I. ASTRONOMICAL QUADRANTS & SEXTANTS WITH TELESCOPIC SIGHTINGS

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

1. 6500
Large wooden quadrant with a telescope
c. 1620 (quadrant); 1669 (telescope)
Length 211, Ø 5
Unsigned but made by Willem Jansz. (Blaeu)
Provenance: Leiden Observatory, 1633-1978

In 1632 the curators of Leiden University paid the sum of 125 guilders to professor Golius, 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 around 1620. During its stay at the Observatory the quadrant was adapted a few times by other instrument-makers. The first alteration was made in 1656, when a revolving plate was added to the quadrant. This azimuthally circle of 20 inches was ordered from the Leiden instrument-maker Hendrick Sneewins. However he died before the work was finished and eventually the circle was 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 sighting of the quadrant was replaced by a telescope, of which the large metal tube still is in place. This large tube is made of (red) copper, painted black, with two brass parts (length 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 Volders' instrument-maker.
Finally in 1743 the acting professor Johan Lulofs ordered two new micrometers for the quadrant, after which he fixed the position of 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 went obsolete as an 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 with 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 requested to the university curators an instrument 'to measure the distances of the stars'. This concerned this large sextant of 4 feet, which was ordered by 'an able workman in Amsterdam'. The instrument required the sum of 1050 guilders and was made by the instrument maker Coenraad Metz. This 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 missing now. 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
Length tube 74, Ø 30
Signed: Metz Fecit Amstelodami
Provenance: Leiden Observatory, 1724-1931

This 'two-feet' 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, the delivery of the instrument was delayed for some twenty years. In February 1724 W.J. 's-Gravesande, then professor of astronomy, informed the university's curators the arrival from Amsterdam of the 'astronomical quadrant, that 'so ingeniously' had been made at the time of Prof De Volder, but which instrument never was 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 performed. Probably this remark refers to the (now lacking) 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-inventory of the Leiden Observatory there were two telescopes attached to this quadrant: a fixed one and a movable one. Only the movable telescope remained. It has two brass dust caps on both ends. 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 which allow a reading into minutes. The usage of a worm gear with pointer – invented by Hooke – prevails a still more precise reading until 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, no. 1 & 6; 1868, A-7

II. EARLY ASTRONOMICAL TELESCOPES AND UNMOUNTED LENSES

The old inventories of Leiden Observatory reveal that the early telescopes were assembled at the spot, every time they were used. Various glasses were installed in drawtubes, some made of cardboard, and others made of iron plate. None of these 17th century telescope tubes have survived, the last testimony of their existence being given in 1838 by F. Kaiser 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 at the Observatory's attic'.
Several telescopic lenses however did survive, a few actually being used at Leiden Observatory, others – like most of the Huygens-glasses – being collected at a later date for reasons of historic 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 which 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, only having the minor disadvantage of placing the image upside down.

A. THE HUYGENS-COLLECTION

A very special collection in Museum Boerhaave is the collection of astronomical glasses made by the natural philosopher Christiaan Huygens (1629-1695) and his brother Constantijn (1628-1697). In 1654 the two became interested in grinding lenses. The year before they had ordered a few telescopes, for instance at a certain 'Master Paulus' in the Dutch city of Arnhem. But having obtained some practical information from other opticians, such as Caspar Calthoff at 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 of this discovery, now being preserved in the Utrecht University Museum. Two other lenses from this early period are in the Boerhaave collection.
A second, more prolific period of telescope making started in 1681, after Christiaan's return to The Hague. In the years between 1682 and 1687 the brothers grinded more than forty object glasses. The largest part of this collection, containing19 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 policing process, most glasses can be dated very precisely.
With only a few exceptions the Huygens-brothers kept all telescopic glasses produced in their lifetimes for themselves. In 1691 Constantijn presented to the Royal Society in London one of his 122-feet object glasses. 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 sun of Lodewijk, the youngest of the three Huygens-brothers, made up an inventory of all telescopic objects still present in the family. Shortly afterwards being followed by a draft-auction catalogue made up by the instrument maker Jan van Musschenbroek. Although this presumed auction never was 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 intermediated with the London sale. All other telescopic objects remained in the Huygens family until 30 September 1754, when the entire collection was put up for auction, of which an annotated printed catalogue has been preserved. Nineteen glasses, the 17-feet telescope and the planetarium were bought by Suzanna Louise Van Wassenaer-Huygens, the only daughter of Constantijn Lzn Huygens. She also had inherited Christiaans' estate 'Hofwijk' at Voorburg. After Suzanna's death her assets were auctioned in 1786. At that occasion one of Suzanna's heirs, Alexandre Jerome Royer (1741-1809), bought nine of her object glasses. Together with some other lenses which probably were bought at the 1754-auction by father Jean Royer (d. 1783), he bequeathed the Huygens-collection at 4 April 1809 to Leiden University, together with some other Huygens-memorabilia, coming from his brother, the *antiquarian-avant-la lettre* Jean Theodore Royer (1737-1807).

In Leiden the Huygens-lenses were stored in the Physical cabinet, in a specially made cupboard. Here these object were studied for the first time as historical relicts: in 1837 by Pieter Johannes Uylenbroek, in 1846 by Frederik Kaiser, in 1867 by Harting and in 1884 by Oudemans. In 1876 most Huygens glasses and the Huygens-telescope were presented in 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 Physical Laboratory to the Observatory, to be kept in the director's room with the 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 presented at an exhibition at Leiden Observatory, in commemoration of the 300 year celebration 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*. Here the collection was catalogued in 1949 by its first director, C.A. Crommelin. In 1995 all available Huygens glasses were intensively studied by Anne van Helden & Rob van Gent, measuring all kind of optical parameters. In comparison they could identify with a high degree of certainty, which glasses which were grinded 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 at 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	*Catalogue Crommelin 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. Object glass of 10 feet 8 inches 9185
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^o ~~44~~ 42 | Chrisst Huijgens'*
At the scale: *'16'*
B 44, C 42, H 3-16/27

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

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

B. Ocular glass 9184
1656
w 0.6, Ø 3.5
Signed on lens: *'Huygens oculair [po]ur [10] p 8 [p] 1656'*

Cover sheet: *'Ch. Huygens | 1656.'*
At the scale: *'21'*

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 with his own telescopes. In this letter he also gave a drawing of the tripod support he has made for these telescopes. In 1656 Huygens made several telescope glasses for a 12 feet-and a 23-feet telescope, for instance for Ismael Boulliau and R. Paget.

Biconvex lens made of whitish glass with a measured focal distance of 5.6 centimeter, which is about 2.1 Rhyneland inches. According to Huygens' 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
Length between 129.5 and 530, Ø 10
Signed at 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, H2/H3-17,28,29,30

Sole remaining complete telescope of 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 at 'Master Dirck', living in The Hague.
In March 1683 Constantijn Huygens tested the telescope in the village of Dieren, by observing the clockwork at the tower of the neighbouring cities of Deventer and Zutphen. After having a few accidents with the original drawtube (having a length of 13 feet and 3 ¾ inches, or 4.2 meter), Constantijn asked his brother to order new, somewhat longer and stronger, iron-plate drawtubes at 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 – now missing - wooden tripod stand for the instrument.

The provenance of this telescope is somewhat puzzling. As in 1837 the early Huygens-scholar Uylenbroek had found this Huygens-telescope between the 'vast bulk of obsolete astronomical apparatus lying together in utter despair' at the attic of Leiden Observatory, the astronomer Kaiser supposed in 1846 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-feet long Huygens-telescope is not mentioned in any of the 18th century inventories of the observatory, Kaisers' statement must be

doubted. Indeed, the 1754-auction sale catalogue of the Huygens relicts 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 in 1786 by her cousin A.J. Royer.
In conclusion, it is most probable that the telescope did enter the university as a Royer-item, being transported in about 1810 to the Observatory as the sole object still useful for astronomical observations. In 1846 for instance, Kaiser used the Huygens-telescope intensively for astronomical observations, being surprised of its very 'favourable' quality, compared to other old telescopes.

The instrument consists of five iron plated draw tubes, 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, hence the Huygens-brothers called such an instrument a 'campanine'.

The biconvex object lens (w 0.37, Ø 6.7) is made by Christiaan Huygens, having a contemporary given focal distance of 12 feet or 3.77 meter, having a measured focal distance of 3.95 meter. The ocular glass (w 0.56, Ø 3.8) and both 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); both 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; Physical 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 (or 4.1 meter), having a measured focal distance of about 4.1 meter. Of the inscription on the lens only the focal distance is in the handwriting of Christiaan Huygens. In 1754 the glass was sold for 18 ½ 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 at the estate 'Frankendaal' at 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 both lenses were bought by the physical department of Felix Meritis. 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*. After the dissolution of the society most of its instruments were given to the University of Amsterdam. The eye glass is missing now.

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

7. 23827
Ocular glass for a telescope of c. 20 feet
c. 1682-1687
w 0.5, Ø 3.3
Lens: *Unsigned, but probably made by 'Meester Dirk' [van der Hoeven]*
Cover sheet: *'N° [~~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'*
At the scale: *'36'*
Provenance: *Huygens family 1656-1786; A.J. Royer, 1786-1809; Leiden University 1809-1931*

Biconvex lens made of pinkish glass with a contemporary given focal distance of 2.25 inches (or 5.9 cm), having a measured focal distance of about 6.1 cm. According to Huygens' table of optimal object/eyepiece combinations, the measured focal distance implies that this ocular was suited for an object glass of c. 18 feet.

8. 23831
Ocular glass for a telescope of c. 21 feet
c. 1682-1687
w 0.5, Ø 3.5
Unsigned, but probably made by 'Meester Dirk' [van der Hoeven]
At the scale: '47'
Provenance: Huygens family 1656-1786; A.J. Royer, 1786-1809; Leiden University 1809-1931

Biconvex lens made of greenish glass with a measured focal distance of 6.5 centimeter, which is about 2.5 Rhyneland inches. According to Huygens' table of optimal object/eyepiece combinations, the measured focal distance implies that this ocular was suited 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
c. 1682-1687
w 0.6, Ø 3.5
Lens: *Unsigned, but probably made by 'Meester Dirk' [van der Hoeven]*
Cover sheet: *'N° 72 | omtrent 3 duym | Focus | 2½ Duym Brantpunt | N° ~~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'*
At the scale: *'37'*
At the ring: *'1660'*
Provenance: *Huygens family 1656-1786; A.J. Royer, 1786-1809; Leiden University 1809-1931*

Biconvex lens made of blue-ish glass with a contemporary given focal distance of 2.5 inches (6,5 cm), having a measured focal distance of about 6.6 cm. According to the cover sheet this objective was fitted to an object glass of 25 feet, but to Huygens' table of optimal object/eyepiece combinations, the measured focal distance implies that this ocular was suited 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; Physical 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 (or 10.7 meter), having a measured focal distance of about 10.2 meter.
This 34-feet object glass is listed in the *Catalogus Der Glaesen tot de Verrekijkers* made up in about 1720 by Constantijn Lzn Huygens. 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 Physical 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 at 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 grinded by Constantijn Huygens, using greyish glass of which the material was delivered by an unknown Amsterdam merchant. In April 1683 Christiaan Huygens had compared this material with glass delivered 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 (or 10.7 meter), having a measured focal distance of about 10.2 meter. According to a list made by C.A. Crommelin this lens originally was accompanied by a cover sheet reading *'13 Nov, 1683.* | *118 .* | *Ped. 34'*. The glass was sold in 1754 with its ocular [of c. 3 inches] for 16 guilders.

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 I-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 (or 10.7 meter), having a measured focal distance of about 10.1 meter. As all other 34-feet Object glasses this lens originally was accompanied by an ocular of 3 inches.

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° 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 I-19, H 3-14

Biconvex lens made by Christiaan Huygens, using greenish glass, which was supplied by a merchant living in Amsterdam. The lens has a contemporary given focal distance of 34 feet (or 10.7 meter), having a measured focal distance of about 10.1 meter.

In about 1722 this double convex objective lens came in the possession of the Leiden professor W.J. 's-Gravesande. Starting in 1719 's-Gravesande had assisted the Huygens family in preparing an inventory of all the Huygens-instruments. Three years later he was an intermediate at the sale of two Huygens-lenses to London, where they eventually ended at the Royal Society. Probably at that occasion 's-Gravesande managed to acquire a Huygens-lens for his own cabinet. After 's-Gravesande's death in 1742 the objective was bought by Leiden university, together with all the apparatus in his private cabinet of scientific instruments. But as the other instruments went directly to the Cabinet of Physics, this *voorglas van een kijker door DH Huygens gemaakt* was transferred to the Observatory, where – according tot the 1793-inventory – this Huygens-objective was used and stored with the other telescope-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 (or 10.7 meter), having a measured focal distance of about 10.1 meter. From the *Catalogus der Glaesen* (c. 1720) it is known this object glass was never mounted for actual use, and did not have an accompanying eye glass. It was sold in 1754 for twelve guilders.

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: *'Aº 1683 10 Maji* | *Pedum 35'*
Provenance: *Auction H.G. Bom, Amsterdam 1889; Leiden University 1889-1931*
H 3-13

Biconvex lens grinded by Christiaan Huygens, using yellowish glass of which the material *glace de Venise* had been delivered by the Leiden instrument-maker Johan van Musschenbroek. According to a letter of Christiaan Huygens of 27 April 1683 he regretted the glass plaquette was just too small to grind an objective of 36 feet. Apparently he succeeded to use the material for a lens with a contemporary given focal distance of 35 feet (or 11.0 meter), having a measured focal distance of about 11.0 meter.

This lens is not mentioned in any of the earlier lists of lenses made by the Huygens-brothers, so apparently the lens must have been parted from the family-collection before the first inventory 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, together with a Dollond reflecting telescope, and probably also with the glasses 23882 , 23829 and 23835.

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

***Astrocopia Compendiarum* or aerial telescope**
1684-1687

In order to avoid achromatic and spheric aberration, is it necessary to use lenses with small curvature. As a consequence these lenses have long focal length. Thus 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 to make telescopes without a tube. These, so called *buysloze kykers* or tube less telescopes needed only an object glass on a console which could be hoisted into a mast, where this object lens was controlled with a string. An ocular at a tripod support completed this arrangement, in which both lenses had a ball-and-socket-joint, providing the possibility of a movement in all directions.
Starting in November 1683 Huygens made several observations with this kind of telescope, using, object glasses from 34 feet (or 10.7 meter) up tot 122 feet (or 38 meter). The latter arrangement needed a mast up to 33 meters in height. This length made the 'tube less' telescope extremely sensitive to wind, and therefore the aerial telescope was not very practical. So, in September 1693 Christiaan abandoned his *Astrocopia Compendiarium* or tube-less telescope arrangement, returning to a large telescope tube with an old 44½ feet object glass, placing the centre of gravity of his nicely crafted four-sided wooden tube at a newly designed wooden stand.

Oeuvres X, 478-479; 488; XV, 18-19, 145-146, 160-161, 232-233

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 I-13, B 15, C 13, H 3-9

Biconvex lens made by Constantijn Huygens, using dark grey glass. The lens has a contemporary given focal distance of 43 feet and 7 inches (or 13.7 meter), having a measured focal distance of about 14.3 meter. 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 missing now. The number 117 on the cover sheet probably refers to the 1786-auction catalogue.

On 11 February 1685 Christiaan Huygens used a 43-feet glass 'made by my brother' to observe the planet Saturn 'without a tube'. Probably this glass was meant. He himself had already grinded a 45-feet object glass in 1669.

Oeuvres VI, 480; XV, 151; 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. Object glass 9194
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 was made much efforts to 'grind again an object glass of 44 feet', because his earlier lens (perhaps number 9193) contained to much veins. He used for this glass greyish English glass.

The lens has a contemporary given focal distance of 43 feet (or 13.5 meter), having in fact a longer measured focal distance of about 14.1 meter.

B. Ocular glass 23822
1685
w 0.4, Ø 4.0
Unsigned, but probably made by Dirk van der Hoeven
At the scale: '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 eye glass for the new '44-feet'-objective he was in the process of grinding. Master Dirk used yellowish glass, with a measured focal distance of 10.5 centimeter, which is about 4.0 Rhyneland inches.
According to Huygens' 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 fits reasonably the measured distance.

According to an old list from Leiden Observatory, this ocular originally was accompanied by a sheet reading *Oculaire de 4 pouces pour 43? pieds* | *N° 11* | *116* The number 11 probably is misread for 14, which refers to both the 'Catalogus Der Glaesen' from about 1720 as well as 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. 23838
Object glass of 62 feet
1687
w 0.8, Ø 14.8
Lens: *unsigned*
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 I-9, B 12, C 10

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

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

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

19. 9183
Ocular glass for a 'tube less' telescope of c. 60 feet
1684-1687
Length 15, Ø 5.5
Lens: Unsigned, but made for Huygens by Dirck van der Hoeven
At the tube: '44'
At a label: '27'and '1671'
Provenance: Huygens-brothers, c. 1684-c.1690; Leiden Observatory, c. 1690-1931

Together with the next item (number 9182) this eye glass was mentioned in the 1742-inventory of Leiden Observatory as *eenige stukken tot de machine uit de astrocopia compendiaria van Huygens* (or 'some pieces from the apparatus mentioned in Huygens' *Astrocopia Compendiaria*). Both eye pieces were acquired for Leiden Observatory, probably in the 1690s, at a time when Christiaan Huygens had returned from Paris into the Netherlands and both brothers became engaged in other activities than grinding lenses.

Round biconvex lens (Ø 4.8) of greenish glass with a measured focal distance of 11.0 cm (= c. 4.2 Rhyneland 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 suited 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-feet object glass.

20. 9182
Ocular glass for an aerial telescope of c. 85-90 feet
Length 12, Ø 6
1684-1687
Lens: Unsigned, but probably made by Dirck van der Hoeven
At the tube: '43'
At a label: '26'
Provenance: Huygens-brothers, c. 1684-c.1690; Leiden Observatory, c. 1690-1931

The correspondence of the Huygens-brothers from the period 1682-1687 reveal that most oculars were grinded by Dirck van der Hoeven living at the Achterom at The Hague, nicknamed the *schoorsteenveger* ['chimney maker']. 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' table of optimal object/eyepiece combinations, the measured focal distance implies the ocular was suited 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-feet Object glass with an eye glass of 5.3 inches, so a smaller value also was used.

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

21. 23821
Ocular glass for a telescope of c. 83 feet

c 1680-1700
0.4, Ø 4.3
Lens: *Unsigned*
At the scale: *'46'*
Provenance: *Leiden Observatory ?-1931*

According to museum registers this eye-glass belongs to the Huygens collection, but as the glass is not grinded from moulds made by the Huygens brothers, its provenance is uncertain.
However, according to Huygens' table of optimal object/eyepiece combinations, the focal distance of c. 5 inches implies that this ocular was fitted 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
Unsigned
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

Already at 8 September 1684 Christiaan Huygens desired to produce an object lens of about 86 feet. In 1685 two 84/85-feet glasses were grinded, one by Constantijn (see next item), the other made by Christiaan. Perhaps this object glass is the one of which Christaan Huygens reported on 23 April 1685 that he had used this 84-85 glass to observe the heavens during three days at the request of some friends. At these observations the lens was accompanied by an eye piece of 6 inches. 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, having a measured focal distance of 26.9 meter, or in old measure about 85.6 feet. There is no accompanying cover sheet, nor diaphragm, but Van Helden & Van Gent have showed 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 he 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 (or 26.7 meter), having a measured focal distance of about 27.6 meter. 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 (or 26.4 meter), having a measured focal distance of 26.2 meter.
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 an ocular glass of 6 inches is also preserved, reading: *'Oculaire de 6 p[ouce] | pour 84 pieds' | No. 112'* . This focal length is one inch more than is prescribed in Huygens' 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 ~~22~~ 34.'
Provenance: Huygens family 1686-1786; A.J. Royer, 1786-1809; Leiden University 1809-1931
A II-7, B 38, C 34

Biconvex lens made by the Huygens-brothers, using white-greenish glass. The lens has no contemporary given focal distance, having a measured focal distance of 26.6 meter, or in old measure about 85 feet. The numbers 34 refers to the 1754-auction catalogue, when the glass was sold for 6 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 eye glass for an astronomical telescope of 120 feet
Provenance: Huygens family 1686-1786; A.J. Royer 1786-1809; Leiden University 1809-1931

A. Object glass 23844
1686
w 0.9, Ø 18.7
Unsigned
A II-4 & 6, B 5-7, C 4-5

Biconvex lens made by the Huygens-brothers, using green-greyish glass. The lens has a contemporary given focal distance of 120 feet (or 37.7 meter), having a measured focal distance of 39.0 meter.
There are two cover sheets in the handwriting of Constantijn Huygens Lzn that can go with this lens, the first reading: *120. Pieds. | 29e Januarij 1686 | Nº ~~6 4~~ 110* and the second reading *120. Pieds. | 1e Febr 1686 | Nº ~~4 5~~ 109*. The first erased number corresponds with 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 both glasses were sold for 39 and 41 guilders.

B. Ocular glass 23832
1686
w 0.7, Ø 6.4
Unsigned
Cover sheet: '[Ocu]lair van 6 ½ [duym. Tot] 120 voet [| Nº 64 | 110 | oculair pour 120 pieds]'.
At the scale: '33'

On 4 April 1686 Constantijn Huygens wrote to his brother he wanted to his 120-feet objective an eye glass with a somewhat larger diameter than they usually chose. Indeed this biconvex eye piece of whitish glass has a larger diameter (6,4 cm) than for instance the eye glass no. 23822 (4.0 cm). The eye piece has a contemporary given focal distance of 6 inches (or 15.7 cm), having a measured focal distance of 16.3 centimeter. According to Huygens' table of

optimal object/eyepiece combinations, an object glass of 120 feet needed an ocular glass with a focal distance of 6.0 inches, which exactly fits the given distance.

Van Helden & Van Gent 1995, 30

27. 23834
Ocular glass for an aerial telescope of 120-122 feet
c. 1686-1687
w 0.7, Ø 6.1
Lens: *Unsigned*
Cover sheet: *'N° 4 | Oculair van | 5 duimen 6 linien | voor een Objectief van | 121 Voeten | van Huygens | Obje'*
At the scale: *'42'*
Provenance: *Huygens family 1686-1786; A.J. Royer, 1786-1809; Leiden University 1809-1931*

As the Huygens brothers never have grinded an object glass of 121 feet, this eye glass probably has functioned as a spare ocular for the object lenses of 120 feet (no. 23844)

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

Van Helden & Van Gent 1995, IV

28. 9186
Object glass of an astronomical telescope of 122 feet
1686
h 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.'*
At the scale: *'1'*
Provenance: Huygens family 1686-1786; unknown 1786-?; H. Veder ?-1894; Leiden University 1894-1931
A I-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 afterward Constantijn also made three 122-feet object glasses. These lenses are all preserved, one (dated 4 June 1686) being at the Royal Society in London, the two others being preserved in Museum Boerhaave. As far as we know only Christiaan has made astronomical observations with a 122-feet aerial telescope. At least on two occasions during the month of May 1686 Christiaan observed the planet Jupiter.

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 (or 38.8 meter), having a measured focal distance of 39.4 meter. In the 1754-auction this object glass was sold with its eye glass 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 a 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'*
At the scale: *'2'*
A I-4, B 4, C 2, H 3-2

Round biconvex lens grinded by Constantijn Huygens, using greenish glass supplied by a London based merchant. The lens has a contemporary given focal distance of 122 feet (or 38.8 meter), having a measured focal distance of 39.1 meter. 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
Lens: *Unsigned*
Cover sheet: *'N.1.| Oculair van 7 ½ duim | voor een Telescoop | van 122 voeten, van | d. Hr Christiaan Huigens'.*
At the scale: *'31'*

Round biconvex lens of yellowish glass, with a contemporary given focal distance of 7.5 inches (or 19,6 cm), having a measured focal distance of about 21.0 cm. According to Huygens' 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
0.56, Ø 6.9
Lens *Unsigned*
Cover sheet: *'N° 7 | Oculair de 10 pou[ce], 327 | ~~N° 36~~ | C. Huijgens'.*
Provenance: *Leiden Observatory ?-1931*
C 36?

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' table of optimal object/eyepiece combinations, the focal distance of c. 10 inches implies that this ocular was fitted for an object glass of c. 325 feet. However, the object glass with the largest focal length grinded by the Huygens brothers was 210 feet, so perhaps this glass is unfinished or it has served other purposes.

According to tradition the lens was part of the Huygens-collection, however Van Helden & Van Gent have demonstrated that the curvature of this eye glass does not fit 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. Object glass 23823
c. 1700
w 0.46, Ø 6.7
Unsigned
At a paper sheet: '25'

Biconvex lens made of greenish glass, with a measured focal distance of 4,76 meter, which is about 16 feet. A metal scale was made at a later date at Leiden Observatory. Perhaps this object glass was one of the objective lenses mentioned in the 1793-inventory of Leiden Observatory: '*8 objectiefglasen van 7 ½ tot 16 voet brandpunt'*.

b. Ocular glass 23828
c. 1700
w 0.12, Ø 4.5
At the scale: '39'

According to Huygens' 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 2 inches, having a measured focal distance of 5.7 centimeter, which is about 2.3 Rhyneland 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
Unsigned
Provenance: Leiden University c. 1700-1931

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

Perhaps this is the object glass of 20 Paris feet (or 6.5 meter), that 's-Gravesande bought in 1727 for fifteen guilders at the auction of the telescopic glasses of Nicolaas Hartsoeker. This glass grinder always used the Paris feet. The same year 's-Gravesande ordered some glass material from England, which was used by Arnold Marcel at Dordrecht to grind twelve new eye glasses. 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-inventory of Leiden Observatory.

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
Unsigned
At the scale: '22'
At a label: '19'
Provenance: Leiden Observatory c. 1700-1931

Biconvex lens made of yellowish glass having a measured focal distance of 7.24 meter, which is about 24 feet. Perhaps this object glass is one of the lenses that belonged to the long iron tubes which were 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-inventory of Leiden Observatory.

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
Unsigned
Provenance: Leiden Observatory c. 1700-1931

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

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

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

Arnold Marcel (1672-1748) was a silversmith in the city of Dordrecht, but like his cousin the famous microscopist Anthony van Leeuwenhoek, Marcel also was active as a natural philosopher. He published on magnetic experiments in the *Philosophical Transactions* and for many years Marcel lectured at Dordrecht for a group of scientific dilettantes. In a portrait Marcel was described as a zealous follower of Newton.

This telescopic eye glass of 'white-greenish' glass has a contemporary given focal distance of three inches (or 7.85 cm), having a measured focal distance of about 7.82 cm.

This lens probably was bought in 1724 by 's-Gravesande, when he got permission to repair some telescopes at the Leiden Observatory. In 1727 's-Gravesande ordered some English ocular lenses, which were grinded by Marcel to fit in the old telescope tubes of the observatory. According to Huygens' table of optimal object/eyepiece combinations, an eye glass of 3 inches would suit to 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*'. According to a note made in 1761 this 30-feet tube was painted, 'so it still could be of any use'.

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

36.
Set of object & ocular glasses for an astronomical telescope of 32-35 feet
c. 1700-1750
Provenance: Leiden Observatory, c. 1890-1931
The three lenses 23882, 23829 and 23835 have the same provenance. They probably were bought in 1889 together with the Huygens-lens 9108 at the Auction house of H.G. Bom at Amsterdam, mentioned in the catalogue as 'Drie diverse lenzen'.

a. Object glass 23882
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'*
At the scale: *'19'*
At the ring: *'12'*

Biconvex lens made of greyish glass made by Arnold Marcel at Dordrecht, with a contemporary given focal distance of 32 feet (or 10.0 meter), having a measured focal distance of 9.41 meter.

b. Pieces of a broken Ocular glass
23829
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'*
At the scale: *'41'*
At the ring: *'5a'*

Broken pieces of a biconvex lens made of reddish glass with a contemporary given focal distance of c. 3 inches (or 7.8 cm). The handwriting of the text of the sheet is the same as with the following lens no. 23835. The Huygens lens referred to is probably no. 9108, having actually a focal distance of 35 feet. According to Huygens' 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. Ocular glass 23835
c. 1750
0.74, Ø 6.3
Lens *Unsigned*
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'*
At the scale: *'38'*

Biconvex lens made of greenish glass with a contemporary given focal distance of 5 inches (or 13.1 cm), having a measured focal distance of 13.9 cm. The translation of the sheet is: 'Extra nice ocular glass with a focal distance of five inches, bought here at De la Haije in The Hague, to be used at both objectives, although the Huygens lens can use an eye glass of 2.5 inches focus, and the Marcel lens an eye glass 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

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

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

Telescopic lens of about 50 feet, made in 1688 by Nicolaas Hartsoeker for Leiden University. 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, wide about two fingers. 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 Huygens had observed the image of the bricks in the houses at the other side of the [Rapenburg?] canal.

Without mentioning Hartsoeker's name the lens was mentioned in De Volder's 1706-inventory of the Observatory. In 1711, 1759 and 1777, in the travel diaries of Von Uffenbach, Ferrner and Bugge, Hartsoeker's 50-feet lens was recorded as a remarkable piece at Leiden Observatory. 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 meter, or 51.7 Paris feet (the old measure Hartsoeker used).

In the auction catalogue of Hartsoeker's glasses of 1727 it is stipulated that these large object glasses were used in 'tube less' telescopes, in a way strongly resembling Huygens *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
Unsigned
Provenance: Leiden Physics Cabinet / Kamerlingh Onnes Laboratory, ?-1931

Plano convex lens made of white glass having a measured focal distance of 16.9 meter, which is about 54 Rhijnland 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 plausible he also bought a glass for his personal cabinet.

At 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
Unsigned
At the scale '3'
Provenance: Leiden University, ? -1931

Biconvex lens made of bluish glass with a measured focal distance of 41 meter, which is about 130,6 Rhynland feet. According to a list made in the early years of the museum the lens was accompanied by a now missing cover sheet reading in red <KRIJT> *'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 the number was marked '15'.

However, as the glass is not grinded 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
Unsigned
Provenance: unknown, probably Leiden Observatory, ?-1931

Biconvex lens made of colourless glass with a measured focal distance of 53 meter, which is about 169 feet. Although the Huygens-brothers have made 170-feet object glasses, according to Van Helden & Van Gent this glass is not grinded 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
Provenance: Leiden Observatory, ?-1931
Unsigned
At the scale: '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' table of optimal object/eyepiece combinations, the measured focal distance implies that this ocular was fitted 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 eye glass does not fit those of other Huygens-oculars, so a positive identification cannot be given.

Van Helden & Van Gent 1995, IV

III. REFRACTORS WITH CARDBOARD OR VELLUM DRAW-TUBES

43. 9985
Large reverse taped refracting telescope
1675-1700
Length between 67 and 240; Ø between 4.6 and 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 for telescopes of English origin in the late 17th century. The decorative tooling also points at an English provenance. The length necessary for use is indicated by pencil point on each tube. The optics is only partly preserved. Simple objective (Ø 4.0) at the small side of the telescope. Simple ocular (Ø 8.0) at the wide side of the instrument. The original broken lens is 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
Length between 22 and 61, Ø 3.1
Signed: I MANN FECIT
Provenance: M.D. van Hest, 1929

The constructor of this telescope, the optical instrument maker James Mann (d. 1756), has played a minor part in the controversy on the invention of the achromatic telescope. In the 1760s a huge priority dispute broke out. The patent for the invention had been granted to John Dollond in 1758, but his opponents claimed he had been only second after the 'true' inventor Chester Moore Hall. The latter, so was claimed, had contracted in about 1730 two different glass grinders to make according to precise specifications a crown convex lens and a flint concave lens. One of them had been James Mann. But as Mann had hired the same subcontractor as the other optician involved (Edward Scarlett), Hall's 'secret' had been revealed, as it was quickly realized the two pieces belonged together. However, dramatic as this story may be, it does not hold against reality, as Sorrenson convincingly has demonstrated. So, Mann remains only a minor technician in the history of science. In 1743 he went into an apprenticeship with James Ascough, signing his instruments from that date 'Mann & Ascough'.

Telescope (tube length 22-61, Ø 2.5-3.1) 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
Length between 31.5 and 71, Ø 4
Unsigned, but 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's-Hertogenbosch, becoming a successfull magistrate. In 1746 the telescope was handed over to his son Antonius Martini at 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 by Jan van Musschenbroek at Leiden, whose workshop offered telescopes for sale, at least since 1711. As the tooling on the tubes is identical with those on English telescopes of the first quarter of the 18th century, it must be doubted 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 which 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 the hand-over 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
Length between 56 and 172, Ø 4.5
Signed at 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 amount of scientific instruments, which collection was intended for auction in 1924, but eventually was sold in parts to several museums, like 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 (hardly readable) signature of Biagio Burlini (1709-1771) and his Italian workshop 'Venezia Archimede'.

The telescope tube has four segments of marbled green cardboard (l. 56-172, Ø 3.7-4.5), 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
Length between 30 and 78, Ø 0.4
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 draw-tubes (Ø 4.2-4.0-3.7-3.5). The outer tube is decorated with some black drawings, mostly of plants. The cover is a bit damaged.. The fittings are made of partly of grey and black horn, and partly of black wood. The dust covers are made of brass.

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

Engberts 1970, 86

48. 13705
Terrestrial telescope
c. 1750
Length between 51 and 161, Ø 4
Provenance: Purchased with assistance of the Leiden University Fund, 1927

Hand-held telescope, probably of German origin (Nuremberg?). The instrument has six drawtubes made of cardboard, the outer one covered with a black linen sheet, richly decorated which several leave- and flower-motives made of very thin wood. The inner tubes are decorated with red pictures of flowers (partly faded and discoloured as a result of sunlight). At some places on the outer tube the paint has worn off, as a result of which a Latin handwriting has become visible. Probably an older manuscript has been used to provide the material for constructing the drawtubes. Also at most of the inner tubes some handwriting in Latin can be read. The fittings are made of brown wood. The objective is replaced by flat glass and the screwable dust-cap is missing. Simple ocular with field lenses (at the end of the 3rd and 4th tube). The diaphragm at the end of 5th tube is missing.

Engberts 1970, 84-85

49. 8908
Terrestrial telescope
1700-1800
Length between 33 and 99, Ø between 2.7 and 3.6
Provenance: M.D. van Hest, 1929

Hand held refractor with four drawtubes of white cardboard with black leather (imitation sharkskin) at 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
Length between 29 and 80, Ø 3.3
Provenance: Leiden university, Physics laboratory, pre 1880-1931

This 18th-century telescope is originating from the Leiden Cabinet of Physics, but can not be identified in the contemporary administration. However in the 1880s it is listed as a *'Verrekijker bestaande uit 4 kokers groen'*.

The green drawtubes of this telescope are made of cardboard, which are fitted with ivory fittings and frames. A screw-cap can be fitted on the eyepiece. The dust-cover of the objective is lacking. The optics of this telescope is incomplete. 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 lacking, but there are two field lenses in the two smallest tubes.

Engberts 1970, 85-6; De Clercq 1997, 132, referring to list 1880s, nr. 265

51. 8919
Night-telescope
1759?
Length between 30 and 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 in 1759 for thirteen guilders from Louis Thornburry, a tradesman at The Hague. Another 'Katoog' with 3 lenses, bought the same year from William Tottie, a brass founder from Rotterdam, is missing now.
A 'Kat-oog' (or Cats-eye) was a 'Night telescope', possessing a large objective, a large field of view and a rather small magnification. These kind of instruments produced reversed images, which is remarkable for a terrestrial telescope, but which was usual for these night telescopes. According to a contemporary statement they were of little use at day time, 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
Length between 17.5 and 38, Ø 30
Signed at the middle tube: DOLLOND / LONDON
Provenance: R. Escher, Leiden, 1926; Collection Van Seters, Amsterdam, 1926-1957

The naturalist and historian of science Wouter Hendrik van Seters (1891-1976) collected optical instruments since his study at Leiden University in the early 1920s. In 1957 he sold the most interesting part of his collection to the 'Rijksmuseum voor de Geschiedenis der Natuurwetenschappen', under which this so called 'optical cabinet'.

The 'Optical cabinet' was a smart marketing invention of the London practitioner and instrument maker Benjamin Martin (1705-1782), who worked on Fleet Street from 1756 until 1777. Such a combination of different optical instruments put together in a same storage box was especially designed for the interested 'gentleman-scientist' with no profound scientific ambition. This square wooden cabinet (6 x 15 x 37) was a composition of 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 Martin's colleague, the Dollond-workshop.

The telescope (l. 17.5-38, Ø 2.5-3.0) consists of three drawtubes made of green cardboard covered partly with green 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
Length between 28.5 and 102, Ø 4.5
*Signed on 4th tube: *DOLLOND LONDON*
Provenance: Mrs. M.G. Kalff-Goedkoop, 1935

Refracting telescope (l. 28-102, Ø 2.9-4.0) made by the well known Dollond workshop, with five drawtubes made of green cardboard, covered with green ray-skin. With 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
Length between 29 and 91.5, Ø 2.8 - 4.0
Provenance: Dr. J.C.M. Timmermans, 1933

Refracting telescope (Ø 2.8-4.0) 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 4th cylinder and a compound ocular with a shutter. The ocular cap and the screwable sun glass are missing.
The telescope resembles the next Dollond telescope no. 8935.

Engberts 1970, 89

55. 8895
Terrestrial telescope
1700-1800
Length between 31 and 86, Ø 4
Provenance: Collection Groenendijk, Amsterdam, 1957

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

This refracting telescope (l. 32-86, Ø 2.8-3.5) has four drawtubes made of cardboard: the outer one covered with brown imitation sharkskin, and the three inner one's 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

56. 8912
Terrestrial telescope
1750-1800
length between 133 and 187, Ø 3.4
Provenance: Collection Burgers, 1946

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

This instrument consists of four draw-tubes made of cardboard. The objective tube is covered with brown leather. 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. 8894
Terrestrial telescope
1775-1800
length between 31.5 and 83, Ø 4
Provenance: Dr. J.A. Koch, 1933

This refracting telescope (l. 31-83, Ø 2.8-4.0) 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 are missing.

Engberts 1970, 91

IV. SMALL (POCKET) REFRACTORS

In the early 18th century the telescope entered the domain of the bourgeois citizen. Domestic usages of the telescope were developed, for instance the pocket telescope, a commodity which could be used at opera's or other theatrical performances. Most of these small refractors – and later on also reflectors – were unsigned, so mostly little is known about their producers. These type of small telescopes possess a rather modest magnification.

58. 8936
Pocket telescope
1700-1725
Length between 7.5 and 11, Ø 4
Provenance: Collection Burgers, 1946

This instrument (tube length 7.5-11, Ø 3.4-4.0) 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
Length between 5.5 and 7.5, Ø between 2.9 and 5.0
Provenance: Collection Burgers, 1946

This very small refracting telescope has two drawtubes made of cardboard. The objective tube is covered with red ray-skin, the eye piece-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 (length 7, Ø 4), covered with black paper at the outside and with red plush on the inside.

Engberts 1970, 117

60. 8906
Small refracting telescope
1739
Length 16, Ø 2.0
Stamped with points in leather housing: ANO I739
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. Simple objective (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. 8898
Pocket telescope
Length between 8.5 and 12.5, Ø 3.5
1752-1766
Signed on the eyepiece tube: P. Dollond Strand London
Provenance: Leiden University, 1931

The instrument maker Peter Dollond (1731-1820) was operational at the Strand in London during the period between 1752 and 1766. When and how this small specimen of his craftsmanship came into the Leiden Cabinet of Physics is not known.

Very small refractors such as this simple two draw brass telescope were used for instance 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

62. 8896
Pocket telescope
1750-1800
Length between 5.5 and 8, d 2.8
Signed: Dollond London
Provenance: Ds. C.B. Heyn, 1945

Very small refractor (l. 5.5-8.0, Ø 2.3-2.8) 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

63. 8904
Pocket telescope with storage cylinder
1750-1800
length between 6.5 and 10, Ø 4.2
Signed in a cartouche on the eyepiece tube:
DOLLOND LONDON
Provenance: unknown, 1935

Small telescope tube (l. 6.5-10, Ø 4.0-4.2) 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 (h. 8, Ø 5.5) is covered with red plush and green ray-skin.

Engberts 1970, 111

64. 8922
Pocket telescope
1750-1775
Length between 6 and 10.5, Ø 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 (l. 6-10.5, Ø 1.9-2.8) made in three segments of brass. The instrument has a simple objective (Ø 3.0) and a simple (incomplete) ocular with two eye glasses, facilitating two different magnifications.

Engberts 1970, 119; Millburn, 1986, 33

65. 8932
Small refracting telescope
1762-1800
Length between 11 and 17, Ø 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 last quarter of the 18th century. In 1758 he was apprenticed to a mathematical instrument maker. Four years later he started his own business as an instrument maker in London, where he worked until his death. After his marriage in 1766 with Sarah Dollond, the daughter of the late John Dollond, he shared in the patent that Dollond had taken out on his most famous invention, the achromatic lens. In his own right Ramsden became famous after the invention in 1777 of a new circular dividing machine, which very much enhanced the scalar precision of all kinds of measuring instruments.

Small hand held refracting telescope (l. 11-17, Ø 3.4-3.8) with two brass drawtubes. The instrument has a simple objective (Ø 3.3) and a simple ocular with two eye glasses (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
Length between 5 and 9.5, Ø 4
Provenance: Posthumus, The Hague, 1929

Small refracting telescope (l. 5.0-9.5, Ø 2.1-4.0) 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
Length between 5 and 9.5, Ø 3.5
Provenance: Prof. Dr. B.G. Escher, 1934

Small refracting telescope (l. 5-9.5, Ø 2.2-3.5) 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
Length 8.8, Ø 3.5
Signed at the inside of the cover with black ink: "x H v Deyl Jans Leiden 1762 x" [tail of the number 'six' erased]
Provenance: G.A. Brongers, 1950

Earliest known refracting telescope by Harmannus van Deijl Jansz (1738-1809), made according to the signature in 1762 in Leiden. At that time Harmannus probably was working as an apprentice at the workshop of the well-known instrument maker Jan Paauw. Harmannus 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 over 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 motive in 13 vertical rows.
At the inside of the cap the number 07936 and the mark GLD 3/6 (hardly readable) are written.

69. 8911
Achromatic pocket telescope
1769
Length between 15.5 and 24, Ø between 1.9 and 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 in 1769. This is the most commonly produced type of telescope made by the Van Deijl workshop.

The instrument is made in two segments: firstly a brass objective tube (l. 14; Ø 3.3) with achromatic objective (Ø 2.1) and dustcover, and secondly a brass eyepiece-tube (l. 11; Ø 1.9) with ocular and field lens. In closed position, the eye-piece-tube can be kept in the objective tube. Before using the instrument, the eye-piece-tube had to be turned loose and then screwed again in opposite direction on the objective tube. With this operation a telescope is formed with a total length of 24 cm. The instrument is almost identical with the following, undated telescope, no. 8882.

Engberts 1970, 94-95

70. 8882
Achromatic pocket telescope in cylindrical case
1765-1775
Length between 15.5 and 24, Ø between 1.9 and 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 is made in two segments: firstly a brass objective tube (l. 14; Ø 3.3) with achromatic objective (Ø 2.1) consisting of two lenses and dustcover, and secondly a brass eyepiece-tube (l. 11; Ø 1.9) with ocular and two field lenses. In closed position, the eye-piece-tube can be kept in the objective tube. Before using the instrument, the eye-piece-tube had to be turned loose and then screwed again in opposite direction on the objective tube. With this operation a telescope is formed with a total length of 24 cm. The instrument 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
Length between 6.5 and 9.0; Ø 1.9 - 2.1
Signed: Jan van Deyl and Zoon Fecit Amsterdam Ao 1776
Provenance: Collection Burgers, 1946

Very small achromatic pocket telescope made in 1776 by the Van Deijl workshop. The instrument (l. 6.5-9.0, Ø 1.9-2.1) has two brass drawtubes, the first with an achromatic objective (Ø 1.9) with screwable dustcover and the second with a simple ocular, also with dustcover. 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
Length between 5.5 and 8.5, Ø 3
Provenance: M.D. van Hest, 1930

Small refracting telescope (l. 5.5-8.5, Ø 3.0) 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
Length between 7.5 and 10, Ø 3
Provenance: M.D. van Hest, 1929

Small refracting telescope (l. 7.5-10, Ø 2.2-3.0) 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
Length between 4 and 11, Ø 3.5
Provenance: Collection Burgers, 1946

Small refracting telescope (l. 4-11, Ø 2.0-3.5) 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
Length between 9 and 13, Ø 3.5
Provenance: Collection Burgers, 1946

Small refracting telescope (l. 9-13, Ø 3.2-3.5) made in two brass segments. The instrument has a simple objective (Ø 2.9) and a simple ocular with two eye glasses (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
Length 15.5, Ø 2.5
Provenance: M.D. van Hest, 1929

Small refracting telescope (l. 15.5, Ø 1.6) 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
Length between 5 and 7, Ø 3.5
Provenance: Mrs. E.C. van Hest, 1941

Very small refracting telescope (l. 5-7, Ø 2.5-3.5) 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
Length between 6 and 11, Ø 4.8
Provenance: J.G. van Tricht, vicar of Delft, c. 1800; C.E. van Manen, Java, 1951

Very small refracting telescope (l. 6-11, Ø 2.6-4.8) 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
length between 5 and 9, Ø 4
*Unsigned, but the ocular tube has a mark: NûB [D]OUBLÉ (the û has a * in the centre).*
Provenance: C.E. van Manen, 1951

Very small refracting telescope (l. 5-9, Ø 2.3-4.0) 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
Length between 3.8 and 8.5, Ø 4
Provenance: Leiden University, 1931

Very small refracting telescope, made in four segments (l. 3.8-8.5, Ø 1.9-4.0). 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 probably it was made just for fun, not for practical usage.

Engberts 1970, 111

81. 8930
Pocket telescope
1800-1900
Length between 8.5 and 17, Ø 3
Provenance: M.D. van Hest, 1941

Small refracting telescope (l. 8.5-17, Ø 1.6-3.0) 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
Length 8.5, Ø 2
Provenance: Collection van Seters, 1957

Small refracting telescope with a tube (l. 8.5, Ø 1.8) made of ivory. The instrument has a simple objective (Ø 1.6) and simple ocular. At the outside of the telescope tube the inscription 'M 81a' can be read.

Engberts 1970, 120

83. 8926
Pocket telescope
1800-1825
Length between 3 and 10, Ø 5
Provenance: Collection Burgers, 1946

Curious small refracting telescope with a tube (l. 3-10, Ø 1.6-5.0) 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 motive of flower vases. The telescope has a simple objective (Ø 4.0) and simple ocular.

Engberts 1970, 117

84. 9032
Pocket telescope
Length 9 cm, Ø 4.5
Provenance: Unknown

Very small refracting telescope.

85. 8907
Small terrestrial telescope
1800-1900
Length between 14 and 37, Ø 3
Provenance: Mrs. J. van der Meer - van de Baan, Eefde, 1967

This hand-held terrestrial telescope (l. 14-37, Ø 1.5-3.0) 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 dust shutter.

Engberts 1970, 109

V. HAND HELD REFRACTORS WITH WOODEN OBJECTIVE TUBE

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

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 were used at sea since the second half of the 17th century, the *Verenigde Oost-Indische Compagnie* (the Dutch East India Company) started in 1731 to include in the standard equipment for its ships some little telescopes with 'kopere bussen' (with copper fittings). None of these early nautical telescopes are 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 the objective lens bears the date '1731'. However the habit of dating instruments after the maker's death was a usual practice at the Van Keulen workshop. It seems that only after their sale instruments were engraved with a date, giving its 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 originally was fitted with four screws on a telescope.

Mörzer Bruyns 1989

87. 11894
Terrestrial - Nautical telescope
ca 1750-1800
Length between 96 and 115, Ø 5
Signed at 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 1 ¾ inches'.

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

Engberts 1970, 82-3; De Clercq 1997, 131

88. 19935
Terrestrial - Nautical telescope
1750-1800
Length between 96-109, Ø 4.5
Provenance: unknown

Telescope with a decagonal objective tube (length 96) made of mahogany. The brass ocular tube has a field lens and can be covered with a dust cover slide. The shutter of the objective is missing.

89. 8913
Terrestrial - Nautical telescope
1750-1800
Length between 34 and 57, Ø 4.4
Provenance: J.G. van Tricht, vicar at 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 (length 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
c. 1760-1774
Length between 66 and 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' from that date onwards.

The instrument consists of two draw-tubes: an mahogany objective tube and a brass ocular tube (Ø 5.2). The cracked and damaged wooden tube has two holes, made probably for the attachment of this telescope to a stand, which however is missing. The eye tube has a rack-and-pinion focus 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
Length between 57 and 169, Ø 6
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 made by the Van Deijl-workshop, who ended their telescope-production in about 1795, due to the shortage of continental flint glass.

The instrument has a reddish mahogany objective-tube (Ø 6) and a brass eye-piece draw-tube (Ø 2.5). The achromatic objective has a doublet consisting of a biconvex front-lens and a concave back-lens. Both original dustcovers are missing.

Engberts 1970, 88

92. 8883
'Day or Night' telescope with box
1775-1835
Length between 38 and 96, Ø 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 (40 x 8 x 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. Ayscough; the name 'Day or Night telescope' suggested that these instruments offered equal quality at night as well as in day time. 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'. What was the claimed improvement, is not explained; perhaps it concerned the two magnifications (9 and 16 times).
Clifton lists six optical instrument makers operational at 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 draw tubes (length 38-96, Ø 3.7-4.9) 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
Length between 48 and 88, Ø 6
Signed: Dolland London Day or Night
Provenance: Collection Burgers, 1946

This telescope – and the following one – bears the signature 'Dolland', resembling to the name of the well known optical instrument makers firm Dollond. However, a telescope maker by the name of 'Dolland' is hitherto unknown. Probably someone has tried to fake the well-known 'Dollond'-brand, probably to sell a telescope of lesser quality.

The hand held telescope (l. 48-88, Ø 6.0) 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.

94. 8886
'Day or Night' telescope
1775-1825
Length between 50 and 89, Ø 5.5
Signed: Dolland London Day or Night
Provenance: Collection Burgers, 1946

This hand held telescope (l. 50-89, Ø 5.5) is made of two segments, the objective tube with achromatic objective (Ø 3.8) is made of reddish mahogany and the eye tube with compound ocular and dust cover slide is made of brass.

Engberts 1970, 106-107

95. 9451
'Day or Night' telescope
1825-1850
Length between 51 and 91 cm, Ø 5.5
Signed: Harris & Son, London, Day or Night. No 316
Provenance: Bureau of verification of the 'Rijkszee-instrumenten', 1939

Telescope made by the workshop of Harris & Son at 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 (l. 51-91, Ø 5.5) has two draw tubes (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.

96. 31355
'Day or Night' telescope
1825-1850
Length between 51 and 90, Ø 6
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 preceding number.

The telescope (l. 51-90, Ø 6) 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, 82, 102; Clifton 1995, 126

97. 8902
'Day or Night' telescope
1800-1850
Length between 37.5 and 91, Ø 6
Signed: Jones London Day or Night.
Provenance: Mrs. E.C. van Hest, 1941

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

Telescope (l. 37.5-91, Ø 3.8-6.0) 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 sun cap of brass, painted black.

Engberts 1970, 105; Clifton 1995, 152-155

98. 8884
'Day or Night' telescope
1800-1850
Length between 51 and 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 (l. 51-89, Ø 5.8) is made in two segments. The main tube is made of brown-red oak (l. 58) with a simple objective (Ø 3.7), of which the dust cap is missing. At the objective side 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
Length between 27 and 62.5, Ø 5
Signed on ocular tube: Spencer Browning & Rust London
At a label: '60.1'
Provenance: Bureau of verification of the 'Rijkszee-instrumenten', 1939

This telescope is made by the optical workshop of 'Spencer Browning & Rust' which was operational in London during the period 1784-1840. Originally the instrument was owned by the Dutch 'Verificatiebureau voor de Rijkszeeinstrumenten' (= the 'Bureau for verification of the national naval-instruments'), which was founded in 1858 at Leiden Observatory. Its first director was Frederik Kaiser, being assisted by his son Pieter Jan Kaiser, who became the second director of the institute in 1872. The bureau received its own building at the Varkensmarkt in Leiden in 1881.

The telescope (l. 27-62.5, Ø 2.6-5.0) 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 (of which the horizontal thread is missing). A brass screwable cap with slide protects the eye tube. The telescope is almost identical to the following number 8929.

100. 8929
Nautical telescope
1784-1840
Length between 27 and 62.5, Ø 5
Signed at the ocular tube: Spencer Browning & Rust London
At a label: '60.2'
Provenance: Bureau of verification of the 'Rijkszee-instrumenten', 1939

This telescope (l. 27-62.5, Ø 2.6-5.0) 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 and a brass screwable cap with dust cover slide.

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

101. 6952
Nautical telescope
1809-1857
Length between 48 and 95, Ø 5.5
Signed: MARINE. J.M. Kleman & Zoon, Koninklijke Instrumentmakers
Provenance: Bureau of verification of the 'Rijkszee-instrumenten', 1939

Refracting telescope made by the instrument makers firm J.M. Kleman, which was operational in the period 1781-1857. The indication '& Zoon' (= 'and son') was added in 1809, the same year in which King Louis Napoleon granted the firm the title of 'Royal instrument maker'.
This telescope was made for the Dutch Navy, as is evident by the word 'Marine' (= Navy) and the engraved coat of arms representing two crossed anchors within a circle, completed with the letter 'Z', which stands for 'Zeemacht', the Dutch expression for Naval Force.

Telescope made of mahogany (l. 29.5) and brass. Simple objective (Ø 3.8) with dust cover slide. Compound ocular (Ø 4.3).

Engberts 1970, 99-100; Maclean, 1976

102. 11890
Nautical telescope
1826-1839
Length between 75.5 and 89, Ø 5.5
Signed on the ocular tube: Merz, Utzschneider und Fraunhofer in München
Provenance: Royal Dutch Navy; transferred at an unknown date to the Bureau of verification of the 'Rijkszeeinstrumenten', 1939

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

Telescope (l. 75.5-89, Ø 4.0-6.0) made of pear wood and brass. The wooden tube is cut out over two-third of its length, probably for the attachment of the telescope to a stand, which however is missing now. 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 '60s' refers to an old inventory number.

103. 11891
Nautical telescope
1826-1839
Length between 75 and 88, Ø 5.5
Signed on the ocular tube: Merz, Utzschneider und Fraunhofer in München
Provenance: Royal Dutch Navy; transferred at an unknown date to the Bureau of verification of the 'Rijkszeeinstrumenten', 1939

Just like the proceeding number 11890 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. A contemporary label with the number '60s' is attached to the tube.

Refracting telescope (l. 75-88, Ø 3.9-5.5) made of walnut and brass. The instrument has an achromatic objective (Ø 4.7) and a compound ocular (with a defect 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
Length between 75 and 88, Ø 6
Signed at the ocular tube: Merz, Utz[schneider u] Fraunhofer in Mü[nchen].
Marked below the signature with a coat of arms representing two crossed anchors within a circle of leaves, completed with the letters 'N[M]'
Provenance: Royal Dutch Navy; transferred at an unknown date to the Bureau of verification of the 'Rijkszeeinstrumenten', 1939

Refracting telescope made of brass (l. 75-88, Ø 4.0-6.0) covered at 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
Length between 97 and 122, Ø 7.5
Provenance: Bureau of verification of the 'Rijkszee-instrumenten', 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 draw tube (Ø 3.2). It has an achromatic objective (Ø 6.0) with movable sun cap and dust shutter. The incomplete compound ocular als has a dust shutter.

Engberts 1970, 97-98

106. 8887
Nautical telescope
1850-1900
Length between 50 and 104, Ø 5.5
Provenance: Collection Burgers, 1946

Refracting telescope (l. 50-104, Ø 4.0-5.5) 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
Length between 51 and 76, Ø 5.5
Provenance: O.F. Muller von Czernicki, 1936

Refracting telescope (l. 51-76, Ø 4.5-5.5) 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
Length between 26 and 81, Ø 5
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 at The Hague at least from the 1850s. The company was based at the Noordeinde in the 1880s. They probably were only retailers of instruments made abroad.

This brass refracting telescope (l. 26-81, Ø 5) 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
Length between 15 and 38, Ø 3.3
Provenance: Mrs. J.H. Springer, 1941

Refracting telescope (l. 15.5-38, Ø 1.8-3.3) 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 the magnetic north is indicated as 21° to 22° North west.

Engberts 1970, 105

110. 8893
Terrestrial telescope
1825-1875
Length between 38 and 96, Ø 6
Provenance: G.A. Spoelstra, unknown date.

Refracting telescope (l. 38-96, Ø 6) with three draw tubes made of mahogany and brass. The instrument has an achromatic objective (Ø 3.9) with a dust cover slide and a defect 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
Length between 34 and 82.5, Ø 4.5
Signed: J. Molteni Paris
Provenance: W. Schoor, Leiden, 1929

In the 1850s the telescopes of the French instrument maker J. Molteni were introduced in the Netherlands. In their modest range of the market they offered great quality for '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
Length between 92 and 101, Ø 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 an ordered Plössl-telescope took a very long time. The 1854 and 1868 inventories of Leiden Observatory describe this telescope as 'a naval telescope by Plössl with an aperture of 23 lines' [= 5,2 cm].

This nautical telescope (l. 92-101, Ø 4.0-5.2) 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 pill box with marking: 'Astr. Ocular of the Plössl Telescope no 10'. Such an 'astronomical eye tube' was at the time available for 4 to 6 Dutch florins. It made the telescope better suited for astronomical observations. On the telescope tube the inscription 'D.10.' is visible, 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

VI. REFRACTING TELESCOPES ON SUPPORT

For astronomical use telescopes had to be equipped with a support. Which one was to be chosen was dependent of the use desired. 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 an observation in all directions. More convenient for a 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 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

This transit telescope was bought in 1740 by W.J. 's-Gravesande for 469 guilders from Jan van Musschenbroek. The instrument was made by the London based instrument maker Jonathan Sisson (1690-1749). By placing the instrument in 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.

This brass transit 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. At the axis (l. 65) two revolving circles (Ø 28) are attached, one of which has a scalar division of which the pointer is missing. The telescope (l. 83, Ø 3) has a plano-convex objective (Ø 3.0) with simple biconvex ocular (Ø 2.5). Behind the eyepiece a rectangular reticule is placed, with an adjusting mechanism, of which the key is missing. A water level (l. 26) is placed on a brass bar between the revolving circles. One sight at the telescope tube is missing, as is the screwable dust-cap of the eyepiece.

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

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) capitalized the success of his father by enlarging his instrument makers firm 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 at 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 eye piece could be drawn out by a rack-and-pinion construction, but this mechanism is out of order. The optics of the compound ocular is only partly preserved.

Engberts 1970, 54-55

115. 11915 & 15005
Refractor on small tripod
c. 1775
Length between 73.5 and 118, Ø 7
Signed at 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 (l. 73.5, Ø 6.0-7.0) and a brass ocular draw tube (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 brass foldable azimuthal tripod (h 37.5, w 31, d 31) has received its own museum number (15005).

Engberts 1970, 54

116. 8699

a. Large achromatic lens telescope
1765-1775
h 174.5, w 202.5, d 89
*Signed around the eye-piece: DOLLOND * LONDON*
Provenance: Sotheby, 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) was already found by Chester Moore Hall in 1731, the invention itself became only 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, who was permitted 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 usage 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. To the tube a brass finder (l. 26, Ø 3.5) is attached with simple objective and compound ocular.

The large wooden storage box (195 x 27,5 x 18) has brass handles. It contained several accessories, such as spare oculars, colour filters, a heliometer objective and a micrometer.

b. Heliometer objective
1765-1775

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

c. Micrometer
1765-1775

Micrometer according to Bradley. In this instrument the distance between two parallel threads can be varied by means of an adjustment screw. This arrangement facilitates in an other way than with the heliometer-objective the precise measurement of small angular distances between stars.

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 unsigned, but 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 made achromatic telescopes of high quality since 1763. A nearly similar instrument with identical stand, dated 1781, is at Teyler Museum, Haarlem. That instrument was bought in the renowned Ebeling sale of 1791. The catalogue of 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 on both ends of brass, resting in a cradle, mounted on a large azimuthal tripod of brown varnished mahogany. Such a wooden tube was intended to isolate from the cold, which was thought to prevent the condensation of moisture at the lenses. Achromatic objective (Ø 7.4 cm) with dustcover (with own number 15037). On the inside of the compound ocular tube the inscription can be read: '*Vergroot 68 maal*' (= magnifies 68 times in diameter).

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 (109 cm) 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 reconstruct the observatory and the Amsterdam instrument makers firm of J.M. Kleman was commissioned to construct some new astronomical instruments at the Kings' expense. In 1809 some of these instruments already were finished, under which an 'achromatic transit telescope for the Royal Observatory at Utrecht', being showed at an exhibition of industrial product in Amsterdam.
In August 1810 however the instruments were still waiting for delivery at Kleman's workshop. However, as a result of the annexation of the Kingdom by Napoleonic France, Utrecht Observatory had to be financed again by the city counsel of Utrecht, resulting in a total annulment of all preceding plans.

As a transit telescope is a typical observatory instrument, whereas this apparatus represents the only known transit telescope by Kleman (made according to its signature somewhere before 1809), it is tempting to suppose that this instrument originally was destined for the Royal Observatory at Utrecht. According to tradition the instrument actually was used by General Kraijenhoff in about 1810, in the course of his large triangulation of the Netherlands. This could 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) is 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) is made by the French instrument maker Jean Francois Richer (1743-c. 1820) at 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. In front of the ocular a dark-orange screen can be placed by means of a small brass lever. 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 stayed rare on the market. In the Netherlands an achromatic binocular telescope was developed by the philosopher Frans Hemsterhuis (1721-1790), which were made in very small quantities by the Van Deijl-workshop. Such a Van Deijl-binocular was bought in 1792 for Teylers Museum. A binocular Dollond-telescope is in the Utrecht University Museum.

Each telescope tube (l. 81, Ø 6) can be covered with a dust-cap. The telescope has achromatic objectives with compound eye tubes, with fine tuning for adjusting the distance between the eyes and the image. At the ocular side the telescope has some small defects. A scale division can provide vernier readings. The instrument can be fitted on a tripod stand of mahogany wood (l. 18, Ø 5.2) with brass fittings and clamps.
The telescope is kept in a contemporary mahogany storage box (h. 8, w. 83, d. 22.5) containing also 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 the telescope once was in the possession of the Dutch Royal family, having most sovereigns the name 'Willem'.

Turner 1973, no. 265

120. 3469
Large achromatic telescope on tripod stand, used in several astronomical observations
1819-1826
h 156, w 186 , d 87
Signed: Utzschneider und Fraunhofer in München
Provenance: J.B. Stoop, Amsterdam (c. 1820), inherited into the De Beaufort family, remaining there until 1967

Achromatic telescope of superb quality, made by the 'Optical-mechanical Institute' founded in 1809 in Benediktbeuern, which moved in 1819 to Munich and was lead until 1826 by Joseph von Utzschneider and Joseph von Fraunhofer (d. 1826).
In 1835 the Leiden astronomer Frederik Kaiser lent this telescope from its first owner, the Amsterdam banker Jan Bernard Stoop (1781-1856), for the observation of the return of comet Halley, performed from the attic of his Leiden home. In 1861 the telescope was lent again by a professional astronomer, Dr. F.W.C. Krecke of the Utrecht Astronomical Observatory 'Zonnenburg'. After Krecke's departure in 1866 the telescope was returned to the Stoop family. In 1874 the telescope was lent for a third time, now by the Utrecht astronomer Dr. J.A.C. Oudemans. He was the leader of the Dutch astronomical expedition to Réunion, in order 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 the telescope was inherited by Dr L.F. de Beaufort (1879-1968). It was on his behalf that the instrument was offered in 1967 to the museum.

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. At the tube a brass finder (l. 36 , Ø 3) is attached with simple objective and compound ocular. According to the descriptions of Kaiser and Oudemans,

the instrument originally was accompanied by a circular micrometer, which is missing now.

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

121. 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 was lead after 1826 by Georg Merz, who bought the company in 1839, having used until 1839 the name of the late Fraunhofer as a guarantee for the workshop's high quality. In the 1840s such a telescope required an investment of some 220 Dutch guilders.

Telescope tube (length 96-107, Ø 8-2,5) of mahogany and brass on large wooden azimuthal tripod stand (length wooden part 172 cm, brass part 16 cm, Ø 17). The telescope has an achromatic objective (Ø 6.0) with dust cap and a compound ocular. At the tube is a finder (l. 15.5, Ø 2) with cross wires.

A wooden storage box (85 x 20 x 12 cm) 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

122. *still in situ*
Large achromatic refractor on an equatorial stand
1838
Unsigned, but made by Merz, Utzschneider & Fraunhofer in Munich
Provenance: Leiden Observatory, 1838-present
[Not in the collection of Museum Boerhaave]

This telescope made by the Optical Institute at Munich with a contemporary aperture of 6-inches and a focal distance of 8 feet was delivered at 18 October 1838 at the Academy building at the Rapenburg. According to Kaiser the telescope was $^{2}/_{3}$ of the famous Dorpat-telescope made in 1824 by the same company. In Leiden it was the first telescope equipped with a parallactic mounting which included a centrifugal clockwork-gearing that followed the rotation speed of the earth. This design by Fraunhofer provided the observer with a steady image of the heaven, which facilitated accurate micrometer-measurements. In 1860 this telescope was the first instrument to be installed at the new observatory. Today the telescope is still operational in the small dome of this Observatory-building, serving since 1974 local amateur-astronomers.

Originally the instrument had one thread micrometer and two circular micrometers. To its accessories belonged two microscopes for the investigation of the micrometers, an observation chair and two observation stairs. Later additions were two achromatic eye tubes made by Durac and one other by Kellner.

Large mahogany telescope tube with brass fittings and a movable eye tube. In the 1930s the original wooden stand was replaced for the present white painted iron stand with gear work and counter weights. The origin of the present finder with its prism is unknown.

Kaiser 1838, 21-25 & 103; 1854, no. 1-2; Invent. 1868, B-3; Van Herk 1983, 98

123. 9965
Achromatic 'Comet Searcher' on an equatorial stand
1826-1839
h 142, w 122, d 55
Signed at 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 the Leiden Observatory still needed. Shortly afterwards he adapted this telescope made by the 'Optical-mechanical Institute' at Munich into such a 'comet searcher'. To that purpose the telescope was placed on a heavy iron bearing after Kaiser's own design, with counter balances that lightened its use. A second feature in this arrangement was the reflecting prism combined which in all positions of the telescope fixed the observers line of sight at a horizontal position. After 1850 the eye piece was replaced by an 'orthoscopic ocular' with a large field of view invented – and made – by the optician C. Kellner (1826-1855) at 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. Probably it was this 'comet searcher' which was sent in 1876 to the famous international exhibition of scientific apparatus at South Kensington in London. At its return in Leiden this instrument appeared to be severely damaged, so it probably was abandoned.

The telescope has a wooden tube (l. 79, Ø 10), achromatic objective, a dust-cap and a reversing prism. The heavy azimuthal tripod mounting has a counterbalance with fine tuning. In a wooden box several small accessories are kept, including four compound ocular-tubes. One of these is the Kellner-ocular, which in 1868 was characterized 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

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: unsigned, but made by E. Wenckebach
Stand: unsigned, but 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. At that time such a mahogany telescope without a stand required an investment of some 100 Dutch guilders. The instrument was made by the 'Optical-mechanical Institute' based since 1819 in Munich and lead until 1826 by Joseph von Utzschneider and Joseph von Fraunhofer (d. 1826). The 1868-inventory of the Observatory 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 (length 71, Ø 5.5-6.5) fitted with brass, standing on a brass folding tripod (azimuthal), with wooden adjustment handles at both axis. 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. 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 in 1830 by J.J. Littrow. 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. Through this arrangement only a small piece of flint glass could be used, avoiding the extreme high price of the large flint glass pieces which otherwise would be necessary. However, this arrangement required a very precise alignment of the lenses, reason why these kinds of telescopes – which were solely made at the workshop of Plössl in Vienna – soon were 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 originally was made for an unnamed astronomer at 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 valued by Oudemans in 1888 as being 'of excellent quality', is now lost.

Brass telescope tube (l. 70, Ø 7.5) on ditto tripod mounting (azimuthal, with fine tuning on both axis. 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 (90 x 26.5 x 13) with submerged handles contains five compound oculars (four of which are numbered I to IIII) and some other accessories. Inside the storage box a label is attached with instructions for the usage of these instruments, ranging from an aperture of 26 lines until 41 lines.

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

126. 13669
Brass refractor on tripod stand with storage box
1853
h 57, w 145, d 33
Signed at a the hinge of the stand: Molteni Frs. à PARIS
Provenance: Leiden Observatory, 1853-1931

In 1853 Frederik Kaiser bought this telescope for Leiden Observatory. Shortly before Mr. P.J. Kipp, director of an instrument firm at Delft, had introduced Molteni's products to Kaiser. Having made some observations with seven different Molteni telescopes, Kaiser reported with great enthusiasm about the great qualities of these modest products, which were available for 'amazingly low prices'. The 1868-inventory of Leiden Observatory gives the description : 'A telescope by Molteni, with an aperture of 34 lines [= 7.7 cm] at 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 (length main tube 108, Ø 8; eye tube 50, Ø 4.2) with dust-cap on a brass azimuthal tripod. The achromatic objective is missing. In the eye tube three compound eye pieces can be placed, (two with sun filters, one with a dust cover slide). The oak storage box (115 x 25 x 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

127. 11920
Refracting telescope
1853
w 92, Ø 6
Signed: MOLTENI FRÈRES. PARIS
Provenance: Leiden Observatory, 1853-1969

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

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

128. 10503
Refracting telescope
1853
Length between 40 and 113, Ø 6.5
Unsigned, but attributed to J. Molteni, Paris
Provenance: Leiden Observatory, 1853-1969

The 1868-inventory of the Leiden Observatory mentions two little 'Zugfernrohre' by Molteni, with astronomical oculars mounted at a wooden stand 'which I have recommended for dilettantes'. Probably this telescope is one of these entries. The wooden stand is missing now.

Telescope (l. 40-113, Ø 3.2-6.5) in five drawtubes made of brass, the outer tube painted in a dark brown colour. With a solar and dust cap at the objective and a shutter at the ocular. All optic 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

129. 13710
Large achromatic telescope on iron mounting
1856
h 12, w 266.5, d 12
Unsigned, but made by Steinheil in München
Provenance: Leiden Observatory, 1856-1933

In 1856 this large walnut telescope was ordered for Leiden Observatory at the workshop of Carl August Steinheil (1801-1870) which was founded at 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 Reunion for the observation of the transit of Venus. At that occasion the telescope was equipped with a helioscopic ocular by Merz with polarisation filter and a photographic camera. However a cloudy sky hindered a proper observation of the transit. At its return at Leiden observatory the crown glass lens appeared to be broken. In the process of preparation for the observation of the second Venus transit, in 1882 at Curaçao, this broken objective was replaced by another made by H. Schröder. At this occasion some other changes were also made at the instrument: a partly reflecting prism was attached for the lessening of the intensity of the sunlight; two wedge-shaped pieces of coloured glass were put in front of both achromatic objectives, the ocular tube was provided with a new set of cross wires and a firm wooden tripod stand was made to the telescope. on which he was movable with crossbars in horizontal and vertical direction.

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

130. 20731 & 17795

a. Achromatic telescope on tripod stand
1819-1839
h 90, w 133, d 45
Signed at the base of the main tube: Utzschneider u. Fraunhofer in München
Provenance: Deventer Natuur- en Scheikundig Genootschap, to be placed in the Deventer HBS, 1867-1974

To celebrate its 50th anniversary in 1867 the 'Natuur- en Scheikundig Genootschap' at Deventer permitted itself the indulgence of buying a good quality telescope. But with a price of 611,50 Dutch guilders this second hand 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 length: 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. In 1867 this mount was bought together with the Utschneider & Fraunhofer telescope, mentioned before. Evidently it was an accessory added to the telescope on a much later date.

Van Helden 2002, no. 191& 191a

131. 11895
Achromatic lens telescope
1826-1839
Length between 94 and 105, Ø 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 lead by Georg Merz who bought the company in 1839, having kept all those years the name of the late Fraunhofer as a guarantee for the workshop's quality.

The telescope (l. 94-105, Ø 5.4-7.5) is made of pear wood and brass. It has an achromatic objective (Ø 5.8) of which the 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 missing now.

Engberts 1970, 108-109

132. 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 Rotterdam based firm of instrument makers was founded in 1763 by A.C. Reballio (c. 1720-1801) and lasted five generations until its demolition around 1925. As most artisans of Italian decent, in the beginning the Reballio's specialised in meteorological instruments, such as barometers and thermometers. This achromatic telescope is one of the few examples from the period in which they called themselves 'opticians'. The instrument probably was made around 1840, when the firm was driven by A.A. Reballio (1778-1851) and his son A.A. Reballio (1822-1904). As during this period the Dutch telescope industry had come to a stand still, it seems likely that this excellent instrument of high quality is retail, made by some unknown foreign instrument maker. This hypotheses seems to be confirmed by the fact that a similar brass 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 massive, adjustable wooden azimuthal stand, with fine tuning on both axes. 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

VII. REFLECTING TELESCOPES

In the early 1730s a new type of telescope entered 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 eye piece, 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 eye piece 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 eye piece in the lign of sight of the tube, establishes also 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 thus magnification) can be achieved. However, in the 18th century it was far more easy to make a concave mirror with the necessary optical requirements, then a convex one, so the Gregorian type remained the most popular one for a long time.

A. BRITISH & FRENCH REFLECTORS

133. 9699
Newtonian reflecting telescope on a table support
c. 1733
h 112.5, w 153.5, d 57
Unsigned, but made 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 feet' 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 Musschenbroeks 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 however being unknown. In the early 19th century the instrument entered the market again 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 azimutal table support. The finder on the tube (still mentioned in the 1838 auction-catalogue) is missing now. The main mirror has a diameter of 13 cm. The secondary mirror has an oval shape (2.6 x 1.8 cm). 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 contained 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; Inventory Diodati 1784; Catalogus Librorum 1838, 61; Invent. 1868, E-21; Autographic note by Kaiser in Arch. MB 571; Engberts 1970, 15-17

134. 8165
Gregorian reflecting telescope on wooden support
1736-1739
h 53.5, w 77, d 30
Unsigned, but attributed to E. Scarlett (d. 1743), 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 on a later date. However, in the 1762-auction catalogue of Van Musschenbroek's instruments it is said 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 Deodati, a wealthy preacher from The Hague, who also bought Van Musschenbroeks Newtonian Scarlett-telescope.

In the 1868-inventory of the Leiden Observatory Kaiser described the telescope as 'an old, but pretty good 2-feet reflector', of which he did not know constructor nor provenance. As Kaiser joined the observatory in 1826 and the telescope is not mentioned in the inventory of 1798, this telescope must be 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 cab 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 eye piece 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

135. 9620
a. Large Newtonian reflecting telescope on wooden support
1736
h 227, w 251, d 80.5
Signed: George Hearne London.
Provenance: Leiden Observatory 1736-1931

This so called '8-foot telescope' was made by George Hearne of London, one of the earliest commercial constructors of reflecting telescopes. Hearne was introduced in the art of making telescopic mirrors by John Hadley.

In 1736 this instrument was purchased by W.J. 's Gravesande for Leiden Observatory at a price of 862 guilders. The instrument was imported by the Leiden instrument maker Jan van Musschenbroek, who filed in a declaration of 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 still mentioned in the 1793-inventory of the Leiden Observatory, but one of them is missing now. 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 missing now. 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 then 30 degrees above the horizon, for reasons of instability of the wooden support of the instrument.

The reflecting telescope is standing 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 dustcover. The distance between the mirrors (c. 215) can be altered by hand. The ocular is fixed in an rectangular copper mounting (9 x 5,2) which can be adjusted. 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 is placed bearing the tube. The inclination of the cradle can be varied slightly.

Accessories to the Hearne telescope
According to the inventories of the Leiden Observatory of 1742 (nr. 32) 1793 (nr. 7) and 1798 (nr 6) the Hearne telescope was accompanied by several accessories and spare parts, some of which are now lost now – such as a little brass quadrant for measuring altitudes - and some of which – described below – are still present.

b. Oculars 9620
Wooden box (22,5 x 18,5 x 11,5 cm), marked 'A 10', containing two tubes with oculars and five loose oculars (of which two 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.*

c. spare mirrors 9620
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.*

d. Micrometer 18960
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 no. 9620, purchased in 1736.
This micrometer was first mentioned in the 1742-inventory of Leiden Observatory. A few years later (in 1751) Lulofs values this micrometer as 'very good'. The inventory of 1798 has a remark saying the micrometer is 'partly defect'. 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, nr 113; AC I-110; Invent. 1742, nr. 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

136. 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, made in Edinburgh (Scotland) shortly before his move from to London in 1737. Five years earlier Short had started producing reflecting telescopes. In contrast to most other British instrument makers Short only produced mirrors. Thanks to this specialisation he enjoyed an unequalled fame. Robert Smith, in his *A compleat System of Opticks* of 1738, praised Short as by far the best constructor of reflecting telescopes. 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 (19 x 8,5 x 7; cracked cover) in which the instrument also can 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

137. 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 in 1741 by James Short, 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 this is probably one of the first Cassegrain-type telescopes Short has made. The number '290' is referring 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 very likely the telescope originally was accompanied by several other secondary mirrors and eye tubes, facilitating also a Gregorian arrangement and other magnifications. (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. At the main tube a brass finder (l. 28, Ø 2.0) is attached.

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

138. 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 (69 x 30 x 20) with original brass mounting contained several notes from former owners. According to a written instruction dating September 1833 the telescope belonged to a certain J. Hisser, who had observed with it 'from here' the large clock at the town of Goes. Archival records show that the only person fitting to this name is the merchant Jan Hisser (d. 1853) living in nearby Middelburg. According to Hisser the telescope was in its category the best he ever had seen 'surpassing all the others in purity, field of view, clearness and magnifying power'. He had used the instrument several times for observing Saturn's' ring and the Jupiter bands. As a similar Short- telescope was auctioned at 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 this was his instrument. In 1798 Fokker had installed an astronomical observatory in the Abbey of his home town Middelburg, being operational at least until 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 (2.3) and can be closed with a dust cap. The eye piece (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. In four tin cans seven other secondary mirrors are store, one of which can be used to change the telescope into a Cassegrain arrangement. Two other eye tubes with compound oculars are also present.

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

139. 8150
Reflecting telescope on tripod stand with wooden case
1747-1748
h38, w 42, d 20
Signed: George Sterrop MAKER
Provenance: bought c. 1928

This Gregorian telescope can be stored in an oak case (44 x 17 x 10 cm) in which an engraved label is fitted, being a short manual in the English and French language 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 during the years 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

140. 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 equipment regulates the fixation 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

141. 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, working from 1738 until 1773. He was the son of the instrument maker John Urings I, operational at London from 1709 until 1751. Only of 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. Eye piece (l. 8.5, Ø 2.8) with compound ocular. Its screwable sun filter is missing.

Engberts 1970, 35; Clifton 1995, 285

142. 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 eye piece (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 (48 x 18 x 10) the old owner's inscription 'BT' can be read.

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

143. 8159 & 6131
Gregorian reflecting telescope with heliometer objective

1760-1780
h 52, w 75, d 30
Signed at the tube: P. Dollond London
Heliometer: unsigned
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'. Wit the latter, most likely this combination of a reflecting telescope with a heliometer objective was meant. 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 no alternative than 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 feet Dollond reflector with pairing heliometer was once the personal property of Frederik Kaiser, 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 with a semicircular gear work (Ø 12). No scalar division. The ocular tube (l. 7.5, Ø 3) has a compound ocular. At the tube a brass finder (l. 25, Ø 2.0) is attached of which the objective is missing.

The mounting of the heliometer objective (h 4.3, w 37.5, d 13.2) is made of brass. At one side the brass frame can be fixed on 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 at a scale with a length of 5.5 inch 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

144. 6130 & 12802
Heliometer objective with wooden box for a – now missing – Dollond reflector
1765-1768
l 50, w 20, d 7
Unsigned, but 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 Physical Laboratory, 1889-1926

This heliometer objective is one of the few surviving instruments of the illustrious astronomical observatory of the reverend Johan Maurits Mohr at Batavia [now Jakarta], which was built and equipped in the years 1765-1768 and was dismantled already after an earthquake in 1775. Most likely it was part of the first shipment of scientific instruments which was send to Batavia in 1765. After Mohrs's death his instruments were bought by the vicar Jan Hooijman at

Batavia, who transported them to Amsterdam for repairs. After more then ten years on an attic of the Amsterdam merchant Hendrik van Akker, Mohr's instruments were used in 1787 to equip the newly erected astronomical observatory of the Society for Arts and Sciences 'Felix Meritis' at Amsterdam. Inventories of the scientific instruments of this Society lists a large 4½ feet Gregorian telescope with heliometer objective made by Dollond, London. It is likely this reflector which is depicted in a 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 Physical 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 side the brass frame can be fixed on a telescope. with a tube diameter of 16.6 cm. Angles can be read using a vernier at a scale with a length of 8 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 received 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

145. 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

This nicely crafted Chippendale styled telescope made by the well known Dollond workshop is decorated at the top of the support with see-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 axis. 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

146. 8030
Gregorian reflecting telescope on tripod stand
c. 1770-1790
h 30, w 43, d 19
Signed around the eye-piece: Chevallier. Ing.^{r} M ^{bre} de l'Athenée des Arts. à Paris.
Provenance: Sotheby, 1984

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

Gregorian reflecting telescope, the objective tube (l. 35, Ø 7) with green leather binding and French style tooled gilt decoration, focussing 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 eye piece (l. 7.5, Ø 2.5) has a compound ocular.

Cat. Sotheby, sept. 1984, no. 228

B. Reflecting telescopes of Dutch origin

147. 9651
Large Cassegrain and Gregorian reflecting telescope on tripod stand
c. 1742
h #, w 225, d 162
Unsigned, but designed and partly made by Jacobus van de Wall at Amsterdam. His monogram is depicted in the quadrant. The (now missing) mirror was casted by Ulrich Bley from Amsterdam
Provenance: J. van de Wall, Amsterdam, c. 1742-1782; Leiden Observatory, 1782-1989

Large reflecting telescope made about 1742 by Jacobus van de Wall (1700-1782), an Amsterdam merchant who was driven by an optical and perhaps purely mechanical interest. The – now missing – mirrors with a focal distance of 8 feet were casted 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 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, Lalalnde and Bugge. Van de Wall also showed them still larger mirrors with a focal distance of twenty feet, however this telescope was never finished. Other, smaller reflecting telescopes made by Van de Wall have not survived or are not recognized as such. In 1782 this telescope was bequeathed to Leiden University, then still being the largest reflector in the Netherlands. However, it never was used properly, although the quality of the instrument was highly regarded by astronomers like Hennert, Van Beeck Calkoen and Kaiser.

Dark copper telescope on a heavy azimuthal tripod bearing, making a triangle at the floor with sides of 162 cm. The bearing has a steel axis, which bears the telescope. On the main tube (l. 215, Ø 23) a finder telescope (l. 108

Ø 4) is placed. However, all 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 with radius 52 cm has a divided scale ranging from -90° to +90°; an altitude quadrant with radius 73 cm has a scale from 0° to 90°. Pointers allows reading with an accuracy of 5'.

Originally this telescope had the following accessories: four large main mirrors, twelve Cassegrain mirrors and one Gregorian mirror in a copper box, three eye tubes for various magnifications, an enlargement tube of two feet for the Gregorian arrangement, and some diaphragms. The telescope is on semi-permanent display at the Oort-building of Leiden university since 1998.

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

148. 8879
Small hand held Gregorian reflecting telescope
c. 1750
h 4, w 19, d 3.3
Signed: H[K]. PRINS Fecit Amsterdam.
Provenance: Bought wits 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 as early as 1712 had constructed some reflecting telescopes.

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

149. 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 exceptionally equatorial stand with a fixed polar height of c. 53 degrees (suited for the Northern Netherlands). The instrument is a joint product of Gerrit Cramer (1707-c. 1755) from Groningen and Jan van der Bildt (1709-1791) from Franeker. In 1745, after 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 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 wel as several reflectors and Foppes delivered an ingenious 'surveying machine' to the Princely 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 prolongs 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. At the base of the instrument a divided circle (Ø 26.5) is placed with a pointer parallel to the tube, having three different scales: two times 0-180° (subdivided in 15'), four times 0-90° and in 24 hours. A geared bow (Ø 7) divided with a scale 0-90° (subdivided in 15') can provide a vertical reading. At the base a water level is missing.

Engberts 1970, 29-31; Zuidervaart 2004

150. 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) at Leeuwarden. was one of those 'men of the province' 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 collection of Museum Boerhaave). This princely order stimulated 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. The telescopes he made resembled those made by Short or his colleague 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 (24 x 10 x 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

151. 8154
Gregorian reflecting telescope on tripod stand
1745-1760
h 38, w 42.5, d 20
Signed: 'I. VAN DER BILDT FRANEKER'
Provenance: Collection Burgers, 1946

Jan Pietersz van der Bildt (1709-1791) started 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 on experimental physics at the Stadholder's court. At that time König characterized 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 specialize in the construction of reflecting telescopes. It is estimated 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

152. 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 day's Jan van der Bildt signed his telescopes with 'I van der Bildt', later on he changed this signature to 'J. van der Bildt'. Around 1768, after a huge quarrel with his sons 'Jan Junior' and 'Lubbertus', who both had started making similar but inferior reflectors, Jan van der Bildt 'the elder' started to number his telescopes, the lowest number known being 316; the largest number 536 (both in the private collection of Mr. Peter Louwman, 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

153. 8202
Gregorian reflecting telescope
1745-1760
h 57, w 79, d 32
Signed: I. van der BILDT FRANEKER
Provenance: Collection Burgers, 1946

At some point in the past the tube of this telescope was enlarged probably to house a speculum with larger focal length. The original length of tube was 65.5 cm, which means that in old Dutch measures this originally was a '27-duims-telescope' with a focal length of around $2\,{}^{1}/_{3}$ feet. After enlargement the focal length rose to $2\,{}^{2}/_{3}$ feet. It is possible that this enlargement was done by Van der Bildt himself. In 1773, in a letter to a business companion, he described a change of specula of four of his earlier telescopes. And in the 1789-catalogue of the Amsterdam Ebeling-collection, a Gregorian reflecting telescope made by Dollond is mentioned, of which the original mirrors 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. To the objective tube a brass finder (l. 24.5, Ø 2,5) is attached with simple objective, simple ocular and a shutter.

Engberts 1970, 36-37; Zuidervaart 2004

154. 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

Probably around 1760 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

155. 20341
Gregorian reflecting telescope with mahogany case
c. 1760-1770
l. 46, Ø 7.5
Signed: J. van der BILDT FRANEKER
Provenance: Deventer Atheneum, becoming in 1845 the Deventer HBS, pre 1828-1980

This Van der Bildt telescope with its mahogany case is mentioned in the inventory of the Deventer Athenaeum made up by Dompeling in 1828. 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 L. Chernac. As this telescope fits the description, it is possible it is the same instrument.

At some point in its history the speculum of this telescope has been changed. In a rather crude way the tube is enlarged by 6 cm, enabling the usage of a speculum with larger focal length. In this process the secondary mirror was also adjusted.

This brass Gregorian reflecting telescope is kept in a mahogany case (51.5 x 19.5 x 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

156. 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: Collection Burgers, 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 in which Van der Bildt only 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), secondary mirror (Ø 2.3) and can be closed with a flat dust cover. The eye piece (l. 8.5, Ø 2.4) has a compound ocular with a red sun glass.

Engberts 1970, 37

157. 9964
Gregorian reflecting telescope on tripod stand
c. 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 the Franeker University. In that quality he made some equipment for professor Antonius Brugmans, who at 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 laudated skills.

Brass reflecting telescope 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), 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

158. 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. Probably about 1768, Van der Bildt started to number his telescopes; to distinguish them from the ones 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), secondary mirror (Ø 2.0) and a (damaged) dust cap. The eye piece (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 (47 x 18 x 11 cm) with brass handles.

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

Engberts 1970, 39-40

159. 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 at 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 eye piece (l. 7, Ø 2.5) has a compound ocular with sun filter.
At its base the azimuthal tripod stand is marked in white ink with the inscription '1950 n. 3'.

The instrument can be stored in an (not original?) oak box (98 x 27 x 19 cm), with a paper label of the Amsterdam auction house Bom & Zoon. It contains a little pillbox with two some screws, a cardboard box (13 x 13 x 4) with three compound oculars of various sizes and two sun filters (both not fitting on the telescope) and a black painted tin box (8 x 7 x 13 cm) with two spare convex secondary mirrors (Ø 2.1 and 2.4).

160. 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 4-feet 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, already in 1750 he had produced a replacement speculum for the Leiden eight-foot Hearne-reflector, which mirror 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-feet 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 of Leiden University. The instrument is not listed in the inventory made 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 in a bombardment 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 eye piece (l. 111, Ø 3.5) is made in two segments and contains an incomplete compound ocular, with an orange sun glass.
On the tube a small finder (l. 18, Ø 2.5) is attached 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 plane.
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

161. 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 '4 feet-telescope' by Van der Bildt made according to its signature and numbering at a later date than the telescope described in the last entry. A similar telescope with storage case was auctioned in 1838 at The Hague in the cabinet of J.J. Cau.

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 on the ground a rectangle of 106 x 60 cm.. With large worm wheels the orientation of the tube can be adjusted in both the vertical and horizontal plane. 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 optics of the eyepiece tube (l. 11, Ø 3.5) is missing, as is the finder. The large wooden case (142 x 28.5 x 31) has a nicely crafted convex cover with brass fittings. It contained a handwritten manual (c. 1900) and an address card from the instrument makers firm 'P.J. Kipp & Zonen, W.J. Giltay opvolger' at Delft with the address of old owner J.J. Taudin Chabot at Rotterdam (1903) and Wurttemberg (1904).

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

162. 9046
Gregorian reflecting telescope on tripod stand with case
c. 1770
h 32, w 45, d 25
Signed at the back plate: CUTHBERTSON, & CHAMPNEYS, AMSTERDAM.
Provenance: Christies London, 1987

In 1768, in the year before the second Venus-transit, 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 market of scientific instruments. This implied a severe competition with 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 got convicted for infringing this patent, which measure eventually lead to his bankruptcy. This probably was 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 to come 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 after 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 focussing 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 eye piece (l. 8, Ø 3.3) has a compound ocular. The instrument can be kept in a mahogany storage case (46 x 18 x 9 cm) with brass plaque, covered at the inside with red velvet. An old owners mark can be read at the wooden edge: *'637 J.C.. H. L.R. f.'*

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

163. 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 from his father from about 1768. Little is known about the life of these two sons. In 1755 Jan van der Bildt junior matriculated as a student to Franeker University. After his marriage in 1762, he was convicted on several occasions for fighting and purgery. 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, of which the dust cover slide is missing. The instrument can be kept in a wooden storage case (48 x 18 x 10 cm) covered at the inside with green paper.

Engberts 1970, 32; Rooseboom, 30-34

164. 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 from 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), secondary mirror (Ø 1.4) and a dust cap. The compound ocular has a sun filter.

Engberts 1970, 48; Zuidervaart 2004

165. 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 both sons had dissociated themselves from their father after 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), secondary mirror (Ø 2.0) and dust cap. The eye piece has a compound ocular with sun filter. Some minor parts are missing. The instrument can be kept in a mahogany storage box (47 x 18 x 10 cm) with a crack in the cover.

Engberts 1970, 40-41

166. 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 'telescope maker' at 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 den 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 (14 x 5,5 x 5).

Engberts 1970, 42; Zuidervaart 2004, 40 & 44

167. 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 at Franeker University as keeper of the scientific instruments.

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 eye piece has a compound ocular.

168. 28471
Gregorian reflecting telescope with case
h 37, w 36, d 23
Signed: B.E. van der Bildt
Provenance: H. Hen, c. 1810; Collection Burgers, 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), secondary mirror (Ø 2.3) and a dust cap. The eye piece has a compound ocular.
The instrument can be kept in a mahogany storage case (46 x 18 x 10 cm) which contains a rectangular tin box with a spare secondary mirror marked: '70 maal' [= magnification 70 times].

At the inside of the cover a paper label is attached testifying the retail 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

169. 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. At the top of the vertical column an undivided semicircle is placed 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), secondary mirror (Ø 3), and a dust cap. The eye piece (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 three spare secondary specula are preserved, two concave mirrors (Ø 2.1) and a convex one (Ø 2.8), facilitating also a Cassegrain arrangement of the telescope.

Engberts 1970, 51-52

170. 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 Buiksloot (near Amsterdam) probably was 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), secondary mirror (Ø 2) and a dust cap. The eye piece (l. 6.5, Ø 2.5) has a compound ocular.

Engberts 1970, 53

171. 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 submission of all brass and copper objects in the possession of civilians, at the imperative 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 a 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. After the completion of these telescopes in about 1828, it transpired that the instruments, although of excellent exterior appearance, were completely unsuited for the intended astronomical observations. In the 1850s both telescopes were dismantled.

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

172. 8166
Newtonian reflecting telescope
c.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 (1770-1845), who worked as an instrument maker since 1798 and settled in Leiden in 1826.

In 1809 Rienks made a 4-feet reflecting telescope which was used by professor Ekama at Franeker and Leiden and which eventually was bought for Leiden Observatory. A similar telescope was bought in 1820 for Gent University, followed in 1827 by a 4-feet telescope for the new Astronomical Observatory in Brussels. The Leiden and Gent copies were placed on an wooden azimuthal table support, whereas the Brussels-reflector had a brass equatorial tripod stand. This 2-feet telescope resembles the one made for Brussels, which still is preserved at the Observatoire Royal de Belgique. An almost identical 2-feet 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

173. 8147
Newtonian reflecting telescope
1775-1825
h 51, w 42, d 26
Unsigned, but 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 are made at a later date.
The 1868-inventory of the Leiden Observatory mentions 'two small telescopes by Rienks with little value'. Perhaps this was one of them.

This brass telescope (tube length 39, Ø 8.5) lies on a wooden cradle (l. 23), connected with a ball-and-socket joint on a brass azimutal 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

174. 12234
Telescopic mirror
1829-1845
d 1.6, Ø 11.5
Signed at 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 is produced during the casting process of the mirror. The diameter of the hole in the mirror is 3 cm.

Rooseboom 1950, 30

C. UNSIGNED REFLECTORS

175. 8842
Small Gregorian reflecting telescope with case
1750-1800
h 3, w 17, d 3
Provenance: Collection van Seters, 1957

Brass hand held Gregorian telescope with an objective tube (l. 11.5, Ø 3) covered white with ray-skin. The tube contains a main mirror (Ø 2.5), secondary mirror (Ø 0.8) and a dust cover. The eye piece has a compound ocular. The storage case (19 x 5,5 x 4) is covered with black shark skin.

Engberts 1970, 50

176. 8163
Small Gregorian reflecting telescope on tripod stand
1750-1800
h 15, w 18, d 10
Provenance: Collection Groenendijk, 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.

Engberts 1970, 46-47; Koperen Kabinet 1994, 54

177. 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 on 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

178. 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

179. 8841
Small Gregorian reflecting telescope with case
c. 1800
h 4, w 14, d 3.5
Provenance: Collection Burgers, 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 (20 x 5 x 4.5 cm) is covered on the outside with black leather and at the inside with green plush.

Engberts 1970, 49

180. 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 screw thread with which it can be attached into a wooden storage box (20 x 9 x 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). On the eye tube a somewhat wider tube can be pushed, with a diaphragm (Ø 0.1) an a dark-red screen for solar observations.

Engberts 1970, 43

181. 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 eye piece (l. 7, Ø 2) has a compound ocular with screwable sun filter.

Engberts 1970, 44-45

182. 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 eye piece has a compound ocular.

Engberts 1970, 50-51

183. 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 on 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

184. 11916
Reflecting telescope without stand
1750-1800
Length between 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 eye piece (l. 12, Ø 2.7) has a compound ocular with screwable dust cap. One butterfly nut is missing.

Engberts 1970, 45

185. 17551
Metal mirror for a reflecting telescope
1800-1875
w. 2, Ø 15.5
Provenance R.H.B.S, becoming the Hegidius Scholen gemeenschap, Deventer, 1974

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

Van Helden 2002, no. 193

VIII. ASTRONOMICAL PRECISION INSTRUMENTS WITH TELESCOPIC SIGHTINGS

In the last quarter of the 18th century technical expertise of the scientific instrument makers reached a pivot in the construction of new astronomical and geodetical instruments, having a precise scalar division of a quality, unheard of before. 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 geodetical theodolites.

186. 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 during the period 1680-1885 produced an impressive stock of maps, books and scientific instruments relating to the art of navigation. 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 probably is 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 in 1769 to his aunt Anna Hendrina Calkoen.

In about 1800 the universal equatorial telescope represented state-of-the-art technology, but 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 wel 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. A compass (Ø 11) is 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

187. 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 on Delft Geodetic Institute), 1843-1934

This precision telescope made by the French instrument maker Pierre Bernard de Mégnié was ordered in June 1779 by the professors Jan Hendrik van Swinden and Nicolaas Ypey for Franeker University. 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'. At the end of 1780 the telescope arrived in Franeker. In 1782 Van Swinden ordered a similar instrument 'like the one delivered in 1780' for the cabinet of the scientific amateur J.A. van de Perre at Middelburg.
In 1812, after the closure of Franeker University by Napoleon, Professor Cornelis Ekama, being transferred from Franeker to Leiden University, took the equatorial with him, to serve at Leiden Observatory. In 1819 in Leiden this very instrument was the subject of a crowned prize essay written by Benjamin Kam, a theological student who had attended Ekama's astronomy lessons. Two years later Ekama was forced to return the instrument to the newly founded Franeker Athenaeum. After its arrival in Friesland it was established that 'the beautiful and costly telescope by De Megnié' was in a very bad shape. In 1843, after the closure of the Franeker Athenaeum, most instruments – including Megnie's equatorial – were sent to the Royal Academy of Civil Engineers at Delft, where this equatorial eventually was 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 (tube length 91.5, Ø 5.0-6.0) is mounted at a cradle on a nicely crafted brass equatorial mounting that had to be fixed on a table, before usage. 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. Simple ocular with sun filter. With a semi-circle the polar height can be adjusted by means of a fine tuning with a worm gear over both axes. The ivory handles are partly incomplete. With a vernier precise readings can be made on both circles (Ø 21). The number '1' on the instrument indicates that this was the first instrument De Mégnié made in the year 1780. A similar equatorial (missing the telescope), dated 1784, is in the collection of historical instruments of the Brera Observatory, Italy.

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

188. 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 to buy a large state-of-the-art repetition circle made in Paris by the precision instrument maker Etienne Lenoir (1744-1832). The instrument was delivered in March 1819 for the amount 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 large Merz-refractor (with an aperture of 7 inch), which was delivered in 1861 for the northern dome of the new observatory. In 1919 this so called '7-inch Merz telescope' was given to the Bosscha Observatory at Lembang (Indonesia) to serve – in its turn – as a finder for a large Bamberg telescope made in the 1920s. In Lembang the Merz telescope still serves practical astronomy today, however without its 'original' Lenoir 'finder' (Courtesy Prof. Bambang Hidayat, Lembang 2005).

This large repeating circle (Ø 53) can be rotated in any plane. It is mounted at one side of a steel axis placed 109 cm above the ground level. At the other side of the axis a counterweight (Ø 14.5, w. 4) is placed to balance the instrument. Around the counterweight a rack-and-pinion arrangement is placed 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. At the centre of the divided circle a telescope is mounted 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 pivoted telescope. At the scalar division of the large circle (0 – 360 degrees) four small microscopes were placed for the reading of the verniers (divided 0-40), of which one is missing now.
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 varying between 4.5 and 10). At the base a smaller divided circle (Ø 25; division 0 to 360 degrees) is placed 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 has 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 a label signed 'Lenoir, Ingenieur pour les instruments a l'usage des sciences' (no. 16168) probably was used for storing one of the telescopes of the instrument. 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; Invent. 1868, A-26; Bennet 1987

189. **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 preceding large circle by Lenoir. The repeating principle was invented in 1785 by the French mathematician Chevalier la Borda on a theoretical basis developed in 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 difference with La Borda who used one telescope and a mirror Lenoir equipped his repetition circles mostly 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 on 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

190. 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 this theodolite and levelling device with two telescopes was given by the Dutch government to the Leiden Observatory, where the Amsterdam instrument maker E. Wenckebach transformed it into a portable transit telescope. The instrument was adapted for its 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 instrument makers firm of Troughton & Simms, operational since 1826, being 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 (Ø 26; h. 4.3), which can be adjusted with three levelling screws. In 1955 two missing levels and a levelling screw were crafted.

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

191. 12822
Universal instrument
1824-1838
h 55, w 41, d 28
Signed at 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 by Traugott Leberecht Ertel (1778-1858) about 1820, 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 observation in every position of the telescope tube. This arrangement lightened the observations and contributed to the accuracy of the measurements.

This 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, lead by Ertel since 1820. The second workshop was separated from the first in 1809, owned by Von Utzschneider and directed by Joseph von Fraunhofer. After the latter's death in 1826 Georg Merz directed 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. To this universal instrument belongs a handwritten description by Ertel with the title '*Erlauterungen zu einem Universalinstrument*'.
In 1875 the instrument was refurbished to be used by university students for instruction purposes. In 1944 the instrument was severely damaged during a bombardment of the museum, but was recently (in 2005) restored.

A vertical conical-shaped tripod rests on three adjusting screws (each having a revolvement scale ranging from 0 to 100). 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 among the vertical steel axis of the stand. At the height of 30 cm a horizontal 'alhidade' circle (Ø 27) is connected with this movable cylinder. Below this azimuth circle a rectification telescope (l. 28, Ø 3) is located, having a simple objective (Ø 3.5) with dust cap. Its ocular is missing. A second movable circle (Ø 25) bearing the telescopic arrangement is positioned concentric with the first circle. The azimuth displacement of both circles to each other can be measured by means of an inlay silver scalar division with vernier readings at the outer circle, to be read with four reading microscopes.
On top of the inner horizontal circle a cradle is located which holds the horizontal hollow axis (l. 28) of the telescope, placed between two vertical circles (Ø 20.5), both having an inlay silver scale. The telescope tube (l. 20, Ø 4-5) is located in the middle of this axis, where a prism reflects the light to the compound ocular at one of the axis ends. Here a (now missing) pointer allowed a first reading of the inclination. At the other end of the axis a smaller 'alhidade' circle (Ø 19) rotates with the telescope, allowing at the silver scalar division a precision vernier-reading of the inclination with four reading microscopes (one missing). Two precision counter-balances within the cradle provides the possibility to adjust the weight of the telescope.
According to Kaiser this instrument allowed readings with an accuracy of 10 arc seconds at the vertical and 4 arc seconds at the horizontal circle. The telescope which was described in 1868 as having an aperture of 15 lines [= 3.4 cm] has an achromatic objective (Ø 3.4) with a dust-cap.

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

192. 8200
Portable transit instrument
1834-1838
h 51, w 35, d 28
Signed at the azimuth circle: Ertel & Sohn in München
Signed at the objective: Utzschneider u. Fraunhofer in München
Provenance: Leiden Observatory,1838-1935

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

These two precision devices were the first instruments ordered by F. Kaiser, after 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 separated from those of the observer. The first measurements on the polar height superseded Kaiser's expectations.

Three adjusting screws bears a horizontal circle (Ø 34) in the centre of which a vertical rod is placed. Around this rod a hollow conical bus can rotate at the lower end of which a second horizontal circle (Ø 30) is placed, with a silvered scalar division and four vernier readings.
At this movable circle two heavy triangular bearings are placed, 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. At one of the ends of the axis a compound ocular is attached. At the other end of the axis a vertical scaled circle (Ø 14.5) is attached, with a scalar division for reading the inclination. The telescope which 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

193. 10680
Universal Instrument
1853
h 58, b 50, d 44
Signed: A. & G. Repsold Hamburg. 1853.
Provenance: Leiden Observatory, 1853-1931

Three generations leaded the Hamburg Repsold firm, starting around 1799 with Johann Georg Repsold, who was succeeded in 1831 by his suns 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 by F. Kaiser for the Leiden Observatory 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, it was necessary to combine the grants for the years 1849-1851, providing an amount of 1.440 guilders. A special grant of 600 guilders allowed the purchase of the instrument, which was delivered in 1853. The instrument was used inter alia 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 bears a horizontal tripod on which an immovable horizontal circle (Ø 35) is attached. A movable hollow column (Ø 7-13) can rotate among the vertical axis of the stand. At the lower end of the column a second horizontal circle (Ø 32) is placed, with a silvered scalar division. The other side of the column bears the horizontal axis in the middle of which the telescope tube (l. 31, Ø 7) is placed, with an (now incomplete) ocular at one of the ends of the axis. On the cradle of the axis two immovable vertical scaled circles (Ø 27) are attached which 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 which 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 (68 x 59 x 49 cm), 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

194. 5917
Small universal instrument
1858
h 32, Ø 30
Signed: Pistor & Martins Berlin, no 990.
Provenance: Leiden Observatory, 1858-1982

In 1848 F. Kaiser was commissioned by the Dutch government 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 less 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 missing now. 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 went into an association with Martins, forming a firm that existed until 1873.

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

IX. MISCELLANIOUS

195. 11893
Walking-stick with a telescope
1800-1900
h 90, Ø 3
Provenance: Collection Groenendijk, 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 J.J. Cau at The Hague.

Cau 1838, no. 74; Engberts 1970, 123

196. 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 divide by two, its result being the desired altitude.

Van Helden no. 190