam], 1794. Only known copy in the Crone collection of the Scheepvaartmuseum in Amsterdam.

Dekker 1987

[Elly Dekker], *De Dollond telescoop*, Leiden (Museum Boerhaave), n.d. [= c. 1987]. (Communication no. 223).

Desaguliers 1732

J.Th. Desaguliers, *Korte Inhoud der Philosophische Lessen*, Amsterdam, 1732.

Dijksterhuis 1999

Fokko Jan Dijksterhuis, *Lenses and Waves. Christiaan Huygens and the Mathematical Science of Opties in the Seventeenth Centurey*, Enschede (diss.), 1999

Ebeling 1789

Naamlijst ... van Wis- en Natuurkundige Werktuigen, bijeen verzameld door Mr. E. Ebeling, Amsterdam (N.C. Gravius), 1789. (Museum Boerhaave Library).

Ekama 1823

Cornelis Ekama, *Oratio de insignium, qui in scientia astronomica facti sunt, progressuum fundamentis, a summis in re mathematica et astronomica viris, partim decimo sexto, maxime decimo septimo seculo, jam praecipue jactis*, Leiden, 1823.

Engberts 1970

E. Engberts, *Descriptive Catalogue of Telescopes in the Rijksmuseum voor de Geschiedenis der Natuurwetenschappen (National Museum of the History of Science)*, Leiden, 1970. (Communication no. 138).

Ferrner 1759

G.W. Kernkamp, 'Bengt Ferrner's dagboek van zyne reis door Nederland in 1759', in: *Bydragen en mededeelingen van het Historisch Genootschap*, 31 (1910), 314-509.

Fournier 2003

Marian Fournier, *Early Microscopes. A Descriptive Catalogue*, Leiden (Museum Boerhaave), 2003. (Communication no. 300)

Franz 2001

Helmut Franz, 'Steinheil Münchener Optik mit Tradition 1826-1939 (1995) Vier Generationen Familienunternehmen', in: *Wissenschaft und Technik*, Stuttgart, 2001.

Gent, Van 1993

Rob H. van Gent, *De reizende astronoom: Nederlandse sterrenkundige expedities naar de Oost en de West*, Leiden (Museum Boerhaave), 1993.

Haasbroek 1968

N.D. Haasbroek, *Gemma Frisius, Tycho Brahe and Snellius and their Triangulations*, Delft, 1968.

Hackmann 1973

W.D. Hackmann, *John and Jonathan Cuthbertson. The Invention and Development of the Eighteenth Century Plate Electrical Machine*, Leiden, 1973.

Harting 1867

P. Harting, 'Oude optische werktuigen', in: *Album der Natuur*, 1867, 257-281.

Hartsoeker 1699

Nicolaas Hartsoeker, *Proeve der Deurzicht Kunde*, Amsterdam, 1699 (Dutch translation of *Essai de Dioptrique*, Paris, 1694).

Heineman

Karen M. Heineman, *Het Academiedak. De Sterrenwacht, het uurwerk van 1589, de academietoren*, unpublished paper, Leiden (Faculty of Art History), n.d. [c. 1980]. (Museum Boerhaave Library).

Helden, Van 1977a

Albert van Helden, 'The Invention of the Telescope', in: *Transactions of the American Philosophical Society*, vol. 67 (1977), no. 4.

Helden, Van 1977b

Albert van Helden, 'The development of compound eyepieces, 1640-1670', in: *Journal for the History of Astronomy*, 8 (1977), 26-37.

Helden, Van 1994

Albert van Helden, 'Telescopes and Authority from Galileo to Cassini', in: *Osiris*, 9 (1994), 9-29.

Helden, Van 2002

[Anne van Helden], *Science in the Provinces: a descriptive catalogue of the 'Deventer' collection*, Leiden (Museum Boerhaave), 2002. (Communication no. 296).

Helden, Van & Van Gent 1995

Anne van Helden & Rob van Gent, *De Huygenscollectie*, Leiden (Museum Boerhaave), 1995. Translated into English as: *The Huygens collection*, 1995. (Communication no. 262).

Helden, Van & Van Gent 1998

Anne van Helden & Rob van Gent, 'The Lens Production by Christiaan and Constantijn Huygens', in: *Annals of Science*, 56 (1999), 69-79.

Hennert 1770

J.F. Hennert, 'Descriptio Telescopii Gregoriani novem pedum, a Nobil. Van de Wall, Amstelaedamensi constructi', in: J.F. Hennert, *Elementa, Optices, Perspectivae, Catoptrices, Dioptrices, et Phaometriae*, Utrecht, 1770. (three unnumbered pages 'post praefationum').

Herk 1983

G. van Herk, H. Kleibrink & W. Bijleveld, *De Leidse Sterrewacht: Vier eeuwen wacht bij dag en nacht*, Zwolle, 1983.

Hooijmaijers 2003

Hans Hooijmaijers, 'De omzwervingen van een telescoop', in: *Gewina. Tijdschrift voor de Geschiedenis der Geneeskunde, Natuurwetenschappen, Wiskunde en Techniek*, 26 (2003), 40-45.

Invent. 1706

Inventory of the instruments of the Astronomical Observatory and the Physics Cabinet, made by Burchard de Volder in 1706, printed in Molhuysen IV, 104*-108*.

Invent. 1742

Inventory of the instruments of Leiden Astronomical Observatory, made by Johan Lulofs on 19 September 1742, AC-I 47, printed in Molhuysen, V, 144*-146*.

Invent. 1761

Inventory of the instruments of Leiden Astronomical Observatory, made by Johan Lulofs in 1761, AC-I 50 (almost identical to Invent. 1742).

Invent. 1769

Inventory of the instruments of Leiden Astronomical Observatory, made by Dionysus van de Wijnpersse in 1768, AC-I 53 (identical to Invent. 1761).

Invent. 1793

Inventory of the instruments of Leiden Astronomical Observatory, made by Pieter Nieuwland & Johan Fas in 1793, AC-I 66.

Invent. 1798

Inventory of the instruments of Leiden Astronomical Observatory, made by Van Beeck Calkoen & Johan Fas in 1798, AC-I 260 (almost identical to Invent. 1793).

Invent. 1854

Inventory of the instruments of Leiden Astronomical Observatory, and of the personal instruments of its director, made by F. Kaiser in 1854. Manuscript in Museum Boerhaave Archive, no. 571.

Invent. 1868

Inventory of the instruments of Leiden Astronomical Observatory, made by F. Kaiser in 1868, printed in: *Annalen der Sternwarte in Leiden*, 1 (1868), LIII-LIX.

Inventory Diodati 1784

Inventory of the physical instruments of the late M.J. Diodati, in Notary protocol no. 4034, Municipal Archive, The Hague.

Kaiser 1836

F. Kaiser, 'Schreiben der Herrn F. Kaiser, Doctor der Philosophie in Leyden, an den herausgeber', in: *Astronomische Nachrichten*, 13 (1836), 177-180.

Kaiser 1838

F. Kaiser, *Het Observatorium te Leiden*, Leiden, 1838.

Kaiser 1845

F. Kaiser, *De Sterrenhemel, tweede deel*, Amsterdam, 1845.

Kaiser 1846

F. Kaiser, 'Iets over de kijkers van de gebroeders Christiaan Huygens' in: *Het Instituut. Verslagen en Mededeelingen uitgegeeven door de vier Klassen van het Koninklijk Nederlandsch Instituut*, Amsterdam, 1846, 396-429.

Kaiser 1851

F. Kaiser, *De Sterrekundige plaatsbepaling in den Indischen Archipel en de maatregelen [...] tot hare voorbereiding genomen*, Amsterdam, 1851.

Kaiser 1853

F. Kaiser, *De Sterrenhemel. Tweede deel*, Tweede druk, Amsterdam, 1853.

Kaiser 1854

F. Kaiser, 'De zakkijkers van Molteni te Parijs, als hulpmiddelen voor eene meer nauwkeurige beschouwing der hemellichten', in *Album der Natuur*, 1854, 195-226.

Kaiser 1868

F. Kaiser, 'Geschichte und Beschreibung der Sternwarte in Leiden', in: *Annalen der Sternwarte in Leiden*, 1 (1868), I-LXVIII.

Kaiser 1894

P.J. Kaiser, 'Korte geschiedenis der Verificatie van Nautische Instrumenten der Nederlandsche Marine', in: *De Natuur*, 14 (1894), 118-119, 140-146, 175-182.

Kechel 1653

Sam. Cor. Kechel van Hollenstein, *Eygentlicke afbeeldinge der Drie-Sonnen, de welcke verschenen zyn Anno 1653 den 14/24 Jan. alhier binnen Leyden, ende op den Toren van de Academie waergenomen*, s.l.; s.d. [Leiden, 1653].

Kernkamp 1940

Gerhard Wilhelm Kernkamp (ed.), *Acta et decreta senatus: vroedschapsresolutiën en andere bescheiden betreffende de Utrechtsche Academie*, 3, Utrecht, 1940.

Koperen Kabinet

Het koperen kabinet : schatkamers van de wetenschap, 1550-1950, Leiden (Museum Boerhaave), 1994. (Communication no. 261).

King 1955

H.C. King, *History of the Telescope*, Cambridge, 1955.

Lalande, De 1792

J.J. de Lalande, *Astronomie*, troisième edition, Paris, 1792.

Litrow 1830

J.J. Litrow, *Dioptrik oder Anleitung zur Verfertigung der Fernröhre*, Wien, 1830.

Lualdi 1999

A. Lualdi, 'Biagio Burlini, un ottico del '700 veneziano', in: *Nuncius*, 14 (1999).

McConnell 1992

Anita McConnell, *Instrument Makers to the World. A History of Cooke, Troughton & Simms*, York, 1992.

Maclean 1976

J. Maclean, *Bijdrage tot de geschiedenis der Nederlandse instrumentmakerijen in de periode 1781-1881: de firma's Kleman en Van Emden*, Leiden, 1976.

Millburn 1976

John Millburn, *Benjamin Martin: Author, Instrument-maker, and 'Country Showman'*, Leiden, 1976.

Millburn 1986

John Millburn, *Retailer of the Sciences. Benjamin Martin's Scientific Instrument Catalogues, 1756-82*, London, 1986.

Millburn 2000

John Millburn, *Adams of Fleet Street, Instrument Makers to King George III*, Ashgate, 2000.

Molhuysen

P.C. Molhuysen (ed.), *Bronnen tot de geschiedenis der Leidsche Universiteit*, I (1574-7 Febr. 1610); II (8 Febr. 1610-7 Febr. 1647); III (8 Febr. 1647 - 18 Febr. 1682); IV (18 Febr. 1682-8 Febr. 1725); V (10 Febr. 1725-8 Febr. 1765); VI (10 Febr. 1765-21 Febr. 1795); VII (23 Febr. 1795-30 Dec. 1811), Den Haag (Martinus Nijhoff), 1913-1924. (Rijks geschiedkundige publicatiën, grote serie nrs. 20,29,38, 45,48,53, 56).

Mooij 1988

Joke Mooij, *Instrumenten, wetenschap en samenleving. Geschiedenis van de instrumentenfabricage en -handel in Nederland. 1840-1940*, Tilburg, 1988.

Mörzer Bruyns 1989

W.F.J. Mörzer Bruyns, 'De instrumenten van de firma Van Keulen', in: E.O. van Keulen, W.F.J. Mörzer Bruyns & E.K. Spits, *'In de Gekroonde Lootsman'. Het Kaarten-, boekuitgevers en instrumentenmakershuis Van Keulen te Amsterdam, 1680-1885*, Utrecht, 1989, 61-71.

Musschenbroek, Van 1739

Petrus van Musschenbroek, *Beginsels der Natuurkunde beschreeven ten dienste der Landgenooten*, Leiden, 1739.

Musschenbroek, Van 1762

P. van Musschenbroek, *Compendium Physicae Experimentalis Conscriptum in Usus Academicos*, Leiden, 1762.

Oudemans 1852

J.A.C. Oudemans, 'Beschrijving en afbeelding van een universaal-instrument van Repsold', in: *Verslag van den staat des Stedelijken Gymnasiums te Leyden*, 14 (1852), 11-38 (2 ill.).

Oudemans 1884

J.A.C. Oudemans, 'Over het vermogen der 10-voets kijker van Huygens', in: *Verslagen en Mededelingen van de Koninklijke Academie van Wetenschappen*, 1884, 290-296.

Oudemans 1888

J.A.C. Oudemans (ed. of) F. Kaiser, *De Sterrenhemel, tweede deel*, vierde druk, Amsterdam, 1888.

Oudemans 1905

J.A.C. Oudemans, 'Kort bericht omtrent de bepaling der Lengte of St. Denis, (Ile de la Réunion), uitgevoerd in 1874', *Verslagen van de Gewone Vergaderingen der Wis- and Natuurkundige Afdeeling of de Koninklijke Akademie van Wetenschappen te Amsterdam,* 13 (1905), 616-625 & 14 (1905), 75-94.

Pelzers 1996

Elio Pelzers, *Natuurbeschermer, jager, bosbouwer: W.H. de Beaufort (1881-1976)* , [S.l.], 1996.

Rapenburg

Th.H. Lunsingh Scheurleer, C. Willemyn Fock, A.J. van Dissel (eds.), *Het Rapenburg : geschiedenis van een Leidse gracht,* 6 vols., Leiden, 1986-1992.

Riekher 1990

Rolf Riekher, *Fernrohre und ihre Meister,* Berlin, 1990

Rooseboom 1950

Maria Rooseboom, *Bijdrage tot de Geschiedenis der Instrumenmakerskunst in de noordelijke Nederlanden tot omstreeks 1840 (National Museum of the History of Science),* Leiden, 1950. (Communication no. 74)

Scheltema 1823

J. Scheltema, 'Levensschets van Jan van der Bildt', in: *Geschied- en Letterkundig Mengelwerk,* 3-II, Amsterdam, 1823, 225-247.

Schroder 1725

Johannes Schroder, *Ter gedachtenis van het driemaal vyftig jaarig jubelfeest, der Leidsche Akademie, geviert den VIII. van Sprokkelmaand des jaars MDCCXXV* , Leiden, 1725.

Sitter, De 1933

W. de Sitter, *Short History of the Observatory of the University at Leiden, 1633-1933,* Haarlem, 1933.

Sotheby's

Sotheby's, *Fine Instruments of Science and Technology,* London (various dates).

Turner 1966

G.L'E. Turner, 'Decorative tooling on 17th and 18th century microscopes and telescopes', in: *Physics,* 8 (1966), 99-128.

Turner 1969

G.L'E. Turner, 'James Short, F.R.S. and his Contributions to the Construction of Reflecting Telescopes', in: *Notes and records of the Royal Society of London,* 24 (1969), 91-108. Reprinted in: G.L'E. Turner, *Scientific Instruments and Experimental Philosophy 1550-1850,* London, 1990.

Turner 1973

G.L'E. Turner, 'Descriptive catalogue of Van Marum's scientific instruments in Teyler's Museum', in: *Martinus van Marum : life and work,* 4, part 2, Leiden, 1973, 125-401.

Turner 1986

G.L'E. Turner, 'Van der Bildt telescope in Teylers Museum', in *Bulletin of the Scientific Instrument Society,* no. 9 (1986), 13-14.

Turner & Wiechmann 1985

G.L'E. Turner and A. Wiechmann, 'Een spiegeltelescoop van Jan van der Bildt', in: *Teylers Museum Magazine,* 3 (1985), no. 1, 9-13.

Uffenbach, Von 1753/54

Zacharias Conrad von Uffenbach, *Merkwürdige Reisen durch Niedersachsen, Holland [1711] und Engelland,* 3 vols., Ulm und Memmingen, 1753-1754.

Uylenbroek 1838

P.J. Uylenbroek, *Oratio de fratribus Christiano atque Constantino Huygenio,* Leiden, 1838.

Verslag

Verslag van den Staat der Sterrenwacht te Leiden, [various years], 1854-1913.

Vollgraff 1914

J.A. Vollgraf, 'Brieven van Rudolph en Willebrord Snellius', in: *Leidsch Jaarboekje,* 1914, 103.

Voort, Van der 1851

G.A. van der Voort, C.J. Matthes, J.A. van Eijk en F.J. Stamkart, 'Waarnemingen bij gelegenheid der zons- verduistering van de 28. Juli 1851, op het gebouw der Maatschappij Felix Meritis te Amsterdam', in: *Algemeene Konst- en Letterbode,* 1851-II.

Vossius 1650

Gerardi Joannis Vossii, *De quatuor artibus popularibus, de philologia, et scientiis mathematicis, cui operi subjungitur, chronologia mathematicorum, libri tres,* Amsterdam, 1650. id. 1660.

Waard, De 1906

C. de Waard, *De uitvinding der verrekijkers. Eene bijdrage tot de beschavingsgeschiedenis,* Den Haag, 1906.

Waard, De 1945

C. de Waard, *Journal tenu par Isaac Beeckman de 1604 à 1634, publié avec une introduction et des notes,* vol. 3, Den Haag, 1945.

Zuidervaart 1995

H.J. Zuidervaart, *Speculatie, wetenschap en vernuft. Fysica en astronomie volgens Wytze Foppes Dongjuma (1707-1778), instrumentmaker te Leeuwarden,* Leeuwarden, 1995.

Zuidervaart 2003

H.J. Zuidervaart, ' "Zo'n mooie machine, waarvan de kwaliteit door alle astronomen wordt erkend". Een biografie van een vrijwel niet gebruikte telescoop', in: *Gewina. Tijdschrift voor de Geschiedenis der Geneeskunde, Natuurwetenschappen, Wiskunde en Techniek,* 25 (2003), 148-165.

Zuidervaart 2004

H.J. Zuidervaart, 'Reflecting "Popular Culture". The Introduction, Diffusion and Construction of the Reflecting Telescope in the Netherlands', in: *Annals of Science* 61 (2004), 407-452.

Zuidervaart & Van Gent 2004

H.J. Zuidervaart & R.H. van Gent, 'A Bare Outpost of Learned European Culture on the Edge of the Jungle of Java. Johan Maurits Mohr (1716-1775) and the Emergence of Instrumental and Institutional Science in Dutch Colonial Indonesia', in: *ISIS. An International Review devoted to the History of Science and its Cultural Influences*, 95 (2004), 1-33.

Zuidervaart 2007

H.J. Zuidervaart, 'De omzwervingen van een achttiende-eeuws Frans equatoriaal', in: *Gewina. Tijdschrift voor de Geschiedenis der Geneeskunde, Natuurwetenschappen, Wiskunde en Techniek* 29 (2007) [in press].

Index of instrument makers

Numerals in bold refer to the catalogue numbers

Index of inventory numbers

The following list provides a means of finding the relevant catalogue number in this catalogue for any given inventory number. Before the 1980s the museum used an alpha-numerical system, which was then turned into a strictly numerical system, so for convenience a list of old inventory numbers is given as well. In addition, inventory numbers of former owners are given.

New inventory number	Catalogue number	Old inventory number	Inventory number of former owner
3468	117	M427	
3467	131	M454	
3469	121	M527	
3470	124	OBS D6	E6
5917	193		C4
6130	143	M23	387
6131	142	OBS A35/M23	
6161	185	OBS A25	A25
6500	1		A4
6952	101	A220	
7365	157	M291	
8030	145		
8147	172	OBS A31	E19
8148	162	M51A	
8149	169	M533	
8150	138	M32	
8151	170	M142	
8152	141	A430	
8153	164	M292	
8154	150	M204	
8155	155	M203	
8156	139	M462	
8157	140	M107	
8158	153	M140	
8159	142	OBS A35/M23	
8160	149	M69	
8161	165	M449	
8162	180	M51A2	
8163	175	M344	1K5
8164	144	M295	
8165	133	OBS A32	E20
8166	171	M510	
8167	168	M31A	
8198	151	M14A	
8199	189	OBS C5	C5
8200	191	OBS C3	C3
8201	136	M79	
8202	152	M202	
8216	176	M15A	
8217	181	M506	
8699	116		

New inventory number	Catalogue number	Old inventory number	Inventory number of former owner
8840	71	M213	
8841	178	M206	
8842	174	M418	
8879	147	M39	
8880	177	M68A	
8881	163	M51A4	
8882	70	M77	
8883	92	M74B	
8884	98	M90	
8885	93	M208	
8886	94	M209	
8887	106	M211	
8888	107	M74C	
8889	46	M16D	
8890	66	M55	
8891	80	M27	
8892	59	M214	
8893	110	M74A	
8894	55	M342	
8895	57	M76	1K2
8896	63	M155	
8898	62	M25	
8899	68	M264	
8900	77	M137	
8901	86	M282	
8902	97	M139	
8904	64	M25A	
8906	60	M276	
8907	85	M532	
8908	49	M53	
8909	73	M57	
8911	69	M444	
8912	56	M207	
8913	89	M16B2	
8915	79	M73	
8918	75	M212	
8919	51	M58	
8920	67	M73A	
8921	82	M400	81a
8922	61	M275	
8923	76	M65	
8925	111	M52	
8926	83	M215	
8928	99	A221	60.1
8929	100	A221	60.2
8930	81	M138	
8931	109	M135	
8932	65	M247	
8933	54	M71	
8934	72	M60	
8935	53	M71A	
8936	58	M216	
8937	78	M48	
8938	74	M217	
9032	84		
9046	161		
9108	15	OBS H3/13	
9109	6	M 22	
9110	14	OBS H3/15	
9182	19	OBS H3/43	
9183	18	OBS H3/44	
9184	4b	OBS H3/27	
9185	4a	OBS H3/16	
9186	28	OBS H3/1	
9187	10	M 22 BIS	
9188	23	OBS H3/6	
9189	12	OBS H3/11	
9190	13	OBS H3/14	
9191	29a	OBS H3/2	
9192	24	OBS H3/7	
9193	16	OBS H3/9	
9194	17a	OBS H3/10	
9195	11	OBS H3/12	
9196	5	OBS H2	
		OBS H3/17/28/29/30	
9197	38	OBS 18	
9206	108		
9451	95	A219	
9452	112	OBS D10	E10
9620	134	OBS A10	A10
9621	113	OBS A11	A11
9651	146		A19
9699	132	OBS A33	E21
9700	148	M40	
9718	159	M14	
9724	2	OBS A6	A6
9725	3	OBS A7	A7
9740	52	M357A	99
9964	156	M41	
9965	122	OBS D2	E2
9985	43	M463	
10503	127	OBS D16	E17
10671	186	M81	
10680	192	OBS C1	C1
10773	34	OBS H3/23	
10813	188	A153	
11872	182	A470	
11873	135	M263	

New inventory number	Catalogue number	Old inventory number	Inventory number of former owner
11874	137	M33	
11888	105	A215	
11889	90	M274	
11890	102	A216	60s
11891	103	A217	60s
11893	194	M340	1K12
11894	87	M16	
11895	130	M299	
11908	104	A218	
11915	115	M67	
11916	183	M100	
11920	126	OBS D9	E9
12802	143	M23	387
12234	173	M14B	
12822	190	OBS C2	C2
13669	125	OBS D8	E8
13705	48	M16C	
13706	50	M17	
13707	44	M54	
13710	128	OBS D1	E1
13711	123	OBS D4	E4
15005	115	M67	
15037	117	M427	
16168	187	OBS A26	A26
17551	184		
17701	129b		
17721	195		NSG 271
17795	129a		
18960	134b		
19382	41		
19935	88		
20341	154		
20731	129a		
22457	114	M78	
22458	118	M154	
22459	160	M326	
22460	120	M571	
23821	21	OBS H3/46	
23822	17b	OBS H3/35	
23823	31a	OBS H3/25	
23824	33	OBS H3/22	
23825	30	OBS H3/40	
23826	32	OBS H3/24	
23827	7	OBS H3/36	
23828	31b	OBS H3/39	
23829	36b	OBS H3/41	
23830	42	OBS H3/34	
23831	8	OBS H3/47	
23832	26b	OBS H3/33	
23833	29b	OBS H3/31	
23834	27	OBS H3/42	
23835	36c	OBS H3/38	
23838	20	OBS H3/8	
23839	25	OBS H3/4	
23840	9	OBS H3/37	
23841	37	OBS H3/21	
23842	40	OBS H3/3	
23843	39	M22A	
23844	26a	OBS H3/20	
23845	22	OBS H3/5	
23882	36a	OBS 19	
23883	35	OBS 45	
25789	158	M50	
26089	187	OBS A26	A26
26115	119	M549	
26441	166	M31	
28470	45		
28471	167	M205	
31354	91	M59	
31355	96	M74	
32072	47	M49	
32073	179	M51	

Appendix: Telescopes & related objects in the inventories of Leiden Observatory (1706-c.1860)

No.	Year of Description	Description
A	**ASTRONOMICAL QUADRANTS & SEXTANTS WITH TELESCOPIC SIGHTS**	
1	**Large wooden quadrant by Blaeu with a finder telescope from a later date**	
	1656	*AC: Quadrant 'staande in het toornken van de Akademie' mag 'aan de asse' voorzien worden van een azimuthale cirkel van 20 duim diameter.*
	1658	*AC: Circle by the late Sneeuwins will be finished by Jan Davidt, for 110 guilders*
	1669	*AC: adjustment of the quadrant with a telescope*
	1682	*AC: quadrant repaired*
	1706	Een quadrant azimuthalis
	1711	*Uffenbach: 'In dem anderen Häusgen gegen über ist noch ein Quadrant, welches derjenige seijn wird, den Vossius De Scientiis Mathematicus C. XXXVI. $ 47 sq. p. 199 sq. so sehr rühmet, und welchen der berühmte Blaeu gemacht haben soll, wiewohl man nirgends keinen Namen darauf finden können, ausser dass auf dem Fuß auf eine Platte von Messing gestochen war: Antonius Hoevenaer fecit Leidae'.*
	1742	Een groote houte quadrant met zijn toebehooren draaijende op een Azimuthale plaat
		De twee glasen van de quadrant op No 2 in kopere buysen *(1761: een glas gebruikt tot het quadrant)*
	1777	*Bugge: [the[separate house with a movable (but leaky) roof, which houses an old fashioned 4 feet quadrant' (with a sketch)*
	1793	Een houten quadrant van 6 1/2 voeten straals met [...] beweeglijken verrekijker; glasen; kruisdraden; visieren; paslood en deszelfs koperen bakje
	1798	Staat vertikaal en kan horizontaal draaije over een Azimuthale plaat...
	1854	Een oud muurquadrant
	1868	Ein hölzerner Quadrant, mit einem Messingenem Rande von 7 Fuss Radius. Dieser Quadrant ist verfertigt von WILHELM BLAEU, und wurde im Jahre 1632 aus dem Nachlass von WILLEBRORD SNELLIUS angekauft. Der Rand dieses Instrumentes ist durch Transversalen unmittelbar in doppelte Minuten getheilt. Er gab Veranlassung zu der Stiftung einer Sternwarte in Leiden im Jahre 1633 und wurde, im Jahre 1669, von VAN MELDER mit einem Fernrohr versehen.
2	**Brass sextant with a finder telescope by Metz**	
	1685	*De Volder requests an instrument 'om de distantie van de sterren te kunnen afmeten'.*
	1706	Een sextans
	1742	Een kopere Sextant met zijn toebehoren *(notitie 1761: 'dit is niet opgezet')*
	1793	Een kopere sextant van omtrend 4 voeten straals, met zijne alidade, houtene voet en kogel, door Coenraad Metz. De rand is verdeelt in graaden en minuten; maar een aangevoegde plaat teekend secunden. De buizen dog zonder glazen en verder toestel liggen in de kas, in een rus kistje.
		Eenig gereedschap tot het sextant behoordende, zie no 70.
	1868	Ein Theil eines Tychonischen Sextanten, im Jahre 1685 angefertigt von C. METZ in Amsterdam. Der Rand dieses Instrumentes, welcher einen Radius von 4 Fuss, ist durch Transversalen unmittelbar in einzelne Minuten getheilt. Es gab im Jahre 1689 Veranlassung zu einem Umbau und einer Vergrösserung der Sternwarte in Leiden.
3	**Brass quadrant with two telescopes by Metz**	
	1742	Een kopere quadrant beneevens zijne kopere voet om ze op te zetten met verder toebehoren en een Eyke kas waar in het quadrant bewaard word.
	1793	Een koperen Quadrant van 2 voeten straals, door C. Metz te Amsterdam, met eenen vasten en eenen beweeglijken verrekijker. de rand verdeeld in graaden, dog door een aangeschroefde wijzer onderscheidende twintigste deelen van een minuut, liggende, nevens zijne schroeven, kopere en ijzere schroefsleutels, schroefbijtels, paslood, in eene afzonderlijke eikene kist".
		Een voet door J. van Musschenbroek gemaakt, tot het kopere quadrant van Metz (zie no 6), met raderwerk en tegenwichten, om in alle richtingen te stellen".
	1868	Ein messinger Azimuthal Quadrant mit einem Radius von 3 (=HJZ verbeterd: 2) Fuss, um das Jahr 1700 verfertigt von C. METZ. Diess Instrument hat ein Schraubenwerk nach HOOKE, zur teilung seines Randes, in kleinere Theile als Grade, in welche er unmittelbar getheilt ist
B	**REFRACTING TELESCOPES & TUBES**	
	1682	*Melder asks for the construction of instruments 'daarop de groote verrekijkers soude moghen rusten'.*
	1706	*Zumbach asks 'tot voortsetting van 't studium astronomium een paal hoog 40 a 50 voeten met zijnen blikken passer en houte goot voor 't gebruk van 't groote telescopium'*

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
	Willem Jzn. Blaeu										6500
	Hendrick Sneeuwins										
	Jan Davidt										
	Hoevenaer										
		1615	1633	1							
	Hoevenaer										
					2						
			1669		33						
							4				
									74		
										A-4	
	Metz	1685	1686								9724
				2							
					1						
							70				
							63				
										A-6	
	Metz	*1705*	1724								9725
					17						
							1 & 6				
	Musschen broek	1724	1724								
										A-7	
			1682								
			1706								

No.	Year of Description	Description
4	**Telescope(s) of 30 feet with a tube made of iron plate and wood**	
	1742	Een blikke buis tot een kijker van 30 voet oud en verroest *(notitie 1761:'dit heb ik laten verwen zo dat dezelve nog van eenige dienst zoude kunnen zijn')*
		Een houte buys en twee dito en stukken tot een kijker van 30 voet
		Twee ijzere raampjes tot de kijker van 30 voet
	1793	drie houtene vierkante buisen zonder toebehoren
		een blikke buis tot verlenging van andere zonder glas
		twee ijsere raampjes voor eenen langen houtenen kijker
5	**Telescope of 25 feet with a tube made of iron plate on a wooden stand**	
	1742	Eenige dito [='een blikke buis tot een kyker] kleinder [dan 30 voet], dog meest buiten staat
		een blikke kijker hout onderlegt van omtrend 25 voeten
	1793	Een lange buis van 25 of 26 voet aan de zolder hangende.
6	**Telescope of approx. 22 Feet with drawtubes**	
	1793	Een dito [buijs], van 22 voet, in een schuivende, als in een koker.
7	**Telescope of approx. 16 Feet with an iron plate tube and a wooden cradle**	
	1742	een dito [een blikke kijker hout onderlegt] ook onderlegt van 16 voeten
	1793	Een vlakke buijs van 15 of 16 voeten met houten onderstel
8	**Telescope of approx. 12 Feet**	
	1706	Een kijker van 12 voet
	1742	een dito [een blikke kijker hout onderlegt] van omtrend 12 voeten
	1793	Een dito [blikke verrekyker], van 13 voet met objectiefglas alleen en houten onderstel. *NB. de glaasen hiertoe lagen te voren bij anderen in het laden tafeltje.*
9	**Helioscope**	
	1682	*AC:'instrument om des sonsvlackte te bestuderen'*
	1742	een bon en kloot en kijker tot helioscope en verder toebehorende *(notitie 1761:'dese heb ik laten verbeteren en een nieuwe kijker daartoe laten maken')*
		Het bord van de Helioscope No 40
		Een stuk van de Helioscope No 40
	1793	een houten vensterste en beweeglijken bol, om door 't insteken van een verrekyker iets in t donker te vertoonen
		Een dito [blikke verrekyker] met 2 glasen gevat in een houten kloot en raampje voor de Chambre Obscure, of Helioscope, met toebehoren en houvast
	1798	[item verwijderd] *disappeared*
10	**Areal telescope from Huygens**	
	1742	eenige stukken tot de machine uit de astrocopia compendiarium van Huygens *(note 1761:'dese leggen op het beneden vertrek')*
		Een blikke buijs *(1761: dese behoort tot de verrekijker van Huygens)*
	1793	eenige stukken tot de astroscopische compendiarium van Huygens
11	**A terrestrial telescope with a parchment tube**	
	1742	Een buijs van papier met glasen
	1793	eene dito [een pergamente landkijker], van 4 leden, 2½ voet met zijne glasen
12	**Incomplete tubes without lenses**	
	1793	Een deel incomplete buisen tot verrekykers zonder glaasen
	1798	[[item verwijderd] / *disappeared*
	1838	*Kaiser:'Kijkers van 40 en vijftig voeten lengte, wier ontzielde ligchamen nog in menigte op de zolders van het Academie-gebouw voorhanden zijn'.*

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
											-
			1682		3						
					18						
					24						
							18				
							24-V-f				
							24-V-e				
											-
			1682		4 & 5						
					19						
							17				
											-
			1682				15				
											-
			1682		20						
							14				
											-
		1683	*1690*	14							
					21						
							12				
											-
			1682								
					22						
					25						
					29						
							2				
							13				
	Huygens										
		1686	*1690*		11						9182
					28						
							61				9183
											-
			<1700		35						
							24-IV-b				
											-
			<1700				24-III				

No.	Year of Description	Description
13	**Telescope with varying magnifications**	
	1743	Een kijker van 6 tot 16 voet met 9 oculairen van 5 tot 14 voeten en 12 oculairen
	1793	Een dito [buijs] met zeildoek bekleed, van 15 voeten in drie stukken
	1798	[[item verwijderd] / *disappeared*
	Some smaller telescopes	
	1743	Eenige kleine kijkers:
14	1793	Een dito [blikke verrekyker], van 10 voet met 2 glasen
15		Een dito [blikke verrekyker], van 8 voet met 2 glasen en een zonglaasje
16		Een dito [blikke verrekyker], van 5 voet met 2 glasen
17		Een blikke verrekyker van 4 ½ voet met zyne 2 glasen
18		een pergamente landkijker, van 5 leden lang, 3 of 4 voet, met zijne glasen.
19	**A telescope by Onderdewijngaard Canzius**	
	1854	Een oude slechte kijker van Onderdewijngaard Canzius.
	1868	Ein altes Fernrohr von ONDERDEWIJNGAARD CANZIUS, mit einer Oeffnung von 32 Linien. [=7.2 cm]
C	**UNMOUNTED OBJECTIVES**	
20	**Object glass made by Hartsoeker for Leiden University in 1688**	
	1706	Een objectiefglas van 50 voet
	1742	een objectiefglas van Hartsoeker van 50 voet focus
	1793	een groot objectiefglas van Hartsoeker ao 1688 van 6 duim diameter 50 voet focus in een blikken doos
	Other object glasses	
21	1706	Nog een [objectiefglas] van 18 voet
22	1742	22 a 23 objectief glasen dog meest alle uitgezonderd 2 a 3 tot kijkers van 4 en 5 voet van geen gebruik *(1761:'maar 12 in een lade gevonden')*
23		Seven objectieven alle in blikke buijsen tot kijkers passende
24		Een doosje met vier gemeene objectieven
25		Drie objectiven; nog vijf objectiven een een doosje met twee sleuteltjes *(1761: NB in plaats van 3 objectiven gevonden 3 oculairen vrij goed onder de objectiven zijn er 3 die tot de Sextans behoren)*
26	1793	8 objectiefglasen van 7½ tot 16 voet brandpunt
27		2 dito [objectiefglazen], die gezegt worden tot het sextant te behoren, doch er niet op passen
28		5 objectief glasen voor korte kijkers
29		een schuifdoos waarin 14 objectif glaasen
30		eene dito waarin 7 betere [objectiefglazen] dito
31	**Huygens objective from 's-Gravesande's estate**	
	1742	Een voorglas van een kijker door DH Huygens gemaakt [van 's-Gravesande]
	1793	een dito [voorstuk] van Huygens van 34 voet brandpunt [van 's-Gravesande]
D	**MOUNTED OCULARS (EYE TUBES)**	
32	1742	Een oculair in een buijsje
33		Vier voorstukken tot een kijker *(notitie 1761:'zonder glasen')*
34	1793	vier blikke oogbuizen tot lange kijkers, elk met een oogglas
35		een blikken oogbuisje met glas kruisdraden & zonglas
36		een pergamente oogbuis met 3 glazen
37		drie oogbuizen van koper blik met houtene schroeven om astronomische kijkers tot landkijkers te maken, zonder glasen
38		vier voorstukken tot astronomische kijkers met glasen

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
											-
		1720	1743			1					
							16				
		1720	1743			4					-
			1743				11				-
			1743				10				-
			1743				9				-
			1743				7				-
			1743				24-IV-a				-
											-
	Canzius		*1800*						31		
										E-12	
											9197
	Hartsoeker	1688	1688	11							
					12						
							32				
			<1706	12							-
			<1742		13						-
			<1742		31						-
			<1742		32						-
			1682		39						-
			<1793				24-IV				-
			<1793				24-IV				-
			<1793				24-IV				-
			<1793				24-V-g				-
			<1793				24-V-h				-
											9190
	Huygens	1683	1742		38						
							24-V-b				
			<1742		37						-
			<1742		23						-
			<1793				c.				-
			<1793				d.				-
			<1793				e.				-
			<1793				f.				-
			<1793				24-V-a				-

No.	Year of Description	Description
39		**drie voorstukken dog sonder glasen**
E	**UNMOUNTED OCULARS**	
40	1706	Oogglazen
	1742	omtrent het zelve getal [= 22 a 23] van oogglasen *(notitie 1761 'dese in zo'n groot een getal niet gevonden')*
41		Tien oculaire en buijsjes tot de 7 objectieven in de voorgaande lade leggende, behorende
42		8 losse oculaire in doosjes *(1761:'hiervan een laten inzetten tot de nieuwe helioscope')*
43	1793	vier stelletjes ieder van 3 oogglazen, tot oogbuizen
44		10 losse oogglazen.
45		7 convexe oogglasen
46		4 concave dito [oogglazen]
F	**UNMOUNTED SUNGLASSES**	
47	1793	eenige gekleurde en ander platte glaasjes
48		6 gekleurde glaasjes van 4 soorten
49		4 platte glaasjes
G	**ACCESSORIES FOR THE REFRACTING TELESCOPES**	
50	**Stands for large telescopes**	
	1682	*AC: instrumenten 'daarop de groote verrekijkers soude moghen rusten'.*
	1742	Een lange paal om kijkers op te halen
		eenige koperen stukken tot (de) paalen behorende
51	**Another large stand with equipment**	
	1706	*AC: een paal hoog 40 a 50 voeten met zijnen blikken passer en houte goot voor 't gebruk van 't groote telescopium*
	1742	twee machines om kijkers te ondersteunen
		twee machines om kijkers op te leggen [9 & 9#]
		De twee gaffels tot de machine No 9 & 9#
	1793	een gaffel om op een hoop support te stellen
		Twee supports met kopere schroefwerk &c, gemonteerd om het agterste van lange kykers te schragen en bestieren.
		een houte support, tot verrekijkers
52	**Various supports for the alignment of a telescope**	
	1793	vijf verscheidene supports, om een verrekijker op te leggen, kunnende uitgeschoven en verhoogt worden.
53	**A parallactic stand according to Cassini**	
	1743	Een machine paralactique
	1793	Een machine parallellica, om een hemelsch voorwerp bestendig in eenen opgelegden kijker te houden. met verdeelcirkel en halve cirkel.
	1838	*Kaiser:'quadrant [van Garama] … voor dien tijd zeer goed bewerkt, … [tot 1818] opgesteld in een torentje op het vlak'*
	1868	Ein sehr rohes Cassinianisches Aequatorial mit einem hölzernen Fussgestell, woran das Fernrohr fehlt. Im Jahre 1743 von der Wittwe GARAMA geschenkt.
H	**EQUAL ALTITUDE INSTRUMENTS**	
54	**Transit telescope by Sisson**	
	1742	een maridionale telescope en steenen om in te hangen met zijne toebehoren in een kas. *(notitie 'dese is geplaatst op de benedenste kamer ten zuiden')*
	1777	*Bugge:'it was of rather oldfashioned construction, dating back from the time of 's Gravesande'.*
	1793	Een kopere meridiaankijker van omtrent 3 voet, door J. Sisson te Londen, [...] liggende de kijker met zijnen waterpas in een eiken kist. De koperen pannen tot deszelfs liggende as, zijn met haar schroefwerk aan twee steenen kolommen gehecht, by t zuiden venster, tot welker bedekking een houten kapje dient.

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
			<1793				24-V-c				-
			1700	15							-
			1700		14						-
			1725		34						-
			<1742		36						-
			<1793				24-IV				-
			<1793				24-IV				-
			<1793				24-IV				-
			<1793				24-IV				-
			<1793				24-I				-
			<1793				24-IV				-
			<1793				24-IV				-
											-
			1682								
					5						
					6						
											-
			1706								
					7 & 8						
					9 & 10						
					26 & 27						
							24-V-d				
							20				
							3				
			1700				19				-
											-
		1720	1743			2					
							21				
										A-12	
											9621
	J. Sisson	1739	1740		16						
							27				

No.	Year of Description	Description
	1854	Het passage instrument van Sisson van hetwelk Lulofs zich bij zijn onderzoeking bediende.
	1868	Ein Mittagrohr mit einer Oeffnung von 12 Linien und einer Brennweite von 2 ½ Fuss, im Jahre 1740 von Sisson in London geliefert. Diess Instrument ist vollständig mit den Kalkstein- blöcken, worin die Zapfenlager eingegossen sind, aufbewahrt.
55	**Equal altitude telescope by Paauw**	
	1768	AC: request by Lulofs to produce under his supervision an instrument for equal altitudes, necessary for the proper observation of the Venus-transit of June 1769.
	1777	*Bugge: 'besides the instrument [of Sisson], placed on the column AB was an equal altitude instrument, like the one described in Smith Optics. It is rather good en made by Paauw'. (B. gives a sketch of the instrument)*
	1793	Een kopere twee voets verrekijker, horizontaal draaiende op zijne ijzere as, in 't focus voorzien van 5 horizontale draaden, om de gelijke hoogtens van zon of sterren voor en na derzelver doorgang door den meridiaan waar te nemen; liggende met zijn waterpas in een houten kistje. Hierbij behoort een houten onderstel met een koperen steeltje dog welk laatste om digter bij t venster te dienen nu gehegt is aan een der steenen colommen van den meridiaankijker. Dit gereedschap is verkreegen a° 1770.
	1854	Een oude toestel voor het waarnemen van gelijke hoogten.
	1868	Ein Instrument zur Zeitbestimmung durch gleiche höhen; im Jahre 1768 von LULOFS bestellt. Der Namen des Verfertigürs ist nicht angedeutet.
1	**REFLECTING TELESCOPES**	
56	**Large newtonian reflector made by George Hearne**	
	1742	een Newtoniaansche reflector van 8 voet leggende op zijn voet beneevens een kasje waar in de glase en oculaire spiegels leggen beneevens de micrometer´.
	1793	Een Newtoniaansche kijker of telescoop van George Hearne te London *[...The 1793-inventory lists several accessories]*
	1854	Een oude en onbruikbare spiegeltelescoop van Nearne, zijnde het werktuig met het welk Lulofs in 1759 de komeet van Halley heeft waargenomen.
	1868	Ein Spiegelteleskop mit einem hölzernen Rohre von 7 Fuss Länge und einem hölzernen Fussgestell, im Jahre 1736 von HEARNE in London geliefert. Dies Instrument ist mit seinem Faden- mikrometer unter Bradley´s Aufsicht verfertigt. Im Jahre 1750 erhielt es von Lulofs einen von VAN DER BILDT verfertigten Spiegel und im Jahre 1862 hat Herr C.A. STEINHEIL dazu einen kugelförmigen versilberten Glasspiegel geliefert.
57	**Small gregorian telescope**	
	1761	(2) Een gregoriaans verrekijkertje in een houten doosje *[afkomstig van 's Gravesande: 1742: 'Een gregoriaans verrekijkertje van 6 duijm']*
	1793	een gregoriaansch verrekijkertje van 6 duijm
58	**Large gregorian telescope by Van de Wal**	
	1793	een gregoriaans Telescoop door den heer Jac. Van de Wal te Amsterdam, aan 's Lands universiteit gelegateerd. [...]
		de spiegels en oogbuizen tot de groote gregoriaansche telescoop, no 29
	1854	Een oude onbruikbare koperen groote spiegeltelescoop van Van de Wal
	1868	Ein Spiegelteleskop mit einem messingenen Rohre von 9 Fuss Länge, einer messingenen Säule, einem getheilten verticalen Quadranten und einem getheilten horizontalen Halbkreis. Dies Instrument ruht auf einem starken eisernen Dreifuss und ist für seine Zeit sehr schön gearbeitet. Es ist verfertigt vom Herrn J. VAN DE WAL und wurde von ihm im Jahre 1782 der Leidner Universität vermacht.
59	**Newtonian telescope by Rienks**	
	1812	De newtoniaanse telescoop met een micrometer *[brought from the closed Franeker University]*
	1816	AC, 4 July: Large reflecting telescope, worth 1000 guilders, like the one given to King Lodewijk Napoleon, on loan since his departure from Franeker. *[Having an aperture of 8 inches and a focal distance of 8 feet]*
	1821	*Returned to Franeker Athenaeum*
60	**Gregorian telescope**	
	1812	De gregoriaanse telescoop *[brought from the closed Franeker University]*
	1821	*Returned to Franeker Athenaeum*
61	**Large 13-foot reflecting telescope by Roelofs & Rienks**	
	1817	*Grant from King William to produce two large telescopes by Roelofs & Rienks*
	1821	*AC: Ekama requests a large telescope made by Roelofs and Rienks*
		Large reflecting telescope of 13 feet focus with a mirror of 55 cm diameter and a tube of mahogany, costing 10,000 guilders

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
									78		
										A-11	
											-
	Paauw	1769	1770								
							28				
									82		
										A-18	
											9620
	Hearne		1736		15						
							7				
									35		
										A-10	
											-
		1736	1742								
							49				
											9651
	Bley / Steitz	1742	1786				29				
							62				
									36		
										A-19	
											-
	Rienks	*1810*	1812					3			
											-
	vd Bildt?	*1790*	1812					4			
											-
	Roelofs & Rienks	1821	1824								

No.	Year of Description	Description
	1838	*Kaiser [over 1818]: 'Een reusachtig gevaarte dat de naam van telescoop werd gegeven, was bestemd het pronkstuk der Leidsche Hoogeschool te worden'…*
	1846	*AC: Demolished at the request of F.Kaiser; sold for scrap 1850*
62	**4-Foot reflecting telescope by Roelofs & Rienks**	
	1818	*Kaiser in 1838 [over 1818]: 'Er werd nog een tweeden teleskoop van denzelfden maker, aangekocht'.*
	1854	Een houten, volstrekt onbeschadigde, onbruikbare vier voets spiegelteleskoop van Rienks.
	1868	Ein Teleskop von RIENKS, mit einem Spiegel, dessen Oeffnung 7 Zoll und Brennweite 4 Fuss betragt, auf einem hölzernen Fuss in der Form eines Tisches. Ein sehr schlechtes Instrument.
	1922	*Demolished at the request of De Sitter*
63	**4-Foot newtonian telescope probably by Scarlett**	
	1854	Een kleine houten Newtoniaansche telescoop [bought by Kaiser in 1838]
	1868	Ein altes, aber gut gearbeitetes und gut erhaltene Spiegelteleskop von 5 Zoll Oeffnung und 4 Fuss länge, mit einem Rohre und einem Fuss von Mahagonyholz. Dieses Teleskop ist verfertigt von SCARLET in London und war früher ein Eigenthum MUSSCHENBROEK's, welcher es in seinem Lehrbuche der Physik (Seite 630) sorgfältig beschrieben und abgebildet hat. Im Jahre 1838 habe ich dieses Teleskop, auf einer Auction, für eine Kleinigkeit, angekauft.
64	**2-Foot gregorian telescope probably by Scarlett**	
	1868	Ein altes aber ziemlich gutes Spiegelteleskoop von zwei Fuss länge, auf einem hölzernen Fussgestell. Der Verfertiger und der Ursprung dieses Teleskopes sind unbekannt.
65	**Small newtonian telescope probably by Rienks**	
	1868	Zwei kleine und unbedeutende Spiegelteleskope von RIENKS.
	1931	Newtonian telescope, probably by Rienks
66	**Gregorian telescope probably by Dollond**	
	1931	Gregorian telescope with heliometer objective
J	**ACHROMATIC TELESCOPES**	
	1768	*AC: permission granted, but not effected by the sudden death of Lulofs*
	1775	*AC: Renewal of the request for a Gregorian reflector and an achromatic telescope*
67	1835	*Achromatic lens telescope, owned by J.B. Stoop, but used by Kaiser in 1835 for the observation of Halley's Comet*
K	**PRECISION INSTRUMENTS WITH TELESCOPIC SIGHTS**	
68	**Repetition circle with two telescopes by Lenoir**	
	1816	*AC: Ekama requests a 'repetition circle of Lenoir'*
	1819	*AC, 17 March: permission to pay Lenoir the amount of 2180 guilders*
	1838	*Kaiser: 'Er werd nog … een zogenaamde repetitie cirkel van groote waarde , aangekocht'… [found unusable 12 years later]*
	1854	Een verminkte repetitie-cirkel van Lenoir
	1868	Ein Repetitionskreis von LENOIR, mit einem Kreise von 2 Fuss Durchmesser. Das Objectiv von einem der beiden Ferrnrohre ist zerbrochen. Der Rand des Kreises ist verbogen und die Theilung ist beschädigt. Das zweite Fernrohr dieses Instrumentes wird, als Hülfsfernrohr, beim 7-zölligen Refractor benütst.
69	**Equatorial telescope by De Mégnié**	
	1812	Equatorial made by De Mégnié
	1821	*AC: Returned to Franeker Athenaeum*
70	**Universal equatorial by Hulst van Keulen**	
	1868	Ein Universal-Aequatorial mit Kreisen von 5 Zoll durchmesser von G. HULST VAN KEULEN.
71	**Theodolite by Troughton & Simms, transformed into a transit telescope**	
	1854	Een kleine algemeene Theodoliet van Troughton en Simms. *N.B. De kijker van dit werktuig is op een bijzonder voetje tot een klein draagbaar passage-instrument ingericht.*

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
											-
	Rienks	*1826*	1827						37		
										E-18	
											9699
	Scarlett?	1733	1838						38		
										E-21	
											9620
	Scarlett?	1736	<1868							E-20	
	Rienks	1800	<1868							E-19	
	Rienks?	1800									8147
	Dollond	1750	1890							A-16	8159
	Utzschneider und Fraunhofer	*1820*	1835								3469
											26089
	Lenoir	*1818*	1819								
									81		
										A-26	
	Megnie	1780	1812					2			10671
	Hulst van Keulen	*1795*	*1795*							A-25	6161
	Troughton & Simms		1833						6		8199

No.	Year of Description	Description
	1868	Ein Theodolit und Nivellir-Maschine von TROUGHTON & SIMMS mit zwei Fernrohren von 13 Linien Oeffnung und einem horizontal-Kreise von 7 Zoll Durchmesser. Diess Instrument wurde im Jahre 1833 von der Regierung an die Sternwarte geschickt. Das obere Fernrohr dieses Instrumentes hat ein, von Herrn WENCKEBACH verfertigtes, eignes Fussgestell, ein Gefass mit Prisma, welches sich vor dem Objectiv anbringen lässt und ein Niveau. Durch diese Hülfs-Apparate lässt sich das Fernrohr in ein Passagen-Instrument, nach STEINHEIL's Construction, umwandeln.
L	**TELESCOPIC INSTRUMENTS BOUGHT BY KAISER BETWEEN 1838 AND 1860**	
72	**Telescope by the optical institute, Munich**	
	1854	Een kijker uit het Optisch Instituut te München met een voorwerpsglas van 6 Par[ijse] duimen op een parallaktischen voet met uurwerk (?), één draden-, twee cirkel-mikromeeters en oogbuizen, waaronder twee achromatische van Durac (?) en een orthoscopisch van Kellner
		Bij dezen kijker behooren eene … machine voor de rectificatie van het objectief, twee microskopen met standaard voor het onderzoek van den mikromeeter, eene observatiestoel en twee observatie-trappen.
	1868	Ein Refractor aus dem optischen Institute von G. MERZ in München, im Jahre 1838 geliefert, mit einer Oeffnung von 6 Zoll und einer Brennweite von 8 Fuss. Dieser Refractor ist parallatisch montirt, hat eine Fraunhofer'sche Centrifugal-Uhr und ruht auf dem von FRAUNHOFER angewandten hölzernen Fussgestelle.
		Zu diesem Instrumente gehören,
		a. ausser den erforderlichen Ocularen,
		b. ein einfaches und ein doppeltes Ring-Mikrometer,
		c. ein Fraunhofer'sches Faden-Mikrometer und
		d. ein Beobachtungs-Stuhl.
	2004	Het instrument, waarvoor deze koepel gebouwd is, is de 6-inch refractor van MERZ uit1838.
		De opening bedraagt 150 mm en de brandpuntsafstand is 240 cm. De kijker, met een houten kijkerbuis, heeft een Duitse opstelling en heeft oorspronkelijk gestaan op het Academie-gebouw.
73	**Universal instrument by the optical & mechanical institutes, Munich**	
	1854	Een universeel-instrument van Ertel met …-kijker van 15 lijnen opening in cirkels met middellijnen van 7 ½ en 9 ½ duimen. Aflezing door noniën. …. inrichting. Overdekt met een … kastje.
	1868	Ein Universal-Instrument von ERTEL, mit einem gebrochenen Fernrohre von 15 Linien Oeffnung und Kreisen von 7,5 und 9,5 Zoll Durchmesser. Durch vier Nonien werden am Vertical-Kreise unmittelbar 10 Secunden und am Horizontal-Kreise 4 Secunden abgelesen. Diess Instrument wurde im Jahre 1838 geliefert.
	1931	*Universaal instrument met 'gebroken kijker'*
74	**Portable universal instrument by the optical & mechanical institutes, Munich**	
	1854	Een draagbaar passage-instrument van Ertel met eenen kijker van 19 lijnen opening. Overdekt met een …-kastje.
	1868	Ein, im Jahre 1838 geliefertes, tragbares Passagen-Instrument von ERTEL, mit einem gebrochenen Fernrohre von 19 Linien Oeffnung und einem Horizontal-Kreise von einem Fuss Durchmesser, durch vier Nonien, von 10 zu 10 Secunden getheilt.
75	**Dialytic telescope by Plössl**	
	1854	Een dialytische kijker van Plössl met een opening van 36 lijnen.
	1868	Ein dialytisches Fernrohr von PLÖSSL, mit einer Oeffnung von 36 Linien auf einem messingenen Fuss mit feiner Bewegung. Diess Instrument, welches für einen Astronomen in Leipzig verfertigt und im Jahre 1838 angekauft wurde, ist nicht besonders gut.
76	**Dialytic telescope by Plössl**	
	1854	Een dialytische kijker van Plössl met eene opening van [ ] lijnen.
	1868	Ein sehr schönes von PLÖSSL, für die Leidner Sternwarte verfertigtes, dialytisches Fernrohr, mit einer Oeffnung von 26 Linien, auf einem Fusse, ohne feine Bewegung.
77	**Naval telescope by Plössl**	
	1854	Een marine kijker van Plössl met eene opening van 23 lijnen.
	1868	Ein Marine-Fernrohr von PLÖSSL, mit einer Oeffnung von 23 Linien.
78	**Comet searcher by the optical institute, Munich**	
	1854	Een kometenzoeker uit het Optisch Instituut te München met eene opening van 43 lijnen, met een prisma en orthoscopisch oculair van Kellner, op eenen voet naar de inrigting van Kaiser.

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
										C-5	
	Optical Institute, Munich		1838						1		Still in use
									2		
	Merz									B-3	
	Ertel		1838						4		
	Ertel									C-2	
	Utzschneider & Fraunhofer										12822
	Ertel		1838						5		8200
										C-3	
	Plössl		1838						25		13711
										E-4	
	Plössl		*1845*						26		-
										E-5	
	Plössl		*1845*						30		9452
										E-10	
	Utzschneider & Fraunhofer / Kellner		*1840*						23		9965

No.	Year of Description	Description
	1868	Ein Cometen-Sucher von G. MERZ, mit einer Oeffnung von 43 Linien und mehrere Oculare, worunter ein merkwürdiges orthoscopisches Cometen-Ocular von KELLNER. Ein grosses Glasprisma von MERZ, unmittelbar hinter dem Oculare, macht die Gesichtslinie horizontal. Diess Rohr ruht auf einem, in Leiden verfertigten, eisernen Fussgestell von besondere Construction, wodurch sein Gebrauch zur Aufsuchung von Cometen ungemein erleichtert wird.
79	**Comet searcher by the optical institute, Munich**	
	1854	Een kometenzoeker uit het Optisch Instituut te München met eene opening van 34 lijnen, op eenen eenvoudigen parallactischen voet.
		Een tabouret (?) bij den kometenzoeker
	1868	Ein Cometen-Sucher von MERZ, mit einer Oeffnung von 34 Linien, auf einem in Leiden angefertigten parallatischen Fussgestell.
80	**Telescope by the optical institute, Munich**	
	1854	Een kijker uit het Optisch Instituut te München met eene opening van 27 lijnen, op een voet van Lerebours.
	1868	Ein Fernrohr von MERZ, mit einer Oeffnung von 27 Linien. Diess Fernrohr hat einen Sucher von WENCKBACH und einen Fuss eigner Construction von LEREBOURS.
	1931	Kijker met diameter van 55-65 mm, met zoeker door Utzschneider & Fraunhofer
81	**Universal instrument by Repsold**	
	1854	Een universeel-instrument van G. & A. Repshold met eenen kijker van 21 lijnen opening in ...cirkels met middellijnen van 10 en 12 duimen, mikroskopische aflezing en ... –toestel. Overdekt met een stoffe kastje.
	1868	Ein im Jahre 1853 geliefertes, Universal-Instrument von G. & A. REPSOLT, mit einem gebrochenen Fernrohre von 21 Linien Oeffnung und Kreisen von 10 und 12 Zoll Durchmesser. Dies Instrument ist zur leichteren Umlegung des oberen Theiles eingerichtet und hat für jeden Kreis zwei Mikrometer-Mikroskope, welche die unmittelbare Ahlesung der einzelnen Secunden gestatten.
82	**Small universal instrument by Pistor & Martins**	
	1868	Ein, im Jahre 1858 geliefertes, Universal-Instrument von PISTOR & MARTINS, mit einem Fernrohre am Ende der Achse von 12 Linien Oefflung. Die Kreise haben Durchmesser von 5 Zoll, und jeder Kreis hat zwei Ablesungs-Mikrometer-Mikroskope. Zu diesem Instrumente gehört ein starkes hölzernes Fussgestell.
	1931	Pistor & Martins, Berlin, no 990
83	**Two artificial horizons by Dollond**	
	1854	Twee artificiëele horizonten met glazen kappen van Dollond
	1868	Zwei künstliche Quecksilber- und Oel-Horizonte mit Glasplatten bedeckt von DOLLOND.
84	**Two artificial horizons by Schonau**	
	1854	Twee kwikzilver-horizonten naar Schöndee (?) met kappen naar de inrichting van Kaiser.
	1868	Drei SCHÖNAU'sche Quecksilber-Horizonte besonderer Einrichtung.
	1931	Kwikhorizon
85	**A brass stand for various reflection instruments**	
	1854	Een koperen voet voor verschillende reflectie-werktuigen.
	1868	Ein messingenes Fussgestell, zur Aufnahme eines beliebigen Reflextions-Instrumentes.
86	**A telescope by Molteni**	
	1854	Een kijker van Molteni met een opening van 34 lijnen.
	1868	Ein Fernrohr von MOLTENI, mit einer Oeffnung von 34 Linien, auf einem messingenen Fuss ohne feine Bewegung. Das Objectiv ist schlecht. Herr G.A. STEINHEIL hat zu diesem Fernrohre sein vortreffliches Objectiv no. 378 geliefert.
87	**A telescope by Molteni**	
	1854	Een kijker van Molteni met een opening van 27 lijnen op een voetje van Wenckebach.
	1868	Ein Fernrohr von MOLTENI, mit einer Oeffnung von 27 Linien, auf einem messingenen Fuss von WENCKEBACH
88	**A telescope by Molteni**	
	1854	Een kijker van Molteni met open. van [ ] lijnen.
	1868	Zwei kleinere Zugfernrohre von MOLTENI, mit astronomischen Oculare, auf dem von mir für Dilettanten empfohlenen hölzernen Fusse.

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
	Merz [Fraunhofer] / Kellner									E-2	
	Optisch Instituut		*1840*						24		-
									88		-
	Merz									E-3	
	Optical Inst. Munich		*1840*						27		3470
	Merz / Wencke bach									E-6	
	Utzschneider & Fraun-hofer										
	Repsold		1853						3		10680
										C-1	
	Pistor & Martins		1858							C-4	5917
	Dollond		?						20		-
										D-17	
			?						21		
										D-18	
											14392
			?						22		0
										D-19	
	Molteni		*1853*						28		13669
	Molteni / Steinheil									E-8	
	Molteni		*1853*						29		11920
										E-9	
	Molteni		*1853*						32		10503
										E-17	

No.	Year of Description	Description
89	**A telescope by Steinheil**	
	1868	Eine im Jahre 1856 von G.A. STEINHEIL gelieferten Fernrohr, mit einem Objective von 4 Zoll Oeffnung und 9 Fuss Brennweite, welches du secundäre Spectrum vollkommen aufhebt. Zu diesem Fernrohre gehört ein eisernes Fussgestell, welches sich an die verschiedenen Fenster des grossen Saales einsetzen lässt und auf dem das Rohr, mittelst schiefer Stangen, welche sich durch ein Triebwerk verlängeren und verkürzen lassen, eine feine Bewegung erhält. Zu diesem Fernrohre gehört auch eine lange Achse, womit es sich parallatisch aufstellen lässt.
90	**A telescope by Steinheil**	
	1868	Ein Fernrohr von G.A. STEINHEIL, mit einer Oeffnung von 34 Linien, auf einem schönen Fussgestell von P.J. KIPP & SÖHNE in Delft. Das Objectiv dieses Fernrohres, *Steinheil* n°. 756, ist sehr merkwürdig, indem es, im Jahre 1858, unter den zahlreichen von Hernn STEINHEIL, mit seinem empfindlichen Apparat untersuchten Objectiven, das einzige war, dessen Glasart sich gänzlich fehlerfrei zeigte.
91	**A small telescope by Woerle**	
	1868	Ein Zugfernrohr von WOERLE, mit einer Oeffnung von 24 Linien.
92	**An orthoscopic telescope by Kellner**	
	1854	Een orthoscopische kijker van Kellner met opening van [ ] lijnen.
	1868	Ein kleines Zugfernrohr von KELLNER, mit dessen orthoscopischen Ocular.
93	**A small telescope by Steinheil**	
	1868	Ein Zugfernrohr von STEINHEIL mit dessen achromatischen Ocular.
94	**A small telescope by Merz**	
	1854	Een kijker van Merz met open. van [ ] lijnen.
	1868	Ein kleines Zugfernrohr von MERZ.
95	**A small telescope by Steinheil**	
	1868	Ein Handsucher von STEINHEIL.
96	**A dipleidoscope with a telescope by Plössl**	
	1868	Ein Dipleidoskoop nach DENT von PLÖSSL, mit einem Fernrohre
97	**A transit prism by Lerebours with a telescope**	
	1868	Ein Passagen-Prisma von LEREBOURS, mit einem Fernrohre.
98	**A small telescope by Merz with two prisms**	
	1868	Ein kleines Fernrohr mit zwei Prismen von MERZ, zu einem kleinen Prismen-Kreis nach meiner Construction.
M	**MISCELLANEOUS**	
99	1742	Een doos met blindingen
100	1793	eene schuifdoos met blindingen en ringen
101		Agt of negen stokken en 2 blikke buijzen
102		Twee trappen zitstoeltjes, eenige banken, een ladder.
103	1854	87. Vijf houten observatiestoelen.
104	1868	Zwei hölzerne Dreifüsse, zur Aufstellung kleinerer Fernrohre.

	Instrument Maker	Estimated date of production	Date of arrival at OBS (estimated dates in italics)	1706	1742	1743 Gift Garama	1793	1812 from Franeker	1854	1868	Boerhaave no.
	Steinheil		1856							E-1	13710
	Steinheil		1858							E-7	-
	Woerle		?							E-11	-
	Kellner		*1850*						34		-
	Kellner									E-13	
	Steinheil		*1855*							E-14.	-
	Merz		*1850*						33		-
	Merz									E-15.	
	Steinheil		*1855*							E-16.	-
	Plossl		*1855*							K-1	-
	Lerebours		?							K-2	-
	Merz		*1840*							K-6	-
					30						?
							24-V-i				?
							73				?
							22				?
									87		?
										K-11	?

Colophon

Publishers
Museum Boerhaave, Leiden

Editor
Hans Hooijmaijers

Design and Layout
2D3D, The Hague

Photography
Tom Haartsen, Ouderkerk a/d Amstel

Printing
Drukkerij Rosbeek b.v., Nuth

ISBN 90 6292 164 7

Communication 320