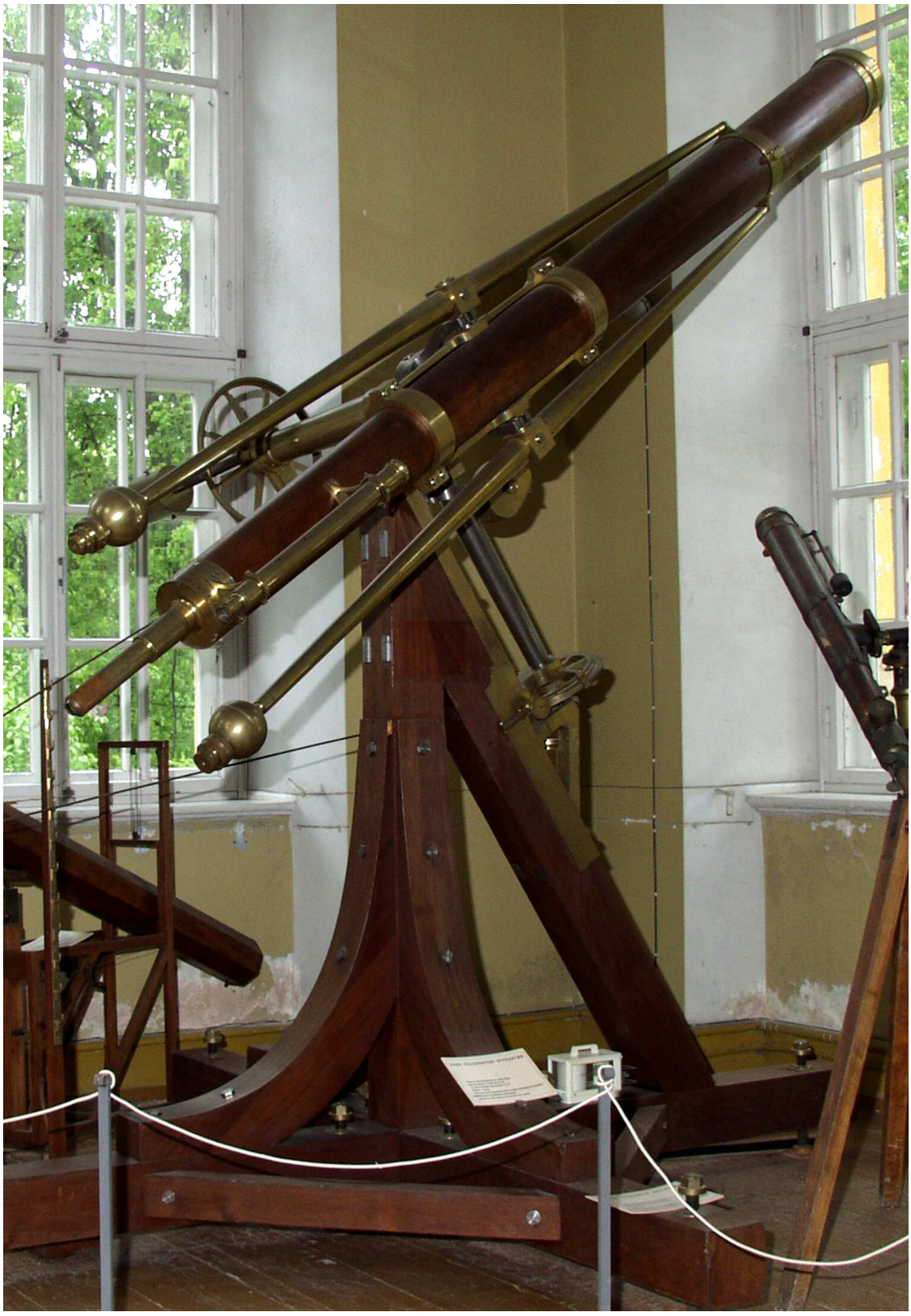

Figure 19.1: *The Fraunhofer refractor, Photo by Andres Tennus (University of Tartu)*

19. The Heritage of the 200-Year-Old University Observatory in Tartu

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Abstract

Tartu Observatory of the University of Tartu will soon celebrate its bicentenary. The observatory was completed in 1810 and soon became widely known as a research centre. In 1964, astronomers left it for a new location out of Tartu. Since then the main task of the old observatory has been to communicate information about astronomy and other sciences to the public. In 2005, the old observatory became a UNESCO World Heritage site as a point on Struve Geodetic Arc. Today, observatory buildings are in bad repair. Yet, a new era is about to dawn – plans have been completed to restore the observatory complex and to open it to the public as a museum. Indeed, the observatory is rich in heritage. The article at hand will give an overview of the material heritage of the Old Observatory of the University of Tartu in its historical context and describe its intended use as a museum. It will be a branch of the University of Tartu History Museum, a museum of science and of the history of the university that. The Museum holds a remarkable collection of historical scientific instruments used in the University of Tartu, including instruments of the observatory.[1] Although in the article the location of the observatory is referred by its current Estonian name of "Tartu", it should be mentioned that the observatory is internationally better known by its older German name – Dorpat Observatory – which was the official name of the observatory in the 19$^{\text{th}}$ century.

19.1 Observatory Buildings and the Observatory as an Institution – Development and Context

The design, construction and development of the ensemble of observatory buildings is closely linked to the history of the University of Tartu, and the history of science and society in general. The planned observatory museum will treat observatory buildings as a part of the overall heritage of the observatory.

The observatory was built in 1808–1810. It was part of a complex of university buildings. The observatory and the rest of the campus were built during the first decade of operation of the University of Tartu, which had just been reopened after having been closed for almost a century.[2] The buildings were designed by the university's architect Johann Wilhelm Krause. The ensemble has almost fully survived to the present day and most of its buildings have become symbolic of the city. The observatory was built on the Dome Hill not far from Town Hall in the city's central square. An anatomical theatre, a clinic and a library were erected in the vicinity of the observatory. The library was installed in the ruins of a medieval cathedral. Today, the same building houses the university's History Museum of which the observatory museum will be a branch. The main building of the university also forms part of this historical campus. All campus buildings share the same functional space – they are all linked by the park on the Dome Hill. The ensemble value of the campus has been stressed by historians of architecture as the reason for its powerful effect in the Tartu of today.[3]

The site where the observatory was erected is of special significance for the history of Tartu. Starting from the middle of the first millennium, that site had been occupied by a stronghold of ancient Estonians, which played an important role in the development of the town. The stronghold was conquered by the Kievan prince Yaroslav the Wise in 1030. Kievan troops were soon forced to leave Tartu, but mention of their conquest in a historical chronicle is considered the first reference to Tartu in historical records. Later, when German Brethren of the Sword captured Tartu in 1224, the bishop's castle was built on the site, and occupied it until the end of the 16$^{\text{th}}$ century.

The observatory complex consists of several buildings. The first building to be completed (by the end of 1810) was the observatory itself. The residence of the Head of the observatory was erected during 1819–1821. Later, the observatory was partly rebuilt and additional buildings were added to the complex. Each of these was dictated by the developments of science or the observatory's administrative or practical needs.

An important change in the observatory complex took place with the reconstruction of the main observation tower in 1825. The new shape was designed by Georg Friedrich Parrot, Rector of the university, and Friedrich Georg Wilhelm Struve, Head of the observatory. The

Figure 19.2: *The Observatory of Dorpat/Tartu (Lithography by W. Krüger, 1837) (University of Tartu Library)*

reason for the change was a Fraunhofer refractor that had been acquired by the observatory in 1824. The needs of the new instrument dictated a series of adjustments and structural changes in the tower. The original domed structure was replaced by a flat-top rotating tower with a balcony around it. The reconstructed observatory was quickly recognised as a model by its counterparts around Europe. Tartu Observatory served as one of the examples for designs for Helsinki University Observatory, which was completed in 1834. That observatory, in turn, provided the inspiration for Pulkovo Observatory (completed in 1839).[4] In addition to this indirect impact, the observatory of the University of Tartu can also be said to exerted an influence on Pulkovo Observatory through the person of F. G. W. Struve, Head of the observatory in Tartu, who was given the task of organising and launching the observatory in Pulkovo. The latter soon became world famous and came to serve as a model for a number of observatories in Europe and America.

In the end of the 19$^{\text{th}}$ and in the beginning of the 20$^{\text{th}}$ century, a smaller stone tower was added to the observatory complex, and two wooden observation pavilions were erected around the observatory. Thus, the trend towards a new type of observatory conceived as a complex of observation facilities can be seen taking shape on a modest scale in Tartu. After that, no more buildings were added to the complex and its later changes only concerned existing buildings.

Thus, in 1952, the observatory's West observation hall was rebuilt in two stories, and the old wooden staircase in the central part of the building was replaced by massive concrete one. The reconstruction resulted from the fact that more space was needed for observatory staff and that the meridian circle in the observatory's West Hall was not needed any longer. At that time the observatory was used by both astronomers and physicists, who at the time were affiliated to one and the same institute of the Academy of Sciences.[5]

Actually, the observatory had been considered too small already earlier, but plans to extend the complex, although they had been entertained as early as during Struve's days, had failed to be realized for one reason or another.

The need for additional office space and better conditions for observations resulted in the creation of a new observatory complex in the village of Tõravere, located 25 kilometers out of Tartu. In 1964, astronomers moved to the new location. The observatory archives and library was moved to the new location as well. From that time on, the observatory in Tartu is often called the 'old observatory' since the name "Tartu Observatory" was transferred to the new complex. With that, the main task of the observatory in Tartu changed from scientific research to that of presenting its heritage to the public.

19.2 Scientific Heritage – Achievements and Instruments

Several scientific discoveries made in the Old Observatory have remarkably broadened mankind's understand-

ing of the physical universe. The work of Friedrich Wilhelm Struve, Johann Heinrich Mädler and Ernst Julius Öpik has been recorded in the history of world science[6] The generation of today's prominent astronomers exemplified by Dr. Jaan Einasto also started their careers in the old observatory.

The most famous person in the history of the observatory is Friedrich Georg Wilhelm Struve (born in 1793 in Altona, Denmark, today part of the German city of Hamburg) – died in 1864 in St. Petersburg, Russia). He started work in the observatory as an observer in 1813 after defending his doctoral thesis which was dedicated to determining the geographical coordinates of Tartu Observatory. In 1820 he became professor and was appointed Head of the observatory. Under his leadership, the observatory was equipped with state-of-the-art observation instruments. A most valuable piece of scientific equipment obtained during that period was a nine-inch Fraunhofer refractor, the largest and the most modern refractor in the world at the time. It was used in the tower until 1908, when it was replaced by a Zeiss refractor, and continued in use for a short time afterwards as well.

Figure 19.3: *Portrait of Friedrich Georg Wilhelm Struve, Lithography by G. F. Schlater (after E. Hauu), 1837 (University of Tartu Library)*

The Fraunhofer refractor, one of the most famous instruments in the history of astronomy, has been preserved in Tartu to date.

Struve used the Fraunhofer refractor with considerable success. He was able to compile a catalogue of double and multiple stars that is used to these days. He was also the first astronomer to measure the distance from the Earth to a star (the Vega) using the parallax method. The same was accomplished almost simultaneously by F. W. Bessel in Königsberg. This achievement of Struve's has been referred to as the apex in the scientific history of Tartu Observatory.[7] Struve also did some pioneering work in geodesy, arranging and carrying out the survey of a segment of a meridian arc stretching from Northern Norway to the Black Sea which today appears in UNESCO's World Heritage list as Struve Geodetic Arc.

Other large instruments that have been preserved from Struve's period include a transit instrument (Dollond, London, 1807) and a meridian circle (Reichenbach & Ertel Munich, 1822). The optical parts of both have been removed for use in other instruments. Tracing the story of these instruments is a good way of following scientific developments of the day and learning about the conditions that existed for scientific work during that period in Tartu.

Struve left Tartu for the new Imperial Observatory of Pulkovo in 1839. His departure was soon reflected in the observatory's equipment, which would never be as modern as during Struve's days. Nevertheless, the next Head of the observatory, Johann Heinrich Mädler (born in 1794 in Berlin, Prussia – died in 1874 in Hannover, Prussia) also holds an outstanding position in the history of science. Although his main achievements in selenography were made earlier in Berlin, where he published a large map of the surface of the Moon, it was in Tartu that he laid the foundations of what would later become known as stellar dynamics.[8] Collections of the History Museum of the University of Tartu include sixteen gypsum models of surface forms of the Moon from the Mädler's period as Head of the observatory in Tartu.

During the first period of the Estonian Republic (between World War I and World War II), the research at the observatory was galvanized by another pioneer of astronomy – Ernst Julius Öpik (born in 1895 in Kunda, Estonia – died in 1985 in Banor, Northern Ireland). His theories of stellar structure and evolution proved a decade ahead of generally accepted views held by astronomers.[9]

The history of the old observatory in Tartu has also experienced its failures and its periods of decline. The planned museum will tell these stories as well.

19.3 The Observatory as a Museum

In 1971, seven years after astronomers had moved out to their new facilities, the old observatory was opened

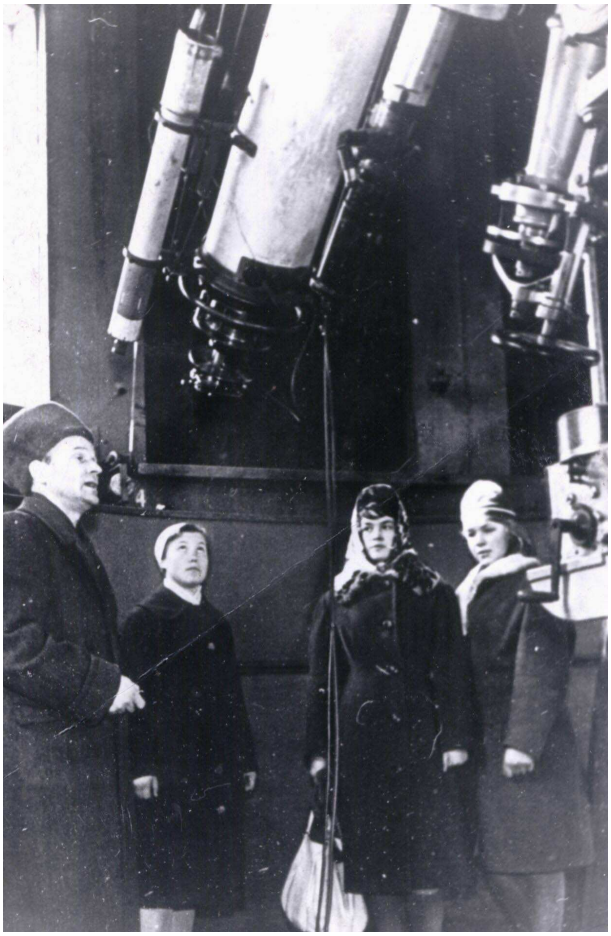

Figure 19.4: *Visitors in the observation tower of Tartu Observatory in 1963, University of Tartu Observatory in 2008, Photo by Andres Tennus (Tartu City Museum, University of Tartu)*

as a museum of astronomy. It was affiliated to Tartu City Museum. The museum's exhibition was located in the East Hall of the observatory building, which had escaped reconstruction and still preserved in its original layout. The most important object on display was the Fraunhofer refractor. During this period, astronomers performed supervised demonstration observations in the tower with a Zeiss refractor.

In 1996 the observatory was returned to the university and the astronomy museum was closed. In the same year, the Astronomy Club of the observatory was officially founded and continued organising observations, lectures and other events for those interested in astronomy as well as for the general public. Four years later, the Science Centre *Ahhaa* was accommodated on observatory premises and in the former residence of the Head of the observatory. The Science Centre was founded by the university[10] with the aim of raising awareness of science among the public and has been remarkably successful in its work. The Astronomy Club has continued its activities as well. In 2009, the Science Centre is expected to move to new facilities.

The buildings of the observatory complex have to date fallen into disrepair. The university has prepared a renovation project that foresees turning the complex into a museum. An application for financial support to carry out the project has been submitted to a programme financed from the Regional Development Fund of the European Union. In fact, a definitive approval has just come through in January 2009 in respect of the application, and work can now begin on the project. According to project schedule, the renovated observatory complex and the new museum will be opened in the beginning of 2011. The University and the University Museum will carry out the project in co-operation with the Astronomy Club, Tartu Observatory (the science institution in Tõravere), Tartu City Government and the Science Centre *Ahhaa*.

The underpinning concept of the museum is preservation of the heritage of the observatory, including its historical ambience, to the greatest extent possible. In the rooms that have been preserved in their original layout, traditional museum solutions will be avoided. The museum will tell a series of stories of which those about the period of the 19$^{\text{th}}$ century will be in the foreground. The stories will link facts about the building and the instruments and other objects in it to the history of scientific disciplines practiced in the observatory. This approach is similar to the one that has been outlined and advised for the musealization of Tapada da Ajuda, the Astronomical Observatory of Lisbon by a group of museum experts of which the author of this article has the privilege to be a member. In 2007, a meeting of UNIVERSEUM, the European university museums network was held in Lisbon, and some of the meeting's participants of which were invited to a workshop to discuss the possibilities of turning the Tapada da Ajuda observatory into a museum. The opinions of the participants were then developed further and published as an article.[11]

The museum in the old observatory in Tartu will show the history of the disciplines that have been practiced here – astronomy, geodesy, seismology and determination of time. Old furniture will be restored and used for storing and displaying instruments and books as they were stored and displayed in the heyday of the observatory. Small instruments that have been held in various storage facilities of the University History Museum because of inadequate security measures in the observatory, will be brought back to the observatory and exhibited. The most important instrument of the old observatory, the Fraunhofer refractor, will be exhibited, too. It is in rather good condition but still needs careful cleaning and slight restoration. The refractor was previously restored in 1993. The restoration was carried out under the supervision of Enno Ruusalepp who works in the new observatory in Tõravere. Restoration was considerably assisted by the international contacts of the astronomer and historian of astronomy Heino Eelsalu from the same institution. Indeed, support by colleagues from Germany was very important – for instance, Mr. Ruusalepp was trained at the *Deutsches Museum* (German Museum) in Munich. Special thanks for their kind help and cooperation are also due to Professor Dr. Gudrun Wolfschmidt and Mr. Ernst Ellinger, master technician of the *Deutches Museum*. Both Eelsalu and Ruusalepp have written about the restoration process, the former about its general background and the latter about particular restoration operations.[12]

A suitable microclimate must be ensured for historical instruments in the restored observatory. The most complicated problems that have to be tackled concern the Fraunhofer refractor. The current situation, in which considerable temperature and humidity swings take place in the observatory rooms daily, threatens the preservation of the instrument over a longer period of time. There are plans to start heating the room of the refractor so as to keep its climatic parameters constant. Architects and technical designers are faced with a difficult task of ensuring suitable conditions for the refractor, while avoiding the introduction of complicated technological solutions into the historical building.

19.4 Struve Geodetic Arc as World Heritage

The old observatory in Tartu belongs to UNESCO's list of world heritage as part of Struve Geodetic Arc. The arc runs through the observatory and a point on the arc is marked in the floor of the entrance hall of the observatory. The arc is a chain of triangulation survey points stretching from Northern Norway to the Black Sea. The survey was carried out in 1816–1855 under the leadership of F. G. W. Struve and Carl Tenner. The survey was of considerable importance for determining the shape and size of the Earth and represented an important step in the development of astronomy, geodesy and cartography. The arc was inscribed in UNESCO's

Figure 19.5: *The Fraunhofer refractor in the 1970s, Photo by E. Sakk (University of Tartu History Museum)*

list of world heritage in July 2005. There are two more points of the arc in Estonia, both of which are also on the world heritage list. A total of 34 preserved sites on Struve Geodetic Arc have been marked as world heritage. The survey actually involved 265 main points.

Struve Geodetic Arc has given rise to the first series of World Heritage nominations shared by a considerable number of countries – according to contemporary geography, the arc passes through ten countries (Norway, Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Belarus, Moldova, Ukraine). The national surveying agencies of these countries have cooperated since the beginning of the nomination process in 1994. The leading role in the process was played by the National Land Survey of Finland. Now, the countries have assumed principal responsibility for the points of the arc in their territory, but they still need to continue cooperation. The goal is to develop common rules and good practice in protecting, presenting and promoting the arc to the public.

The fact that the old observatory of the University of Tartu is included in the world heritage list is a great recognition to the heritage of the observatory. It adds both responsibility and motivation to preserve that heritage and keep the observatory open to the public.

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1. The other highlights of the collection are that of physics, chermistry and medicine. The Museum was founded in 1976. It is one of the three museums of the University of Tartu. The other museums – the Natural History Museum (1802) and the Art Museum (1803) are the oldest museums in Estonia.
2. The University of Tartu is the oldest and the only *universitas-type* university in Estonia. It was founded in 1632 as a Swedish university. The operation of the university was supended in 1710 due to the Great Northern War. The university was reopened in 1802, soon becoming a Russian imperial university, although for the most part of the 19th century it remained intellectually a German institution.
3. Maiste, Polli, Raisma 2003, p. 177.
4. Markkanen, Linnaluoto, Poutanen 1984, p. 49 and pp. 58–60.
5. In the Soviet system, research and higher education were regarded as separate fields – institutes of the Adacemy of Sciences were expected to be leading in research, while universities had to act as providers of higher education as their primary task. In 1948, the old observatory of the University of Tartu was taken from the university and affiliated to the Academy of Sciences of the Estonian SSR.
6. Eelsalu 1999, p. 111.
7. Eelsalu 1999, pp. 116–117.
8. Eelsalu 1999, p. 116.
9. Einasto 2004, p. 64.
10. Since 2004, the Science Centre Ahhaa works as a foundation established by the University of Tartu, the City of Tartu and the Ministry for Education and Reseach.
11. Clercq et al. 2008.
12. Eelsalu 1999, p. 120; Ruusalepp and Pehk 1994.

19.5 Bibliography

Clercq, Steven de; Talas, Sofia; Soubiran Sébastien; Mägi, Reet and Panu Nykänen: Greenwich on the river Tagus: Reflections on the scientific, cultural and historical significance of Ajuda, the Astronomical Observatory of Lisbon. In: *Opuscula Musealia* **16** (2008), pp. 23–31.

Eelsalu, Heino: The rise and fall of small astronomical observatories: a case study Dorpat/Tartu Observatory. In: *Journal of Astronomical History and Heritage* **2** (1999), (2), pp. 111–123.

Einasto, Jaan: Tartu Ülikool teaduskeskusena [The University of Tartu as a research centre]. In: *Kaiserliche Universität Dorpat 200 – Academia Gustaviana 370 – The Jubilee of the University of Tartu.* Festschrift. Ed. by Reet Mägi and Wolfgang Drechsler. Tartu: Tartu University Press 2004, pp. 61–77.

Maiste, Juhan; Polli, Kadi and Mariann Raisma: *Alma Mater Tartuensis. Tartu University and its Architect Johann Wilhelm Krause.* (s.l.): Eesti Keele Sihtasutus 2003.

Markkanen, Tapio; Linnaluoto, Seppo and Markku Poutanen: *Tähtitieteen vaiheita Helsingin yliopistossa – Observatorio 150 vuotta.* [Chapters of the history of astronomy in the University of Helsinki – 150 years of the Observatory.] Vaasa: Helsingin Yliopisto 1984.

Ruusalepp, Enno and Matti Pehk: Die Überholung des Fraunhoferschen Refraktors. In: *Geodeet* **6** (1994), (30), pp. 24–25.