Figure 27.1: *In the Stockholm old observatory, the main room for observations was the ground floor round central room oriented towards the south. Exhibited are from the left a John Dollond achromatic refractor, which belonged to Samuel Klingenstierna, and was bought in 1760, a quadrant by John Bird from 1757 and a gregorian reflector by William Cary c 1800. (Photo Helen Pohl)*

27. The Old Stockholm Observatory in a Swedish Context and an Argument for the Necessity of an Inventory of the Swedish Astronomical Heritage

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27.1 Swedish Astronomical Heritage

Sweden is endowed with a rich treasure of astronomical heritage. Since the end of the 16$^{\text{th}}$ century separate astronomical observatories were erected and were places of theoretical and empirical research related to astronomy. Particular architecture and specialized instrumentation has made these places distinctly different from other types of buildings. It is not unusual that an observatory would be included as a prominent feature on cityscapes or be represented as one of the most important buildings in the city. As such the observatory became a symbol of a learned society and its representative function had as a consequence that large sums were invested and prominent architects commissioned.

This article is concerned with astronomical observatories of the modern period, from the end of the 16$^{\text{th}}$ century to the 20$^{\text{th}}$. The main focus is on the old observatory in Stockholm, due to its historical importance, and being the oldest separately build observatory which is fairly intact. There is no comprehensive study of Swedish observatories, their instrumentation, and present status of the heritage as whole in relation to the scientific activities that went on there. However, I would like to mention three studies of prime importance in this respect: Nordenmark's *Astronomiens historia i Sverige intill år 1800*, which treats the period up until 1800, Holmberg's *Reaching for the stars: Studies in the History of Swedish Stellar and Nebular Astronomy 1860–1940*, for a later period, and the most comprehensive account on the buildings found in Kristenson's *Vetenskapens byggnader under 1800-talet: Lund och Europa*, for the period up until 1900.

27.2 The Stockholm Old Observatory

The Stockholm old observatory was founded in 1748 and inaugurated in 1753. It is the oldest observatory in Sweden which still in use, today however only for museum purposes and by amateurs.

The idea of a new observatory in Stockholm originated from Pehr Elvius the younger, who had been a student of Anders Celsius at Uppsala. He was astronomer and secretary general to the Royal Swedish academy of sciences. The architect Carl Hårleman, who had already been acquainted to the task of making an observatory at Uppsala a few years earlier got the commission to design the first own building of the academy. At the time of the decision Hårleman was also conveniently president of the academy. As an architect he is the main representative of Swedish rococo.

The building was placed on top of a hill, outside of the city, but well visible from it. This was the first time that a secular building for scientific purposes was granted such a prominent place. The location, the visibility and the architecture was a statement of the importance of the academy and of astronomy.

The ground plan shows a rectangle with a central round room with three windows protruding towards the south, and entrance from a courtyard in the north. Added to the rectangle are two small rooms to the east and west. The central square consists of three floors, and a basement. On top of a the building was placed a small turret. The main location for observation was the central room on the ground floor, besides the meridian room in the room farthest to the east. The observatory housed not only working space for the astronomer, but also on ground level the cabinet of naturalia, library, archive and in the basement a work-shop for instrumentmaking. The living quarters were on the second and third floors.

In Swedish architectural history, the observatory has mainly been regarded as an example of the rococo, and an outstanding work of Hårleman. Comparisons have been made with secular countryside residences, especially the Villa Rotunda and the French tradition of the *Maison de plaisance* as well as churches.[1] However relevant such comparisons might be, the form as an observatory in relation to other such contemporary buildings have not been properly investigated.[2] Conform to the temporary ideal image of an observatory it is a squarish building placed on top of a hill, in front of which it was possible to make outdoor observations. The building also contained other functions which corresponded to

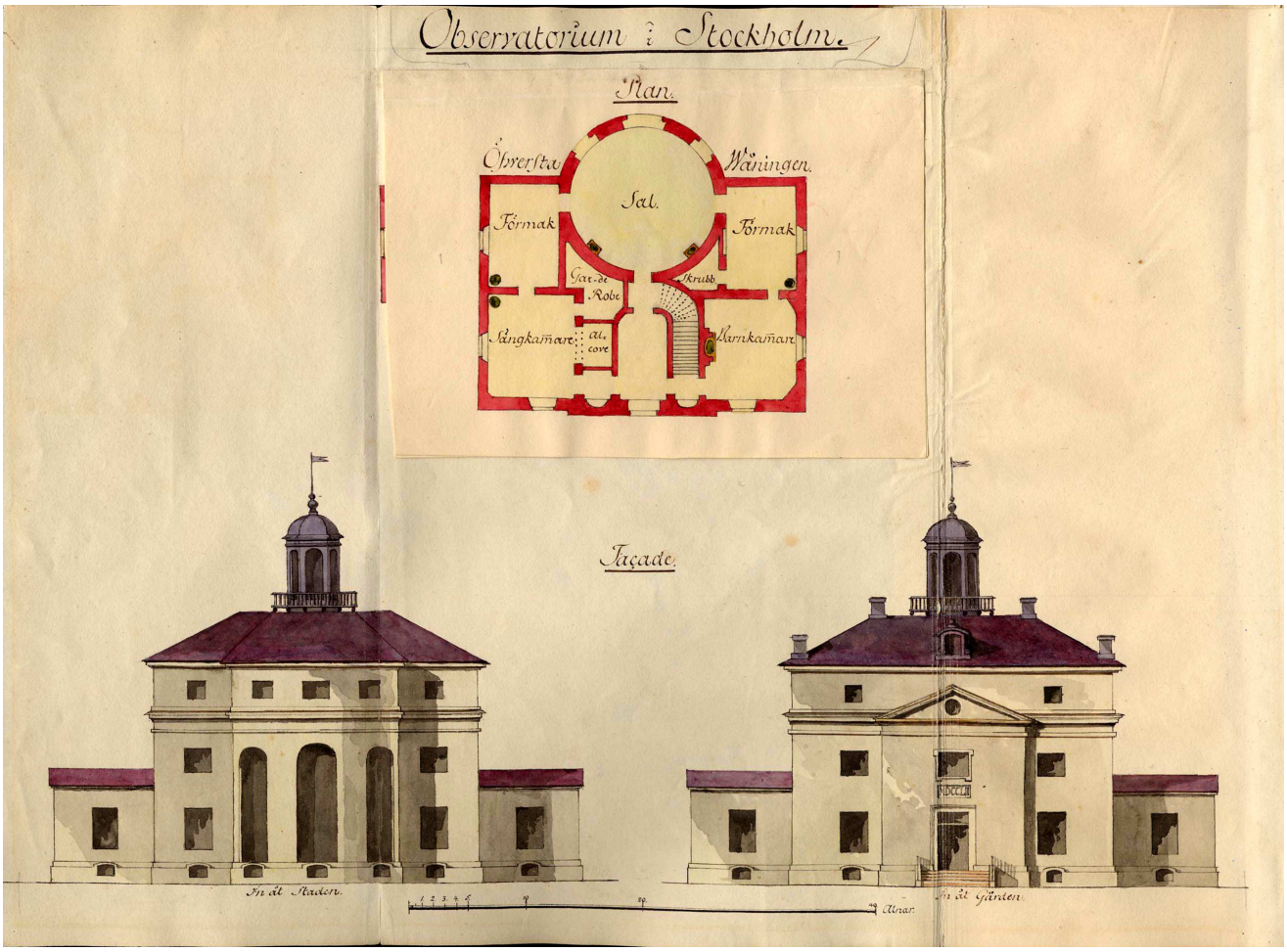

Figure 27.2: *Drawing of the old observatory Stockholm, made by Olof Tempelman in 1797. The architect was Carl Hårleman, and the building was inaugurated in 1753. (Center for History of Science at the Royal Swedish Academy of Sciences)*

the ideal understanding of what an observatory should be: rooms for meetings, library and other collections, living quarters and initially rooms for physical experiments were also planned.[3] In one aspect however, the Stockholm observatory differs: it is not a tower. Here Hårleman set a new trend, which later becomes the usual observatory design.

The otherwise excellent inventory of observatories by Peter Müller enigmatically excludes the Stockholm old observatory. This is odd in that he also treats the architect Simon Louis Du Ry, who designed the Kassel tower observatory connected to the Fridericanum. Müller mentions that Du Ry was educated mainly in Paris and Italy, and it seems the observatory at Bologna was a source of inspiration.[4]

The architecture shows obvious relationships to the Bolognese observatory, but yet, it is not irrelevant that Du Ry had had been involved as an apprentice of Hårleman in Stockholm between 1746 to 1748, where he specifically sought to learn the skills of architectural drawing.[5] One of his tasks had been to draw a fair copy of Hårleman's designs for the Stockholm observatory.[6] Such connections need be further elucidated.

It is however also possible that the Stockholm observatory is omitted because it does not fit in Müller's understanding of the historical development of observatory design. As the Stockholm old observatory was constructed before it became fashionable to make ground floor observatories it does not fit Müller's time line. He writes that the first such observatory was the one at Richmond designed by the architect William Chambers.[7] It had been erected to accomodate for the transit of Venus in 1769. It is probable, that Chambers, born in Sweden and a member of the Royal Swedish Academy of sciences, knew about the design of the Stockholm observatory. Certainly he corresponded with the director of the observatory, but there seems to be no conclusive evidence that the design of the observatory in Stockholm was discussed in the preserved correspondence.[8]

As many observatories at this time, part of the motives behind the construction and funding was the navigational applications. The first responsible astronomer was Pehr Wargentin also secretary general of the academy of sciences. He was already internationally renowned when he came to Stockholm due to his published tables of the movements of the Jovian satellites. He continued his work with these and among his exten-

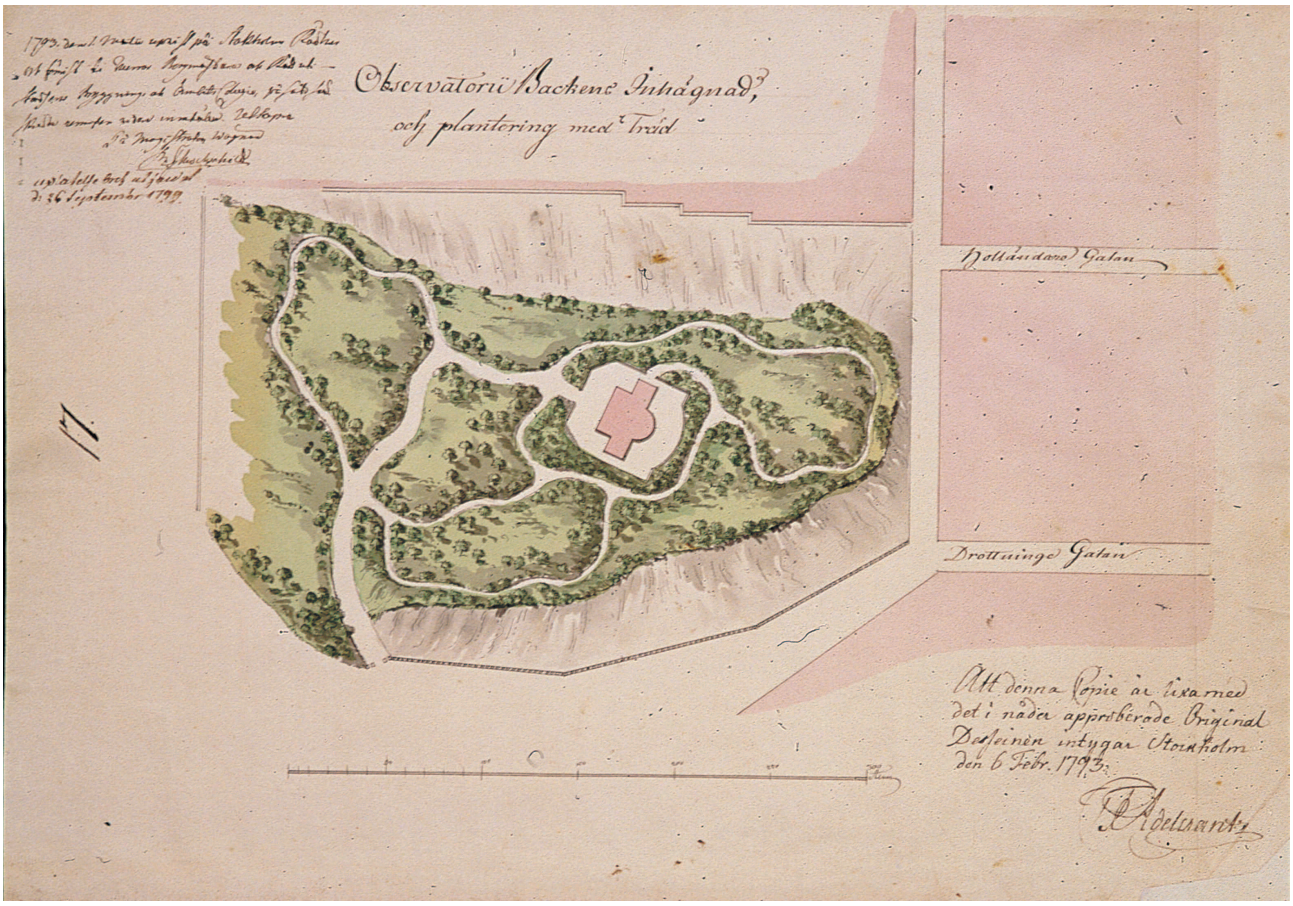

Figure 27.3: *Designs for an English landscape park around the old observatory Stockholm, made by J. F. Adelcrantz in 1793. (Center for History of Science at the Royal Swedish Academy of Sciences)*

sive preserved corresondents were Lalande, who published his tablesin his revised edition og Halley's tables. They were also published in German accounts and in the *Nautical almanach.*[9] The large amount of preserved correpsondence in the archives proves international exchange of observational results and experiences, besides other matters concerning an academy of sciences. The organisation of the national undertakings for the observations during the transits of Venus in 1761 and 1769 were such moments when international cooperation was essential. Swedish astronomers were gaining self confidence, being able to play on the international arena and contribute with valuable research and gaining esteem from abroad.[10]

In the beginning the observatory seems to have been rather void of instruments. A note from Wargentin's dairy even states just after the inauguration that there was no instrument to observe with, but that he instead had to use his plain eyes. This must be an exaggeration. He must have brought some instruments with him. Already before the observatory was built, a few instruments were acquired as gifts, e. g. a two foot reflector and a telescope from Hevelius workshop, now lost. They were probably too old and useless. The first preserved inventory dates from 1775. For the time preceding this year numerous receipts, observational journals, protocols from meetings and the published transactions still makes it possible to get a fair view of the instrumentation.

Besides the astronomer Wargentin, the skilled instrument-maker Daniel Ekström also resided at the observatory. He had had his training in Sweden and England, where he came in contact with among others George Graham and Jonathan Sisson. He also went to Paris, but sources are scant about his whereabouts. Abroad he learned the difficult task of dividing the circle. Ekström was involved with producing instruments for export abroad and for other users within Sweden. Unfortunately he suddenly died. At the death of Ekström, the workshop was divided between his apprentices. Carl Lehnberg took care of the optical workshop and made the first achromatic lens in Sweden in 1760. The other part of the workshop was divided between Johan Ahl and Johan Zacharias Steinholtz. The quality was not satisfactory and they could not cooperate. The workshop was moved away from the observatory. Ahl left for Denmark, where he made a successful career as producing instruments for the observatory in Copenhagen.[11]

Since the followers of Ekström were not considered accomplished enough, Wargentin turned to England to find replacements: A quadrant from John Bird was ordered in 1756 through the agent John Ellicot. In the first inventory it was listed as the far most expensive

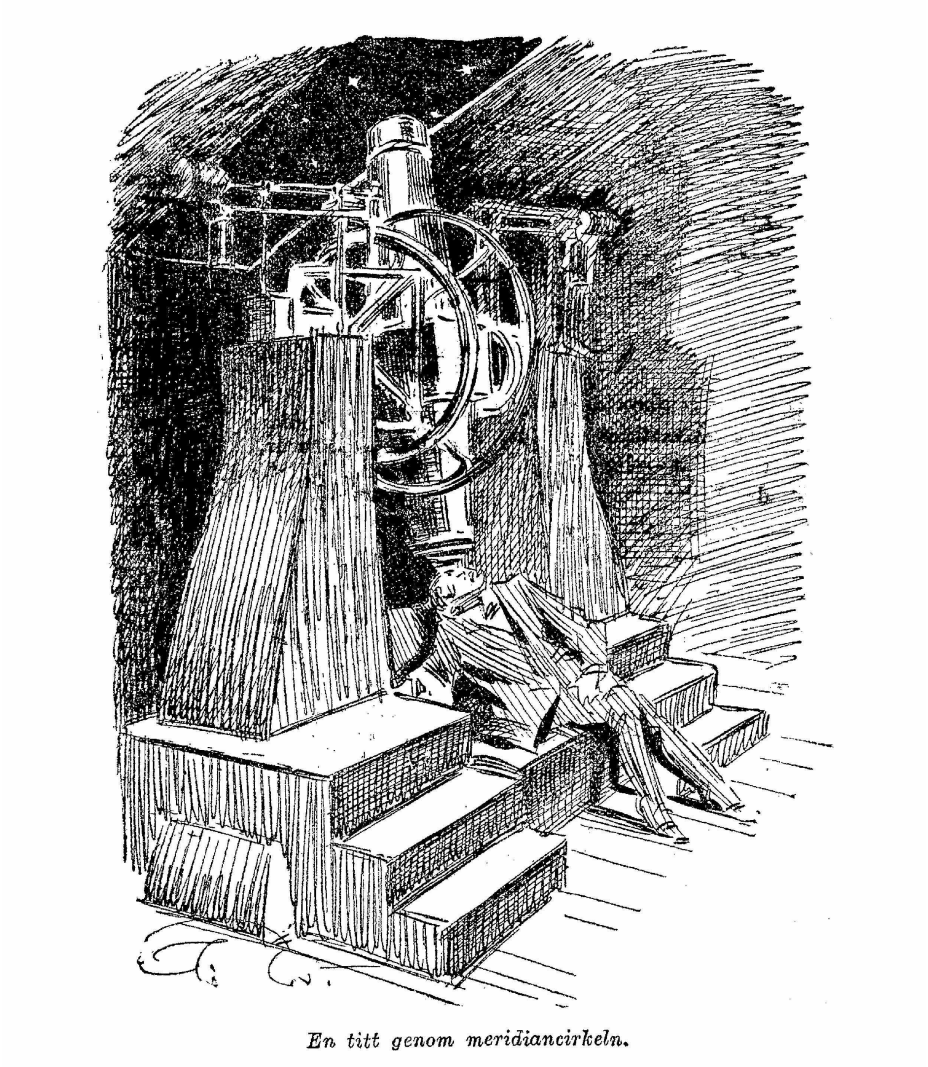

Figure 27.4: *A man observing from the western meridian room with the meridian circle by T. L. Ertel from 1830. The instrument is preserved and exhibited in its original setting at the Observatory museum Stockholm. (Center for History of Science at the Royal Swedish Academy of Sciences)*

instrument. The extensive archives of the academy also contains a letter from Bird which specifies the use, and upkeep of the instrument. The member of the academy Bengt Ferrner visited the studio of Bird in London in 1759 to see whether also a transit instrument could be ordered, and it was decided on a three foot transit telescope. From the mathematician Samuel Klingenstierna a ten foot achromatic tube made by John Dollond could also be obtained. Klingenstierna and Dollond had at first been on friendly terms in correspondence concerning the possibility of an achromatic lens, but later became involved in a priority dispute.[12] The still preserved Dollond's achromatic refractor was an excellent aid in Wargentins study of the Jovian Satellites. A smaller achromatic refractor was also bought from Dollond.[13]

Wargentins diary states that the daily observations were made to correct the clocks. The corrections are very carefully noted with considerations of temperature, whether the clock had been cleaned, if the pendulum has to be prolonged or shortened. A meridian was carefully marked out. Several clocks were ordered from the Stockholm clockmaker Nylander. One of them is still in the collections and on display in the old meridian room. New and more precise clocks were ordered from the Swedish clockmaker Peter Ernst. He seems to have taken care to copy a George Graham clock.

After the transits of Venus in the 1760s no great new orders were made until a seven foot Newtonian reflector was ordered from William Herschel in 1788. By this time the observatory had a new director, Henrik Nicander. During the 19$^{\text{th}}$ century the directors Jöns Svanberg, Simon Anders Cronstrand and Nils Haqvin Selander were all interested in geography and topography. Work was done with fundamental astronomy and to chart accurate star positions. One of the expeditions prepared from the observatory was the one to Lapland in 1802 to 1803, led by Svanberg, questioning the results of Maupertuis measurements from 1736. Later, Selander participated in the measurements for the Struve geodetic arch. He was responsible for the measurements between Torneå and

Stuor-Oivi. Several still preserved portable instruments were bought for these expeditions.[14]

In the 1820s the quadrant of John Bird was taken out of use and new instruments were ordered from a five foot transit from Reichenbach & Ertel in Munich with a lens from Utzscheider and Fraunhofer and a transit circle from Ertel with a Merz objective. The meridian was moved and a foundation was made to stabilize the position of the instruments. In the 1830s a new building adjacent to the courtyard was erected on the initiative by Fredric Rudberg. It was built to house magnetic experiments and was constructed without any magnetic material. In the 1850s the transit circle from Ertel was fitted with A. & G. Repsold microscopes reading seconds. The instruments are placed in the original room in the western meridian room. Stockholm local time was determined at the observatory. In 1879 standard time was introduced. The Swedish standard time was defined as one meridian, three degrees west of the meridian of the Stockholm observatory, in between Stockholm and Gothenburg. Telegraphical signals were sent from the Stockholm observatory, where time was established. Regulator clocks were needed. A Cope & Molyneux clock with a compensated pendulum with mercury made in London about 1825 was used. It was placed in the "clock-room" nearby the meridian room. A regulator clock made by Kessels in Altona in 1839 was commissioned and used as sidereal standard until 1932. These instruments are at present all exhibited in their original location in the museum.

Under the professor Hugo Gyldén, appointed in 1871, the observatory was reshaped. Gyldén had studied in Helsinki, studied and worked in Gotha, and at the Pulkovo observatory. It was probably one of the observatories he had seen during these years, uncertain which of them, that inspired him to have the observatory changed with working spaces in a northern extension and a tower with space for a refractor at the top. The commissioned architect was Johan Erik Söderlund, but due to his untimely death, H. G. Sandels and Frans Gustaf Abraham Dahl continued the work.

A refractor was ordered in 1875 from Repsold & Söhne in Hamburg, with a Merz lens of a diametre of 18,9 cm, mounted equatorially with a clockwork. A portable transit instrument from Repsold was also bought to determine geographical longitude with the help of the electrical telegraph.

Gyldén attended the astrophotographical conference in Paris in 1887. At this time the dry gelatine plate had diminished the needed time for exposure, which made photography more interesting for astronomers. Soon an astrophotographical objective was bought from Steinheil & Söhne in Munich. It was tested with success, and parallax measurements on the photographical material could begin.[15] A number of photographical equipment was bought from the bove mentioned makers but also Carl Zeiss in Jena, Voigtländer, Krüss and the Swedish maker P. M. Sörensen. A photographic laboratory was also established. Besides a number of precision clocks and calculating machines were acquired.[16] Thanks to the preserved published accounts and archival material all acquisitions can be followed.

Gyldén contributed to the photographic use of astronomy, but also to theoretical work in the fields of the motion of the comets, and specifically the perturbation theory of the planetary motions. He worked within stellar statistics measuring the luminosity of the stars, and their distances and motions. He was also engaged as the chairman of the *Astronomische Gesellschaft* from 1896 to his death.

During the professorship of Karl Bohlin, appointed in 1897, the growth of Stockholm presented increasing difficulties. Light pollution and traffic near the observatory hill was problematic. The observational activities continued, and a few new instruments were acquired. The kind of observations that Bohlin published were eg drawings of the planet Mars in 1909–1912 in the heat of the debate of the canals of Mars. He also continued theoretical work on the perturbation theory.

For the eclipse of the sun in 1914, visible in northern Sweden, preparations were untertaken in Stockholm. The main interest was to investigate the corona, which it was possible to photograph. Parliament granted a fund to buy instruments for meteorological, magnetic and electric measurements. A 10-inch Carl Zeiss reflector with a Spectrograph was bought. After the eclipse the instrument was mounted in a newly constructed pavilion north of the observatory. This was the last larger acquisition to be made for the astronomers at the observatory hill. The expedition was planned by Vilhelm Carlheim Gyllensköld, assistant at the observatory. He later organised the historical collections and was the driving force behind the Museum of the exact sciences, a museum which never opened its doors to the general audience. It is this collection that is the foundation of the Royal Swedish academy of sciences. As concerns scientific instruments, it could be considered the foremost as concerns the period from the 18$^{\text{th}}$ to the 20$^{\text{th}}$ century in Scandinavia. It contains about 6000 inventorie numbers of scientific instruments.

In 1927 Bertil Lindblad was appointed as the new director but now work was concentrated on equipping the new observatory in Saltjöbaden outside Stockholm.

The area around the observatory had become associated to learning. Therefore a number of institutions were placed around the observatory hill around the year 1900. The Stockholm university was only one of the institutions that had buildings erected below the hill (Royal institute of technology, Stockholms school of Economics, the city library). In the 1930ies the astronomers moved out and the Geographical institution moved in. The institution remained there until the 1980ies, when moving to a new university campus at Frescati. When moving out to Saltsjöbaden, the Royal Swedish academy of sciences sold the observatory to Stockholm city in order to finance the building of the new observatory. Different possible usage was discussed. Stockholm city was about to sell the observatory to

Figure 27.5: *In 1877 a refractor ordered from A. Repsold & Söhne with an objective from Merz was mounted in the new tower at the old observatory in Stockholm. The instrument is preserved, but not on display. In its original place is a user-friendly Zeiss refractor from 1910 which is used for public observations and by amateur astronomers. (Center for History of Science at the Royal Swedish Academy of Sciences)*

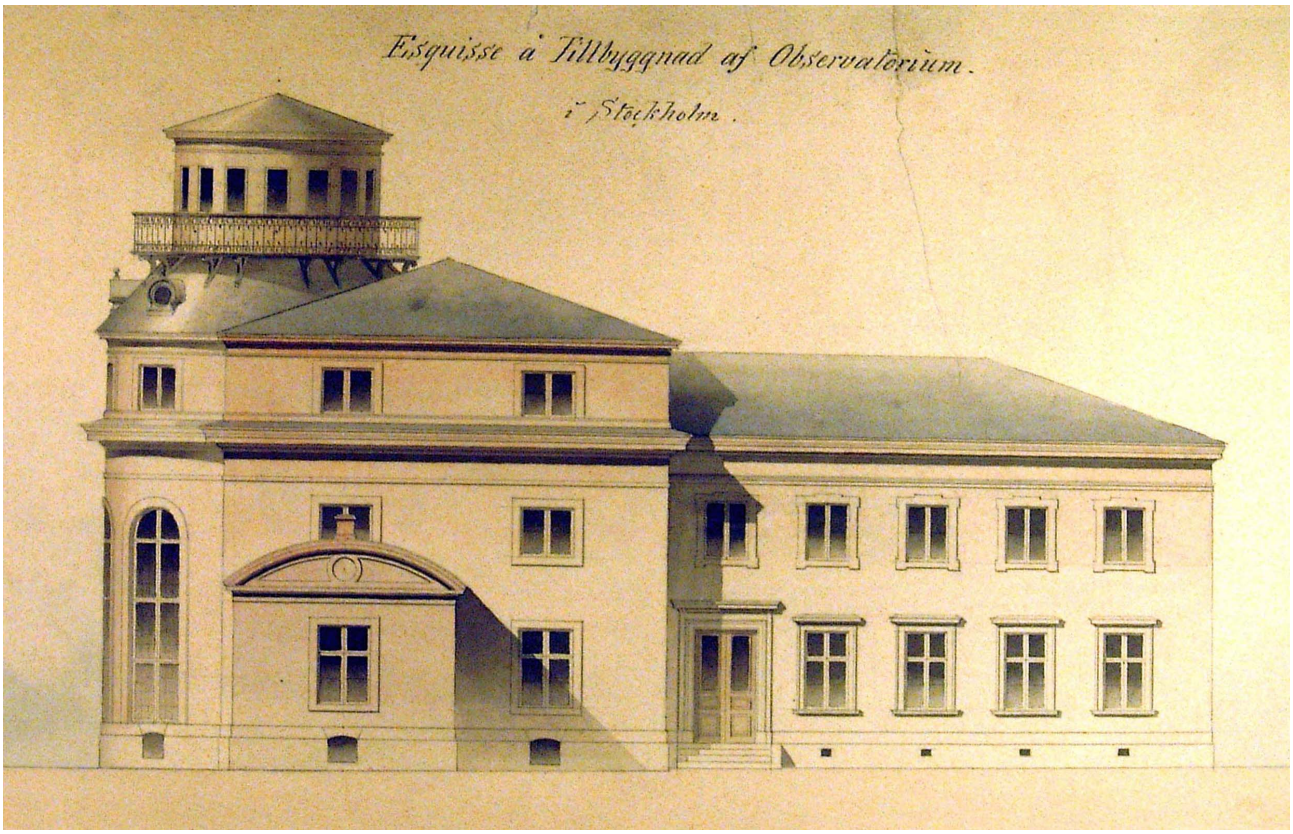

Figure 27.6: *In the late 1870s, the old observatory in Stockholm was extended towards the north and with a tower for a refractor on top of the 18th century building. The architects were Johan Erik Söderlund, H.G. Sandels and F.G.A. Dahl. (Center for History of Science at the Royal Swedish Academy of Sciences)*

the Moslem society so that it should be transformed into a mosque. If there were any ideological or strictly economical motives behind this move is uncertain. The vaulted dome of the round observation room has a sacral atmosphere, and was presumably alluring as a place of religious cult. However this change in the usage of the building was not desirable by the scientific community. And an initiative from several museums and universities found a museum as a private foundation. A museum of Swedish history of science was opened in 1991, and it is now run by the Royal Swedish academy of sciences.[17]

27.3 Other Observatories in Sweden

The Observatory of Stockholm did not emerge from a vacuum, but had several important precedents and followers, of which the main observatories will be mentioned here.

27.3.1 Uraniborg/Stjerneborg – Vhen

The combined castle and observatory erected for Tycho Brahe at Vhen can as by John Robert Christianson (or Victor E. Thoren or Owen Gingerich) be regarded as the place where European "big science", founded on empirical research, was born. From all over Europe came scientifically interested and Tycho could establish a household of the sciences and the arts. The site contained a castle with living quarters, a "museum", and towers for astronomical observation, an alchemical laboratory, a renaissance garden with a subterranean observatory, a printing-shop and a paper-mill with a system of dams to serve the mill. Observations essential to the development of European astronomy were made here. In the work-shops important instruments, works of art and books were produced. The castle, erected 1576–80, was dedicated to Urania and soon became legendary. Tycho abandoned the island in 1597 and it was soon ruined. Despite (or perhaps because of) its ruined state published accounts such as Joan Blaeus *Atlas Maior* (1665) praised and spread the exceptional beauties and treasures of this Utopian place of the arts and sciences. Already during the 17th century it became a place of scientific minded pilgrimage.

The area is listed as a monument (fast fornlämning) and the owner is the National property board, whereas the exhibited objects related to the excavation are the property of Lund university museum. The remnants at Vhen became a matter of regional, national, astronomical and historical identity. Among others the astronomer Carl Vilhelm Ludwig Charlier had been involved in excavations in connection to the 300 year remembrance of Tycho's death in 1901, but the remnants had been covered with sand. In 1929–31 a small building for museum purposes was erected on the grounds. For the 350 years remembrance, the National committee of

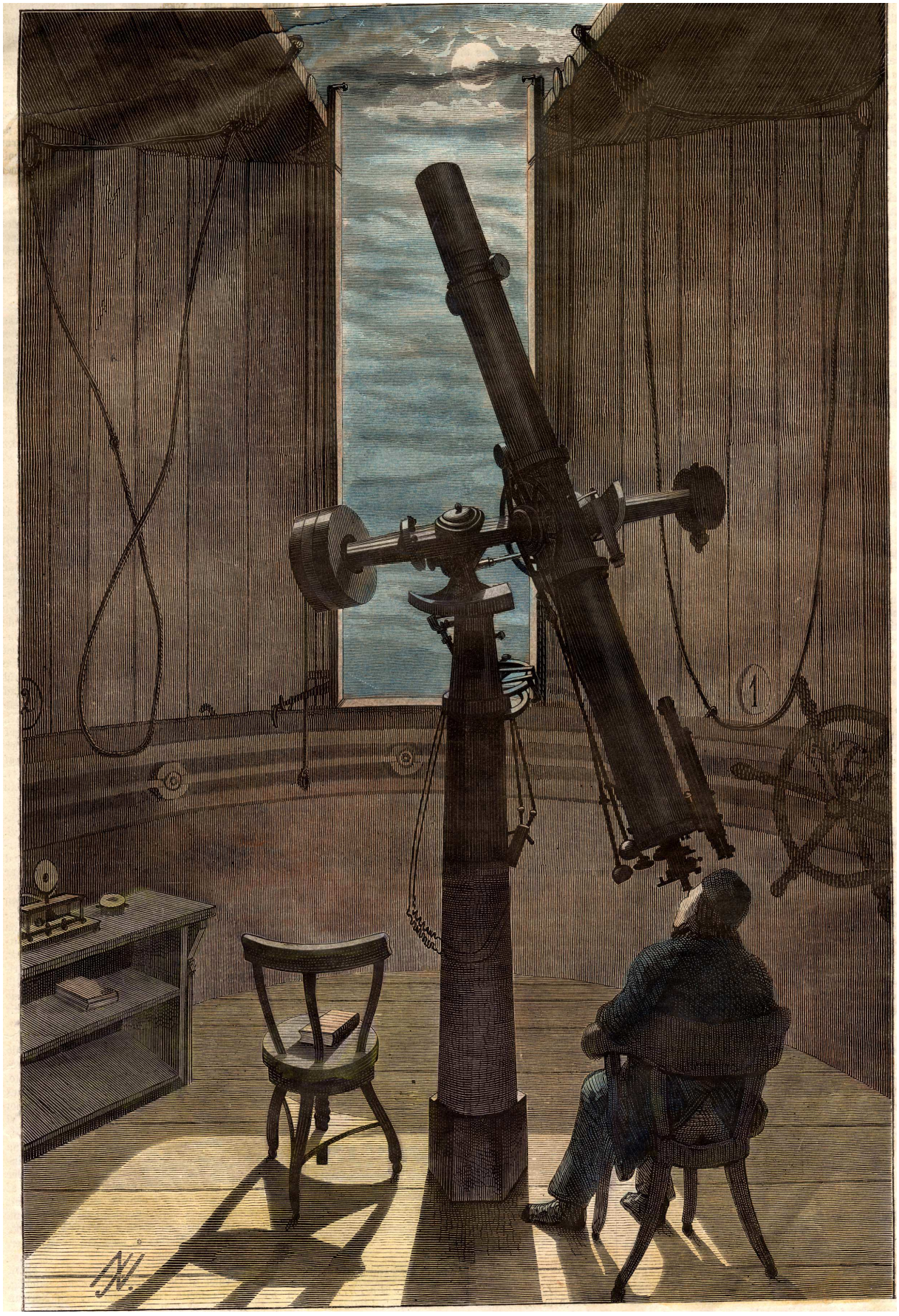

Figure 27.7: *Observation of the moon with the Repsold refractor from the tower, Stockholm old observatory. Nils G. Janzon in Ny illustrerad tidning, 1877. (The observatory museum)*

Figure 27.8: *The old observatory of Stockholm. O. A. Mankell in Ny illustrerad tidning, after 1877. (The observatory museum)*

astronomy with support of the Royal Swedish academy of sciences urged the National board of antiquities to excavate the area and cover it with concrete in order to protect it. They also recommended that it should be made accessible to visitors.[18] In 2005 a new museum in the nearby neogothic church, converted for museum purposes was opened. The museum is important for the tourist industry in the area and has about 40,000 visitors a year.[19]

27.3.2 Uppsala

Uppsala university was founded in 1477. There had been some temporary observing places during the 17th century. Bengt Hedraeus, who also wrote on the ideal structure of an observatory, had constructed a platform for observation, but as far as we know, the observatory there was never finished and it is not preserved. It seems he was the first to establish a work-shop for mathematical instruments.[20]

On top of an already existing medieval structure, Anders Celsius had the first larger separate observatory built, "Celeiushuset". The architect Carl Hårleman was commissioned. The building consisted of three floors. On top was a tower for observations crowned with a celestial globe. Unfortunately this tower was torn down, but the lower part of the building is preserved. The university now owns the building, but the lower floor houses a shop.

A new observatory was erected in 1844–1853. It was designed in collaboration between the professor of astronomy Gustaf Svanberg and John Way, "ritmästare", but these drawing were changed by the state authorities. The first instrument was a refractor from Steinheil in Munich from 1860. In 1890 the tower was rebuilt and the refractor was in 1893 replaced with a double refractor, with the visual and photographic parts from Steinheil and the mechanics from Repsold.[21] This instrument is still in use by amateur astronomers and for the general public. Work was mainly performed by Herman Schultz for the "New General Catalogue of Nebulae and Clusters of Stars", and Nils Dunér specifically moved forward with spectrographical observations. Other astronomers who contributed were Hugo von Zeipel, Gunnar Malmquist, Östen Bergstrand, and Erik Holmberg.

The astronomical institution moved in the year 2000 to Ångströmlaboratoriet. Into the observatory moved the Department of Education. In the move, the university museum, Gustavianum, was consulted, and a few instruments were transferred to their collections. The astronomical institution is however still the proprietor and responsible for a great number of instruments related to the history of astronomy in Uppsala.

To Uppsala university also belongs the observatory of Kvistaberg, originally a private observatory from 1818, with later additions. These premises are still used for astronomical research.

27.3.3 Lund

Lund university was inaugurated in the 1668. The first observatory was in a tower in the house of the professor of astronomy Anders Spole. The roof was constructed in such a fashion that all sides could be opened, but the observatory is not preserved. In 1753 an already existing building, Lundagårdshuset, was foreseen with a roof-top observatory.

In 1865 to 1867 the first free standing purpose-built observatory was erected. The building was planned by the astronomer Axel Möller, the building entrepreneurs P. C. Sörensen and F. G. Escher, and the facade designed by Helgo Zettervall as a medieval brick fortress. On the grounds were also erected a building for the astrograph, movable on rails, a subterranean building for the seismograph, and living quarters for the janitor on the grounds. Another building, the calculating house (räknehuset) was erected in 1911–12 designed by the architect Henrik Sjöström.[22]

Old instruments were brought from Lundagårdshuset, but a new refractor constructed by Jünger in Copenhagen with optical parts from Merz, with a clock drive by C. V. Holten, was mounted in 1867. A meridian circle by Repsold was mounted in the 1870s. A seismograph was ordered from Georg Bartels of Göttingen. Important contributions were made by Carl Charlier in his work on stellar statistics, galactic structure and cosmological theory, followed by Knut Lundmark, who studied the galaxies and their distances.

In the 1960s a new place for observations outside Lund was erected, at Jävan. The institution within Lund moved to new premises in 2001. All the instruments were cleared from the old building, as it changed ownership to the community of Lund. As far as I could gather, it is the astronomical institution which is responsible for their documentation and care, and a few of the old instruments are on exhibit at present in the new building. Nearby the new brick building is a water tower, with a small cupola mounted on the top.

27.3.4 Saltsjöbaden

In 1931 the Stockholm the new observatory in Saltsjöbaden south of Stockholm was inaugurated. The architect was Axel Anderberg. The main building was put on an elevation with surrounding smaller buildings for different instruments as well as a work-shop and living quarters for the staff. The donors (Knut och Alice Wallenbergs stiftelse) behind the new observatory added the condition that it should be called Stockholm observatory, hence there are now three places with the same name, which is a matter of confusion (the old Stockholm observatory, the observatory at Saltsjöbaden, and the present university institution at Alba nova).

The largest instrument was a double refractor, placed on top of the main building in a dome of eleven meters diameter. It was ordered from Grubb, Parsons & Company, from where a reflector with a mirror of one metre diameter was also ordered. The latter was put in a dome of the same size, but in a separate building. An astrograph from Carl Zeiss was also installed. In 1960 the "Schmidt telescope" was added. There had also been a now removed radio telescope. This equipment made the observatory at Saltsjöbaden one of the better equipped at the time being. The work and instrumentation was thoroughly specialised for astrophysics. The research undertaken under the leadership of Bertil Lindblad was mainly concerned with the properties of stars which would elucidate the structure of the Milky Way, and the rotation of the stellar system. The theoretically informed observational astronomy became fashionable. The international outlook had changed. During the 19$^{\text{th}}$ century, Swedish astronomers had collaborated rather with Russian or German colleagues, but now moved westwards to America.[23]

The institution moved to new premises at "Alba nova" in 2001. The larger fixed instruments remain in their original cupolas, but as to their future usage it is uncertain. The buildings are the property of the National property board, but are let to a school which had the buildings converted for accommodated usage.

27.3.5 Other buildings

The usage of churches and other types of buildings in Sweden are as far as I know largely unknown. For example, the tower of Strängnäs Domkyrka was rebuilt after a fire in the 18$^{\text{th}}$ century, there is a note, that a balcony should be erected. A gallery or platform at the top was proposed in order to decorate and serve as a place for astronomical observations.[24] I have already mentioned a few private and school observatories. Other examples are Nya Elementar (Stockholm), and Lundsberg (Lungfors). Smaller observatories and their collections still needs to be investigated.

The Radio observatory Onsala was founded in 1949, and is still in active use. Its huge radio telescopes dominate the landscape. A rocket range and research center, *Esrange,* is situated in Kiruna. It was built in 1964.

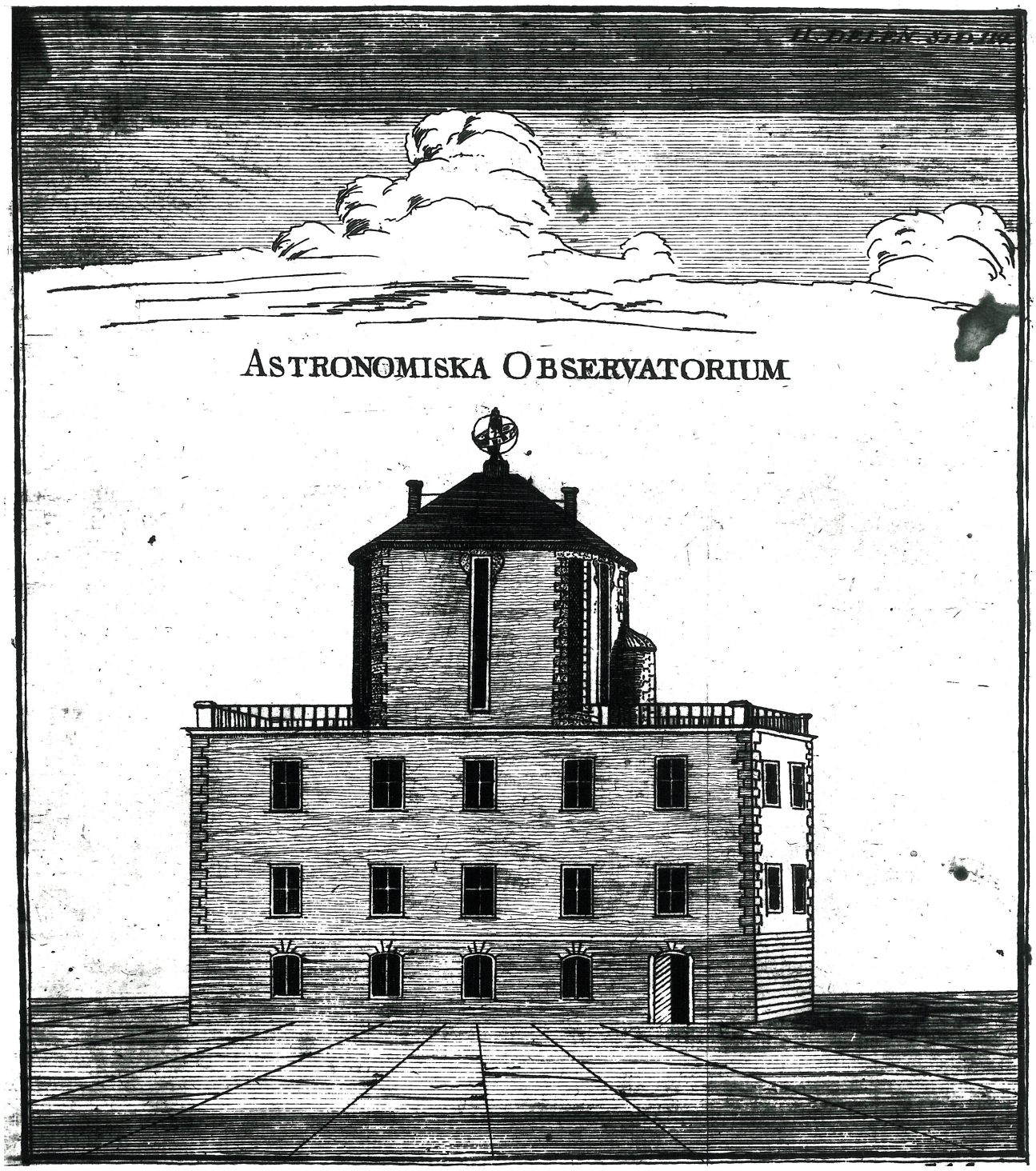

Figure 27.9: *Uppsala university observatory*

Figure 27.10: *Lund observatory (1867)*

27.4 Swedish Heritage Legislation and Protection

The astronomical heritage can be classified within several different types. Depending on whether it concerns an archaelogical site, a building, a park, an instrument or other types of inventories, printed, archival or research material and on the status of the owner of the property different legislation is applicable. For archaeological sites, like remnant from Tycho Brahe's observatory at Vhen, "Fornminneslagen" applies, whereas "Kulturminneslagen" applies for other heritage. Buildings and grounds can be protected in that they are listed by the County Administrative Boards of Sweden. This concerns the observatories in Stockholm (the old observatory and Saltsjöbaden), Lund (Svanelyckan), Uppsala (Observatorieparken) and two schools with adjacent observatories (Skeppsholmen: Gamla sjökrigsskolan, and Karlstad: Gamla gymnasiet). That so many observatory buildings have been protected shows that the astronomical heritage is recognized and is considered important to preserve by the authorities in various parts of Sweden. The legislative protection for buildings can only apply to the building, the grounds, and permanent installations, but not artefacts. As concerns archival material the National archives are responsible for state institutions to which the universities belong. For printed material the National Library of Sweden is responsible.

For the inventories (any furniture or instruments) there seems to be a gap in the legislative protection. It is possible to commission a prohibition of export for specific objects, but there is no legislation which could coerce the documentation and upkeep of artefacts. This means that there is no legislation which could protect an observatory site with buildings, instruments, books, research activities and archival material as a whole entity.

This is unfortunate since there is a risk of loss of heritage value when the inventories together with the traditional activities are moved away from the site. The 19^{th} and 20^{th} century observatories in Lund, Uppsala and Saltsjöbaden (Stockholm) has been abandoned by the universities within the last ten years due to the changing practises of astronomy.

The universities have not been willing or able to keep those buildings for astronomical, museum or public purposes. As a consequence three major observatories have been cleared of their content recently. Fortunately some of the larger fixed instruments remain in their original site in that they are fixed (applies to Uppsala and Stockholm, whereas the Lund observatory seems to have been completely cleared). The usage and access to these instruments are as far as I know restricted to amateurs and private initiatives. The other artefacts – instruments, furniture, documents and books have however been moved and the usage changed. The universities and astronomical institutions in Stockholm, Lund and Uppsala, the latter with the support of the university museum Gustavianum, are the proprietors of the inventories, and are responsible for their preservation, documentation or display. As such this is problematic since the universities have no explicit charge to provide for such tasks. When needs for such purposes have to compete with funds for research it is likely that charges outside the main objectives will come off a loser.

At present there are two organisations in Sweden, the Tycho Brahe museum at Vhen and the Observatory museum in Stockholm (as part of the Center for the history of science at the Royal Swedish academy of sciences), whose main objectives include preservation of an astronomical heritage site with related inventories and public outreach. Besides there are a few museums which either treat modern astronomy, hold astronomical instruments, and make temporary exhibitions on astronomy.

27.5 An Argument for an Inventory of Swedish Astronomical Heritage

Considering the long and complex histories of the above mentioned observatories a comprehensive inventory would be very valuable. The danger of loss of knowledge as well as heritage is urgent in that three major observatories have been abandoned within the last ten years. The French model as undertaken by Françoise Le Guet Tully and Jean Davoigneau under the ministry of culture is an exemplary model. Here the buildings, grounds, artefacts together with the scientific activities and archival material are taken as the point of departure for the way history of French astronomy is told.

A specific field is that of Swedish scientific instruments. Their history has been outlined by Gunnar Pipping and Olov Amelin (1999), but as concerns even this article, the contributions by foreign makers are enhanced. A comprehensive history of Swedish scientific instruments still needs to be written.

As an alternative a proper inventory of astronomical heritage could even take a wider outlook and include different types of cultural activities related to astronomy. That astronomical observatories and related artefacts should be included in such an inventory is obvious. To only include such material as could be identified with the present understanding of the astronomy performed in a modern university context would make a very narrow definition of astronomical heritage. It would leave out the important cultural aspects which makes astronomy relevant to mankind. A proper astronomical heritage inventory should include the area of archeoastronomy archaeological material such as petroglyphs, burial mounds or ship settings. If also ethno-astronomy with its objects of cult such as eg the shamanic drums depicting the northern cosmology of the Sami people could be considered. The importance and relevance of astronomical phenomena to our cultural heritage is also included in objects of art. This can be exemplified by the first known depiction of Stockholm, "Vädersol-

stavlan".[25] It was commissioned in 1535 by the onset of unusual astronomical/meteorological phenomena which were considered to be important enough to be recorded. Early spectacular objects can be found in varied collections such as the Visby lenses, archaeological finds, dated to the 10th or 11th century (Länsmuseet på Gotland) or an astrolabe from 1329 (Sjöhistoriska museet), or the armillary sphere and astronomical clock, ca 1580, by Jost Bürgi and Anton Eisenhoit (Nordiska museet).[26] Different kinds of collections also contain objects of international renown which were part of war booty such as the Copernicana collection at Uppsala University library.

A gem is the small 17th century cabinet with scientific instruments at Skokloster Castle.[27] Astronomical instruments together with important printed and archival material is found in the collections of a variety of different types of institutions, and different types of buildings and sites bear witness of activities related to astronomy. In order to get a fuller understanding of the relevance of astronomy to human culture, I advocate that these other aspects should also be included. To sum up, I would propose the necessity and usefulness of a project to make a national inventory of Swedish astronomical heritage. This could result in a new Swedish history of astronomy.

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1. H. Alm 1982, Stavenow 1927, G. Alm 1993, Millhagen 2000.
2. Surprisingly the layout of the rooms is similar to the observatory of Kremsmünster, built just after the Stockholm observatory. Those two buildings however differ in the important aspect that the one in Kremsmünster is built as a very high tower. So far I have not been able to establish any relationships between the involved architects or other persons, or if they had a mutual source of inspiration, but it remains to be investigated. Other international correspondence which needs be investigated is the note by Linderoth, that there are drawings of the Observatory of Stockholm in a neoclassical guise in the collections the Heremitage in St. Petersburg.
3. Compare the texts quoted in Donnelly, p. 29.
4. Müller 1975, p. 97. See also Klamt, p. 382 ff.
5. De Robelin, p. 19 ff. Stavenow 1927, p. 91 ff.
6. Alm, H. 1982, p. 120, Folcker 1997, p. 10. He was given this task on 7. July 1746, and the drawings were presumably presented to the academy on July 28 the same year. The whereabouts of these drawings is unknown.
7. Müller 1992, p. 234.
8. In the archives at the Center for history of science at the Royal Swedish Academy of Sciences there are five letters between 1760 to 1768 from Chambers to Wargentin. See also Kristenson, p. 150 f.
9. Sinnerstad, Nordenmark 1939, 1959, Collinder 1970.
10. Frängsmyr 1989.
11. Amelin 1999, Pipping.
12. Amelin 1999, p. 165.
13. Amelin 1999, Pipping.
14. Widmalm, Pipping.
15. Holmberg 1999.
16. Unpublished report on the observatory of Stockholm between 1871 and 1931, Petander, Einar, The observatory museum, Stockholm.
17. The most comprehensive description of the museum and history of the building and instruments is found in Bergström et al. 2003.
18. Berthelson 1953. Holmberg 2001.
19. I would like to thank Göran Nyström for this information.
20. Pipping, p. 43.
21. Kristenson, Holmberg 1999.
22. Kristenson, Holmberg 1999, Schalén et al.
23. Holmberg 1999, Lindblad 2003.
24. H. Alm 1933, p. 66.
25. The original was painted by Urban Målare. The present painting in Storkyrkan in Stockholm is a copy from 1636 by Jacob Elbfas.
26. Inv.-nr. 301.573.
27. Losman.

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