Gustav Heyde Dresden Telescope ca 1896 – 1912 – in our collection

Contents:

I. Introduction

We would like to present our astronomical telescope, produced by Gustav Heyde in Dresden, Germany. We presume, that our telescope was manufactured ca. 1896 – 1905.

Let's begin from short film from Royal Museums Greenwich Planetarium.
https://www.youtube.com/watch?v=L7ke7QmfhVQ ;
https://www.youtube.com/watch?v=onpizYulI5c

Origin of the word "telescope" originate from the Greek language – *tele* does mean *far* and *skopein* – to look or see. The word was introduced by the Greek mathematician Giovanni Demisiani, in 1611. He named in this word presented one of the Galileo instrument. Galileo has used the word "perspicillum" – microscope.

II. A short history of the "Gustav Heyde- Mathematisch-mechanisches Institut und Optische Präcizions-Werkstätten"

According to the Dresden archive Heyde Gustav was born on 09. 25. 1846, in Dresden. He died 11.13.1930 in Dresden. At those dates he was described as: "optician, mechanic, shop owner, director of the company Gustav Heyde of Dresden".

On the economical part of the Dresden Archives we can read about economic activity of **Brothers Heyde KG**, in Dresden; dating: 1933-1934:

History: *In 1872, Gustav Heyde of Dresden in a company for astronomical devices.*

From 1919, John JULIUS August Heyde and Ernst Albin JOHN Heyde, both factory owners in Dresden, became co-partners.
*Oskar Hans GUSTAVHeyde was personally liable partner and Manager. The company produced items of precision mechanics, optics and mechanical engineering. In 1931**[**after G. Heyde death**]** the company Gustav Heyde was converted into a limited partnership. In 1945, the company operated under the name Gustav Heyde GmbH. On the basis of the referendum in Saxony of 30.06.1946, the company was expropriated and nationalized. The company was named the "Optics, VVB for precision mechanical and optical equipment" held in Jena, Germany. Since 1949, it was named name "Optics - Feinmess Dresden VEB". His descendant since 1990 is the - Feinmess Dresden GmbH.*

Finally, in 1992 Feinmess Dresden has become a part of *Steinmeyer Group*.

Reading the history of *Steinmeyer Group* Company, we learn:

"In 1872, when Gustav Heyde founded 'Gustav Heyde - Mathematisch-mechanisches Institut und Optische Präcizions-Werkstätten', his first products were optical components. Soon these were followed by circular dividing engines, the prism grindery, and industrially manufactured photographical lenses. By the start of the 20th century, the continuously growing company already sold its products worldwide including manufactured astronomical instruments, optical systems and geodesic measuring instruments. In 1912, the Company counted 200 employees."

The Company was produced the items during WWII. They received a war code; bwt - Heyde K.-G., Instrumente, Dresden N 23, Kleistr. 10.

Gustav Heyde Catalogue[1]

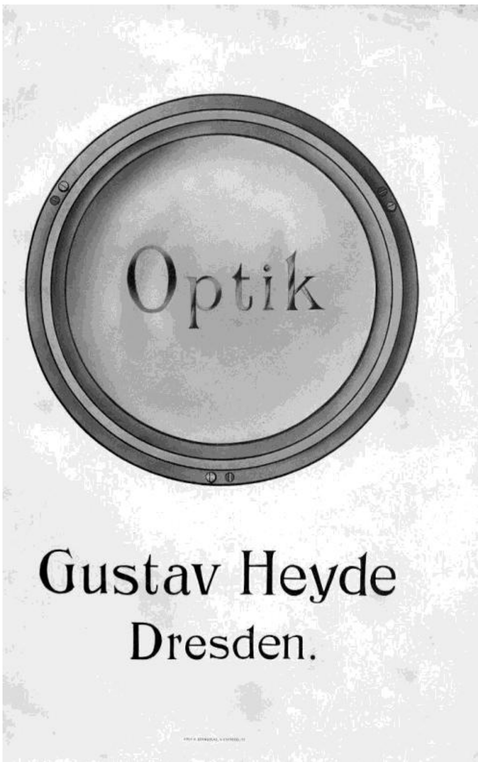
In the Gustav Heyde catalogue, 1911 we found the Company address: "Gustav Heyde, Dresden-A., Fredrichstrasse 18; and telegram address –"Optik Dresden". There it was given address the company branch in Brazil, Rio de Janeiro - Avenida central 29, Caixa postal 1365.
The address in catalogue published in 1912, was changed to: Dresden-N, 10 Kleist-Strasse 10, it remained the same to the WWII.
The address was no more specified in Brazil.

We can learn about devices the Gustav Heyde Company produced from price list catalogues, published by Company.
We have found some - price lists catalogues for;
- Astronomical Instruments - March 1905,
- Optics - January 1909,
- Part machines and auxiliary instruments - February 1911

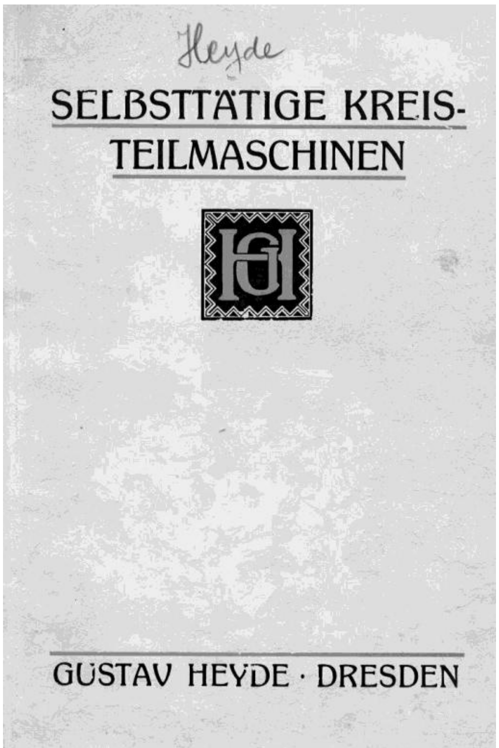
[1] All photos Courtesy http://www.astropa.unipa.it/biblioteca/Strumenti/strum_list.html

- and Astronomical Instruments -December 1912.
As we learnt, the Company published more catalogues.

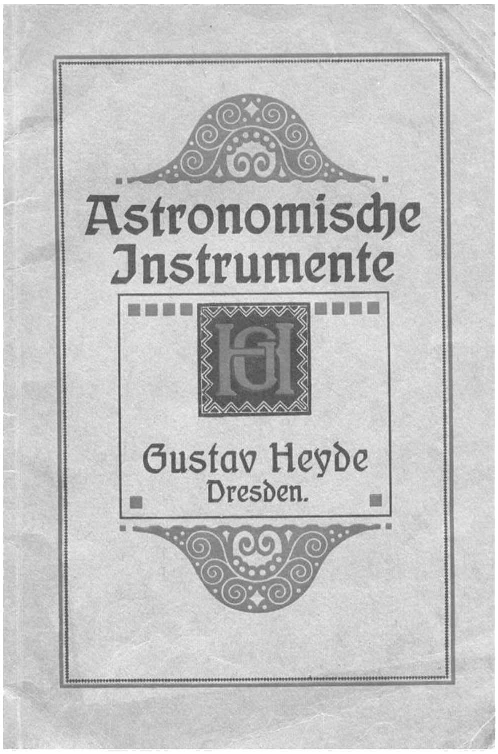
Catalogue 1905 front page



Catalogue 1909 front page



Catalogue 1911 front page



Catalogue 1912 front page

In 1875, Heyde participated in an exhibition of instruments in Dresden.

The company products were awarded since 1896 on the Dresdner commercial exhibition. The pictures of medals were inserted into the 1905 catalogue, page 1.

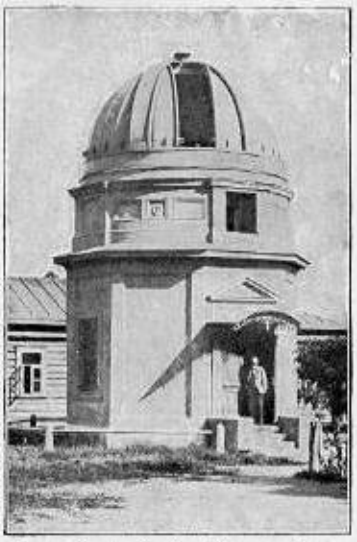
Catalogue 1905, page 1

On the web site of Steinmeyer Group we are reading about the Gustav Heyde products:

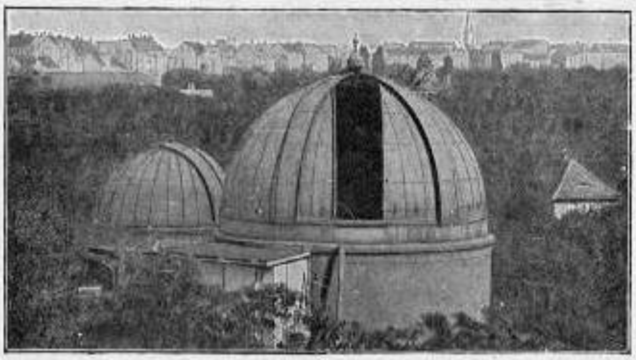
Steinmeyer Mechatronik GmbH:
Precision engineering and precision optics - this combination was the key to success for the company founder, Gustav Heyde. In 1872 he established the "Mathematical Mechanical Institute" which became a rapidly expanding enterprise for high precision optic-mechanical systems [...] or aerial mapping cameras for aircrafts. Astronomical observatories in Moscow, Budapest and Rio de Janeiro were supplied with Heyde's telescopes - including rotating dome and positioning systems.

In the Catalogue 1905 – page 44, we can see the pictures of that observatories:

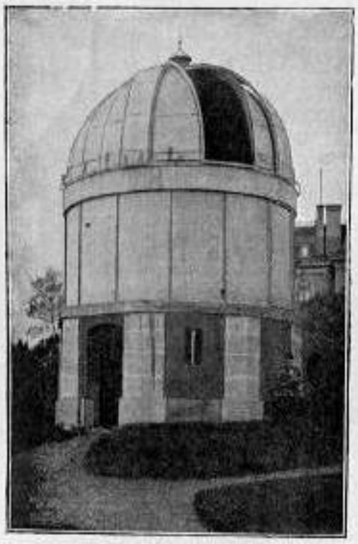
4,5 m-Kuppel, eig. Konstr., des Herrn *Schwanecke, Derenburg i. H.*



5 m-Kuppel, eig. Konstr., der *Kaiserl. Universitäts-Sternwarte Moskau.*

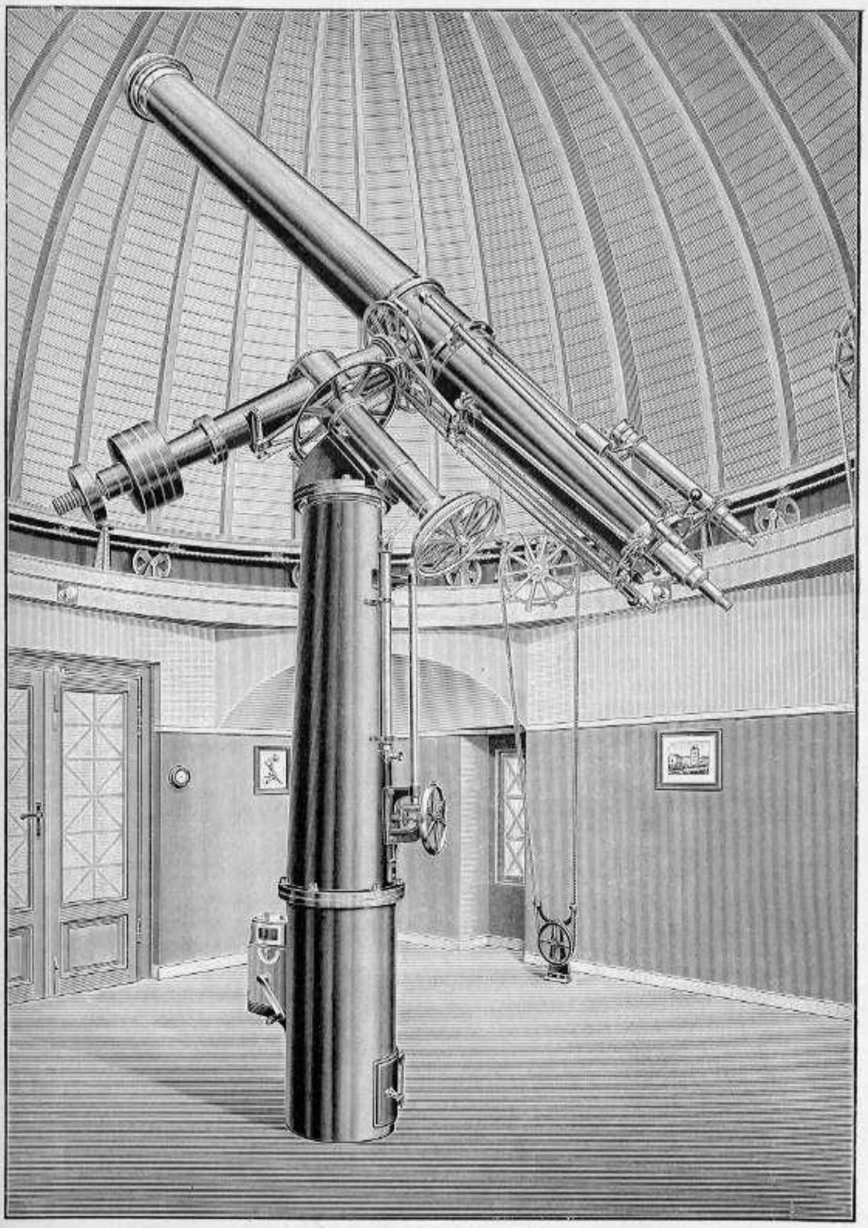


4,5 und 6,5 m-Kuppel, eig. Konstr., der *Sternwarte Leipzig.*



4 m-Kuppel, eig. Konstr., des Herrn Astronom *Winkler, Jena*

5 m-Kuppel, eig. Konstr., der *böhm. Universitäts-Sternwarte Prag*
(vorm. Herrn Pastor *Brödel* in *Stöntzsch* gehörig).



Refraktor Nr. 50

29

Catalogue 1912

Looking through all Gustav Heyde catalogues we can see what the instruments the company was producing:

- Astronomical instruments (telescopes, astronomical oculars, terrestrial oculars, apparatus for winding of spun threads on diaphragms for Telescopes –page 33/1911; collimators;

viewfinders, reflecting telescope, astronomical clocks; chronographs). Some of the instruments were mounted on the large bases.

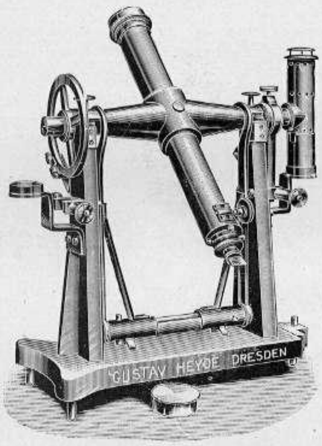
20 Gustav Heyde, Dresden.

suchekreis hat einliegende Libellenalhidade, Nonien Minuten angebend. Okularschlitten, Okularmikrometer mit Prisma und Sonnenglas. Die Hängelibelle ist mit Glasschutz und Tuchumhüllung gegen jähen Temperaturwechsel geschützt. Die Empfindlichkeit richtet sich nach der Größe des Instrumentes, 1—3 Sekunden.

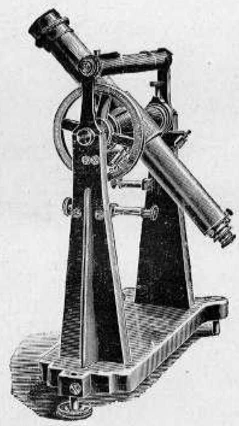
Mk.

36. **Transportables Durchgangs-Instrument** mit geradem Fernrohr von 68 mm Öffnung und 90 cm Brennweite. Vergrößerung 72- und 100mal. Lagerweite 45 cm **1300**

37. **Transportables Durchgangs-Instrument** mit geradem Fernrohr von 61 mm Öffnung und 65 cm Brennweite. Vergrößerung 54- und 76mal. Lagerweite 35 cm **950**



Nr. 39.



Nr. 40.

38. **Transportables Durchgangs-Instrument** mit geradem Fernrohr von 48 mm Öffnung und 54 cm Brennweite. Vergrößerung 36- und 54mal. Nur mit Okularschlitten. Ohne Mikrometer. Lagerweite 25 cm **600**

39. **Kleines transportables Durchgangs-Instrument** mit geradem Fernrohr von 35 mm Öffnung und 32 cm Brennweite. Vergrößerung 36 mal, mit Okularschlitten. Lagerweite 18 cm **360**

40. **Kleines transportables Durchgangs-Instrument** mit geradem Fernrohr von 35 mm Öffnung und 32 cm Brennweite, ganz einfach ausgeführt, mit Aufsatzlibelle. Kreisablesung durch Index. Sehr beliebtes Instrument für Uhrmacher **150**

41. **Unterlegscheiben** mit Stellung zur Azimutalkorrektion **18**

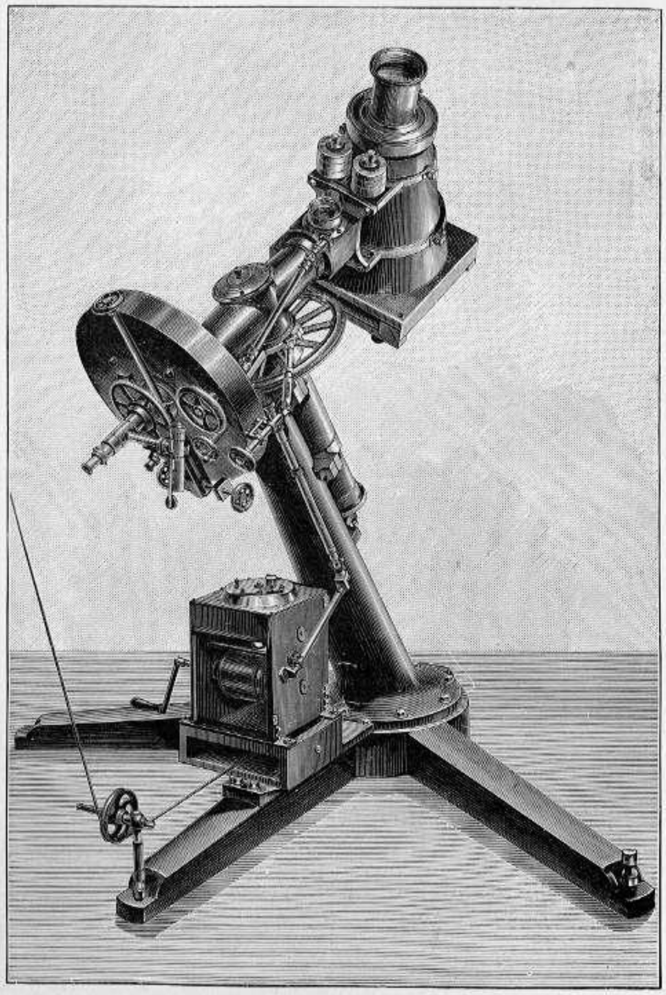
Eine „Anleitung zur Zeitbestimmung mittelst des Passage-Instruments" ist in ausführlichster Weise von Herrn Astronom R. Etzold herausgegeben worden; ich liefere dieselbe auf Wunsch zum Originalpreise von Mk. 2.

Page 20 – 1905 cat

- surveying instruments (Geodetic instruments, measuring instruments, instruments for the character table)
- Optic (objectives, oculars, prisms, Screws and estimation Microscopes, Achromatic telescope lenses; Parabolic mirrors)
- Photographic objective and instruments (Dragonflies with air camera),

28 Gustav Heyde, Dresden.

Photographische Durchmusterungs-Instrumente.



76. **Photographisches Äquatoreal.** Das Achsensystem wie für einen 10zölligen Tubus auf niederer, nach dem Pole gerichteter Säule. Deklinationsachse durchbohrt und als Einstellungsfernrohr gebrochen eingerichtet. Objektiv 3 Zoll. Vergrößerung 60- bis 100fach. Die photographische Kamera ist am Ende der Deklinationsachse befestigt. Das photographische Objektiv hat 4 Zoll Öffnung und 55 cm Brennweite. Hierzu drei Kassetten für Plattengrößen 24×30 cm, Uhrwerk etc. . . . . Mk. 6500

Geliefert für die *Kaiserliche Universitäts-Sternwarte in Moskau.*

Kleinere Instrumente mit vollendetster Sorgfalt ausgeführt, nach Übereinkommen.

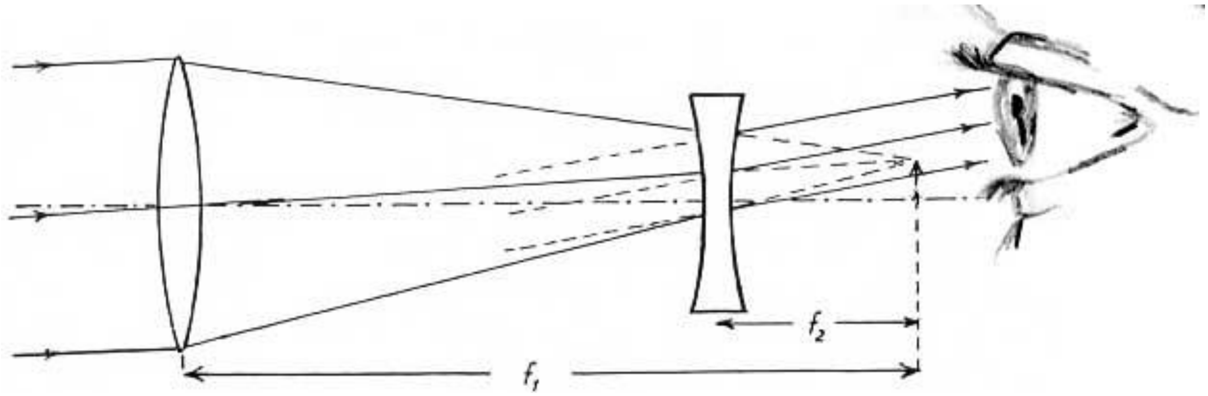
Photographic screening instruments- Photograph equatorial

It seems the company was very innovative; in July/August 1918 the Company advertised the “Self-closing valve, compression, injection and drain valve for engines Aller Art”, in a *Motor Magazine*.

Summarizing, Gustav Heyde produced many high precision heavy machines, but telescopes were only small part of his complete production.

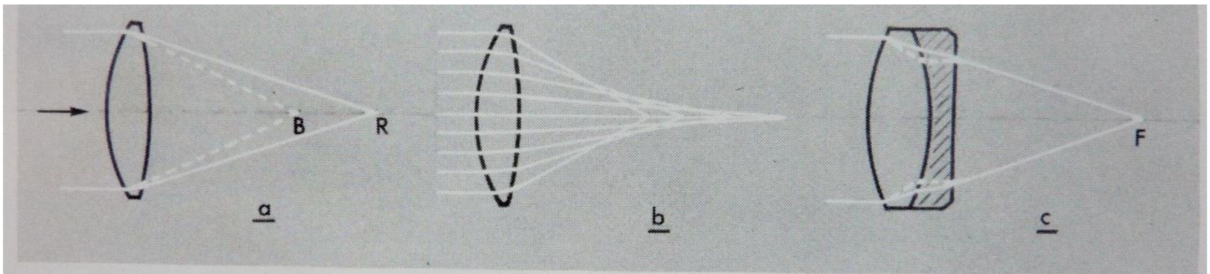
III. The beginning of the telescopes – a few words

To introduce a compendium of historical knowledge about telescopes, we have to start from Galileo Galilei.
In 1609 he introduced to the astronomy his telescope. It was the beginning of acquiring the universe, by man.
His telescope was a slim tube with their thumb sized two lenses. It was refractor telescope – they featured a concave eyepiece lens and a convex objective lens.



Courtesy of http://www.aip.org/history/cosmology/tools/pic-first-telescopes-galilean-telescope-diagram.htm

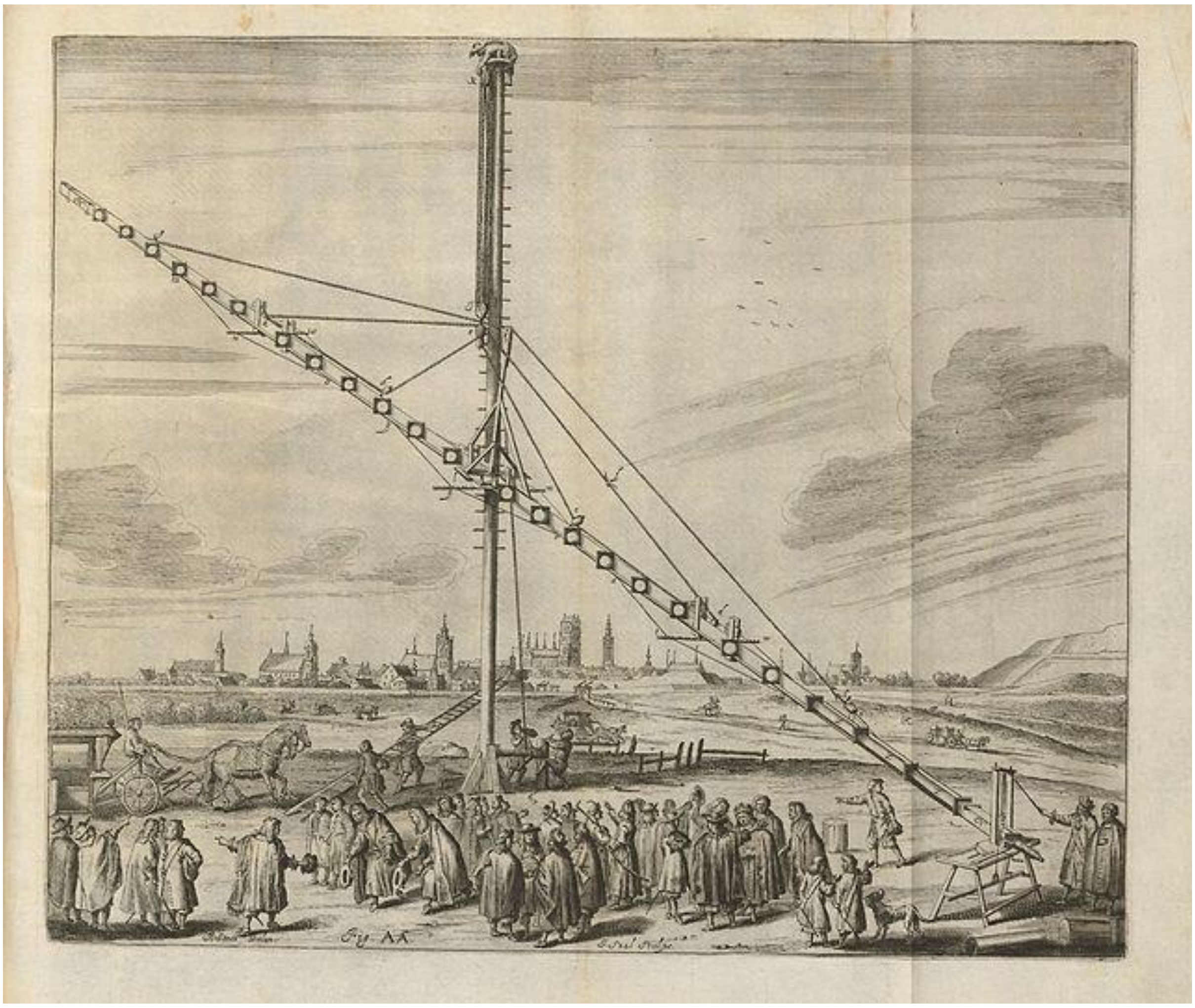
Because of quality of the lenses, at that time, Galileo received the image of the stars blurry and surrounded by chromatic aberration. It gave small field of view.
Next improvement was made by Johannes Kepler, in 1611. He used two convex lenses. The telescope gives larger field of view, but the image was upside down and still with chromatic aberration. Since that time was born the astronomical telescope.



3.4 – **Lens errors illustrated.** (left) **Color or chromatic error – different colors do not focus the same.** (middle) **Spherical error – focus of edge light different from central light.** (right) **Combining crown and flint glass elements for a corrected "achromat." By the author.**

Picture from the book -"Telescopes for Skygazing", by Dr. Henry E. Paul (in our collection); page 40

In XVII centuries the telescopes were built longer and longer. They achieved length 15, 20, 23 feet; up to 150 feet (46 m) and lenses up to 8 inches, which was built by Johannes Hevelius (Gdansk Poland).
http://en.wikipedia.org/wiki/Johannes_Hevelius - it is an interesting Hevelius bibliography.



Johannes Hevelius woodcut telescope; picture from *Houghton Library, Harvard University*

Next step in the telescope field was made in 1663, when James Gregory, a Scottish astronomer and mathematician, designed the *first reflecting* telescope using mirrors.

Since that time the astronomers have concentrated their efforts on:
- improving mirrors – polishing and curving, to avoid distortion;
- to design a proper mount for telescopes;
- to eliminate chromatic aberration,
- to improve techniques of glass production and its coatings. Since that moment the spectroscopy and spectro-heliography appears.

You can read about those changes, and much more on the telescope subject on:

http://www.aip.org/history/cosmology/tools/tools-first-telescopes.htm#galilean

IV. Technical terms of telescopes in a view of Gustav Heyde telescope in our collection

In Gustav Heyde catalogues, we have found our telescope; in 1905 edition, page 35 and in 1912 edition – page 46. The tripod mount is a little different in 1905.

Aussichts-Fernrohre

mit festen oder zusammenlegbaren verstrebten Stativen, Horizontal- und Vertikalbewegung. Rohr aus Messing. Hoch- und Tiefstellung durch Zahnstange und Schnecke. Okulare terrestrisch oder bildumkehrender Prismensatz mit astronomischen Okularen.

Nr. 125.

		Mk.
120.	**Fernrohr** mit Objektiv von 80 mm Öffnung, 120 cm Brennweite. Zwei terrestrische Okulare von 40- und 60 facher Vergrößerung	450
121.	**Dasselbe** mit Hoch- und Tiefstellung	500
122.	**Fernrohr** mit Objektiv von 90 mm Öffnung, 130 cm Brennweite. Zwei terrestrische Okulare, 43- und 65 fache Vergrößerung	525
123.	**Dasselbe** mit Hoch- und Tiefstellung	575
124.	**Fernrohr** mit Objektiv von 100 mm Öffnung, 140 cm Brennweite. Zwei terrestrische Okulare, 47- und 70 fache Vergrößerung	625
125.	**Dasselbe** mit Hoch- und Tiefstellung	700

Cat.1905

Azimutale Fernrohre

mit Dreifuß-Stativen auf den Boden zu stellen.

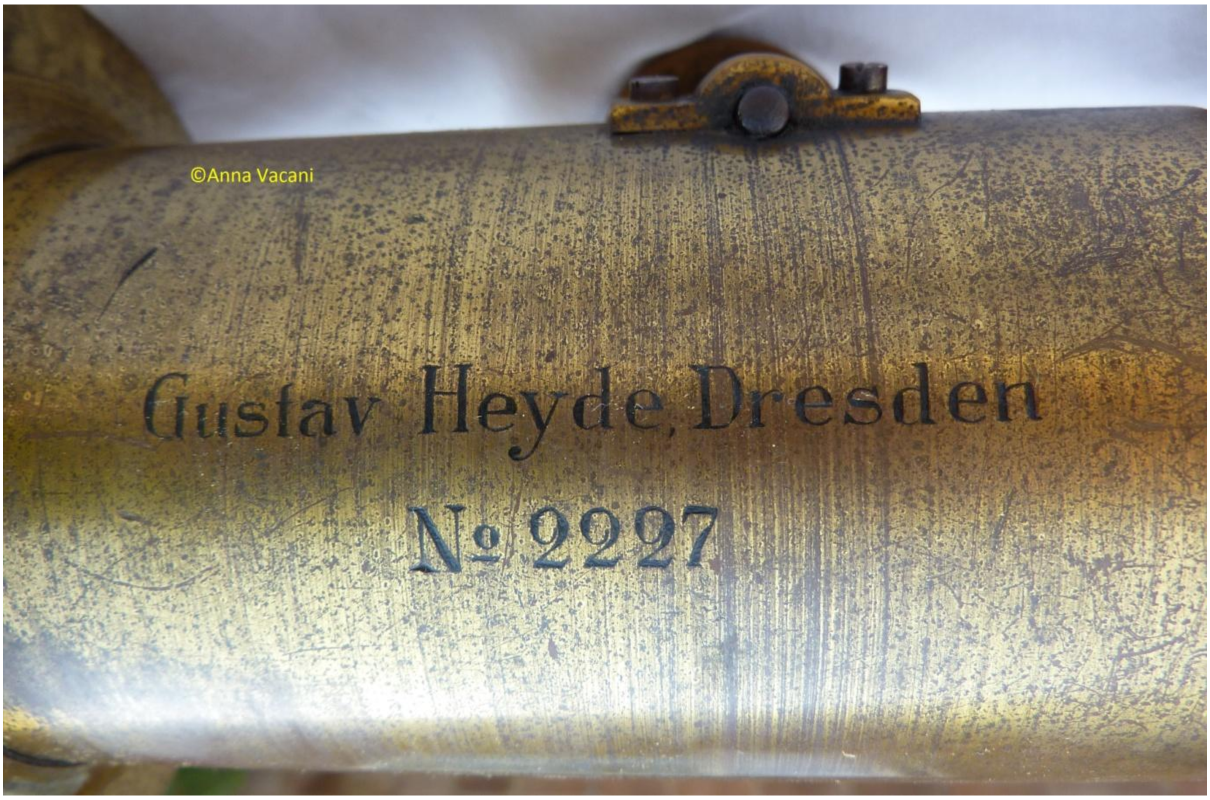
Nr. 122 mit 415 und Sucher 184.

Die Stative sind leicht und doch äußerst kräftig gehalten. Der Kopf ist stark und groß im Durchmesser, wodurch eine bedeutende Standfestigkeit erzielt wird. Die Fernrohre sind in einem Gabelkopf aufgehängt, welcher Beobachtungen bis zum Zenit zuläßt. Die Instrumente können mit Klemmung und Feinstellschraube für Horizontal- und Vertikalbewegung, sowie mit Schneckenrad und Kurbel zur Hoch- und Tiefstellung ausgestattet werden. Die Fernrohre sind vollkommen ausbalanziert; zu ihrer Aufbewahrung dient ein einfacher Fichtenholzkasten.

Diese Instrumente eignen sich besonders für den Unterricht an höheren Schulen.

Catalogue 1912 p.46

Our telescope, we bought in an Antiques Market in Warsaw, in 1991. As a kind of curiosity; at that time there was huge inflation in Poland. We paid for the telescope 3 000000 zloty, today it sounds as an astronomical price.



Gustav Heyde telescope in our collection; ©Anna Vacani

The telescope full length is 1800 mm (ca 6 ft).

Gustav Heyde telescope in our collection; length; ©Anna Vacani

Gustav Heyde telescope in our collection; length; ©Anna Vacani

Gustav Heyde telescope in our collection; ©Anna Vacani

The telescope is in not original box. It is box for Ascania camera.

As enthusiasts of the amateur astronomers say, it is medium size telescope – cover refractors of 3-in. to 5-in. aperture.
It is a refractor with the large achromatic objective lens - Fraunhofer type.

Basically, the groups of telescopes are divided into:

- Refractors
- And reflectors.

Refractors

Refracting telescopes have refracting lenses at the front, and they are shortly called – Refractors.
The refracting telescope is the type most familiar in ordinary use, for instant, the telescopes used at sea, and in the form of gun sights, are all refractors.
As we said, the principal component of a refracting telescope is the large achromatic objective lens mounted at the end of the tube. This lens gathers the rays of light which come to a focus at the other end of the tube where a primary image is created. It is this image which is magnified by an eyepiece.

Advantages of the refractors:

The refracting telescope is, however, easy to use, since it requires no further adjustment other than focusing and optics tend to stay in collimation.
The tube is closed; it is advantage, because minimal temperatures (during observation) change effects.
It does not have central obstruction, permitting good performance on planetary, lunar and solar observation.

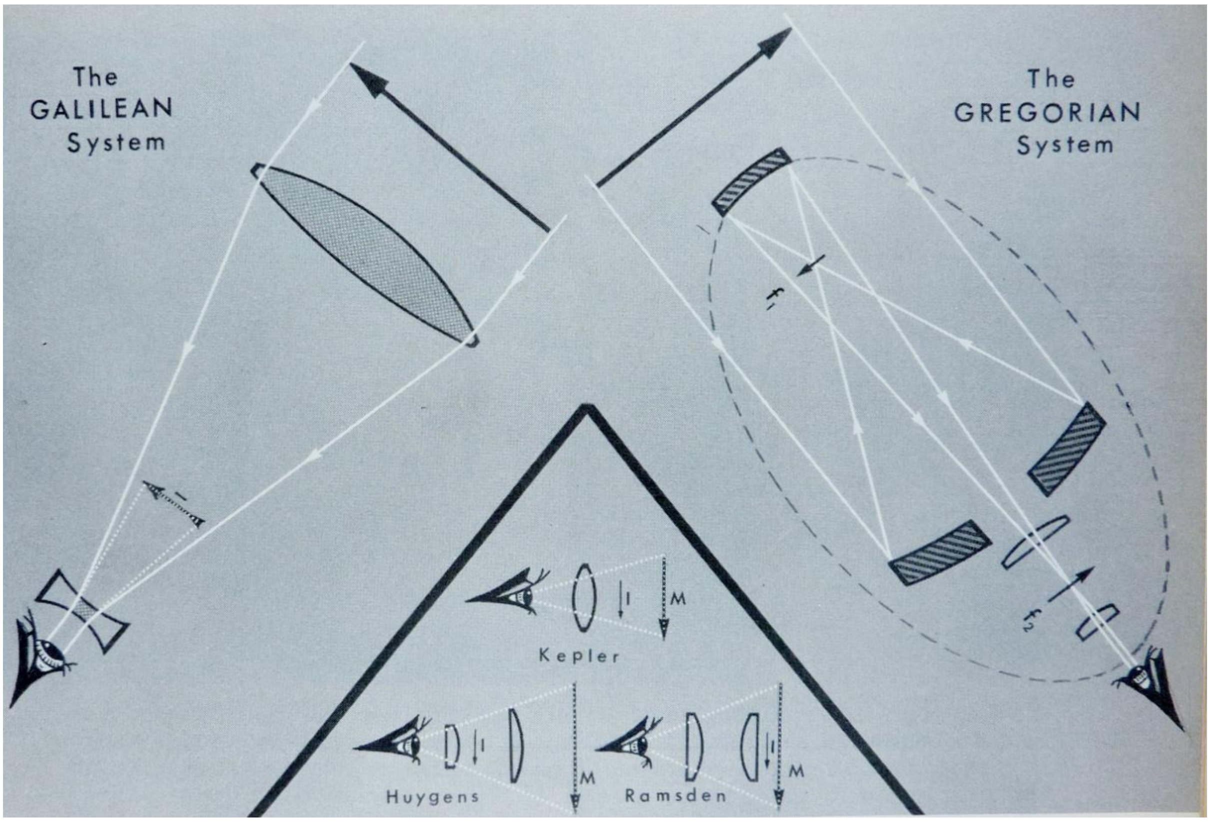
Disadvantages of the refractors:

Refractors have some disadvantages as well; colour error – slight secondary image colour; long tube gives problems with transporting and housing; photographic use necessitates filters and bright objectives; awkward tall mount and location eyepiece. Important disadvantage is big cost of refractors.

Reflectors

Reflecting telescopes have a concave (bowl shaped) mirror at the bottom to replace a lens as the light collector.
In reflecting telescope, the image of a distant object is reflected off a concave aluminized or silvered mirror to a plane diagonal mirror. This, in turn, reflects the image through to the outside of the tube, when it can be examined with an eyepiece.
The benefit of the reflecting telescope is that it is easier and cheaper for an armature to grind and polish own mirror or buy a finished one than buy an achromatic objective lens of equivalent diameter.
Assuming the mirror is correctly curved, the resolving power is usually a function of the aperture of objective lens or mirror.
Reflectors telescopes have many advantages. They do not give unrelated colour in image. The eyepiece is located in convenient position; because it does not need a big size mount. It is very good for astrophotography. And it is low cost telescope.
The biggest disadvantage is temperature effects, when telescope has opened tube and changing temperature reasonably unpleasant for reflectors. These models have delicate mirror surface and single mirror surface must be of highest perfection for best performance.

For centuries these two designs were combined and developed.



Picture from the book -"Telescopes for Skygazing", by Dr. Henry E. Paul (in our collection); page 43

The lens or mirror functions, in all telescopes, are as receiver of the light from a distant object. It should be emphasized that this primary lens does not magnify the object. It collects and bends, or refracts, the light to shape a moderately small image at its focus; near the rear of telescope tube of the refractors, or near the top of the reflectors.
However a compact high magnification lens or lens set in eyepiece, applies the all important magnification to the image.

Terrestrial and astronomical telescopes

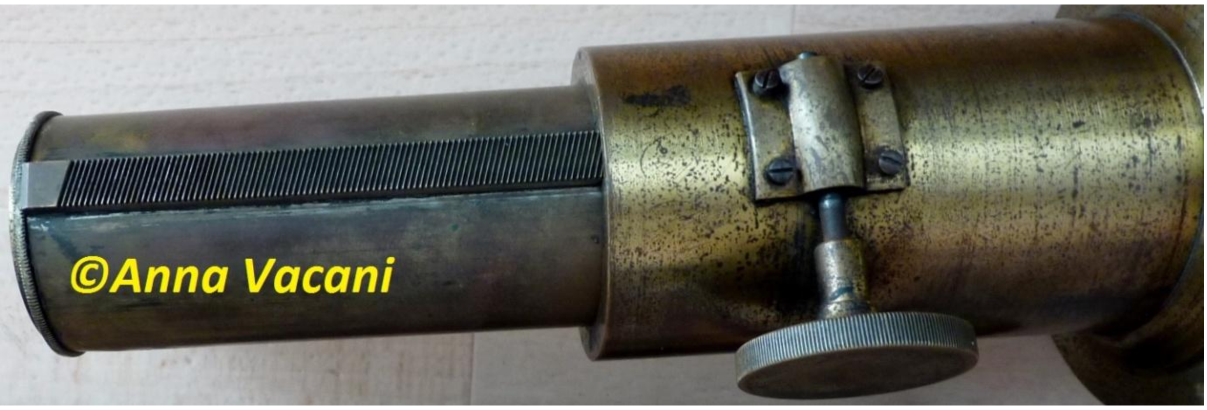
Considering the purpose of using the telescope, we can divide telescopes, into:
- Astronomical telescopes;
- Terrestrial observation telescopes

The image in astronomical telescope is inverted – but the observer of the stars does not concern that a star is upside down. In reflector telescopes the image is inverted.
Terrestrial telescope does not invert the image. Often, the users name them spotting scopes. It is used to observe distant objects.
The Galilean telescope is named as a terrestrial telescope.
Our telescope is terrestrial tube observation model. It is named Day Eyepiece draw tube, as well.

Terrestrial tube of our telescope; ©Anna Vacani

Rack and pinion focusing adjustment

There are two types of focus adjustments in telescopes; by draw tubes (look at Binoculars -> *"Antique Monocular Brass & Mother of Pearl" French*) and rack and pinion.
The mechanism rack and pinion, in old catalogues (in our collection), often was named – rackwork focusing or rack and sliding tube focusing adjustment.



Rack and pinion focusing adjustment in our telescope; ©Anna Vacani

Our telescope: Terrestrial tube; main body tube; Rack and pinion focusing adjustment; ©Anna Vacani

Main body tube and mounting

In the telescopes history, the body tubes were built from many materials, depending of the time. The ancient tube telescopes were built from wood, for instant, the Hevelius telescope. At the same time, they were built from brass as well; rough brass or polished brass. Next the tubes were built from many alloys, to be stronger, lighter or resist to the temperature. At present fibreglass tubes are preferred.

At the time, when our telescope was dated new metal alloys were introduced on the market. This made it possible the production of much larger, yet much lighter devices, among other things, telescopes as well.
Considering the length of our telescope (1800 mm), its weight is small – only 10, 5 kg (22.04lb). It is easy to move the device, without any effort.

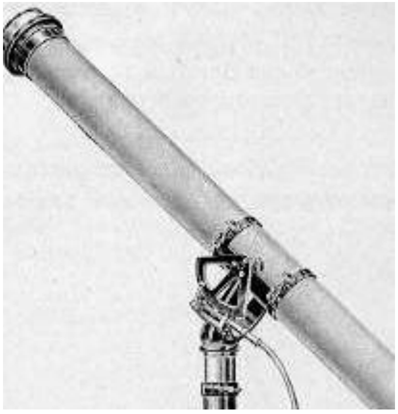
Main body tube of our telescope; ©Anna Vacani

Inside the body are mounted many aperture stops. The stops limit the light and reduce internal reflection from the main body tube interior. The diameter of the aperture stops becomes smaller towards the focus point of the eyepiece.
When a telescope is more expensive, it has more aperture stops in main body tube.
Our tube has two dents. If we would choose to remove these dents, we have to remove the aperture stops.

The specialists in telescope fields say that the importance of a good strong mounting for a telescope cannot be stressed enough. It should be remember that magnification, besides enlargement an image also amplifies any shake in the telescope.

There are two main types of mountings for telescopes;

- The Altazimuth, which enables movement in a horizontal and vertical plane;


Gustav Heyde Altazimuth mounting

- The Equatorial, which is specially designed for the observation of celestial objects.

Picture from catalogue ca 1920s "Seeing stars with our famous astronomical telescopes"; in our collection

Another mounting is a combination of the two types described above – The Universal mounting. Our telescope has part of the Altazimuth mount on the main body, which is adjustable for balance.

The mount on the main body; ©Anna Vacani

As we learned from Gustav Heyde catalogue – 1905, page 45, there were sold telescopes without tripods, as well:

Fernrohre

ohne Stative.

Dieselben werden je nach Wunsch aus Messing, Stahl oder Holzrohr angefertigt; bei letzteren zieht man die konische Form der zylindrischen vor. Sämtliche Rohre sind mit Okulartrieb versehen und werden vor ihrer Absendung in der optischen Achse genau zentriert. Die Objektivdeckel der Fernrohre haben für Sonnenbeobachtungen eine entsprechend große verschließbare Öffnung. Fernrohre bis zu Nr. 165 sind mit den Okularen in einem schwarzen Fichtenholzkasten eingerichtet, bei größeren sind die Okulare nebst Zubehör in einem besonderen Kästchen.

Objective lens

There are two types of the telescope objectives:

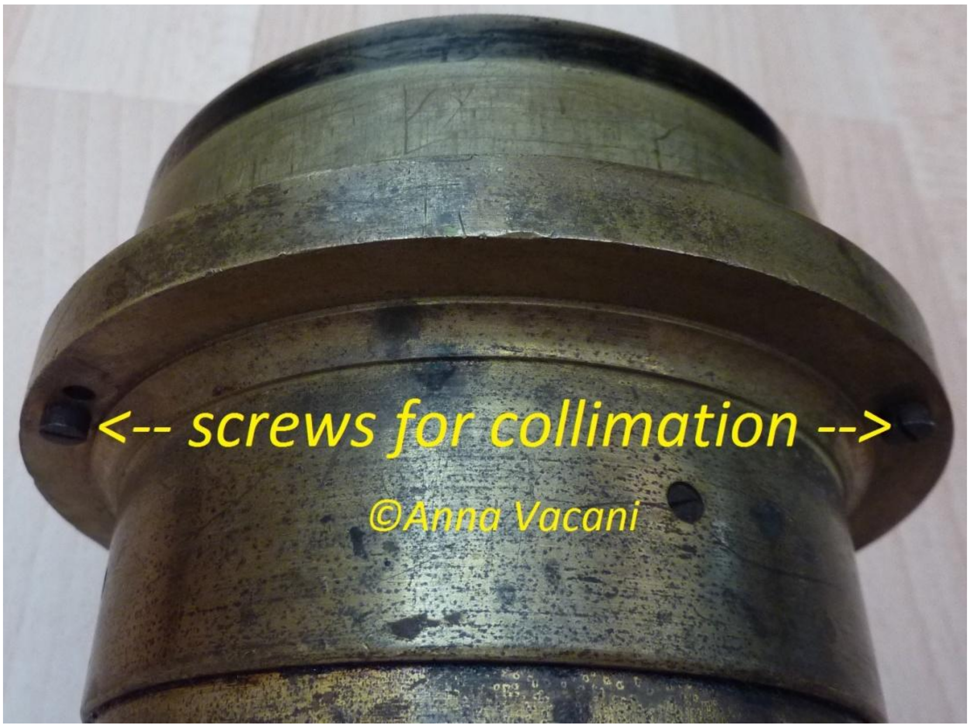
- The first type consists of a two lenses system with a small air space separating two lenses. It is achromatic, fully corrected for spherical aberration and fulfils, thus ensuring the largest possible flat field. The inevitable secondary spectrum inherent to this type of objective is due to the images formed by the various colours of the spectrum not being in the same place along the axis. Images which are formed by monochromatic green light, for example, lie appreciably closer to the objective than images formed by monochromatic blue or red light.
  The aperture ratio of this type objective is f/15, it does mean – the focus equals 15 times the diameter of the objective.
  This two lens achromatic objective was invented by a German optician – Joseph Fraunhofer ca 1811. http://en.wikipedia.org/wiki/Joseph_von_Fraunhofer
  This two lens objective, **Fraunhofer type** – specified in Gustav Heyde catalogues – 1905 – page 45 and 1912 – page 51.
- The second type consists of a three lens system with small air spaces separating the three lenses one from the other. This type follows very closely to the specification of the first type objective, in respect of its correction for spherical aberration and aperture ratio; but differs in the most vital item – the colour correction. By the selection of special glass and the addition of the third lens it has been possible to reduce the colour aberration to less than one quarter of the amount present in the first type objective.

Our telescope is 100 mm (ca 4 inches) aperture. It is the first type (described above) the two lens achromatic objective. Exit pupil is 3 mm.

The objective lens in our telescope; ©Anna Vacani

We were calculating the magnification of our telescope, it is 33.33 x. The focal length is 1500 mm.

Below the objective ring are three special screws, which are for the collimation adjustment of the objective glass of the telescope. All good telescopes have this type of the adjustment.



The collimation adjustment; ©Anna Vacani

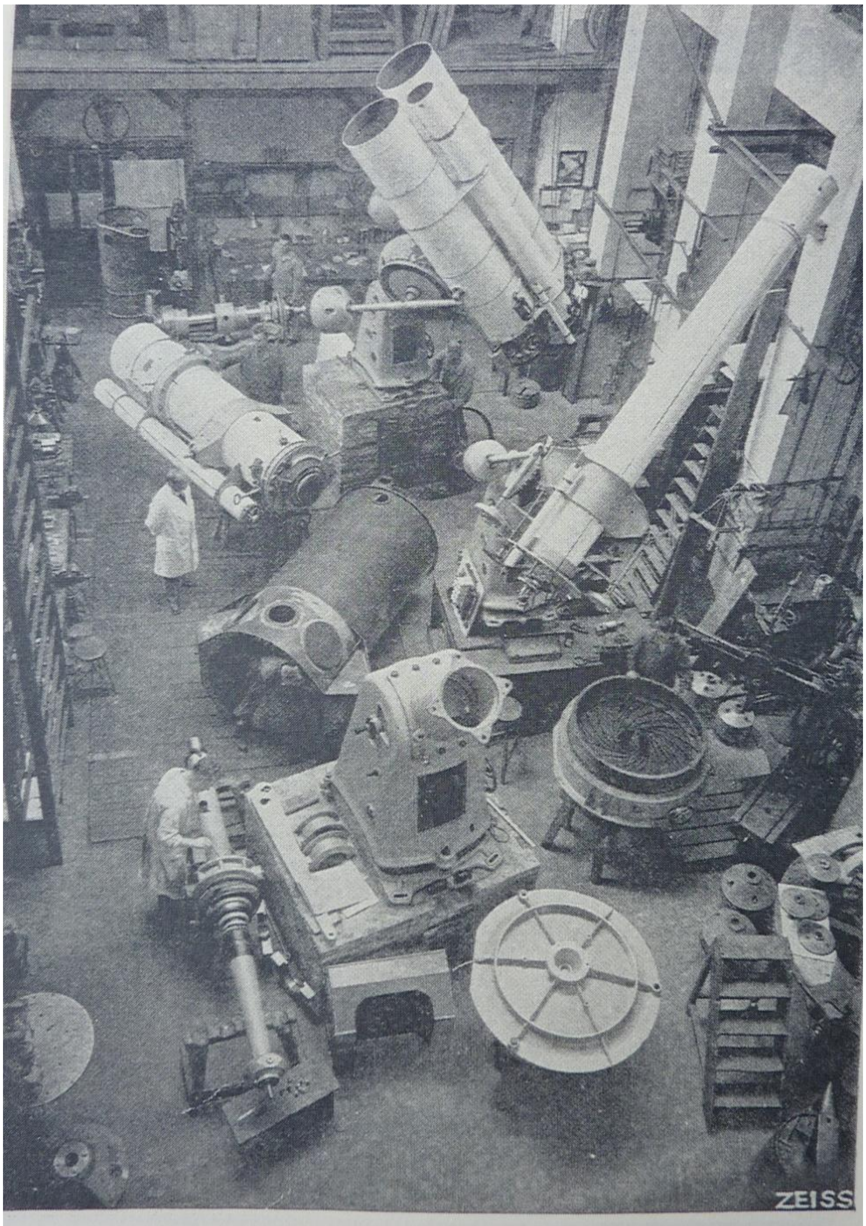
The telescope has two engraved numbers; on the objective mount and on the rack & pinion tube.

The objective and Rack & Pinion numbers; ©Anna Vacani

In analogy to the binoculars or movie Items, it would seem that these numbers are production numbers. However, they are numbers of the parts listed in the Gustav Heyde catalogues.
As far as today, we have not seen other telescope of Gustav Heyde, in this size.

At the time of Gustav Heyde production, it was huge competition on the market. The astronomical items were produced in many countries in Europe, as in; Britain, France, Hungarian, Italy, and in America.
In Germany were a few other companies which manufactured items for astronomy. Among them was Carl Zeiss. We can see those apparatus in Carl Zeiss Jena book - catalogue: "Zeiss Astronomical Instruments – Observatory Domes; Observation Stages; Rising Floors", published in 1930s by Carl Zeiss Jena (in our collection).

All pictures courtesy: "Zeiss Astronomical Instruments – Observatory Domes; Observation Stages; Rising Floors":



View into Telescope Erecting Hall 9696

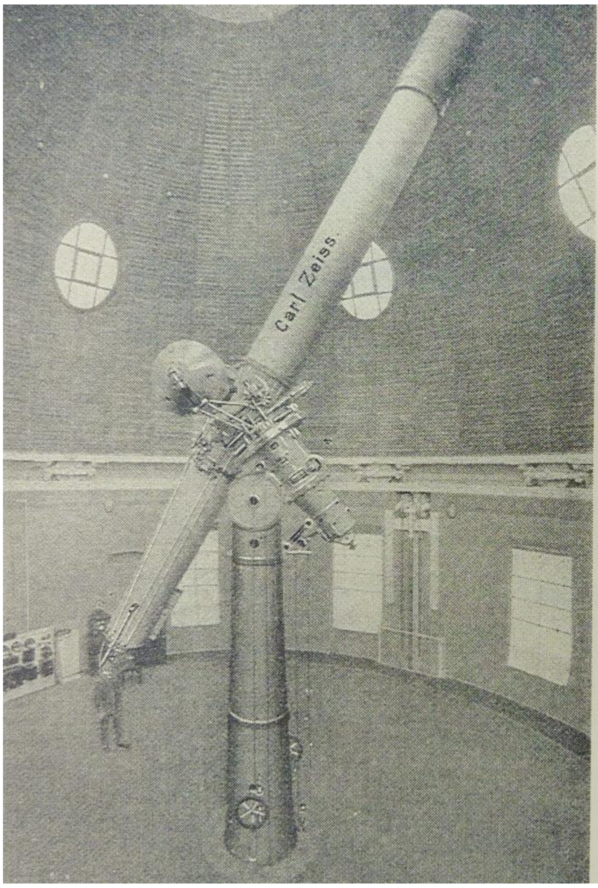


Fig. 2

25.5 in. (650 mm.) Refractor

of the University Observatory at Berlin-Babelsberg

Diameter of objective:	25.5 in. (650 mm.)
Focal length:	34.4 ft. (10.5 m.)
Internal diameter of dome:	47.4 ft. (14.5 m.)

The dome has a rising floor capable of a vertical travel of 13.8 ft. (4.2 m.)

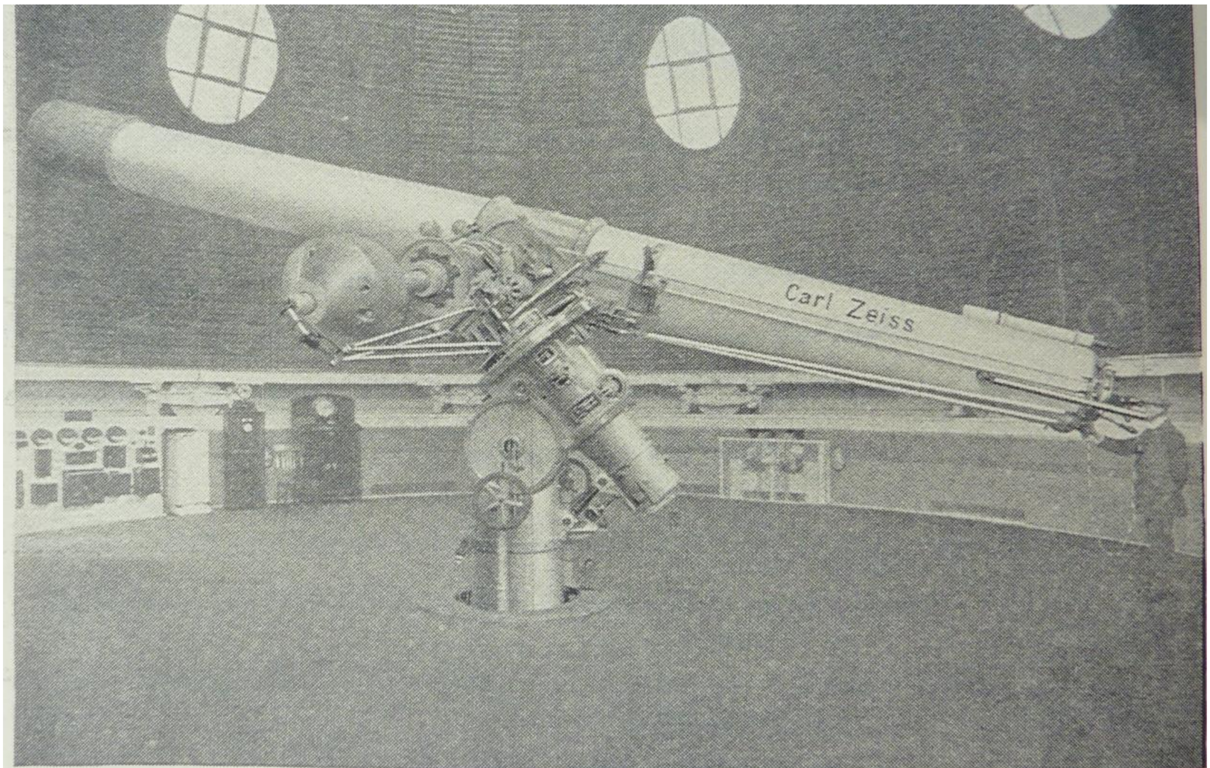
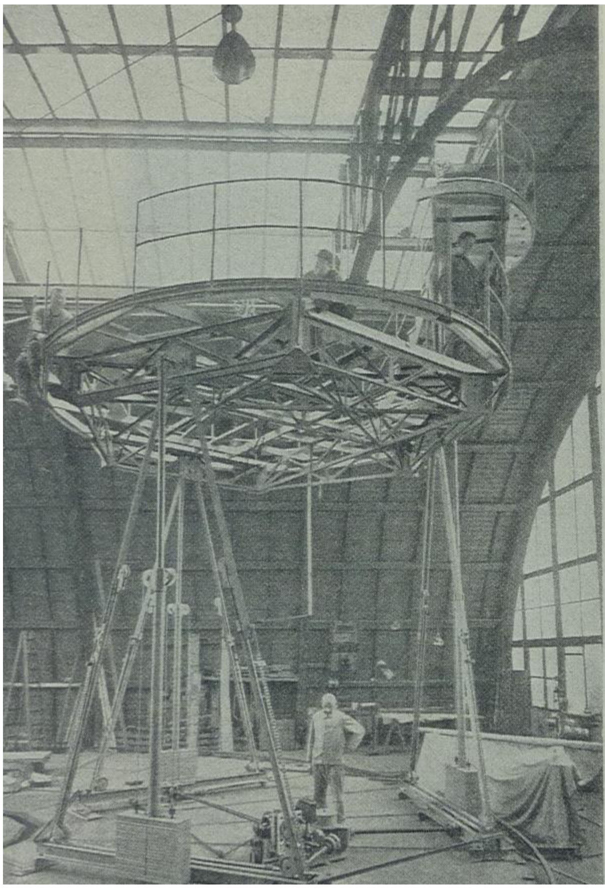


Fig. 3. Floor in midway position 2380



Figs. 158 and 159

Rising floor for the 23.6 in. (600 mm.) Refractor

of the Observatory at Budapest-Svabhegy

Diameter of floor 19.7 ft. (6 m.)
Vertical range 6.6 ft. (2 m.)

Three telescoping supports coact in the raising and lowering of the platform. This movement is effected by three flat-link chains driven by a common motor.

Travelling around the floor on a circular track is a movable stage with a small swinging platform, from which observation is made when the instrument is used with the Newtonian system.

9771

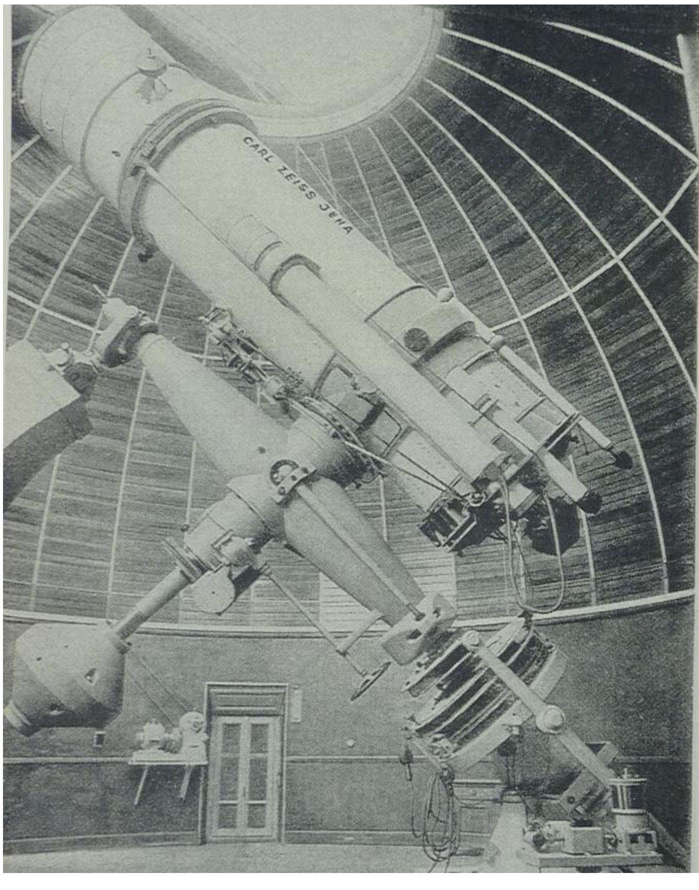


Fig. 17

39.4 in. (1 m.) Reflector

of the Royal Observatory at Merate, near Como

Silvered glass parabolic mirror of 39.4 in. (1000 mm.) diameter and 16.4 ft. (5 m.) focal length. 11 in. (280 mm.) diameter convex mirror for 58 ft. (17.7 m.) Cassegrain system. 12.4×17.5 in. (315×445 mm.) plane mirror for Newtonian system. Guide telescope of 7.9 in. (200 mm.) aperture and 9.8 ft. (3 m.) focal length. Two finders, each of 4 in. (100 mm.) aperture and 3.3 ft. (1 m.) focal length.

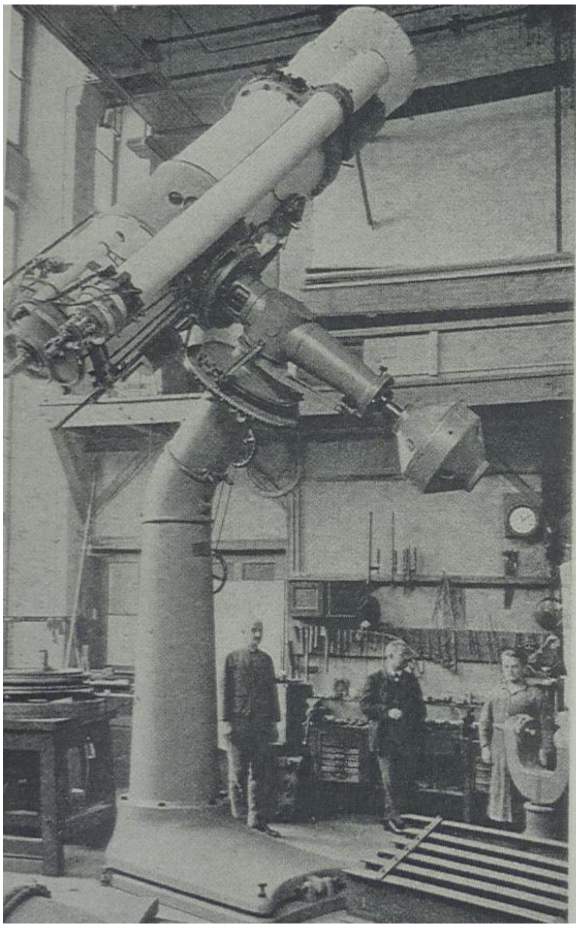


Fig. 30

23.6 in. (600 mm.) Reflector

of the Observatory at Stàra Dàla (C.S.R.)

Parabolic mirror of 23.6 in. (600 mm.) diameter and 10.8 ft. (3.3 m.) focal length.

Plane mirror, 9.8 × 6.9 in. (250 × 175 mm.), for Newtonian system.

Convex mirror of 6.9 in. (175 mm.) diameter and 32.8 ft. (10 m.) focal length for Cassegrain system.

Guide telescope of 7.9 in. (200 mm.) aperture and 9.8 ft. (3 m.) focal length.

9758

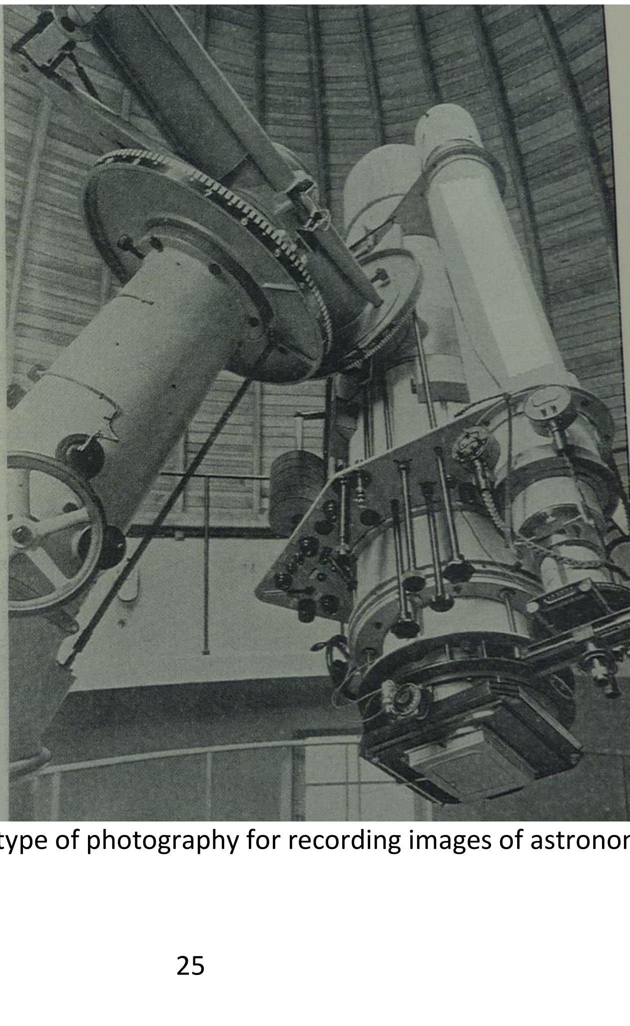


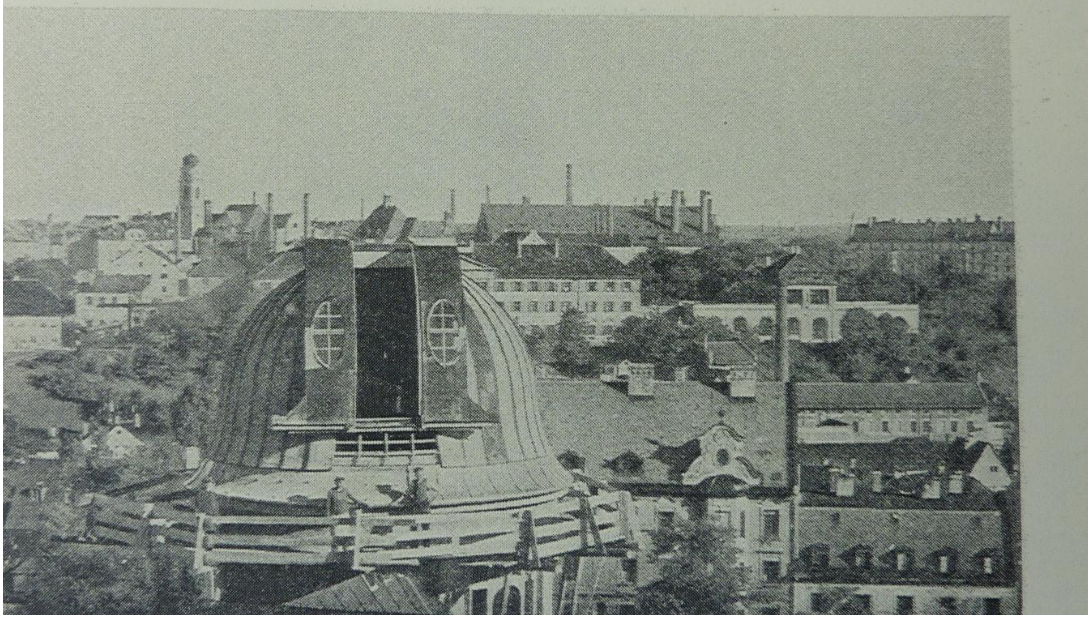
Fig. 43

15.7 in. (400 mm.) Astrograph

of the Stockholm Observatory at Saltsjoebaden

Astrophotography is a specialized type of photography for recording images of astronomical objects and large areas of the night sky.

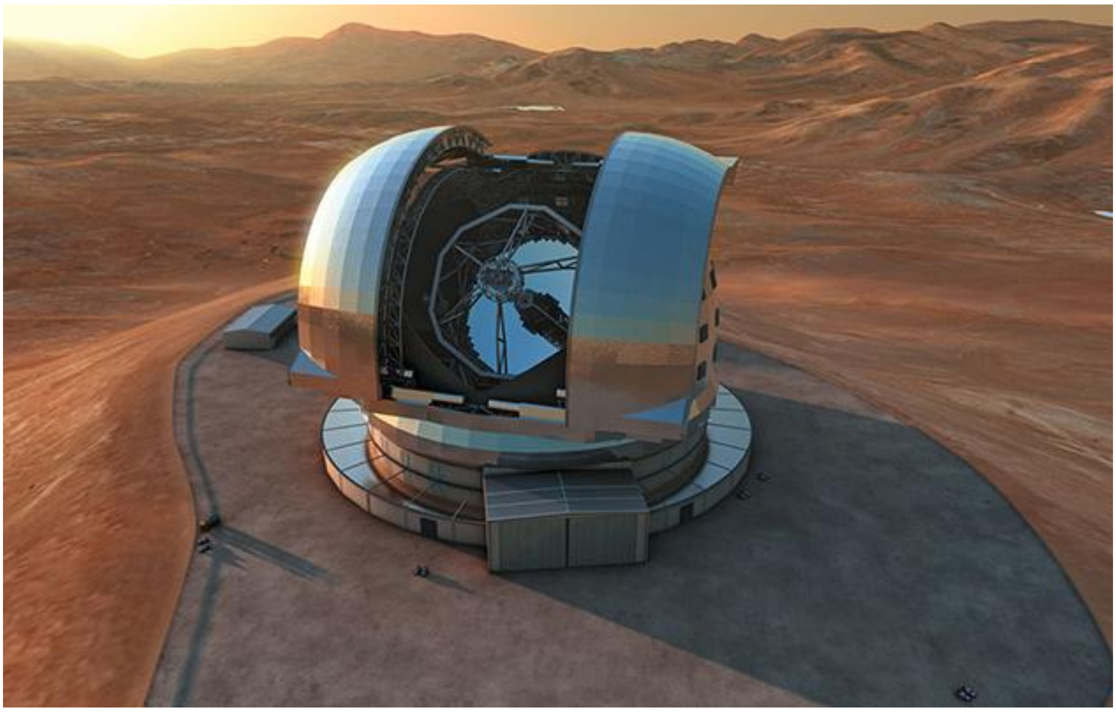
Fig. 148
The east dome, 21.3 ft. (6.5 m.) in diameter inside, contains a 15.7 in. (400 mm.) reflector by C. P. Goerz.



We can learn from the above picture – Deutsche Museum Munich – Zeiss observatory dome, that C.P.Goerz produced telescopes as well.

V. Summary

Going through that short history of the sky observation, we can see how big progress was done during only three centuries.
The modern professional telescopic field is connected with space and very large astronomical observatories.
Looking at this giant telescope in the picture; we can visualize the size of it, looking at the cars parked by the observatory.



Picture courtesy **http://news.discovery.com/space/astronomy/mountaintop-blows-up-to-make-way-for-giant-telescope-140619.htm**

We were described only one type of telescope – optical telescopes observe visible light from space. They allow the amateurs to observe the sky during the night with their relatively small telescopes. When professional astronomers are using very large telescopes located around the world. They can be used only at night and they cannot be used if the weather is poor or cloudy.

Other modern telescopes are independent of the weather, on any given day or night. They are radio telescopes, which detect radio waves coming from space. The radio waves cannot be blocked by clouds because they pass through the atmosphere.

Next groups of modern telescopes are – space telescopes.
Some objects in the cosmos emit other electromagnetic radiation - infrared, X-rays and Gamma-rays, which are stopped up by the Earth's atmosphere. They can be discovered by telescopes placed in orbit round the Earth.
The biggest disadvantage of those telescopes is cost and if anything will be wrong with telescope only astronauts can repair it.

We hope the article will inspired our readers for possessing a modern telescope and be the family pleasure of observing stars and galaxies in the universe.
If you would like to share with us your reflection, we will be happy to hear from you.

VI. Literature

In our collection:

Books:

1. *Telescope for Skygazing* – by Henry E. Paul, Ph.D.; third edition ; published by American Photographic Book Publishing Co., Inc. Garden City, N.Y. 11530 in 1976;
2. Frank's Book of the Telescope – by Charles Frank; published by Charles Frank LTD. Of the SALTMARKET, GLASGOW; MCMLXII;
3. Zeiss Astronomical Instruments; Observatory Domes; Observation Stages; Rising Floors – Carl Zeiss Jena; Astro 516 e. Published in the beginning of 1930s.

Catalogues:

1. *"Seeing stars with our famous astronomical telescopes" – 1920s;*
2. *"Portable Telescopes" – 1920s;*
3. *Ross Binoculars and Telescopes – 193;*
4. *Telescope Binoculars Microscopes Compasses – Special Optical Bargain List – Broadhurst, Clarkson & Co. Ltd Telescope House – 1920;*
5. *Fullerscopes – 1964;*
6. *United Technical Supplies Ltd – Catalogue Third Edition – 1964*