Konkoly Observatory of the Hungarian
Academy of Sciences

Monographs
No. 1

THE ROLE OF
MIKLÓS KONKOLY THEGE
IN THE HISTORY OF ASTRONOMY IN HUNGARY

**The 120th Anniversary of Konkoly Observatory,
Meeting in Budapest, 5-6 September 1991**

PROCEEDINGS

Edited by
MAGDA VARGHA
LÁSZLÓ PATKÓS *and* IMRE TÓTH

BUDAPEST
KONKOLY OBSERVATORY
1992

Konkoly Observatory of the Hungarian
Academy of Sciences

Monographs
No. 1

THE ROLE OF
MIKLÓS KONKOLY THEGE
IN THE HISTORY OF ASTRONOMY IN HUNGARY

**The 120th Anniversary of Konkoly Observatory,
Meeting in Budapest, 5-6 September 1991**

PROCEEDINGS

Edited by
MAGDA VARGHA
LÁSZLÓ PATKÓS *and* IMRE TÓTH

BUDAPEST
KONKOLY OBSERVATORY
1992

ISBN 963 8361 45X
HU ISSN 1216-5824
Felelős Kiadó: Szeidl Béla
Hozott anyagból sokszorosítva
9220693 **AKAPRINT** Nyomdaipari Kft. Budapest. F. v.: dr. Héczey Lászlóné

Preface

On the occasion of the 120th anniversary of the founding of Konkoly Observatory a meeeting was held commemorating this historical event on September 5-6th, 1991. In 1871 a Hungarian estate owner erected a small telescope on the balcony of his castle in Ógyalla where he had opportunity to observe the sky at his pleasure. His name was Miklós Konkoly Thege. Back then he did not know that he had established the basis of modern astronomy in Hungary. The Hungarian State accepted this observatory at Ógyalla as Konkoly Thege's generous gift on May 16th, 1899 and the new Royal Astrophysical Konkoly Observatory started its work from this year. Before that date Konkoly Thege had many unsuccessful attempts to transfer his observatory into Government hands. Konkoly Thege had no children, and nationalization was the only way for Konkoly Thege to preserve his institute for the future. By this time the astronomical research work had already firm base in Hungary. In 1920 Ógyalla came under Czechoslovak Jurisdiction. By the end of 1921, here on the Svábhegy the first dome was built. By the end of 1926 the new National Observatory's Central buiding was completed. Almost fifty astronomers gathered to celebrate the anniversary in September 1991 at the Konkoly Observatory in Budapest. Some of them came from other countries, Austria, Germany and Slovakia. In 1992 we commemorate the 150th anniversary of the birth of Miklós Konkoly Thege. By this book we want to acknowledge him and to give publicity to his scientific work.

Budapest, August 31, 1992

* * *

Contents

***

MIKLÓS KONKOLY THEGE, THE HUNGARIAN ASTRONOMER

LÁSZLÓ PATKÓS
Konkoly Observatory
Budapest, P.O. Box 67 H-1525, Hungary

Miklós (Nicholas) Konkoly Thege (1842-1916) was not the first Hungarian astronomer, but none the less could be regarded as the founder of Hungarian astronomy. Because well known Hungarian astronomers of previous ages (e.g. F.X. Zach or M. Hell) worked abroad, their being Hungarian is hardly known. There were earlier astronomical observatories in Hungary, for example at Eger and at Buda, but after several years of useful work they all stopped functioning. By the middle of the 19th century there were no astronomical observatories operational in Hungary. Konkoly Thege recognised that the country needed modern scientific research, and he did his best to lay the foundation for a permanent astronomical observatory.

The main period of his life, the second half of the 19th century, was a period of rapid development in Hungary. Growing industry and commerce affected not only Hungarian culture but also Hungarian science.

This was in fact an era of great achievements in science all over the world. Nineteenth century astrophysics was a breakthrough equivalent to seventeenth century work on planetary motions. At the end of the 19th century astronomers knew much about the universe around us. Distances of the planets and the nearby stars were known. It became evident that our whole solar system, including the Sun with all its planets, was on a journey towards the constellation Hercules. It was known that the Sun is one of the stars, and a rather small one at that. Little was known about the energy production of the Sun. Yet the nineteenth century witnessed a major turning point in the development of astronomy - the rise of astrophysics.

The crucial factor in the early development of astrophysics was the study of spectra. Early astronomical spectroscopy concentrated on the Sun, in part because it was the brightest object available. Some astronomers attempted to photograph stellar spectra in the 1860's, but no results of value were obtained until 1870's. The first Doppler shift in a stellar spectrum was established soon. By the end of the century the main aim of stellar spectroscopy became stellar classification.

Photography was the other major technological development that helped to transform astronomy during the second half of the nineteenth century. The spectroscope provided information on the physical and chemical composition of the stars while photographic plates replaced the human eye. Their combination formed the real technological foundation for astrophysics.

The third important area of developing astrophysics was the photometry of stars. The last thirty years of the nineteenth century saw instrumentation and technologies develop sufficiently for a variety of astrophysical investigations. However, the main retarding factor was the lack of an adequate theoretical basis for interpreting the observations.

This was the environment in which M. Konkoly Thege - the son of a Hungarian noble family began his career, at first as an enthusiastic, later as a professional astronomer, founder of the astronomical (and later the meteorological) observatories. He was a member of the Hungarian Academy of Sciences, the Royal Astronomical Society, the Astronomische Gesellschaft, and the Societe Astronomique de France.

He began his studies in physics and mathematics in Budapest. One of his professors here was the famous Hungarian physicist Á. Jedlik. Next he continued his studies in Berlin with J.F. Encke, J.H. Dove and H.G. Magnus. After graduation he spent some years in Heidelberg, Göttingen, Greenwich, London, Brussels and Paris working in laboratories and workshops. As he worked mainly in spectroscopy he had close contact with A. Secchi but W. Huggins and K.F. Zöllner also made a great impression on him. Later he had good personal contact with H.K. Vogel and M. Wolf.

He founded his astronomical observatory in 1871 at his country estate, Ógyalla (today: Hurbanovo, Czech and Slovak Federational Republic). Some years later the Ógyalla observatory (legal predecessor of today's Konkoly Observatory of Budapest) was one of the best equipped observatories in Europe.

Konkoly Thege recognized soon that he could raise astronomical research to a European level only with the help of high quality equipments. Therefore he travelled through Europe and renewed and extended his former relations with the best firms and ordered his instruments from them. He was a good mechanical designer. Part of his instruments were manufactured by him, and these instruments became well known for their usefulness and elegant design. For example his blinck-komparator was manufactured later by G. Heide (Dresden).

The first instruments of the Ógyalla observatory were a small meridian circle, a 10″ Browning reflector, a 6″ Merz equatorial refractor and a 4″ photoheliograph. The mechanical part of his 3″ astrograph was partly made by him as well as a new 10″ Merz-Konkoly refractor which he installed instead of the sold 10″ Browning. Later (in 1906) he mounted to the 10″ Merz-Konkoly refractor a 6″ astrograph. This astrograph was used until the 1960's at the Konkoly Observatory in Budapest, and the 10″ Merz-Konkoly is even now in use at the Heliophysical Observatory at Debrecen.

As a rich man Konkoly Thege had the option of establishing an observatory, but he knew well that after his death his observatory would come to an end too. There were a lot of examples for the sad fate of once prospering observatories. Maintaining a big observatory was beyond his means and so he tried first to offer his observatory to the University of Pozsony (today: Bratislava Czech and Slovak Federational Republic), but the offer wasn't accepted. He didn't give up, and finally handed over his private observatory to the Hungarian state in 1899.

In European countries state finance had, in fact, been involved in the foundation of astrophysical observatories like Potsdam or Meudon as early as the 1870's. In the United States the founding of astrophysical observatories by private donations ultimately proved fruitful, leading to the creation of a series of major observatories committed to astrophysics - Lick in 1876, Yerkes in 1897 and Mount Wilson in 1904. At the same time, old established government observatories sooner or later became involved in some astrophysical work too. For example solar observations in Greenwich started in 1873.

Regular observing programs of the Sun started at Ógyalla in 1872. In the first years only the position and extension of sunspots were determined. From 1885 the Wolf relative number was determined daily. Observation of the Sun was a key program at the Ógyalla observatory and Konkoly Thege was one of the first to make micrometric measurements on the surface of the Sun. He observed planets as well. His drawings of Jupiter and Mars were of high quality and reliability. By the observation of the red spot of Jupiter the rotational period was determined (Wonaszek 1901).

The era when Konkoly Thege began his work in astronomy, the last decades of the 19th century was the beginning of the interweaving of physics and astronomy. The main tools in this process were photography and spectroscopy. His skill in designing and preparing different instruments was a great help for him in this field.

Konkoly Thege made important contributions to spectroscopy. First he bought, later he designed and built a number of spectroscopes - from the wide-field "meteor-spectroscope" through the high resolution sun-prominence spectroscope to the ultraviolet spectrograph. The observatory had 27 spectroscopes ! His prominence spectroscope was later manufactured for decades by Zeiss Jena. Although he was a great photographer, he made his spectroscopic observations mainly visually.

Konkoly Thege and the group at his observatory worked in the field of stellar classification too. Classification is a typical preliminary stage of any scientific work. One of the great problems in astrophysics and particularly in stellar classification was that while the observational data accumulated, agreed interpretations of the data came slower. The vast majority of stellar spectra were classified into three main categories (one of which was subdivided into two). The Ógyalla observatory took part in the international cooperation to determine the spectra of stars. They tried to classify the spectral type of stars between 0° and -15° declination which were brighter than 7.5 mag. (This work was done by R. Kövesligethy and others with Konkoly Thege's supervision). Stars between 0° and +40° were observed in Potsdam (H.C. Vogel) and those between +40° and 90° at Lund (Duner). This catalogue of stellar spectra containing 2202 stars was prepared in Ógyalla (Konkoly Thege 1887). They also observed spectra of variable stars (*beta* Lyr, *gamma* Cas) and novae.

Konkoly Thege studied the spectra of comets and even meteors. He observed spectroscopically 30 comets. He was not only successful in obtaining comet spectra but he was able to recognize certain changes in them too. As a result of his comet spectroscopy he established a so-called "normal comet spectrum" with 3 main and 3 complementary lines. In some cases he was able to see absorption lines (Konkoly Thege, 1882; 1884). He also made reference spectrum measurements to establish the exact chemical compostion of the observed celestial bodies.

Visual spectroscopic observations of meteors require speed and extensive practice. Konkoly Thege observed lines of Na, Mg, Li, Fe and sometimes different CH lines as well in the spectra of meteors (Konkoly Thege, 1883). These observations of Konkoly Thege were considered an indication of the close relationship between meteors and comets (Wolf, 1892)

Konkoly Thege was an all around researcher, who proved to be at home in doing observational work as well as instrument design. He published a number of articles in different journals, primarily very straightforward observational pieces on astronomy. These were not particularly earth-shaking contributions, but indications of a man who worked very hard.

He organized simultaneous meteor observations, making it possible not only to determine the radiant on the sky but to reconstruct the spatial track of the meteor. By the help of the highest observed meteor tracks it was possible to establish the thickness of the earth atmosphere. You can read about Konkoly Thege's scientific activity for example on page 344 in the Feb. 15, 1877 issue of Nature.

Konkoly Thege wasn't a man locking himself into the ivory tower of science. He was a scientist who matched European standards, but he wasn't a narrowminded specialist. He was a great hunter, a music-lover and a music player. He was always the centre of the company. While staying at his small estate at Tagyos he was able to persuade the fashionable set to take part in meteor observations!

As in 1890 M. Konkoly Thege became the director of the National Royal Hungarian Meteorological and Geo-magnetic Institute as well, his attention and work was divided between astronomy and meteorology since then. He continued his astronomical work until his death, but it was the two decades of his activity before 1890 that were decisive in developing Hungarian astronomy. It is not accidental that during this short time period three more astronomical observatories were founded in Hungary: L. Haynald archbishop's observatory at Kalocsa, the Gothard brothers' observatory at Herény, and baron G. Podmaniczky's observatory at Kiskartal.

Astrophysics from the start required the assistance of another group of experts - the instrument makers. Progress in astrophysics and particularly in astronomical spectroscopy obviously depended on the production of spectroscopes and various other instruments.

His knowledge and experience in manufacturing astronomical instruments made Konkoly Thege capable of writing his textbooks. These were useful first of all for those who were interested in practical work. Reading these books you can see that the author had a real personal contact with and knowledge about the instruments described there (Fig. 1 and 3).

The three textbooks he wrote made his name well known. This is why he was asked by W. Valentiner to write the chapter "Astrophotographie" for his famous book "Handwörterbuch der Astronomie" (Vol. I-VI. 1897-1902).

The three textbooks were as follows:

First book: "Practical Guide to Making Astronomical Observations with Special Consideration for Astrophysics, Secondarily a Review of Modern Instruments". This book was issued in Braunschweig (Germany) in 1883. You can find 345 excellent woodcuts in it. It is a textbook in the true meaning of the word. If you had been a young astronomer at the start of your career in the second half of the 19th century, you would have found everything in this book necessary for establishing an up-to-date observatory of your own. Good old days! I wish that somebody told me how to make everything, and I could be sure that it was really well done that way! The main topics of the book are: - clocks - bubble glasses - meridian circles - parallactically mounted telescopes - micrometers - helioscopes - spectroscopes - sky photographic cameras - heliostats - siderostats - astrophotometers.

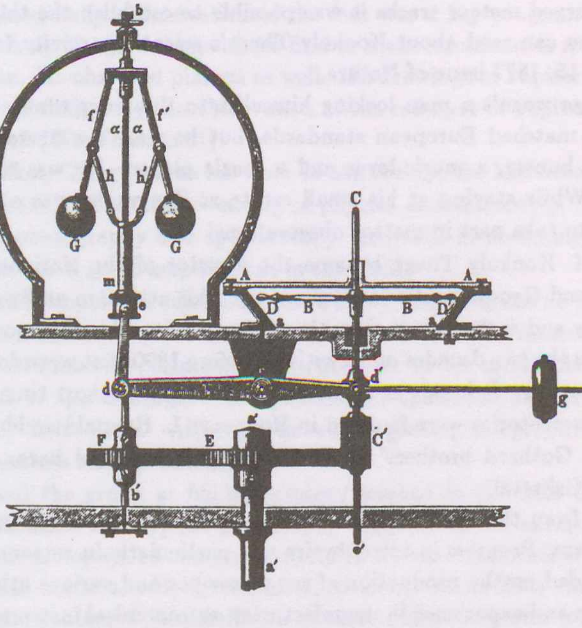


Fig. 1

Merz's clockwork regulator for telescopes. You can read about this book in the periodicals Sirius (XVI, Neue Folge Vol. XI. p 142, Leipzig 1883) and in Zentralzeitung f. Optik u. Mechanik Vol. Xi. p 81, Leipzig 1883).

Second book: "Practical Introduction for Sky Photography and Draft Description of Modern Photography and Spectroscopy in the Laboratory". This book was published in Halle (Germany) in 1887. It deals with every aspect of photography and especially with astrophotography. The quality of the 218 figures is at the same high level as in the first book. In this book you can get a detailed description of a photographic laboratory, including answers to such questions as "How do you carry out photographic emulsion?". The main topics of the book are: - photographic laboratory - photographic plates - photographic cabinet - photography with telescopes: Sun, solar spectrum, Moon, comets, planets, stars, stellar spectra.

In particular I found interesting the description around page 88 of how to get different emulsions sensible for different spectral regions. There are a lot of interesting instruments described in this book. One of the most remarkable of them I think is the double pointer eyepiece which was attached to v. Gotthard's telescope (Fig 2). With one eyepiece you can get a wide field view, then you can switch to the pointer. This eyepiece with a much smaller field and cross-hairs is movable in two perpendicular directions, so you can easily find a star for guiding the telescope for the photographic exposition.

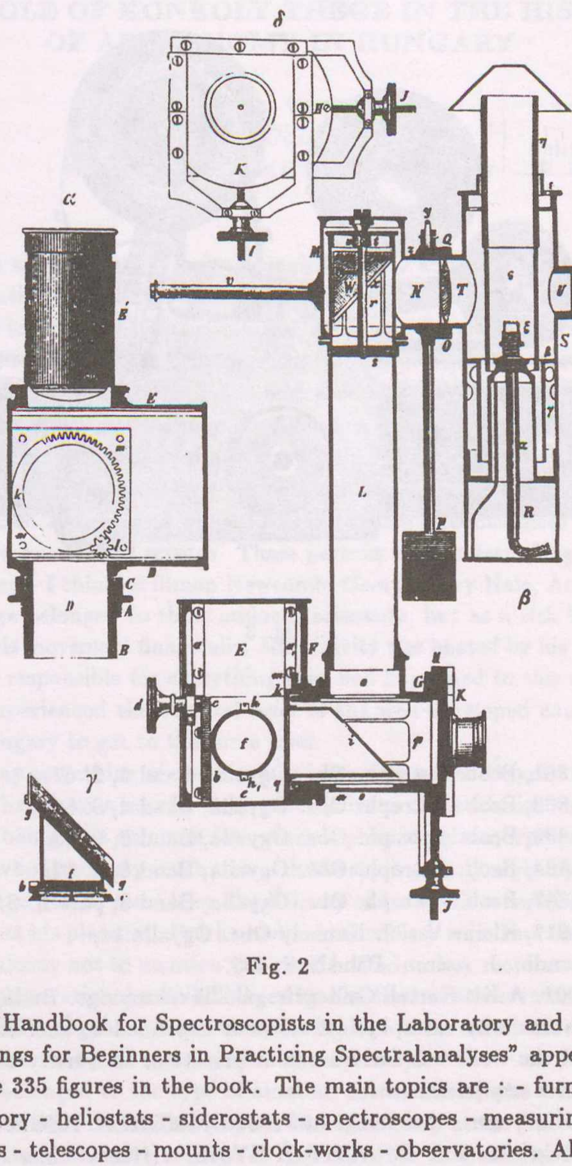


Fig. 2

The third book: "Handbook for Spectroscopists in the Laboratory and at the Telescope. Practical Warnings for Beginners in Practicing Spectralanalyses" appeared in Halle, in 1890. There are 335 figures in the book. The main topics are : - furnishing a spectroscopical laboratory - heliostats - siderostats - spectroscopes - measuring spectra - spectral photometers - telescopes - mounts - clock-works - observatories. Although this book deals mainly with different spectroscopic devices and some supplementary equipments, for me the most interesting description was that on v. Gothard's wedge-photometer. The 110 mm long wedge itself originates from Steinheil (Munich). With the help of an apparatus attached to the photometre Gothard could print the actual position of the wedge in the consecutive measurements.

Konkoly Thege published his last textbook in 1890. Since he lived and worked until 1916, these books don't represent his final knowledge about astronomical instruments. Readers who are interested in further developments can get some more information [1].

[1] E.g.: by Konkoly Thege (1912).

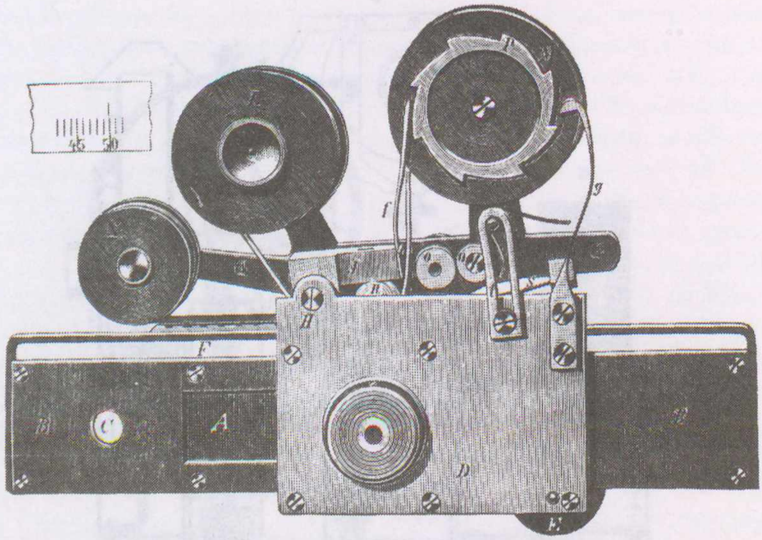


Fig. 3

References

Konkoly Thege 1881, Beob. Astroph. Obs. Ógyalla, Band 3, S. 67.
Konkoly Thege 1882, Beob. Astroph. Obs. Ógyalla, Band 4, S. 5.
Konkoly Thege 1883, Beob. Astroph. Obs. Ógyalla, Band 5, S. 85.
Konkoly Thege 1884, Beob. Astroph. Obs. Ógyalla, Band 6, S. 12.
Konkoly Thege 1887, Beob. Astroph. Obs. Ógyalla, Band 8, part II. S. 1-41.
Konkoly Thege 1912, Kleine Veröff. Konkoly Obs. Ógyalla 14,
Wolf, R. 1892, Handb. d. Astron. Band 2, S. 495.
Wonaszek, A., 1901. A Kis-Kartali Csillagvizsgáló Tevékenysége. Budapest.

One of the reasons why astrophysical research expanded so successfully at that time was that much of the work was carried out at private or university observatories, where usefulness was not a requirement.

"Praktische anleitung zur Anstellung ASTRONOMISCHER BEOBACHTUNGEN mit besonderer Rücksicht auf die ASTROPHYSIK" (Nebst einer modernen Instrumentenkunde)

"Practische Anleitung zur HIMMELSPHOTOGRAPHIE nebst einer kurzgefassten Anleitung zur modernen photographischen Operation und der SPECTRALPHOTOGRAPHIE im Cabinet"

Third book: "Handbuch für SPEKTROSCOPIKER im Cabinet und am Fernrohr. Praktische Winke für Anfanger auf dem Gebiete der Spectralanalyse."

* * *

THE ROLE OF KONKOLY THEGE IN THE HISTORY OF ASTRONOMY IN HUNGARY

MAGDA VARGHA
Konkoly Observatory
Budapest, P.O. Box 67 H-1525, Hungary

In our era, when a single person feels so lonely, helpless and bedwarfed in the new world of technical civilization, in an age when one person's will does not hardly mean anything, it is very imposing to follow with attention the life of an outstanding personality as Miklós Konkoly Thege, to whom we thank for so much invaluable legacy.

For centuries only the politicians, kings and generals could intervene effectively in the advancement of a country. The role of a scientist was to deal with his own field in science, and he could help the development of a country only in an indirect way.

In the nineteenth century a new type of scientists emerged, the great organizer, who was dealing with the science itself, and wanted to create ideal circumstances and a productive atmosphere for advancement of science. These persons were outstanding scientists as well as genious organizers. I think of Simon Newcomb, Georg Ellery Hale, Arthur Auwers, etc. Our Konkoly Thege belonged to these eminent scientists, but as a rich landowner he was also able to help this movement financially. His activity was heated by his patriotism, which means that he felt responsible for everything that had happened to this country. Through his journeys, he experienced the cultural level of the well-developed countries in Europe, and he wanted Hungary to get to the same level.

I would like to say something about the very beginning of the Ógyalla Observatory with Miklós Konkoly Thege's own words: "As other private observatories the Observatory in Ógyalla came into being on a common fate, when a private person, who was very interested in astronomy and who liked very much to watch the sky regularly night by night, decided to buy a small telescope and to erect it on the balcony of his castle where he had opportunity to observe the sky at his pleasure. But he had to realize very soon that this instrument was very heavy for a balcony not to mention the case he liked to buy more and more accessories for improving his observational possibilities. Also the famous Observatory in Potsdam had such an origin"... "The Ógyalla Observatory had grown from a little nucleus to a big tree, that has been wellknown by its activity abroad very early"

Konkoly Thege belonged to the type of amateur astronomers, who was a landowner but a learned scientist as well. He studied physics and astronomy at the University in Pest, and in Berlin. In Pest-Buda he was a student of Ányos Jedlik. In Berlin he learned astronomy by Encke, Dove etc. It is moving to think about the fact, that Encke who applied for the directorship of Observatory Gellért Hill in 1820 and was close friend of Pasquich and Tittel, set in motion Konkoly Thege's astronomical career. For what reason Konkoly Thege had decided to choose the work of astronomers for his whole life, is very difficult to trace now. But knowing his personality it seems clear he was firmly resolved to do it very early. He wrote in his lecture on comets: "I saw an 'honest' solar spectrum also by telescope while I was listening a lecture of Dove in Berlin in 1860" (he was only eighteen years old). In an other place he mentioned that he observed 40 comets from 1864 until 1913.

1870, 1871, were two very sorrowful years for Miklós Konkoly Thege. He lost his two little sons in these years. It is very probable that this is why he began to set up his own private observatory that time, it was his way to preserve his name for the future.

Today it seems incredible, how he could achieve such rapid development at that time.

In 1871 only a few smaller instruments stood on the balcony of the castle.

By 1873 his studies were published in Monthy Notices.

By 1874 the first dome in the garden of the castle was built and equipped with 10 inch reflecting telescope, brought from Browning Company, London.

Starting from 1876 Konkoly Thege had regularly published his observations in the Treatises published by the Hungarian Academy of Sciences. In 1879 the new observatory issued his own Publication. (Beobachtungen 1-16 (1879-1894), Halle). Konkoly Thege became member of the Royal Astronomical Society of London in 1881, only ten years after he had founded his Observatory at Ógyalla.

Konkoly Thege became a full member of the Hungarian Academy of Sciences in 1884.

Konkoly Thege studied by brilliant teachers, he himself had intellectual power for mathematics and physics, and he had extra capacities for dealing with technical apparatus and with scientific instruments. However, searching for the key to his extra talents for doing science theoretically as well as practically, and of his excellent abilities as organizer of scientific researches we will find the answer in his rich flattering character.

He was the classic type of the *"homo ludens"*.

It was a very interesting game for Konkoly Thege to build up a new observatory, by his own purchase, while nobody could intervene in his plans. There were some famous astronomers that time, who were - as Konkoly Thege - educated scientists and rich magnates at the same time. (I think of William Huggins, Lord Rosse etc).

Konkoly Thege liked very much to create from nothing, to solve seemingly insoluble problems, the most difficult task was the best game for him. The situation in Hungary was not similar to that in England. After many decades the Ógyalla Observatory was the first existing astronomical institution in Hungary, its task was to play the role of a state astronomical observatory in this country. After he had realized very early that his games were very important, Konkoly Thege had two choices, either to create a new observatory with the help of the state or to run his own observatory by himself which would have ment giving up his previous plans. Konkoly Thege could not accept any compromises. As he had decided to be an astronomer, he had to cultivate it on the highest level.

But he was not only a *"homo ludens"* we may as well call him also the *"homo aesteticus"*.

Konkoly Thege was a devotee of classical music very much, he played the piano on an artistic level. As a famous hunter he also found much beauty in nature itself. But as a scientist he knew other ways for being aesthetical. He liked very much the order in everything, in the theories and in the practice. Looking at the wonderful items in the Science Museum of Firenze, I could realize for the first time what does art mean, the common word for fine arts, sciences and for the handicrafts.

Aesthetics belong to the astronomy very closely. Not only the bright sky is full of beauty, the astronomical books could not miss the wonderful illustrations and all the astronomical instruments must have their aesthetical features. Konkoly Thege could find aesthetics in the books and also in instruments, he was bibliophile and instrument maker, and he extremely liked the order and rationality in all items what we use. There are few so entartaining papers as the Konkoly Thege's travel diaries. Travelling across Europe, he visited all important astronomical observatories of his age. He used very severe words if he found ugly, useless dirty instruments, and he praised everything that was suitable for work and was aesthetical as well. As a practical man, he found every mistake. He was an expert in instrument making, in their uses, and in the financial problems. He hated the dull sparing and wasting as well. He had brave fantasy in the plans, but he had his feet on the ground.

He had extra capacity to recognize the first class in everything. First he created astronomical friendship with eminent astronomers of his age. They were: William Huggins, Max Wolf, Carl C. Vogel, Gustav Spörer, Arthur Auwers, etc. He also knew it is not less important to have close friends among the capable instrument makers. Among them his best friend was Georg Merz. He was also fortune with his friends at home. Baron Béla Harkányi, Radó Kövesligethy, and his best companion Jenő (Eugen) Gothard were excellent scientists as well as honest men.

Konkoly Thege realized very soon that Ógyalla could not exist as the only observatory in the country. That is why he helped other persons to create astronomical observatories in Hungary.

The Observatory in Kalocsa founded by bishop Haynald in 1879, Observatory Herény, founded by Gothard brothers, in 1883, Observatory Kiskartal founded by Baron Géza Podmaniczky and his wife (countess Berta Dégenfeld-Schomburg) in 1886 started their work in Hungary.

Reading his valuable three textbooks (Praktische Anleitung zur Astronomischer Beobachtungen..., Practische Anleitung zur Himmelsphotographie ..., Handbuch für Spectroskopiker) we may get an insight not only into his knowledge, but also his personality. He, who wanted to build his astronomical career on a firm base, not finding good new textbooks that would have been satisfied to his claim he wrote himself proper ones. That is very charesteristic of Konkoly Thege's personality.

But after some "honey years" Konkoly Thege had to realize the fact that it was impossible to take up the role of a state observatory by his own purchase. He tried to offer his Institute to the country officials. His work for creating an official institution of his private observatory took him 21 years.

In 1878, he wanted to offer his Institutes to the would be Posonian University. Next year he hoped that the newly founded Technical University would accept his observatory. At last in 1899 Konkoly Thege's efforts turned out a success, and the Konkoly Thege founded Royal Astrophysical Observatory in Ógyalla started to work that year. Why did Konkoly Thege want it so eagerly?

In 1879 he wrote to the leader of Technical University ... considering that all scientific instruments, accessories and also whole scientific institutes that had belonged to private persons and were created by tremendous effort went wrong just after the death of their owner without any trace, or at best they got in a museum without any use...I have decided to offer my well equipped Observatory Ógyalla to the University so that I could preserve it for helping advancement of science in our country in the future too."

During his European tours he had opportunities to visit state observatories. He wrote on the Greenwich Observatory that - (he knew it well, because he was a dozen time there) - "The Greenwich Observatory is one of the oldest observatories in Europe. It is constantly perfected. They spend a lot of money for its operating." ...The astronomical instruments in Greenwich are well-cured, there is cleanliness, and order everywhere".

On an other occasion speaking about the Observatoire Nationale he wrote "The astronomy in Paris is well cultivated, because their officials spent a huge sum of money on maintaining it. They installed their old building with good new instruments complying with the modern requirements. The Observatory in Potsdam owes its advancement to the help of the Emperor Wilhelm, II. He visited this observatory many times, even Miklós Konkoly Thege had once the opportunity to teach him the beauty of the sky.

He could experience the opposite case, the fate of the Nizza Observatory, that got into the ownership of the State after the death of its owner, but nobody cared for it after nationalization. It is why Konkoly Thege's offer contained many important stipulations for the sake of the observatory also in the future.

The heroes in the old tales surmounted every obstacle by the help of their significant personality.

While forming his own observatory Konkoly Thege excercised various activities, he preferred to create everything by his own plan, by his own efforts. And as we see from the results, Konkoly Thege succeeded in everything he had undertaken and in one decade our country became known in other astronomical institutions by his observatory.

After some years Konkoly Thege's heroic efforts to create suitable circumstances for developing astronomical works in Hungary got another feature. Konkoly Thege began difficult struggles against the officials, very often he send them into Walhalla. In one side it is a pity that the talented Konkoly Thege had to deal with many other things which had no contacts with the scientific work. But we think these public activities which were very useful for the community, might have caused much pleasure for Konkoly Thege. It is very easy to blame Konkoly Thege for leaving so early the daily life of the astronomers, and changing it for a directorship in a Meteorological Institue, not to mention his manyfold activities as a member of the Hungarian Parliament. It is true, in a traditional place, among good circumstances, the talented Konkoly Thege could have develop his talent and capacities with greater success, but what would have happened to the advancement of astronomy in Hungary in the later time.

For the *homo ludens* Konkoly Thege it was a new kind of games to solve seemingly hopeless things, to mobilize men of various professions. By all means he as good speaker in the Parliament, as a galant landlord at Ógyalla, as a respected director of Meteorological Institute (1890-1911) helped the development of astronomy in Hungary. Touring in Europe, visiting the astronomical and meteorological observatories, by his up to date knowledge in astronomy, by his extra capacity in dealing with astronomical instruments and with his amusing and lovely personality he could obtain many friends to the Hungarian astronomy.

Also in the years when he was very engaged in political activities, and as the director of Meteorological Institution he had to fight against bureuacracy, he always could spare time for scientific work too. He never abandoned his observational work, and he always kept up with consideration the current astronomical literature. The Public relations were important to him for the only reason, to help to create the proper atmosphere for practicing sciences. Doing scientific work ceaselessly without any disturbing thing gave pleasure to him. We owe him tremendous things: Our observatory itself, his instruments still existing now, some very valuable books in our library. But we must thank him first of all, for that he realized, he had to undertake this organizer role that was very often tiring for him. This is why we can speak about Hungarian Astronomy now. How excellent it would be to have several new Konkoly Thege's among us.

* * *

ASTRONOMICAL FRIENDSHIPS
KONKOLY THEGE'S SCIENTIFIC RELATIONS

KATALIN BARLAI
Konkoly Observatory
Budapest, P.O. Box 67 H-1525, Hungary

The title may sound obsolete, romantic or even nostalgic nowadays when the scientific interaction is mostly characterized by the impersonal and objective "impact factor". The idea was given by SIMON NEWCOMB. His book *Side-lights on Astronomy* [1] contains an essay with the title *An astronomical friendship* and deals with his relationship with Father MAXIMILIAN HELL, the well known astronomer of the 18th century, whom he never met.

NEWCOMB writes: *"There are few men with whom I would like so well to have a quiet talk as with Father Hell. I have known more important and more interesting men, but none whose acquaintance has afforded me serener satisfaction... The ties that bind us are peculiar. When I call him friend, I do not mean that we ever hobnobbed together. But if we are in sympathy what matters it that he was dead long before I was born, that he lived in one century and I in another? Such differences of generations count for little in the brotherhood of astronomy..."*

This essay somehow inspired me to look after KONKOLY THEGE's connections. He had been widely known among contemporary astronomers and scientists and enjoyed great popularity among them. In spite of this fact, this kind of passionate relationship cannot be reported in the following paper. Still we try to shed light on his scientific partners and the position he had in the world of contemporary astronomy.

In the year 1897 the first volume of the *Handwörterbuch der Astronomie* as part of the *Enzyklopädie der Naturwissenschaften* was published in Breslau (today Wroclaw). Its editor was Prof. KARL FRIEDRICH JOHANNES VALENTINER, one of the directors of the Heidelberg Observatory. The single chapters have been written by outstanding experts of the given topics as the editor writes in the Preface [2]:

"Auch der Umstand dass das ganze Werk nicht von einer Hand bearbeitet wurde, hat nothwendig eine Ungleichförmigkeit zur Folge gehabt. Indessen ist durch die Gewinnung der bewährtesten Mitarbeiter erreicht worden, dass die betreffenden Theile von solchen Gelehrten verfasst wurden, die in ihnen die meiste Erfahrung durch eigene Untersuchungen hatten, und der so erlangte Vortheil dürfte die angedeuteten Nachtheile reichlich aufwiegen."

The majority of the authors is from German speaking regions although non German speaking scientists are also represented among them; e.g. from the Habsburg Monarchy KARL ZELBR from Brno, author of the chapter *Himmelsmechanik*. The chapter *Astrophotographie* was written by KONKOLY THEGE.

From the numerous authors let's mention here WALTER FRIEDRICH WISLICENUS from Strassbourg because of his interdisciplinary interest, which was not characteristic of this epoch. He wrote the chapters Photometrie and Spektroskopie, both were pioneering new disciplines in the last third of the 19th century, and the part Chronologie has been written by him as well. His chronological activity is better known nowadays.

The second half of the last century is the period when astrophysics began to develop dynamically. Especially the last three decades of the 19th century show conspicuous progress in this field. The new features characterizing this epoch are the application of photographic techniques and spectral analysis to celestial objects and the development of various instruments for this purpose. An outstanding "international team" took part in this pioneering work and dealt with gathering a huge amount of data in the ways mentioned above and attempted to classify them.

The following list of names is far from complete: HENRY DRAPER, EDWARD PICKERING, ANTONIA MAURY, ANNIE J. CANNON et al, in the United States; the Jesuit father ANGELO SECCHI, GIOVANNI SCHIAPARELLI in Italy, WILLIAM HUGGINS in England, NILS DUNÉR in Denmark, MAX WOLF in Heidelberg, HERMANN CARL VOGEL, W. O. LOHSE, G. SPOERER, JOHANN KARL FRIEDRICH ZÖLLNER in Potsdam, A. BELOPOLSKY in Pulkovo, and it could be continued...

Several main trends can be found almost simultaneously in classifying the spectral characteristics of the stars . The system of SECCHI, and the one of VOGEL are the European attempts in spectral classification. KONKOLY THEGE joined the efforts of Potsdam astronomers in preparing the Ógyalla spectral catalogue (E. ZSOLDOS [3]). The Harvard Classification, generally used nowadays, was only being prepared at this time and got its final form only as late as the beginning of our century. The rich heritage of HENRY DRAPER, consisting of about half a million stellar spectra was used to this classification.

Through the courtesy of our colleagues in Hurbanovo* (present name of the former village Ó-Gyalla, now in Slovakia) a part of KONKOLY THEGE's correspondence has been presented to us in copies. From these letters one can get an insight into KONKOLY THEGE's personal relationships with his colleagues. Among the 28 letters 12 are from colleagues in Potsdam (VOGEL, SPOERER, LOHSE) several further letters are from SCHIAPARELLI, SECCHI and ZÖLLNER. There are 3 letters from HUGGINS in this small collection. They seem to be very friendly. Apart from the material concerning astronomy, sign of personal sympathy can be deciphered from them. It is no wonder at all. J. B. HEARNSHAW writes about HUGGINS in his book *The analysis of starlight* [4]:

"His illustrious career is remarkable in that it was pursued entirely as an amateur and without the benefit of any university education in natural science." And further: "HUGGINS *devoted his time in 1856 to astronomy and supported himself by his own private means."*

---

* According to the peace treaty after the First World War that area has been assigned to Czechoslovakia. The main part of the library and equipment, however, — being the Ógyalla Observatory property of the Hungarian State — has been transferred to Budapest, and here the Konkoly Observatory is the successor of KONKOLY THEGE's nationalized Institute although the Geophysical Institute and a scientific–popular Observatory also preserves the foundation of KONKOLY THEGE in Hurbanovo.

Many circumstances are so similar in the lives of HUGGINS and KONKOLY THEGE that their mutual sympathy is not unexpected. None of them enjoyed the benefit of having children. Both KONKOLY THEGE and HUGGINS were fond of natural, rural life, of hunting (KONKOLY THEGE presented a book to HUGGINS on hunting) and passionate friends of animals. HUGGINS esteemed animals so highly that he named his two dogs Kepler and Tycho, and this fact should not have hurt the two outstanding astronomers. HUGGINS finishes one of his letters (June 15, 1875) to KONKOLY THEGE with the sentence: *"the dogs 'Kepler' and 'Tycho Barkee' bark their love to you"*. Two years later: *"You will regret to hear that I have lost my large dog. A few months since he was taken suddenly ill with typhoid fever..."*

The rest of the correspondence in the archive of the Hurbanovo Observatory contains numerous further letters written to KONKOLY THEGE by partners already mentioned and by other leading personalities of contemporary astrophysics (e.g. G. MERZ, et al.) Some of them were personally acquainted with KONKOLY THEGE, others only by correspondence. This material would also be of interest and deserves further investigation.

In 1898 the usual biennial assembly of the *Astronomische Gesellschaft* (founded in Heidelberg, 1863) took place in Budapest. The decision was made two years earlier at the Bamberg meeting, where the two Heidelberg directors, MAX WOLF and VALENTINER put forward Heidelberg as the possible venue for their next meeting. KONKOLY THEGE was not present at this meeting, he only sent a written invitation. Still the final vote was 21 to 16 in favour of Budapest. Some astronomers strongly supported the choice of our capital (among others WISLICENUS). This fact shows that the private observatory, founded almost three decades before by KONKOLY THEGE, had already achieved a good scientific reputation, and KONKOLY THEGE himself must have been respected among his colleagues.

The 17th assembly of the Astronomische Gesellschaft (AG) was held between 24–27 September 1898. From the minutes of the assembly published in *Vierteljahrsschrift der Astronomischen Gesellschaft, 1898* [5], one can learn that the session was opened by the Hungarian cultural minister, GYULA WLASSICH. In his opening address, delivered in French, the news has been announced that from the coming year on, (1899) the private observatory founded by KONKOLY THEGE in the village Ógyalla would finally be taken over by the state and that FRANZ JOSEF I, the Austrian Emperor and the King of Hungary would provide a certain sum in the state budget for the maintenance and expenses of the Observatory.

The second speaker was the physicist, baron ROLAND EÖTVÖS, president of the Hungarian Academy of Sciences. Addressing the assembly in German, he expressed his high esteem that the AG held its assembly in Budapest and underlined the meaning of it for Hungary.

"Wir wollen lernen, und wir wollen arbeiten in reiner Liebe zur Wissenschaft, welche sich über die Liebhaberei des Dilettanten hoch erhebt, mit jenem echten Ehrgeize, der sich an knechtischer Reproduktion nicht genügen lässt und auch nach selbständigen Schaffen strebt. In diesem unseren Bestreben sind Sie uns ein leuchtendes Vorbild; die Die Fusstapfen, die Sie hier zurücklassen, sollen unsere Schritte lenken und dem Ziele näher führen" — he said.

The third speaker of the opening ceremony was prof. HUGO VON SEELIGER, president of the Astronomische Gesellschaft. In his speech he suggested one minute silence to commemorate the tragic death of Queen ELIZABETH, the wife of FRANZ JOSEPH, the Austrian Emperor and King of Hungary, who was assassinated a few days earlier on the 10th September in Geneva. This act was not a conventional attitude of politeness but sincere bereavement. Queen ELIZABETH due to her beauty and kindness was popular all over Europe and especially beloved by Hungarians because of her sympathetic attitude towards Hungary.

The scientific programme of the assembly contained two papers by Hungarian astronomers, as well. One was read by RADÓ KÖVESLIGETHY in German on stellar spectra, and the second by the Jesuit father GYULA FÉNYI on solar physics in Latin.

A decision was made concerning the venue of the next assembly. The former offer of WOLF and VALENTINER was accepted, and Heidelberg was chosen as the next meeting place.

Let us mention some of the interesting issues dealt with at the meeting. The president, VON SEELIGER gave an account of the number of members of the Astronomische Gesellschaft. With the 9 newcomers registered at this meeting altogether 338 members belonged to the AG in the year 1898. Compared to this large number the participation in the general assemblies seems to be very low (see the participants at the former Bamberg meeting: 37, and in Budapest: 44).

Examination of the member's list shows, that a considerable number of members were from Germany or from German speaking regions ($\approx 30\%$) but almost all European countries, from Finland to Malta were represented among them. E.g. Russia with 28 members, Hungary with 18 members (almost the half of the membership of the Austrian Monarchy). Fifty members were from the USA, 6 from Latin America, and two from Africa.

Ensuing a discussion led by the president, the publishing of the *Astronomischer Jahresbericht* upon the suggestion of WISLICENUS was decided by the Assembly.

In the nineties of the last century it became clear that a modern observatory could no longer be maintained by private financial means only, notwithstanding that KONKOLY THEGE was a wealthy land owner. (Think of the financial support given by the Royal Society to Sir WILLIAM HUGGINS' observatory on Tulse Hill.) KONKOLY THEGE had already proposed earlier that his observatory in Ógyalla be nationalized. However, this offer was not accepted by the authorities at this time. The idea of holding the AG Assembly in Budapest shows the good political sense of KONKOLY THEGE. He made his invitation at the proper time. The international recognition Hungarian astronomy received helped pave the way for the nationalization of the Ógyalla Observatory, a process which KONKOLY THEGE had been advocating for some time. The fact that the AG meeting was held in Budapest shows that both KONKOLY THEGE and the scientific work done in his observatory had gained international respect.

KONKOLY THEGE writes in one of his papers in Hungarian [6] that the much younger MAX WOLF used to show the visitors of the Heidelberg Observatory a worn out book, *Praktische Anleitung zur Himmelsphotographie* [7] by KONKOLY THEGE as the guide which taught him the technique of photographic observations. WOLF himself was a devoted and skillful photographer of the sky, especially of minor planets. H. FREIESLEBEN's informative biography on MAX WOLF [8] does not contain any reference to KONKOLY THEGE. Several years after the publishing of the WOLF-biography, in April 1970, a letter was sent by the author to Prof. L. DETRE, the former director of the Konkoly Observatory. From the letter it becomes clear that FREIESLEBEN when writing the biography had not been aware of KONKOLY THEGE's scientific activities and the friendships with the people with whom he corresponded.*

25.4.70

To the Hungarian Academy of Sciences

Budapest

von Konkoly, Miklós Thege, Dr. phil. 1842--1916

Dear Sir:

The Dictionary of scientific Biography at New York asked me for a contribution about von Konkoly, who was a member of the Hungarian Academy of sciences. As I know the pioneer books on astrophysics and spectroscopy, written by v. K. I accepted the proposal to write a short note of 400--500 words concerning the astronomical and geophysical merits of v. K., who became a famous scientist origining as an amateur. Now the dictionary has a scheme, to fulfil if possible, giving the names of father and mother and if there were woman *(sic!)* and children. I would be very glad if you could teach me these and other personal data concerning v. K.

Yours sincerely
H. C. Freiesleben

The author of the present paper was committed to formulate the answer to Dr. FREIESLEBEN. When writing the letter she could not help wondering about the strangeness of the situation. Why did the Publisher in New York turn to a German historian of sciences — although of good reputation — instead of requesting to see the data on KONKOLY THEGE MIKLÓS from Ógyalla or from the Konkoly Observatory in Budapest. Here, based on an established tradition, the necessary data could have been found without difficulties. The political situation must have been responsible for this fact. The lack of adequate relations between the West and East created a "spiritual iron curtain" between the two worlds.

* Through the courtesy of the National Technical Museum in Budapest a facsimile copy of one of the letters written by MAX WOLF to KONKOLY THEGE could be attached to this paper. The letter contains a list of 30 photographs ("Laternbilder") sent by MAX WOLF to KONKOLY THEGE in the same letter.

Reading HEARNSHAW's excellent book [4] which refers also to KONKOLY THEGE's activities in stellar spectroscopy hope does exist that after the fall of the physical iron curtain, the spiritual one will slowly be demolished as well. Contribution to the scientific world from the East is essential if we wish to retain a global perspective. Due to the lack of proper bibliographies from the last third of the 19th century, it is not easy to make this contribution clear, although Hungarian and other East-European astronomers published also in different foreign languages, mostly in German.

The true history of astronomy can only be the result of international cooperation and it seems promising to search for further binding ties "in the brotherhood of astronomy".

REFERENCES

[1] Newcomb, S.: *Side-lights on Astronomy*, (essays and addresses) Harper and Brothers, London, New York 1906

[2] *Handwörterbuch der Astronomie*, herausgegeben von W. Walentiner, Bd. 1, Verlag Eduard Trewendt, Breslau 1897

[3] Zsoldos, E.: *The Ó-Gyalla Catalogues*, in this volume

[4] Hearnshaw,J. B.: *The analysis of starlight*, Cambridge University Press, 1986

[5] *Vierteljahrsschrift der Astronomischen Gesellschaft 1898*, bei Wilhelm Engelmann Leipzig, 1898

[6] Konkoly Thege, M: *Körültekintés néhány európai obszervatóriumban III* (Looking around in some European Observatories, *in Hungarian*), Heisler, Budapest 1898

[6] v. Konkoly Thege, N: *Praktische Anleitung zur Himmelsphotographie*, Verlag von Wilhelm Knapp, Halle a. S, 1887

[8] Freiesleben, H. C.: *Max Wolf*, Wissenschaftliche Verlagsgesellschaft M.B.H, Stuttgart, 1962

* * *

Gr. Bad. Sternwarte
Heidelberg den 15 Juni 1912

Lieber Freund!

Bei mir ist vollständiger Bankerott eingetreten, sodaß ich 100 unbeantwortete Briefe und ebensoviele unerledigte Arbeiten habe. Von Ordre auszugeben ist keine Rede, da ich aus Geldmangel keinen Photographen habe. Ich mußte also alles selbst machen. Für jemand andern thu ich es schon lange nicht mehr, aber für Dich muß ich es eben machen und deshalb habe ich 2 Nächte durch gearbeitet und Dir 30 Stück Laternenbilder gemacht, die Du behalten sollst. Wenn sie nicht so gut geworden sind, so mußt Du denken, daß ich arg müde bin. Du bekommst sie heute. Instrumente habe ich nicht kopiert. Ich finde die Platten dazu nicht. Es hat sie einer der Herren irgendwo hin geräumt. Vielleicht – wenn ich die Zeit finde?? — mache ich Dir auch noch ein paar Instrumente. Also vorläufig mußt Du mit den 30 Bildern zufrieden sein. Aber — — Ihr müßt sie selbst mit Masken versehen und selbst verkleben!!! Es ist sehr feucht hier. Du mußt also die Bilder gleich auspacken und gut trocknen.

Auf jedem Bild ist mit d. Diamant auf der Rückseite eine Nummer eingeritzt. Die Beschreibung zu diesen Nummern lege ich hier bei.

Im Übrigen singe ich mit Mozart:

Keine Ruh bei Tag u. Nacht
nichts was mir Vergnügen macht
schmale „Kost" und wenig Geld
Das ertrage wem's gefällt
nur die „Kost" ist gut, heute allerdings auch nicht.

Dein
Max W.

Facsimile Copy of One the Letters written by Max Wolf to Konkoly Thege

1. Nebel M 100 Comae Platte D 101 Reflektor Apr 5, 1907 1^{20} bel.
2. ε Morehouse Refl. ~~D 391~~ " Nov 16. 1908 Bel 10^m
3. Details vom Andromeda Nebel Reflektor ~~D 25~~ Refl. Aug 8, 1906, $2\frac{1}{2}^h$ bel.
4. ε Morehouse Refl. ~~D 383~~ Nov 10, 1908, 10 Min bel.
5. Nebel 12 Monocerotis, Jan 18, 1909, Refl. bel 1^{30}
6. Spindelnebel NGC 4565 Comae, Refl. April 4, 1907, Bel 1^{50}
7. Triangulumnebel, Refl. Aug 8, 1907 bel 35 Min.
8. Große Spirale M. 101, Ursae, Refl. Apr 5, 1907. 2^{00} bel.
9. NGC 6992 (Gasnebel), Refl. Aug 2, 1908, 3^{00} –
10. Spiralnebel Canum M 51, Refl. Apr 11, 1907, 2^{00} –
11. Dumbbell-Nebel, Refl, Mai 4, 1907, 1^{28} bel.
12. Höhle des Nebels, H IV 74, Cephei, Übersichtsbild, 16 Zoller, Juli 10, 1904, Bel 4^h. ~~Refl, April 19, 1907, bel 40 Min~~.
13. Höhle des Nebels bei π_2 Cygni, Refl, Aug 14, 1907, bel 3^h
14. Orionnebel, Refl., 1906 Nov 24, Bel 30 min.
15. Andromedanebel, Refl, 1906 Aug 8, Bel 2^{30} –
16. Milchstraße im Cygnus, Unar Zeiß
17. 3 kleine Planeten 11. 12. u 13 Größe, 16 Zoller, Aug 27 1904, bel $3\frac{1}{4}^h$.
(12) (43) (514)
18. Unar aufn. d. Milchstr in Aquila – Scutum – Sagittarius.
19. Die Plejadennebel, Refl. Jan 20, 1909, Bel 2^h.
20. Die Umgebung des Amerikanebels, 6 Zoller, um 1891 gemacht, cca 6^h.
21. ε Morehouse, Refl, Okt 29, 1908, Bel 10 min
22. der Andromedanebel, 6 Zoller, 1901 Sept. 5, Bel 6^h
23. Umgebung von γ Cygni, 16 Zoller, 1901 Juli 16 & 18, Bel $6\frac{3}{4}^h$
24. Nebel bei δ Monocerotis, 16 ", 1903 Febr 18, $5\frac{1}{4}^h$
25. Doppelbild des ε Morehouse, 6 Zoller, Aufschrift abschreiben vor dem Maskieren, Muß maskiert werden, sonst Wirkung sehr schlecht.
26. π_2 Cygni, Höhle des Nebels, Refl, April 19, 1907, bel 40 Min.
27. Spektrum des Kometen Brooks 1911 Sept 26, Bel 183 min, 2 Prismen.
28. Spektrum des planet. Nebels NGC 6527, 1911 Juli 12–19. Bel. $12^h 3^m$
29. Spektrum des Andromedanebels, 1911 Febr 3 – 22, Belichtg $25^h 7^m$
30. Spektrum des Ringnebels in der Leyer, 1911 Juli 5–10, Belichtg $20^h 10^m$.

15 Juni 1912

M. Wolf

JENŐ GOTHARD AND MIKLÓS KONKOLY THEGE

JÓZSEF HORVÁTH
Gothard Observatory, Gothard Amatőrcsillagászati Egyesület
Szombathely, Szent Imre Herceg útja 112, H-9707, Hungary

In autumn 1880 Miklós Konkoly Thege got acquainted with a 23-year-old man, young by his age but as a researcher already well known. The name of the young man, who on the basis of his visits to the observatory in Ógyalla and influenced by Konkoly Thege decided to establish an observatory himself, was Jenő Gothard. He (1857-1909) was born in Herény, a village near Szombathely, County Vas as a son of a wealthy landowner. He graduated from the College of Engineering in Vienna. After returning home he used his extraordinary talent and large property for the service and prosperity of Hungarian science and for raising it to the European level. With his research and experimentation activities he soon aroused the interest of the Hungarian scientific life. Having become enthusiastic by his early success he wanted to set up a physical research institute on his land property,but after meeting with Konkoly Thege he modified his plan and decided to set up an astrophysical observatory. Konkoly Thege who spared no efforts to establish an astronomical observatory network in Hungary naturally offered his immediate help to assist Gothard in realising his plan.

Prior to starting his work Gothard went on a one-month study journey to Western Europe as recommended by Konkoly Thege, so that he could begin the practical realisation of his grandious plan based on a wider scope and more experiences.The route of the study journey in summer 1881 is well known from one of the letters by Gothard: his way led through Austria and Switzerland to France, then he was accompanied by Konkoly Thege to England, Belgium and Germany.

After coming home he immediately began the construction of the observatory. The realisation of his plan was largely facilitated by taking into account the rich experiences of Konkoly Thege. They were in continual correspondence and Gothard was supplied with good pieces of advice and guidelines if he had any obstacles in his undertaking. Based on the lively correspondence and the personal contacts a life-long friendship developed between the two enthusiastic leaders of the observatories in Ógyalla and Herény. Based on the continuous encouragement and advice offered by Konkoly Thege, Jenő Gothard was able to overcome all difficulties of the start. Gothard expressed his gratitude "thousand times" in a letter of 13th December to Konkoly Thege for his generous help and for the fact he had directed his interests to astrophysical research:

> *"This way, based on years of hard work I probably will be able to contribute to science" he wrote.*

Even after the construction of the observatory Gothard was assisted and supported by Konkoly Thege in every way. His reputation and extensive international contacts made it possible for the young researcher to announce the first results of the observatory in Herény abroad as well. Gothard became a member of the Astronomische Gesellschaft already at

the end of 1881 and joined the Royal Astronomical Society during the autumn of 1883. Also recommended by Konkoly Thege he became a corresponding member of the Hungarian Academy of Sciences. I would not like to go into details of his achievements, this is not the objective of this paper,but it is important to emphasize that based on his extraordinary talent and the opportunities offered by Konkoly Thege in the beginning, his activity in the field of astrophysics received global reputation. The close co-operation of Konkoly Thege and Gothard not only manifested in common observation programmes, it also extended to the area of astronomical equipment technology. Gothard was an excellent instrument designer and constructor himself, but there are a lot of references in his correspondence to how highly he appreciated Konkoly Thege's advice also in matters of instrument planning. In the publications written by Konkoly Thege in German Gothard could also write about the means, methods and techniques of his observations and become known internationally.

The creation of the first and unique telephone connection in July 1885 bridging the 178 km distance between the observatories of Herény and Ógyalla is also connected to their names.

The extremely successful astrophysical activity of Gothard ended at the middle of 1894 and from that time on he redevoted his whole energy to the cause of the electrification of the Western Transdanubian region. This move was not surprising at all. In addition to his astrophysical observations, Gothard had always intensively dealt with experiments in electrical engineering. He became the Director of Engineering of the County Vas Electric Company established to realise this monumental plan. The next decade of his life was totally devoted to this work. The facts of the friendly connections between Konkoly Thege and Gothard are hardly known from that time on, as their correspondence has almost totally been lost or scattered. Thus we do not exactly know how these contacts were effected by Gothard's new undertaking which took up almost all his time and energy. One is sure that their personal meetings had become less frequent, which is also shown by a letter of July 16th, 1896 written by Gothard to Konkoly Thege:

"To my deepest regret I could not meet you last time ... since then I have not had the time ... I am administering all matters ..." and the letter was closed by the following lines:

"I will write to you again in a few days time, but right now I am totally exhausted".

Gothard left his leading position at the company in 1905 but it was too late.

He tried in vain to look for peace in his long travels abroad. The life of this outstanding personality of the Hungarian scientific and technical progress was put an end to by cardiac disease on the 29th May, 1909. This paper could most suitably be finished by the closing lines of the funeral speech written by the faithful friend, Miklós Konkoly Thege:

"We can say about this rare man, who went as far as Chartoom in order to be able to see the alpha Centauri and the Southern Cross, that his death was as peaceful as his life had been".

* * *

KONKOLY THEGE'S RESEARCHES IN SOLAR PHYSICS

BÉLA KÁLMÁN, JR.
Heliophysical Observatory
Debrecen, KLTE Botanikus Kert, P.O. Box 30, H-4010, Hungary

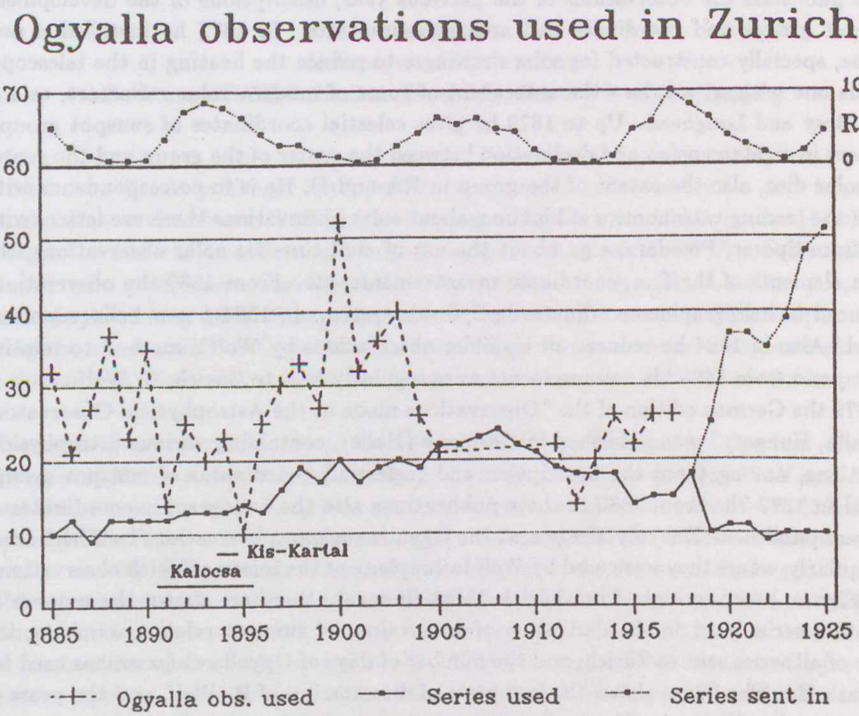
Miklós von Konkoly Thege, the talented Hungarian astronomer made also important contributions to the observations of solar activity. Already in his first private observatory he began to make observations of sunspots by projection with a 4" Steinheil refractor. He made also prominence drawings with a spectroscope. The first drawing of sunspots was made on 16 May 1872. From that date the regular solar observations were continued during the whole period of Ógyalla as Konkoly Thege's private observatory, and also after the donation of the observatory to the Hungarian state, up to the end of the first World War.

For solar observations the end of the 19th century was an important period. Not long before, in 1843 the sunspot cycle was discovered by Schwabe. In 1851 Wolf and Sabine noted the coincidence of geomagnetic storm activity and sunspot maxima. Wolf in Zürich established his Relative Sunspot Number (Rz), and continued his fundamental research on the solar activity cycle. On the other hand Carrington in England and Spörer in Germany (1853 - 1861 and 1860 - 1881, respectively) observed the positions and the development of the individual sunspots and groups, and determined the elements of rotation of the Sun (inclination of the solar equator to the ecliptic, longitude of the ascending node of the solar equator, and sidereal period of the rotation of the Sun). For some time in the reduction of solar observations both of these elements were used concurrently, only in the middle of the 20th century became Carrington's elements universally used. Very probably a significant factor in the universal acceptance of Carrington's elements was the century-long series of Greenwich Photo-Heliographic Results, a series of regular daily measurements from photographs of sunspot groups (area and mean position), which began in 1874 and was terminated in Greenwich with the measurements of 1976 plates, but on the request of the IAU is continued by the Debrecen Heliophysical Observatory. The regular observations of solar prominences with the not long before developed spectroscope were also begun by Secchi in 1869.

Konkoly Thege, as a keen observer and talented organizer and instrument designer, organized the Hungarian sunspot and prominence observations. In the "Communications from the Mathematical Sciences", the journal of the IIIth Department of the Hungarian Academy of Sciences, Konkoly Thege regularly published (in Hungarian) his observations. In the first one of this series, in 1874, he shortly describes his observatory, and at the end some miscellaneous observations (mostly meteors), but from 65 pages 54 deal with sunspots (1872-73) and the three plates at the end show sunspot groups and prominences. This paper was followed by a second one describing the observations of 1874-75, and after his election as a honorary member of the Hungarian Academy of Sciences, his inaugural lecture (8 January 1877) was also about his sunspot observations of 1876.

From then on as he continued to develop his observatory and instruments, every year until 1885 he published the observations of the previous year, descriptions of the development of sunspot groups and coordinate and area measurements. In 1877 he installed a new telescope, specially constructed for solar drawings: to reduce the heating in the telescope, he builds one without a tube - the antecedent of some of modern solar refractors, as e.g. that of Bray and Loughead. Up to 1879 he gives celestial coordinates of sunspot groups, differences in rightascension and declination between the center of the group and the center of the solar disc, also the extent of the group in RA and D. He is in correspondence with many of the leading astronomers of his time, about solar observations there are letters with advice from Spörer, Potsdam, e.g. about the use of civil time for solar observations, the rotation elements of the Sun, coordinate measurements, etc. From 1880 the observations are reduced to heliographic coordinates in Spörer's system. In 1884 a new heliograph was installed. Also in 1884 he reduces all his older observations by Wolf's method to relative numbers, and from 1885 his measurements were regularly sent to Zürich, to Wolf.

In 1879 the German edition of the "Observations made at the Astrophysical Observatory in Ógyalla, Hungary" was published in Germany (Halle), containing various astrophysical observations, among them the description and (celestial) coordinates of sunspot groups observed in 1872-78. From 1880 in these publications also the heliographic coordinates of spots were published. Konkoly Thege sent the Ógyalla sunspot observations to Zürich from 1885 regularly, where they were used by Wolf to supplement the missing Zürich observations. In the Figure, based on data from Zürich "Mitteilungen", there are shown the number of observation series used in the derivation of final values of sunspot relative numbers, the number of all series sent to Zürich, and the number of days of Ógyalla observations used for that year's Rz. The figure shows the last years of directorship of R. Wolf, and the years of directorship of A. Wolfer in Zürich. Ógyalla supplied observations for almost 30 years, and especially significant was the Hungarian contribution after the death of Wolf in 1893, in the year 1894 one fourth of the data series used was from Hungarian observatories. Konkoly Thege personally sent the Ógyalla data to Wolf, after 1894 the data were taken from the above mentioned series of Ógyalla publications. The sunspot data were not published after 1906, the 1906-1910 data were sent retrospectively to Zürich together with ones for 1911,and after the end of the first World War the use of Ógyalla sunspot observations ceased in Zürich, the last year being 1917. In the figure it is visible that after 1918 there is a sharp rise in the number of cooperating observatories sending data, these were mainly amateurs, and the main source of data for Rz comes from a lesser number of specialized, reliable observatories. So one may conclude that the Ógyalla observations helped the Zürich Observatory in a significant period, when not so many reliable observations were available. The drawings made at Ógyalla in the period 1872-1891 are preserved in the library of the Heliophysical Observatory in Debrecen.



Konkoly Thege, besides being a good observer, was also a capable instrument designer. In the field of solar physics the specialized telescope for solar drawings was already mentioned. He built also a photoheliograph, which is described in his "Himmelsphotographie". This instrument is fixed and looks down in the direction of the south celestial pole, from where a clockwork-driven heliostat directs the rays of the Sun to the telescope. In the design of this instrument one can see the typical characteristics of Konkoly Thege's designs: simplicity, robustness, easy operation. Later he built another photoheliograph, and according to Zürich "Mitteilungen" the spots from 1907 were counted on photographs, but the fate of the photographic observations of the Sun is unknown. He also developed two types of prominence spectroscopes, both of it were of direct vision and simple, robust construction. One of these was later marketed by Zeiss, but (according to Konkoly Thege) without reference to its designer. These instruments were essential to the long and continuous series of observations made in Ógyalla, but also in other places.

For the promotion of solar physics the organisational talent of Konkoly Thege was also important. Very early he acquired a good reputation as a capable astronomer and good organizer, so Cardinal Haynald asked him to help establish the Kalocsa Observatory. Konkoly Thege was involved in every new observatory in Hungary in his time, but the Haynald Observatory in Kalocsa was the most important among them. The instruments obtained on the Konkoly Thege's advice were well suited for solar observations, and the third director of the Kalocsa Observatory, Gyula Fényi, S.J. became a worldwide known specialist in prominence observations. For some years sunspot data also were sent from Kalocsa to Zürich (see Figure), but the 32 year long uninterrupted series of prominence observations made by Fényi is of great significance, many statistical properties of prominences were derived from these data. In honor of his achievements, Fényi's name was given by the IAU to a crater on the far side of the Moon.

So Konkoly Thege had a great influence on the Hungarian researches in solar physics. He was the first serious observer of sunspots and prominences in Hungary, initiated some long series of observations which were used internationally, built several world-class instruments for solar observations, and also helped to organize the Kalocsa observatory, where the great work of Fényi became possible. Unfortunately already at the end of the 19th century new large telescopes were built throughout the world, and in the 1900's the domination of the American astrophysics began with G.E. Hale, these developments exceeded by far the possibilities of Konkoly Thege. In the later years of his life he was more concerned with the establishment of the Hungarian Meteorological Service, also under his directorship, but he continued to publish his very well-written remarks on astrophysical observing methods also in the Hungarian journal "Időjárás" (Weather). Practically all the present work in solar physics in Hungary is based on a fundament laid down by Konkoly Thege.

* * *

KONKOLY THEGE AND THE RESEARCH OF COMETS

IMRE TÓTH
Konkoly Observatory
Budapest, P.O. Box 67 H-1525, Hungary

1. Introduction

The 19th century is the era of appearance of bright comets and the discovery of minor planets [1]. Astronomers of the last century had the following goals in the studies of the minor bodies of the Solar System: a) analysis of orbital motion (orbit determination, changes in the orbit of some periodic comets due to non-gravitational effects, celestial mechanics); b) morphological studies of the coma and tail of bright comets; c) spectroscopic and polarimetric observations and theory on the origin of comets and meteors; d) study of the meteor-streams based on the similarity and diversity between orbital motion and spectroscopic analyses. During his studies, Konkoly Thege was interested in the spectroscopic and optical observations as well as in laboratory experiments. He also observed the visible comets regularly. Since the 1870's at his Ógyalla observatory the systematic spectroscopic study of comets was an important astronomical discipline among other observations.

His studies on the Solar System included: visual and photographic observations of comets, by the application of drawing the detailed structure of the coma, determination of the position of comets and asteroids, some celestial mechanical studies - especially the perturbation theory - meteor observations like position measurements, spectroscopy, determination of position of meteor-showers, observations of major planets. Besides his studies on the Solar System he also observed the Sun and Moon, eclipses even more, he performed geophysical and meteorological observations. Konkoly Thege's scientific connections in the field of spectroscopy, instrument designing and manufacturing together with other astronomical relations were important in the instrumentation of his observatory. A brief historical review is presented here on the development of physical spectroscopy in the last century and on the instrumentation background of Konkoly Thege's observatory representing the world standard of his era. A special attention will be taken for his comet observations [2].

---

[1] Even an important astronomical meeting was held and organized by F. X. von Zách in 1796 at Gotha on the systematic search for a possible planet between the orbits of Mars and Jupiter.

[2] Moreover, some of Konkoly Thege's publications will be recommended to the reader's attention for more details in spectroscopy, telescope instrumentation and comet/meteor observations made at Ógyalla (see the complementary bibliography).

2. The spectroscopy of the era

Konkoly Thege's most important results were in the fields the qualitative spectroscopy of comets and bright meteors. He made important contribution to the theory of common origin of comets and meteors according to similarity between their chemical composition. The astronomical spectroscopic results have also been compared with spectra obtained in the laboratory.

2.1 Physical spectroscopy

At the beginning of the last century the first solar spectra were obtained and studied. The quantitative spectroscopy was established which allows to determine the chemical composition of a sample material. Other developments in physical optics were also achieved in the middle of the last century. Hungarian physicist and teacher Father Ányos Jedlik (1859) also studied the solar spectrum and made many high-resolution spectroscopic grating plates (diffraction gratings) and a machine for making gratings. Konkoly Thege also studied the experimental spectroscopy in Jedlik's laboratory and at Dove's laboratory in Berlin (1860). The detailed studies of electromagnetic phenomena and a self-consistent mathematical description led to the foundation of the electromagnetic theory (Maxwell's equations, 1861). From 1870's to the beginning of the 1900's the experimental physical and chemical spectroscopy developed, but there was no exact theoretical knowledge on the origin of the spectral features. Although some physical characteristics of the electron were known (mass and charge, Faraday, Millikan, Lorenz-Larmor's electron theory) in the middle of the last century, the first modern models of the atom (Rutherford, Bohr, Sommerfeld), the molecular spectroscopy, the quantum-theory (Planck, 1900) and relativity theory (Einstein) were developed later in our century.

2.2 Comet spectroscopy

The results of physical optics and experimental spectroscopy have also been applied in the astronomy for explaining the Fraunhofer-lines, solar spectrum, spectroscopic observation of stars [3].

[3] Struve (Pulkovo, 1838) showed that during the occultation of a star of 14^{m} by comet P/Encke the optical thickness of the coma was very low (at a distance of 400,000 km from the nucleus, the starlight was not dimmed by the cometary coma) therefore the mass density in the coma and tail might have been very low. Arago obtained polarimetric observations on the comet P/Halley during the return in 1835.

The first spectroscopic observations of a comet were taken by Donati at Florence on August 5 and 6, 1864 on the comet P/Tempel 1864 I [4]. Donati has described the spectra of the comet as similar to the spectra of metals with broadened spectral features (bands) [5]. Donati also drew the spectrum marked with millimeter scale and the three most important bands of hydrocarbons could be identified. Further comets were observed spectroscopically: the comet 1866 I by Father Secchi (Roma) and Huggins (Upper Tulse Hill, London). Huggins also observed the spectrum of the periodic comet 1867 II, the comet P/Brorsen was systematically observed by Huggins and Secchi during the 1868 and 1879 returns. Huggins was the first observer who regularly compared the cometary spectra with the gas-spectra of hydrocarbons using a gas-glass-tube exciting the gas content with electric-sparks. The accuracy of Huggins' wavelength determination is about the order of the separation of the two prominent D-lines of sodium.

The most prominent Fraunhofer-lines D, b, F and G in the reflected spectrum of Venus were used to calibrate the spectrum of comets, their wavelength was found 589.2, 517.5, 486.1 and 430.1 nanometer (in the contemporary units it was given in units of milli-millimeter = m.m.m.), measured by Secchi. Using this calibration Secchi and independently from Secchi's data Young, Bredichin (Moscow), Copeland (Lord Lindsay's Observatory, Dun Echt), Maunder (Greenwich) and Konkoly Thege verified the characteristic spectral features of hydrocarbon material during the apparition of P/Brorsen in 1879 [6, 7].

The first successful photographic spectrum of a comet was obtained by Huggins in 1881 on comet Tebbutt. During the following half-century or more, objective prism spectra were taken fairly systematically.

---

4 Discovered by G. Tempel, on August 4, 1864.

5 A.N. Bd. 62, No. 1488.

6 The first case of discovering that the cometary spectra are similar or identical to the spectra of hydrocarbons was pointed out observing the comet 1868 II by Huggins and C. Wolf (Paris). C. Wolf has stated that the difference in intensity of the most characteristic spectral features of this comet and of the comet P/Brorsen might be due to different physical conditions (at that time the differences were explained in terms of different gas pressures as suggested by the results of laboratory spectroscopic experiments of the era).

7 Further spectroscopic observations were obtained on the comets 1870 I by Rayet and C. Wolf, 1871 I by Huggins and Vogel (Bothcamp) verifying that this comet was similar to P/Brorsen spectroscopically. The comet P/Encke was observed by Huggins, Young and Harkness in 1871 and only by Konkoly Thege in 1875 and Tachini (Rome) in 1881. The comet Tuttle 1871 IV was observed by Vogel, the comet 1873 III by Rayet and C. Wolf, the comet Henry 1873 IV by Rayet, C. Wolf and Vogel, the faint comet 1874 III by Secchi. The accuracy of Vogel's careful wavelength measurements of spectroscopic bands was about 1-6 Å. The naked eye comet Coggia 1874 III was studied by Vogel, Bredichin and Konkoly Thege and the determined wavelengths of the three characteristic bands of hydrocarbon were identical in the spectrum of the two latter comets.

2.3 Contemporary laboratory spectroscopy

To identify the spectral features of comets and of other astronomical objects comparison spectra were necessary. Certain type of comparison material gas sample could be attached to the telescope spectroscope and an electric spark provided the excitation. The comparison spectrum of more complex gases (most of hydrocarbons) or dangerous material (cyan gas) could only be obtained in the laboratory.

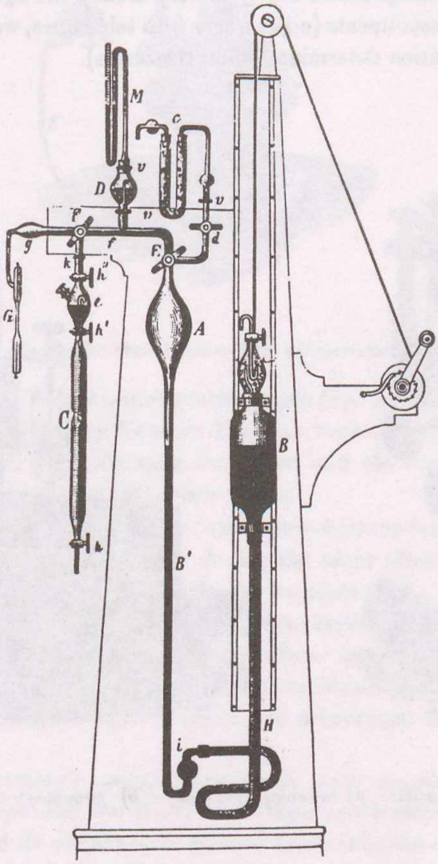


Fig. 1 *The vacuum-pump in Konkoly Thege's laboratory in Ógyalla*

The spectroscopic observations of hydrocarbon gases were taken by Lecoque de Boisbaudran (a-f bands measuring the spectra of lighting/coal-gas), Hasselberg, Swan (laboratory spectra and cometary Swan-bands), Ångström and Thalen (carbon-dioxide), v. d. Willigen, Vogel and Kempf (Potsdam, observing the spectra of mixing of coal-gas and carbon-dioxide), Attfield, Plücker and Hittorf, Wüllner, Watts, Salet, Dewar, Berthelot, and Konkoly Thege (comparing the gas spectra with the cometary spectra).

The very important tool of the laboratory spectroscopy was the Geissler's tube [8], a tube was filled with the gas sample to be examined and closed hermetically at the desired internal pressure. The various vacuum-pumps (usually working with mercury) decreased the gas pressure to the sufficient value (Fig. 1). The electric-spark inductors (Rumkorff-coil) generated the sparks and electric-flashes excited the gas sample in the Geissler's tube (Figs. 2 a and b), several type of electric power supplies (batteries, electric network systems) gave the energy to excite the samples and batteries were usually the lighting sources of lamps to illuminate the scales of instruments (night works with telescopes, wavelength measurements, comparison spectra, position determination on the scales).

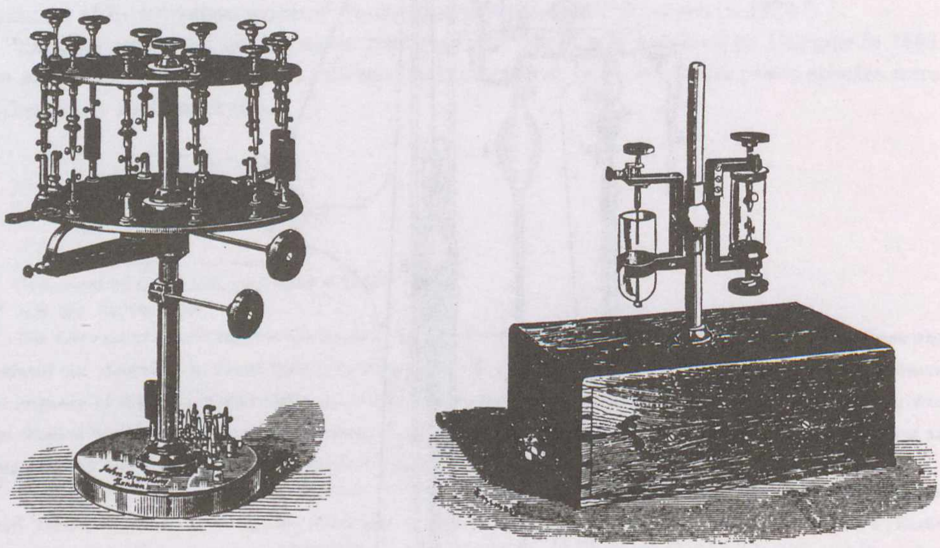


Fig. 2 *Electric spark-inductors:* a) *Browning's multiplexer,* b) *Browning's inductor with condensator*

[8] Constructed by a glass-blower master Geissler and named after him by Plücker's suggestion.

3. Special tools for comet observations

Konkoly modified and fabricated many instruments and devices for observational purposes, these were the so called 'system-Konkoly Thege' equipments.

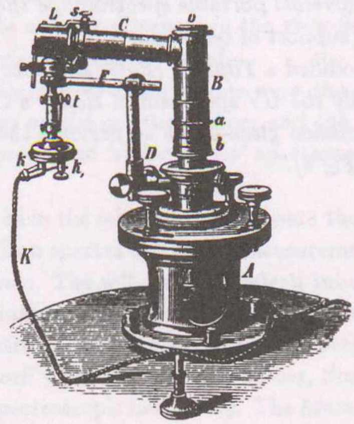


Fig. 3 *The Vogel-Heustreu (No. 40) spectroscope*

The new versions of Vogel's comet-spectroscopes (e.g. reconstructed by Schmidt and Haensch, and modified by Konkoly Thege as Vogel-Heustreu-Konkoly No. 40 spectroscope, Fig. 3) were the most important and the majority of his comet observations were taken using this spectroscope.

The Konkoly-Steinheil spectroscope (with screw-micrometer) was supplied with electric-lamp to illuminate the scales during the night observations. This and Heustreu No. 40 spectroscopes were effective to observe the faint spectra. The Merz-Konkoly 254 mm refractor at Ógyalla was supplied with an electric equipment as power supply and near the eyepiece tube or spectroscope a spectroscope-lamp-rheostat was installed to vary the electric resistance of the circuit to change the intensity of illumination light of scales and micrometer fibre (a voltage of 3 Volts was applied).

The Mc Clan-Browning's spectroscope (with screw-micrometer), the Merz-universal spectroscope and the No. II type Vogel-spectrosope (this applied for brighter comets, and its construction allowed to observe the object and its spectrum at the same time), the Zöllner-Vogel spectroscope and a pure Zöllner's ocular-spectroscope were portable instruments.

The 200 mm Heyde, the 162 mm Merz-Cook refractors (with orthoscopic Merz eyepieces e.g. with power 42x), the 10 1/4 inches Browning reflector, a 100 mm Merz-refractor (at Nagytagyos station), a Merz-binocular and field-binocular (powers are 6x and 30x) and some astrographs and comet-finders (6 inches photo-telescope supported to 254 mm refractor) were also available for comet observations. Konkoly Thege as a guest astronomer accepted the invitation by baron Géza Podmaniczky to the baron's country estate at Kiskartal and they observed the comet Sawerthal 1888 with the baron's 7 inches Merz-refractor supplied with Konkoly Thege's Merz-universal portable spectroscope the support size of which was compatible with the support of telescope.

Konkoly Thege also modified a Töpfer's (Potsdam) spectroscope to observe ultraviolet spectra especially the UV spectrum of Halley's Comet. Konkoly Thege himself made UV transmission glass-filters to perform the UV-spectroscopic observation of this comet (Fig 4).

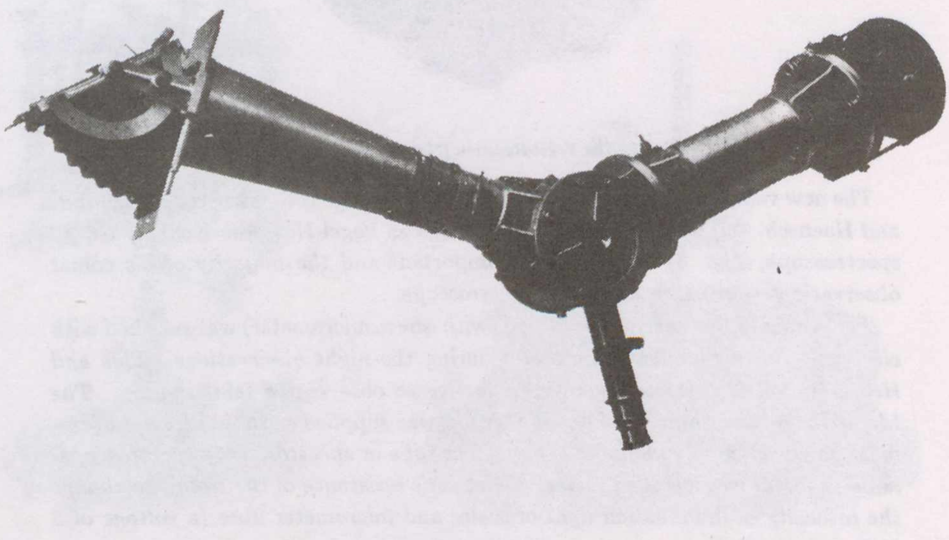


Fig. 4 ***The ultraviolet spectrograph***

The polariscopes were available to polarization observations both for the comets and for Earth's atmosphere. The Savart-polariscope and the more effective Vogel-polariscope were used for these purposes.

The fine-motion control (with respect to clock-work) was very important to observe a moving, extended cometary object. An independent motion and shifting allowed to scan the comet coma, consequently detailed drawings and photos could be obtained. The Repsold-key (in fine-motion control) had an important role in the observation of Comet Halley when professor-director Johannes Hartmann of the Göttingen Observatory prepared detailed drawings. He performed photometric measurements using his new photometer for surface photometry of coma and spectroscopic observations by Konkoly Thege's spectroscopes attached to a larger telescope the 254 mm Merz-Konkoly refractor. Browning's fibre-micrometer was used to determine the angular distances in the view-field of telescope when measuring the apparent size of cometary head.

The instruments for meteor observations were the meteoroscopes to measure the angular directions on the celestial sphere and the meteor-spectroscopes (e.g. Browning's meteoroscope and 'vision direct' spectroscope - 'à vision directe').

Konkoly Thege worked in the laboratory to prepare the gas samples in the Geissler's tubes to obtain comparison spectra during the measurements both at the telescope and at laboratory experiments. The self-made Geissler's tubes (soldering the glass closing tube) kept the desired internal gas pressure for a long time which was important when comparing the gas spectra at various pressures. The special (mercury) barometers and vacuum-pumps, Rumkorff's electric spark inductors, Smee-batteries and chrome-acid batteries supplied his spectroscopic laboratory. The Merz-cabinet spectroscope ('vision direct') was used in the laboratory to study the gas spectra supplied by Konkoly Thege with a Christie-type Half-prism.

4. Studies of comets, meteors and minor planets

At Konkoly Thege's observatory the scientific goal in comet and asteroid studies was not the hunting and discovery of new objects, but the physical study of known comets and position determination of known asteroids. Celestial bodies of these type were observed sporadically as stated by Konkoly Thege: the brigther comets and asteroids were observed, but the main direction of scientific studies was other systematic observations (stellar spectroscopy, colorimetry, catalog-compilation works, determination of meteor showers, solar observations). Konkoly Thege, however, was very interested in the comet and meteor spectroscopy and in the observation of details of large comets: spectroscopic observations of coma, morphology of the tail.

4.1 The comets

The first observers of cometary spectra were the above mentioned astronomers, however, Huggins was the pioneer of comet spectroscopy because he was the first to compare the cometary spectra with hydrocarbon spectra attaching a small gasometer with electric spark inductor to the telescope together with the spectroscope. Konkoly Thege also studied the spectra of the gas compounds believed to contribute in comet spectrum in the laboratory and published the preliminary results of experiments [9]. The laboratory experiments and some comet observations have been taken together with Dr. Radó Kövesligethy. Although Konkoly Thege had studied chemistry for three years at Heinrich Rose's laboratory in Berlin, in the small laboratory at Ógyalla Konkoly Thege was afraid to create the cyan-gas to obtain gas-sample for the spectroscopic analyses, because it was a very dangerous procedure. The professors of the Chemical Institute No. II of the University of Budapest Dr. Béla Lengyel and Dr. Károly Than had given Konkoly Thege the free run of their well furnished laboratory where the experiments were carried out with the very dangerous materials. A further problem was that hydrocarbon gases could not be separated from other gases they needed to create them in the laboratory to obtain the desired chemical composition and undisturbed spectra by other gases [10].

---

[9] Treatise of the Hungarian Academy of Sciences, III Section, May 19, 1884, in Hungarian.

[10] For example the methane can usually mix with carbon-dyoxide and the measured wavelengths of methane bands can be changed in the spectrum. The methane gas was created from sodium acetate heating with potassium hydroxide. The applied gas pressure (in the Geissler's tubes) varied from few tenths to 50 or 100 torrs.

Konkoly Thege's results in the comparative spectroscopy are mainly in connection with hydrocarbons described by the set of chemical formulae C_mH_n where m=2 and n=3,4 or 6 generally as in the case of methane (C_2H_4), benzine (C_2H_3), ether (C_2H_6), aethylene, petrol, terpentine, lighting/coal gas (Leuchtgas), moreover the ethane, alcohol, carbon-monoxide, carbon-dioxide, cyan have been analysed. Konkoly Thege and Kövesligethy at Ógyalla and Gothard at Herény observed the spectra of visible comets. The visibility and ephemerides were given by telegrams. The majority of comet observations was taken at Ógyalla. The summary and details of results can be found in annually published reports communicated by Konkoly Thege. The first comet was the Comet Coggia 1874 and the last was the Comet Halley 1910 observed spectroscopically by Konkoly Thege, and among others the Great September Comet 1883 and Great January Comet (Comet Johannesburg 1910) were studied. The last comet observations at Ógyalla were in 1914 (Comet Zlatinsky). The spectra of planets were applied as a comparison spectrum to obtain the instrumental scale-wavelength calibration for example the spectrum of Mars was used in case of Comet Johannesburg (Fig 5). The observations also were carried out on the brightness variation of comets with heliocentric distance (e.g.: L. Terkán, Fig. 6).

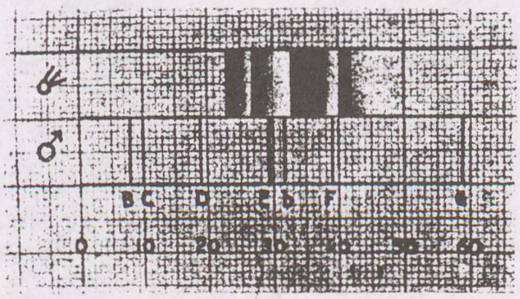


Fig. 5 *Spectra of Comet Johannesburg and Mars*

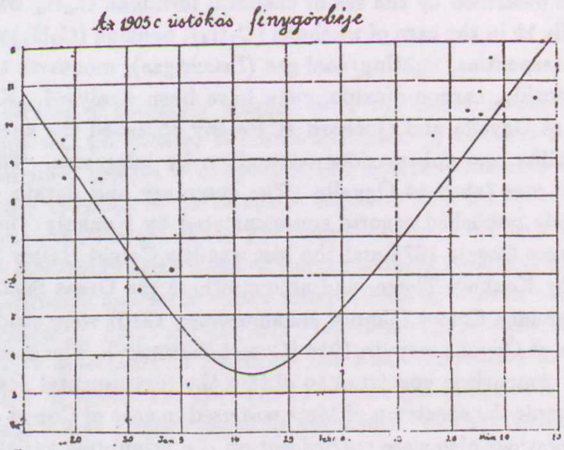


Fig. 6 *Light curve of Comet 1905 c vs. heliocentric distance*

From comparing the gas and cometary spectra Konkoly Thege concluded on the fact on the similarity between the cometary and hydrocarbon spectra [11].

To study the details of comet coma and tails drawings and photos were taken at Ógyalla. The fountain-shaped lines drawn characterize the jet activity according to modern knowledge on the physics of comets. Similar observations were made by Olbers and Bessel and also by Konkoly Thege.

A single, poor photographic image of Comet Donati obtained on a wet plate by Usherwood in 1858 was apparently the first photograph of a comet. Usable pictures were not obtained until silver bromide dry plates became available as the result of experiments during the 1870's. Beginning with Comet Tebbutt in 1881, increasing use was made of photography in studying comets, and by the 1910's it was a well-developed technique used universally by astronomers [12].

Konkoly Thege and his collaborators and guest astronomer (J. Hartmann) observed the famous Comet P/Halley on February 12, May 18/19, May 26 (Hartmann) and June 1, 1910 (Fig. 7).

[11] Treatise of the Hungarian Academy of Sciences, III Section, No. IX/8, February 13, 1882, in Hungarian.

[12] Jenő Gothard at Herény Observatory made beautiful photos of comets of his era. At that time Max Wolf in Heidelberg was the greatest expert of celestial photography specializing to photographic discovery of asteroids and comets. Both visual and photographic spectrum observations were also taken by Gothard using objective prism of 5° and also compared the comet spectra with that of gas sample excited by spark inductor. The comets Great September Comet 1883, Pons-Brooks 1884 and Barnard-Hartwig 1886 were photographed by Gothard and a high quality (easily measurable) photo of the spectrum of Comet Swift 1892 was also made by Gothard.

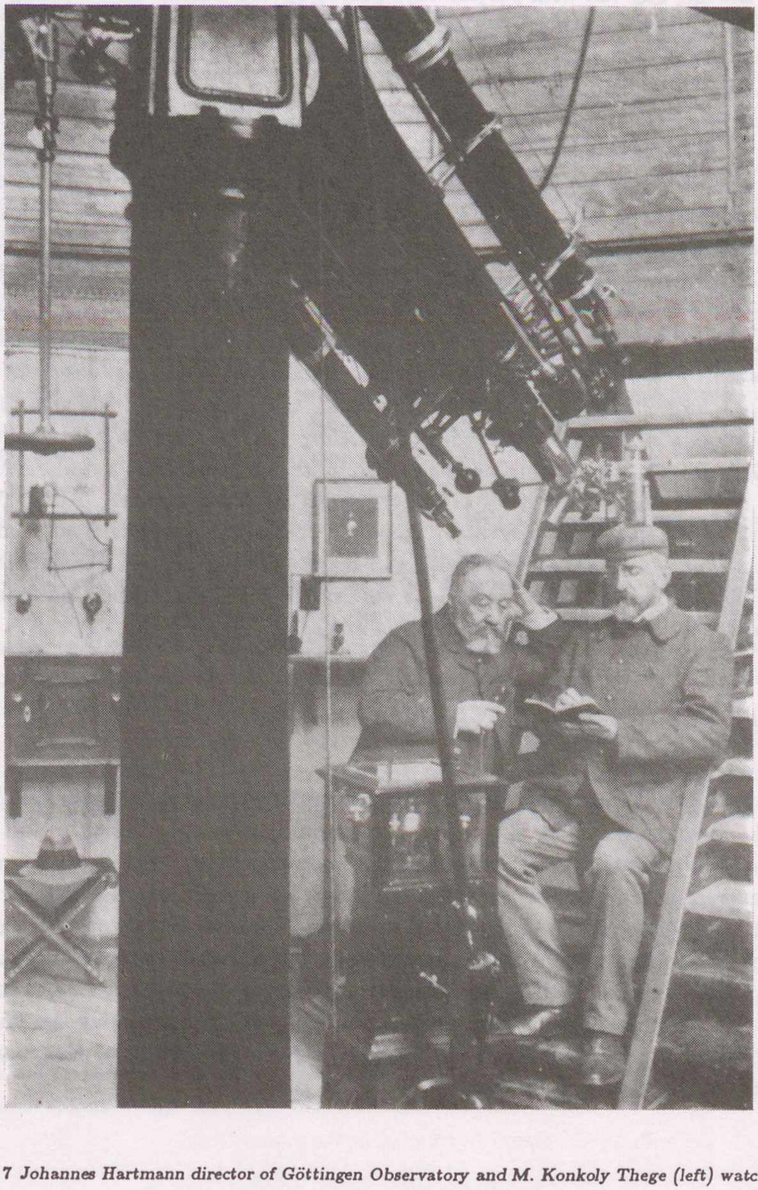


Fig. 7 *Johannes Hartmann director of Göttingen Observatory and M. Konkoly Thege (left) watching Comet Halley in 1910 with the 254 mm refractor*

Konkoly Thege organized a wide observational campaign on 'The Great Day of Comet Halley' on May 18/19 in 1910. On that day the comet was in closest approach to the Earth. The tail with the tail-rays passed by the Earth. The working groups were concerned with both astronomical, solar and meteorological observations. These were: the meteor observing group (Lajos Terkán and István Bodócs, the first assistants to Konkoly Thege and Elemér Endrey, the assistant of the Meteorological Institute), the group for geophysical measurements led by Aurél Büky, director of Meteorological Institute, observing the geomagnetism and intensity of geo-electric currents (with 3-component magnetographs, Mascart's automatic electricity measuring device and a galvanometer). The atmospheric electricity was measured by assistant Bálint Szabó (with a photographic Mascart's electrometer supported with radiotelluric electrode, with Elster-Geitel's normal electroscope and with a water-collector to absolute measurements of electric field, and with an Elster-Geitel's device to measure the charge, and with wind-speed measuring device). The atmospheric polarization measurements were taken by vice-director of the astrophysical observatory and first assistant Miklós Konkoly Thege Jr. (with a Savart-polariscope), the solar monitoring was taken by Lajos Terkán and István Bodócs (with photoheliograph, for a few days interval around 'The Great Day'), and the chief and supervisor of the observations was Miklós Konkoly Thege himself who helped Büky to measure with the galvanometer. Antal Tass the observer of astrophysical observatory answered the journalists' questions (public relations). The Mascart's electric device and magnetographs worked permanently and automatically. No significant deviations were observed in the physical parameters at the Earth's surface and lower atmosphere during 'The Great Day'.

4.2 The interrelation between comets and meteors

From the beginning of observations at Konkoly Thege's observational sites (both at Ógyalla observatory and at Nagytagyos observational station), systematic and permanent meteor observations were taken in this respect first of all in July, August and November of every year. The main scientific point of view was to observe the apparent path of the meteor on the celestial sphere, in order to determine the celestial position of meteors using a special instrument, the so called meteoroscope and also giving the exact time of the phenomena. The simultaneous observations of the same meteor from several observational sites were important in determining the true orbit of the meteor. Observational sites were e.g.: Ógyalla, Nagytagyos, Nagybecskerek, Selmecbánya (Schemnitz), Pozsony (Pressburg), Budapest.

From the derived positions of a meteor it can be decided whether the meteor is sporadic or a member of a meteor stream. For example when observing the meteor stream on November 27, 1872 Konkoly Thege counted 294 falls from 7^h45^m to 8^h19^m and from 9^h07^m to 9^h54^m 1796 falls were counted (there were 6-8 falls simultaneously). Konkoly Thege observed spectroscopically 130 meteors (most of them for 2.5 minutes) and identified the bands of hydrocarbons and sodium lines in August 1874. The results of observations were published annually in communications of Ógyalla observatory (Beobachtungen...). An excellent summary was published by Lajos Terkán in 1904 on the 251 meteor showers derived from 1641 meteors observed at Ógyalla. Moreover it was also important to observe the spectrum of the trace of bright meteors and bolides (the trace of which can be seen for several minutes) to determine the chemical composition of meteors by carefully separating the meteor spectrum from the spectral features of atmospheric gas components. Konkoly Thege himself observed spectroscopically many meteor traces. Browning (London), Huggins (Upper Tulse Hill), Alexander Herschel (Newcastle), Secchi (Roma) also studied the spectra of meteors and Konkoly Thege was in continual correspondence mainly with Huggins in this subject (in connection with the publishing of papers in Monthly Notices of the R.A.S.) and Konkoly Thege visited him at Upper Tulse Hill.

An example of Konkoly Thege's spectroscopic observation on the trace of a bright meteor was obtained on October 13, 1873. At 9^h41^m p.m. his man-servant announced to Konkoly Thege that 'a long star can be seen on the sky'. Konkoly Thege had studied the spectrum of the trace for 11 minutes from the terrace of his observatory using the Browning-type meteor-spectroscope and a spectroscope with 5 prisms was supported to a refractor immediately. The width of trace was about 15-20 arcminutes. His colleagues reported that in the comet-finder telescope the trace dimmed and was lost 25 minutes after the meteor-fall, but for the spectroscopy the time of 11 minutes was available when the brightness of the trace was not too faint to take spectroscopic observations. Konkoly Thege identified two red and two green spectroscopic bands with the spectral features of lighting/coal gas (Kohlenwasserstoff) [13].

13 Spectra using comparison spectra of the gas sample contained by Geissler's tube and excited by a large electric-spark inductor of Rumkorff-type applying 12 large Smee-batteries without Leyden electric jar.

The spectral features of other chemical elements and compounds have been identified in this spectrum by Konkoly Thege: sodium, magnesium and hydrocarbons [14]. Furthermore, during the meteor-stream in August 1882 the bright hydrocarbon, carbon-monoxide bands and sodium lines were identified. Konkoly Thege also identified the spectral lines of potassium (e.g. the K$\alpha\beta$ with contemporary designation), lythium, magnesium, iron and copper many times. The sodium lines and other lines of excited refractory material can be seen due to partly the intrinsic chemical composition of the meteor and partly the refractory content of the Earth's atmosphere as the meteor interacts with this atmospheric dust at the lower part of its path. At the point of atmospheric entry the sodium spectra can only be seen if sodium is present in the meteor body. Konkoly Thege referred to the laboratory experiment that would demonstrate how to create the combined spectra of excited gas and sodium. The gas was filled in a Geissler's tube and the tube was supplied with a glass-sphere which contained the sodium sample. The sparks excited the gas and a Bunsen-burner increased the temperature of sodium and the intensity of sodium lines increased in the spectrum as the temperature increased. In the case of the Great September Comet 1882 the intensity variation of sodium lines was observed as a function of the heliocentric distance: closer to the Sun the sodium lines were strong and far from the Sun the hydrocarbon bands dominated in the spectra [15].

Konkoly Thege referred to the laboratory results of analyses of meteorite spectra and to samples of meteorite falls which had been found all over the world. Comparing the observational results of comets and meteors with the other laboratory spectroscopic experiments he concluded that the common chemical components both in the meteorites and comets are the hydrocarbons and carbon-oxides and other elements (sodium, magnesium, iron etc.).

The main gaseous atomic and molecular components identified in the meteorite samples are CO_2, CO, H and CH_4. The Tazewell, Singlespring, Árva, Texas, Dickinson, Ohio, Pultusk, Parnallee, Weston and Iowa meteorite collections were analysed. Nordeskjöld found and collected during his polar expedition fine meteoritic dust sample which was rich in iron compounds.

---

[14] A.N. No. 1554.

[15] Gothard also demonstrated in the laboratory the variation of spectral features depending on the relative abundance examining the spectra of the flame of a Bunsen-burner (hydrocarbon spectra) with and without the sodium content (common salt) and observing with a pure meteorspectroscope (with single prism).

In spite of the disintegration processes interacting with the Earth's atmosphere the size distribution of meteors is continuous from small grains to larger boulders orbiting around the Sun. Chladni (1819) stated that the meteors and comets are in close connection (sometimes when a great comet could be observed the meteor activity was strongly increasing).

Schiaparelli analysed the orbits of comets and meteor-streams and found that orbits of some comets and meteor-streams are very similar, practically are identical [16]. Other pieces of evidence referred to the belief that the origin of meteor-streams is connected with the break-up processes of cometary nuclei (comet Biela 1846, the Great Comet 1882 and comet Brooks 1889). E. Weiss (Vienna) argued that the origin of meteors was due to disintegration of comets, but Schiaparelli stated that the origin of comets was a result of an accumulation process of meteors, while other authors believed that the meteors were sporadic small bodies in the Solar System. Furthermore Niessl stated that some meteors had a hyperbolic orbit (did they come from the interstellar space ?). The origin of comets and meteors was an open and debated question in the last century.

In this dispute Konkoly Thege cited the results of spectroscopic observations made by Copeland and Lohse at Lord Lindsay's Observatory on the comets 1881 III and 1881 IV and those taken by Dunechti on the comet 1882 I, their spectra were similar to those of meteors. Konkoly Thege's observations on the comets Coggia 1874, Great Comet 1881 [17], comet Wells 1882, Great September Comet 1883, comet Swift-Brooks 1883 (also referred to Gothard's spectroscopic measurements) confirm the spectroscopic similarities between comets and meteors i.e. the hydrocarbon spectral features are dominant in both object types. Konkoly Thege summarized this conclusion in his communication [18].

4.3 The minor planets

To determine the accurate orbit and to improve the orbital elements of minor planets many accurate position determinations are needed. The celestial mechanical perturbation theory was also developed and improved at that time. The position measurements and the derived equatorial coordinates were published in tabular form every year in communications of Ógyalla Observatory (Beobachtungen...). Konkoly Thege and his collaborators used both telescopes and meridian-circles to determine the position of asteroids using reference stars and meridian transits as well as accurate clocks to obtain exact time-base. Theoretical works on the orbital motion of asteroids taking into account the secular perturbations were carried out by L. Terkán.

---

16 The stream in August is connected with the comet 1862 III, the stream in November with the comet 1866 I, these streams are known as Perseids and Leonids, respectively.

17 The photographs of spectra taken by Huggins

18 In: The Treatises of the Hungarian Academy of Sciences, III Section, No. 6, 1883, in Hungarian.

However, at that time the knowledge of the possible physical relations between certain comets and asteroids was not established. There was not any information either on the physical characteristics of comet nucleus or the Near-Earth Asteroid group or Earth-orbit crossing asteroids with high orbital eccentricity, small irregular sizes and low albedo. Therefore at that time the position measurements, analyses of orbital motion and some light-variation estimations were the main subjects in asteroid studies. Several papers have been published by guest authors in communication periodicals edited by Konkoly Thege on subject of minor bodies[19].

Konkoly Thege was a well known astronomer. He published in famous European astronomical periodicals and in books (in Astronomische Nachrichten, Monthly Notices of the Royal Astronomical Society, Observatory, and in his annales of the Ógyalla Observatory ... observations in Beobachtungen ...). The following numbered minor planets were named in relation with Konkoly Thege and his observatory place: (1259) Ógyalla (1933 BT) and (1445) Konkolya (1938 AF). The Main-Belt asteroid (1259) Ógyalla was discovered by K. Reinmuth (January 29, 1933, Heidelberg), a=3.106 AU, e=0.1267, i=2.°310 showing periodic light-variation with about 12^h period and with an amplitude $0.^m3$ due to rotation and shape and/or surface albedo irregularities. The Main-Belt asteroid (1445) Konkolya was discovered by G. Kulin (January 6, 1938, Budapest), a=3.114 AU, e=0.1857, i=2.°303 orbiting in Themis-A group, the taxonomic-type is C or EU(?).

5. Concluding remarks

Konkoly Thege's and his collaborators' compilations of comet and meteor observations are significant with respect to the spectral characteristics of minor bodies of the Solar System. Konkoly Thege's spectroscopic observations contributed to the idea on the relationship between comets and meteors that some comets and meteors (meteor streams) are in close physical connection concerning their common origin and interrelations. The tabulated and published observations (both spectroscopy and position determination of showers of meteor streams) were important for contemporary astronomy and inspired further studies. The scientific correspondence and relations were very active between Ógyalla observatory and the world. Konkoly Thege's public relations played an important role in informing the general public and the press on the explanation of the natural phenomena. The orginization of an interdisciplinary observational campaign during the return of Comet P/Halley in 1910 ('The Great Day on May 18/19, 1910') is a good example of Konkoly Thege's comprehensive knowledge and organizing ability.

19 Discussions were published on the planetary and lunar surface photometry in the topic of the basic formulae which were constructed by Lambert and Lommel in connection of the surface photometry of atmosphereless bodies. G. Müller: Photometrie der Gestirne, Publ. des Astrophys. Obs. zu Potsdam VIII. Band (in German). In: 'Small Communications of the Konkoly's Observatory Ógyalla, 1906, Budapest' pp. 54-85, (A M. Kir. Konkoly Alapitványú Astrophysikai Obszervaórium Kisebb Kiadványai (Dr. Konkoly Thege Miklós, Budapest, 1906)

The large telescopes in North America and some European large telescopes soon surpassed the parallel results taken by smaller telescopes. Among others thinking about Percival Lowell's spectrophotographic observations made with large telescope on the Comet Halley from ultraviolet to red end of the spectrum, and Lick Observatory compilations etc. ... However, at that time there was no great need for high spectral resolution or quantitative photometric measurements (the plates were uncalibrated), since the level of knowledge of the structure of atoms or molecules did not rise the necessity of detailed spectroscopic observations before modern models of atom and development of quantum-theory. Nevertheless, Konkoly Thege's work in comet and meteor observations, spectroscopic and chemical laboratory experiments were outstanding at that time for the comparative studies on chemistry and on the origin of minor bodies of the Solar System.

6. Compendious bibliography

Beobachtungen angestellt am Astrophysikalischen Observatorium in Ógyalla in Ungarn, Bd. I-XVI, XVII-XVIII Halle, 1879-1894, 1894-1911.

Praktische Anleitung zur Anstellung astronomischer Beobachtungen mit besonderer Rücksicht auf die Astrophysik, nebst einer modernen Instrumentenkunde. Braunschweig, 1883, 913.

Praktische Anleitung zur Himmelsphotographie nebst einer kurzgefaßten Anleitung zur modernen photographischen Operation und der Spectralphotographie im Cabinet. Halle, 1887, Knapp, 372.

Handbuch für Spectroscopiker im Cabinet und am Fernrohr. Halle, 1890.

Astrophotographie, Dr. W. Valentiner: Handwörterbuch der Astronomie. Leipzig, 1897-1902, Bd. I, 212-304.

Mitteilungen der Sternwarte zu Ógyalla (in Mathema.-Naturw. Berichte aus Ungarn), Bd. 1-11.

Astronomische Nachrichten Bd. 80 (1873) - Bd. 202 (1914).

Der Naturforscher, Bd. 7, 14, 15. (since 1874)

Photographische Rundschau, Bd. 1-3 (since 1887)

Photographische Korrespondenz, Bd. 25 (1888)

Centralzeitung für Optik und Mechanik, Bd. 2-10. (since 1881)

The Observatory, Vols. 1-6 (since 1877)

Monthly Notices of the Royal Astronomical Society, Vols. 33-44, (1873-1884)

The American Journal of Science, Vol. 27 (1884).

* * *

ON KONKOLY THEGE'S JUPITER OBSERVATIONS

E. ILLÉS-ALMÁR
Konkoly Observatory
Budapest, P.O. Box 67 H-1525, Hungary

ABSTRACT — ***A short summary is given on Jupiter-investigation in Hungary between 1878 and 1908 - mostly fulfilled or inspired by Konkoly Thege. Partly based on these observations Wonaszek suggested that the Jovian belt activity is connected to orbital phase, later observations are compared with some of his forecasted times of extrema.***

Jupiter is one of the most conspicuous objects of the night sky which cought the interest of mankind after the invention of the telescope as well. Moreover, it became the most interesting object for telescopic observations, as even more types of changes showed up: 1./ several large satellites are orbiting visibly around it and 2./ its disk proved to have a continuously and quickly changing pattern. Since it always produced something new, it was worthwhile observing it at any time. These changes were quick enough to notice, but were slow enough to remember the details. Very probably these lucky circumstances made it possible that astronomers from the very beginning started to make drawings of its disk. Especially when they glimpsed remarkable figures besides the numerous parallel dark belts and light zones: elliptical spots, that were returning now and again many times. Already in 1665 Cassini used the returning of a spot to determine the rotation period of the planet.

When in 1878 a large spot became of a very intensive red colour, no wonder that simultaneously so many observers noticed the change. It was the time when astronomers realized that the spot is a permanent feature observed earlier several times and gave it the name "Red Spot".

In 1879 Konkoly Thege heard about the new discovery, and he was quick to include the observation of Jupiter into the program of the Ógyalla Observatory. He continued to observe it until 1884, when the Red Spot faded again. Konkoly Thege published only 57 drawings, but the observatory ought to possess much more, since Antal Wonaszek in a summary investigation in 1901 [9] used 94 as a selection of drawings of Ógyalla! Very probably on Konkoly Thege's influence the Gothard brothers in Herény observed Jupiter as well in 1882 [5] and 1884 [8] (they published 45 drawings), moreover Antal Wonaszek in Kis-Kartal published 16 drawings between 1891 and 1900 [9]. Ernő Massány in Ógyalla enriched the collection again in 1902 by 24 drawings [10]. Konkoly Thege even in 1908, as director of the Meteorological Institute, observed Jupiter [11].

Konkoly Thege's observations were very objective, respectful to the nature: he drew what he saw, not influenced by fashionable theories (Fig. 1). The largest appreciation of his work is probably the criticism by Antal Wonaszek who wrote the following in 1901 [9] : "Comparing the simultaneous drawings of Ógyalla and Moscow there is a certain controversy due to the subjectivity of the different observers. The observers in Ógyalla gave the bands parallel to the Equator a fuzzy, cloudy appearance. In such a representation the real character of the bands disappears. On the contrary the observers in Moscow represented the bands like made of a solid stuff, which corresponds better to reality. Therefore I based my study, if available, on data of Moscow rather than of Ógyalla."

Nowadays we know that Wonaszek was wrong, and recent results justify Konkoly Thege. Later generations can learn from him this type of attitude towards the observation of the nature.

The large number of Jupiter-drawings made all over the world – among them here in Hungary (Table I) – made it possible to clarify the typical characteristics of the changing patterns on the disk of Jupiter. The first idea that the Red Spot belongs

TABLE I
Jupiter-observations published in Hungary
between 1879 and 1908, made or inspired by Konkoly Thege

year of observations	observer	number of drawings	reference
1879	Konkoly Thege	19	[1]
1880	Konkoly Thege	3	[2]
1881	Konkoly Thege	16	[3]
1882	Gothard, S.	18	[5]
1883	Konkoly Thege	3	[6]
1884	Konkoly Thege	13	[7]
1884	Gothard, J.	24	[8]
1891	Wonaszek	1	[9]
1893	Wonaszek	2	[9]
1894	Wonaszek	2	[9]
1896	Wonaszek	3	[9]
1897	Wonaszek	3	[9]
1898	Wonaszek	3	[9]
1899	Wonaszek	1	[9]
1900	Wonaszek	1	[9]
1902	Massány	24	[10]
1908	Konkoly Thege	3	[11]

Summing: Konkoly Thege 57, Massány 24, Gothard J. 24,
Gothard S. 18 and Wonaszek 16 drawings.

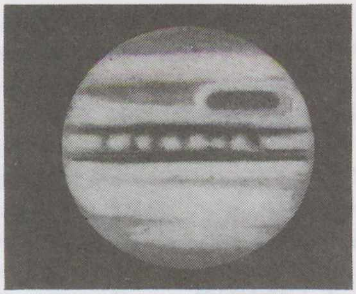
TABLE II

Distribution of the 486 Jupiter drawings
used by Antal Wonaszek (Kis-Kartal, Hungary, 1901, [9])

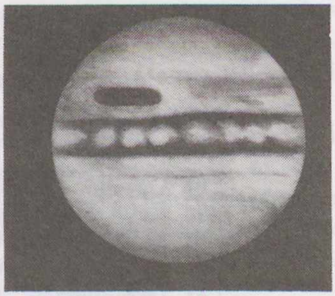
94	Ógyalla	10	Lick	3	Ougrée
93	Kis-Kartal	10	Pola	3	Durlach
68	Moscow	9	Barcelona	3	Soissons
32	Landstuhl	6	Osterath	1	Washington
31	Lussinpiccolo	5	Bristol	1	Cambridge
16	Herény	5	Lowain	1	Paris
12	Juvisy	4	Wien	1	Tortose
11	Trient	3	Bothkamp	1	Konstantinápoly
	72 without source				

to the surface of a solid planet disappeared, because of the changes in size and of the proper motion as well as of changes in proper motion, moreover because of the discoveries of other spots on other parts of Jupiter, and on Saturn's disk as well. It became obvious that real clouds can be seen on the disk of Jupiter and the Great Red Spot was considered an enormous hurricane. The question what energy can drive it for such a long time (300 years or more if Cassini's spot was the same, see Table IV) was answered as follows: there must be some energy source beneath the planet's body, a volcano for instance, that generates it. Nowadays computer simulations and laboratory experiments show that large spots can be created as vortices spontaneously under certain conditions and remain stable, rolling between two currents of air of opposite direction.

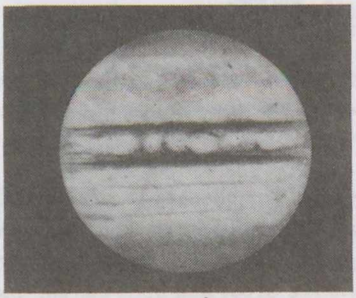
First spectroscopy in visible light (1910: water, 1932: methan and ammonia, sixties: molecular hydrogen), then radioastronomy and space probes (Pioneer 10, 11 and Voyager 1, 2: acetylene, ethan), later infrared spectroscopy (seventies: carbon-monoxide, phosphine, germane, 1989: arsine) helped to understand the nature of the patterns, the colouring of the cloud features and the source of the non-equilibrium gases. Now with high probability we can say that the material giving brownish colour is mainly phosphine carried from the lower layers by upwelling air-masses. The fact that in the late eighties the same non-equilibrium gases have also been found in the atmosphere of Saturn, – but in about 10 times higher concentration – led to the conclusion that the outer planet's formation occurred by a two-stage accretion: first the solid material coalesced into aggregation that finally formed the rocky cores of these planets, and only when the gravitation of the cores was large enough the surrounding gas collapsed. This scenario of the formation is strengthened by the results that the core of the giant planets varies only between 10-20 Earth-masses, while the masses of the planets themselves differ much more: from 15 to 318.



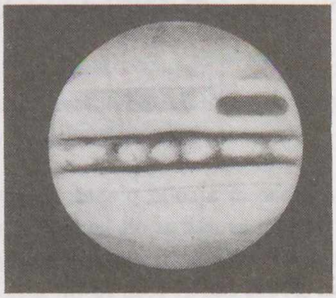
1880 October 2, $10^{h}50^{m}$ p.m.



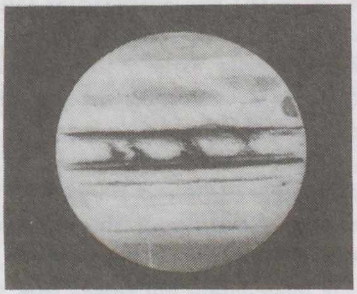
1880 October 5, $09^{h}30^{m}$ p.m.



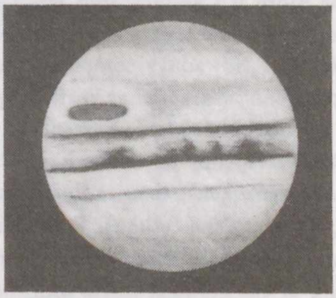
1880 October 6, $09^{h}00^{m}$ p.m.



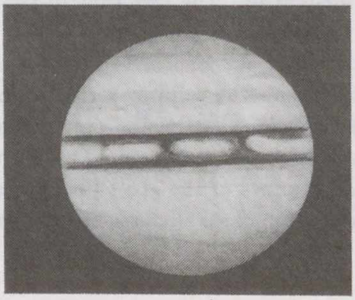
1880 October 7, $09^{h}40^{m}$ p.m.



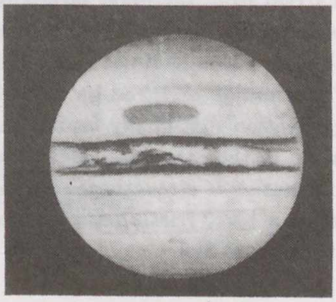
1880 October 9, $10^{h}15^{m}$ p.m.



1880 October 14, $12^{h}10^{m}$ p.m.



1880 October 16, $09^{h}35^{m}$ p.m.



1880 October 24, $09^{h}55^{m}$ p.m.

The investigation of Antal Wonaszek on the belt-activity on Jupiter using, among others, Konkoly Thege's observations (Kis-Kartal, Hungary, 1901 [9])

Referring to a statement of Williams Stanley (the belts and zones change their colour with an approximately 12-year periodicity) Antal Wonaszek completed an investigation taking into consideration not only the colour but also the distribution and the thickness of the belts and zones. He collected all available observations from all over the world. To introduce some kind of objectivity into the investigation only the drawings were used and not the reports of the observers telling how Jupiter looked like at the time of observations. He could not, however, completely exclude subjectivity because drawings are also subjective. He emphasised the differences in one's attention what to notice on Jupiter's surface and in the mode of drawing, i.e. the manual skill of the observer.

Altogether 486 drawings – made between the years 1856 and 1900 – have been investigated by A. Wonaszek. For 414 drawings 24 different observatories are listed as places of observation, for the remaining 72 no source is given (Table II).

He focused on the belt activity, that is the lighting up and fading, the appearance and disappearance of belts and zones. He found a periodicity of 11.76 years, which is nearly identical with the orbital period of Jupiter. His epoch for maximum was 1891.7 that is near perihelium and for minimum 1896.4 near aphelium, so he concluded that the reason for changes in belt activity should be very probably the changes in solar tide and in solar irradiance because of the orbital eccentricity of Jupiter. The building up time of the maximal belt-activity is longer (7 years) than the diminution period (5 years).

Wonaszek's prediction can be controlled using subsequent observations up till now. In Table III some examples are given. + designates years of forecasted extrema when the pattern of the Jovian disk shows the characteristics of that extrema, while – designates cases when at the given epoch opposite level of activity has been registered.

TABLE III

Wonaszek's prediction and the reality in the light of some subsequent observations

Maxima		
1903	+	GRS visible (Massány's observations)
1915	+	in 1913 GRS strong (Flammarion)
1950	–	in 1951 the South Equatorial Belt disappeared
1974	+	Pioneers at Jupiter, GRS very strong
Minima		
1908	+	GRS faint (Konkoly Thege's observation)
1955	+	1953: GRS almost invisible 1958: GRS almost white
1979	–	Voyagers at Jupiter, GRS very conspicuous
1990	+	South Equatorial Belt disappeared

TABLE IV
History of the observation
of the Great Red Spot (GRS) of Jupiter

1611	first glimpse of Jupiter in telescope
1664	Robert Hooke noticed a spot
1664	Cassini's drawing
1665	Cassini's period determination for 50 years it was continuously observed
1711	Donato Creti's painting (Vatican)
1831	Schwabe found a drawing from that time
1839. VI. 3.	South's drawing with a spot
1856	drawing, but no spot mentioned
1859	back until this time GRS on drawings
1869	Gledhill, GRS is visible
1872. XII. 31.	Rosse and Copeland observed GRS independently
1878	Pritchett, Tempel, Bregyhin, Donnett independently stated "GRS became an intense brick-red"
1879. VIII.	Konkoly Thege started the observations
1880	the most intense red
1882-84	fainter and fainter
1884	on Konkoly Thege's drawings its place is visible as a discontinuity of the belt
1884-89	no one could find it
1890	reappeared
1891	the most intense
1892	faint pink, sometimes disappeared
1897	became stronger
1902	the most intense
1910	very faint, Stanley Williams's period determination The period within one minute is the same as Cassini's determination in 1665
1912	Y-shape cloud feature went through it
1953	faint, hardly seen
1960	not conspicuous, only its halo is visible
1973-74	Pioneer-encounters, GRS rather prominent
1979	Voyager-encounters, GRS prominent

It is interesting to look at the marvellous Voyager-pictures of Jupiter and simultaneously read Wonaszek's description of the Jovian equatorial belt: "Sometimes in the equatorial belt snatches are lengthening to each other and divide the belt into lighter patches. At other times dark smudges overrun the belt."

TABLE V

Belt disappearence on Jupiter

North Equatorial Belt	1891-96
Equatorial Zone	1897-99
South Equatorial Belt	1951
South Equatorial Belt	1989. VII - 1990. VIII.

Very probably these features are identical with the so called horsetrail clouds, i.e. the 12-15 wave-forms around the Equator of Jupiter. If their number changes in time and especially with some periodicity than it is worthwhile looking after this pattern on the old drawings, possibly they were visible from the Earth (similarly as on some old drawings the spokes on Saturn's B ring can be discovered).

E. Massány's investigation (Ógyalla, 1904 [10])

There were two explanations for the periodicity of the belt activity on Jupiter published in the literature at that time: 1./ correlation with sunspot activity (Raynard, Zöllner) 2./ correlation with the orbital phase (Wonaszek) Explanation 1. was disproved by Massány on the basis of his new observations, but he could neither prove nor disprove explanation 2. because of lack of observations. He concluded that more drawings were needed.

TABLE VI

Other quasi-permanent features on Jupiter

i) South Tropical Turbulence:
   1901-1940 continuously, $\Delta\lambda = 60$, interaction with GRS
   1955 new distúrbance on the same place
ii) White spots: often on the southern hemisphere, lifetime generally several years, sometimes 40 years
iii) Small Red Spot:
   1972. VI - XII. in the North Tropical Zone (Pioneer 10 photo) at Pioneer 11 encounter it disappeared
iv) Dark holes: Voyager-discovery, only on North Tropical Belt

REFERENCES

1. Konkoly Thege, M., Jupiter felületének megfigyelése. M. Tud. Akad. Értek. a Math. Tud. köréből VII, 14, p.3. 1880.
2. Konkoly Thege, M., Jupiter felülete 1880-ban. M. Tud. Akad. Értek. a Math. Tud. köréből VIII, 2, p. 5 1881.
3. Konkoly Thege, M., Jupiter felületének megfigyelése 1881-ben. M. Tud. Akad. Értek. a Math. Tud. köréből IX, 7, p.1. 1882.
4. Gothard, S., Beobachtung der Oberflächen der Planeten Jupiter und Mars. Publikationen des Astrophysikalischen Observatoriums zu Herény in Ungarn, Heft 3, p.65, 1884.
5. Gothard, S., Jupiter megfigyelések. M. Tud. Akad. Értek. a Math. Tud. köréből X, 9, p.1. 1883.
6. Konkoly Thege, M., Jupiter felületének megfigyelése 1883-ban. M. Tud. Akad. Értek. a Math. Tud. köréből XI, 1, p.15, 1885.
7. Konkoly Thege, M., Adatok a Jupiter physikájához. M. Tud. Akad. Értek. a Math. Tud. köréből XII, 7, p.1, 1886.
8. Gothard, J., A nagybolygók felületének megfigyelése. M. Tud. Akad. Értek. a Math. Tud. köréből XII, 3, p. 25, 1886.
9. Wonaszek, A.A., A Jupiter felületi képződményeinek periodicitása. A Kis-Kartali Csillagvizsgáló Tevékenysége, Budapest, 1901.
10. Massány, E., Beiträge zur Geschichte der Beobachtung des Jupiter. Budapest. 1904. (Kleinere Veröffentlichungen des O-gyallaer Astrophysikalischen Observatoriums Stiftung v. Konkoly Thege 5.)
11. Konkoly Thege, M., Jupiter megfigyelése. A Nagytagyosi Meteorológiai Obszervatórium évi jelentése II, p. 34. Budapest, 1909. (M. Kir. Orsz. Meteorológiai és Földmágnességi Intézet Kisebb Kiadványai 7)

* * *

THE ÓGYALLA CATALOGUES

ENDRE ZSOLDOS
Konkoly Observatory
Budapest, P.O. Box 67 H-1525, Hungary

1. Introduction

Star catalogues have a long history — the first is supposed to have been made by Eudoxus in the fourth century B.C. (Knobel, 1876), and this was followed by numerous others. The 19th century saw the emergence of specialized catalogues: those of variable stars, red stars, double stars, etc. A list of various catalogues published before 1876 is given by Knobel (1876).

Astronomy was revived in Hungary in the last quarter of the 19th century, with N. von Konkoly Thege and his Ógyalla Observatory in the lead. Konkoly Thege's interests in astronomy and astrophysics were diverse, so it is not surprising that star catalogues were also produced in Ógyalla. The first of these catalogues is spectroscopic, the second is photometric. These catalogues are, however, not the only ones that can be connected to Hungarian astronomy. The first was made by the Baron Zach (1792) who was Hungarian though his observations were made and the catalogue was published in Gotha (he is the author of more than one catalogue). Another catalogue was produced by D. Kmeth of the Buda (Blocksberg) Observatory (Kmeth, 1821). This is a short list of the right ascensions of 147 stars reduced to 1819. It is worth mentioning that J. Pasquich (he was a Croatian and the director of the Buda Observatory) also made a catalogue of 191 stars (reduced to 1815), but it remained unpublished.

2. The spectroscopic catalogue

With the development of stellar spectroscopy the need for classification and cataloguing naturally arose (see Hearnshaw, 1986). One of the pioneers was H. C. Vogel of Potsdam, who planned a spectroscopic survey of the northern hemisphere. Konkoly Thege (1877) remarked that around 1875 Vogel asked him if he would participate in this survey of all stars brighter than 7.5 mag and north of −15° declination. Two other astronomers were asked to cooperate (D'Arrest and Julius Schmidt), however, they did not contribute to the survey.

Konkoly Thege agreed with the plan, and he published his first list in 1877 (Konkoly Thege, 1877). It contained the classification of 160 bright stars, each of them was observed at least twice. He published two more similar lists (Konkoly Thege, 1881, 1883), but the last one contained the observations of R. Kövesligethy. They used the classification of Vogel (1874).

The observations, intended to form the catalogue, began in August 1, 1883. Ninety nights were used for this purpose, the last one was August 29, 1886. On the average, 36 stars were inspected at one night. They observed stars between 0° and −15° declination, and considered it as a continuation of the Potsdam spectroscopic catalogue (Vogel and Müller, 1883). The observing instruments were a 162-mm Merz refractor, with a Zöllner spectroscope attached to it. The observer was Kövesligethy. The original plan to observe each star twice failed because of the unfavourable weather conditions in Ógyalla. The observations were made near the upper culmination of the stars to minimize the effects of the atmosphere. The identification of the stars was done with the help of the catalogues of Lalande (Baily, 1847), Weisse (1846) and Schjellerup (1864). Kövesligethy observed the colours of the stars, too, he used the Potsdam scale. To avoid preconceptions in the classification the colours were estimated only after the inspection of the spectra. When two observations gave discordant results, the star was observed again with the 254-mm refractor by both Kövesligethy and Konkoly Thege.

The catalogue was published in 1887 in Halle, its title was *"Spektroskopische Beobachtung der Sterne zwischen* 0° *und* −15° *bis zu* 7.5*ter Grösse"* (Konkoly Thege, 1887). It was published in Hungary, too (Konkoly Thege, 1884, 1885, 1886). It contains the spectral type (according to the Vogel classification), the colour and position (reduced to 1880.0 by Mr. E. Farkas) of 2022 stars.

Since there are stars common to both the Ógyalla and the Potsdam catalogues it is possible to compare the classifications. The agreement is usually good, in some cases Kövesligethy gave "earlier" type than Vogel or Müller (earlier means that instead of e.g. IIa Kövesligethy estimated Ia-IIa). It is also possible to compare the types with the MK classification: the Vogel types Ia, IIa, IIIa correspond to A, F5–K5 and M, respectively (see Hearnshaw, 1986), in the Ógyalla catalogues the corresponding mean spectral types are A5, G0 and M, respectively. There are some mistakes in the catalogue: misidentifications, e.g. it lists υ Ceti instead of ι Ceti and γ Ceti instead of λ Ceti, or wrong coordinates, e.g. it gives $\delta \approx -2°$ for λ Aqr instead of $\delta \approx -8°$. The errors are, however, few, and some of them are clearly typographic, since e.g. ι Ceti is correctly identified in the Hungarian version (Konkoly Thege, 1884). The comparison to the Potsdam catalogue shows that the work of Kövesligethy and Konkoly Thege is not inferior to that of Vogel and Müller (1883).

I made a short survey of the contemporary literature to see the reception of this catalogue. The following references were found: Birmingham and Espin (1890), Espin (1889), Fleming (1912), Krüger (1893a, 1893b), and Monck(1893). Moreover, it was used for comparison in the Henry Draper Memorial (unfortunately, this volume is missing from our library, but a reference for using the Ógyalla catalogue can be found in *M.N.* **52**,298,1892). This short list of references shows that the catalogue was both known and used. It is somewhat surprising, that there is no reference to it from the Potsdam astronomers (especially from Vogel).

It is very unfortunate for Konkoly Thege and Kövesligethy that the classification of Vogel was replaced by the Harvard classification in a few years. The latter was used as early as 1892 (e.g. Monck, 1892, Gore, 1892). If they had used the Harvard classification, their catalogue might have been used more often.

3. The photometric catalogue

The second catalogue made in Ógyalla is a photometric one. The motivation came from Potsdam again, it is considered to be the continuation of the Potsdam Photometric Durchmusterung (Müller and Kempf, 1907).

The observations for this catalogue were made between September 8, 1904 and December 8, 1913, on 380 nights. The observers were originally L. Terkán and Zs. Fejes. Fejes left the observatory in 1906, so the majority of the observations were made by Terkán and A. Tass. Their plan was to observe stars brighter than 7.5 mag between 0° and −10°. They used a Zöllner astrophotometer made by O. Toepfer in Potsdam.

First, they derived the magnitudes of 22 bright and 120 faint comparison stars using 42 stars from the Potsdam Durchmusterung. The comparison stars were chosen so, that every zone (the region was divided into 418 zones) had one or more comparison stars. Extinction was also taken into account. A total of 6380 observations was made, 5400 of them with zenith distances smaller than 60°. The observations of one zone usually required 40–50 minutes. They measured 50–60 stars on an average good night, and more than 100 in exceptionally favourable weather (this was very rare).

The first results were published by Terkán (1905, 1906). The catalogue itself appeared in 1916 with the title "*Photometrische Durchmusterung des südlichen Himmels enthaltend alle Sterne der* BD *bis zur Grösse* 7.5, *Teil I, Zone* 0° *bis* −10° *Deklination*" (Tass and Terkán, 1916). It contains the magnitudes of 2122 stars.

Tass and Terkán compared their catalogue to other catalogues, e.g. to those made in the Harvard Observatory. They found good agreement, but, nevertheless, strongly criticized the methods used by Pickering (Pickering *et al.*, 1884, Pickering and Wendell, 1890). I compared it to the *Revised Harvard Photometry* (Pickering, 1908) and found good agreement (the standard deviation of the differences is ≈ 0.1 mag). There are, however, stars, where the difference is larger than 0.5–0.6 mag. One of the most interesting cases is 61 Ceti, where $m_{Ogyalla}$=7.35 mag while $m_{HA50,1}$=6.01 mag. Since its magnitude is 5.93 in the last edition of the Bright Star Catalogue, 61 Ceti was probably misidentified by Tass and Terkán. The number of these cases is small.

I made a literature survey again for references and the only one I found was by Zinner (1926). This does not necessarily mean that the catalogue is useless, there are some possible causes for its neglect: (1) it was published in 1916, during the Great War, so there might have been difficulties with distribution; (2) photoelectric photometry had been in an experimental phase for years; (3) photographic surveys were replacing visual ones; etc.

4. Conclusions

Two catalogues were published in the Ógyalla Observatory during its existence. The first, made by R. Kövesligethy, was a well-received and, it appears, well-known catalogue (see Monck, 1893). Unfortunately for its makers, the classification of Vogel which was used in the catalogue was soon replaced by that of the Harvard Observatory, so the catalogue lost some of its value. The other, photometric catalogue was published in unfavourable circumstances, there are few signs of its being known in the world.

References

Baily, F. 1847, *A Catalogue of those Stars in the* Histoire Céleste Française *of Jêrome de Lalande for which Tables of Reduction to the Epoch 1800 have been Published by Professor Schumacher*, R. and J. E. Taylor, London

Birmingham, J.; Espin, T. E. 1890, *Roy. Irish Acad., Cunningham Memoirs* V

Espin, T. E. 1889, *Monthly Not. Roy. Astron. Soc.* **49**,364

Fleming, W. P. 1912, *Harvard Ann.* **56**, No.6

Gore, J. E. 1892, *Astron. Astrophys.* **11**,326

Hearnshaw, J. B. 1986, *The Analysis of Starlight*, Cambridge UP, Cambridge

Kmeth, D. 1821, *Observationes Astronomicae*, p.64, Buda

Knobel, E. B. 1876, *Mem. Roy. Astron. Soc.* **43**, 1

Konkoly Thege, N. von 1877, *160 álló csillag színképe*, Publ. Hungarian Academy of Sciences

Budapest (The spectra of 160 fixed stars)

Konkoly Thege, N. von 1881, *Ért. Mat. Tud. Kör.* **8**, No.1

Konkoly Thege, N. von 1883, *Ért. Mat. Tud. Kör.* **10**, No.2

Konkoly Thege, N. von 1884, *Ért. Mat. Tud. Kör.* **11**, No.4

Konkoly Thege, N. von 1885, *Ért. Mat. Tud. Kör.* **12**, No.5

Konkoly Thege, N. von 1886, *Ért. Mat. Tud. Kör.* **13**, No.3

Konkoly Thege, N. von 1887, *Beob. Astrophys. Obs. Ógyalla*, Band 8, Teil II

Krüger, F. 1893a, *Astron. Nachr.* **132**,83

Krüger, F. 1893b, *Kiel Publ.* No.8

Monck, W. H. S. 1892, *Astron. Astrophys.* **11**,326

Monck, W. H. S. 1893, *Astron. Astrophys.* **12**,513

Müller, G.; Kempf, P. 1907, *Potsdam Publ.* No.52

Pickering, E. C. 1908, *Harvard Ann.* **50**,1

Pickering, E. C.; Searle, A.; Wendell, O. C. 1884, *Harvard Ann.* **14**,1

Pickering, E. C.; Wendell, O. C. 1890, *Harvard Ann.* **24**,1

Schjellerup, H. C. F. C. 1864, *Stjerne fortegnelse indeholdende 10000 Positioner af teleskopiske Fixstjerner imellem* −15 *og* +15 *Graders Deklination*, Kjøbenhavn

Tass, A.; Terkán, L. 1916, *Publ. Kön. Ung. Astrophys. Obs. v. Konkoly Thege's Stiftungin Ógyalla*, Band I, No.1

Terkán, L. 1905, *Astron. Nachr.* 169,153
Terkán, L. 1906, *Astron. Nachr.* 173,177
Vogel, H. C. 1874, *Astron. Nachr.* 84,113
Vogel, H. C.; Müller, G. 1883, *Potsdam Publ.* No.11
Weisse, M. 1846, *Positiones Mediae Stellarum Fixarum*, Petropoli
Zach, F. de 1792, *Fixarum Praecipuarum Catalogus Novus*, Gotha
Zinner, E. 1926, *Bamberg Veröff.* Band II

* * *

LATER RESULTS BASED ON OLD OBSERVATIONS OF VARIABLE STARS

LÁSZLÓ SZABADOS
Konkoly Observatory
Budapest, P.O. Box 67 H-1525, Hungary

Abstract

This paper discusses how the previously published variable star observations can be used for achieving new results. In addition to the possibility for revealing secular (evolutionary or other) changes, old observations are suitable for pointing out a number of other effects summarized here as far as variety of the phenomena permits.

Introduction

The main aim of this paper is to present several examples in order to show the influence of the old data. Special emphasis is given to such results achieved at Konkoly Observatory. This arbitrary step is forgivable in this particular case because these results demonstrate that small or modest equipments are suitable for contributing to progress in astrophysics, and at the same time show that the study of variable stars has been an important and successful field of research at Konkoly Observatory from the very beginning. The observations of variable stars serve as a treasury for the present and future generations. While the scientific value of the contemporaneous observations is self-evident, importance of the previous, old or even ancient observations is not trivial.
The two essential questions that raise are as follows:
How can we use the earlier observations?
How to make observations valuable for the future?
The remainder of the paper concentrates on answering the first question and, in conclusion, the second question can also be answered very concisely.

The fact that certain observable (and observed in fact) phenomena pass unnoticed, does not necessarily mean the observer's carelessness. The discovery of slow or cumulative phenomena necessitates observations spread over a longer time-base, therefore the (mostly) subtle effects can only be revealed at a later date. An obvious example is the determination of the orbit of the astrometric binaries, though this example is not an astrophysical one. A well-known direct consequence of the determination of the astrometric orbit of Sirius was, however, the discovery of the first white dwarf star (Sirius B), and the ancient observations of Sirius turned out to be closely connected to its variability (see below).

Pre-telescopic observations

The possibility of using pre-telescopic observations for stellar variability purposes is very limited. The identification of some supernova remnants with the corresponding explosion event (e.g. the supernova observed in 1054 A.D. and the Crab nebula) has led to an independent distance determination of supernovae. The big difference between the epoch of observations made by ancient Greek astronomers (mainly Hipparchos and Ptolemy) and our age facilitates the discovery of any considerable secular brightness variation. Due to the limited accuracy of the visual observations, a difference reaching at least one magnitude can only be taken seriously. The examples for secular brightening during the past two millenia are β CMa and α Oph, while δ UMa, α Gem, β Leo and Pleione (BU Tau) might show secular fading in brightness (Detre, 1969). Although these cases are rather uncertain, it is worth mentioning that β CMa is a typical representative of the pulsating β Cephei variables. This kind of variability occurs when the star leaves the main sequence, and rapid evolution is able to produce the observed brightness increase. The decrease in Pleione's luminosity may also be the consequence of its intrinsic variability (an eruptive Be star) but the other cases listed above cannot be accepted without reserve. A similarly doubtful case is the colour change of Sirius claimed on the basis of ancient and early mediaeval sources. In his recent note Tang (1991) lists arguments that the reports on the seemingly red colour of Sirius do not necessarily reflect an intrinsic colour variation.

In what follows I try to summarize the various types of phenomena detectable with the help of observations made well prior to the discovery of the phenomenon itself.

Sudden variations

A classical way to detect sudden variations in brightness, spectral type or any particular spectral feature (*e.g.* presence of emission lines) is to search for such variations on sky patrol plates or, on any photographic plate available in archives. Although the overwhelming majority of such events is usually discovered just after the development process, there is a good chance to find objects showing sudden variation during the subsequent inspection of the plates. On direct plates, supernovae and flare stars, on plates illuminated through an objective prism, emission line objects can be revealed well after the moment of the observation.

Secular variation in brightness and colour

Secular variation occurs in various types of stars. This phenomenon may be primarily caused by stellar evolution and shell ejection. In order to discover such event, earlier observations are necessary because the secular variation necessitates a longer time scale. An expressive example is the slow variation in the average brightness of the hypergiant variable V509 Cas (Zsoldos, 1986). The visual magnitudes that have led to the discovery of the slow brightness increase were taken from various astrometric catalogues compiled in the last century. The photoelectric observations spread over the last decades also confirm the decreasing V magnitude and, in addition, reveal that the B-V colour index of V509 Cas tends to become redder. Another well known example for secular brightness variation is FG Sge (Hoffmeister *et al.*, 1984), the central star of a pre-historic planetary nebula. In this case the photographic brightness increased as much as three magnitudes between J.D. 2415000 and J.D. 2440000. Variability of FG Sge was discovered in 1943, when brightness increase had been in progress in a well documented way for half a century. The secular brightening is accompanied with a continuous colour variation: photoelectric multi-colour observations clearly show that FG Sge is evolving redward on the HR diagram.

Fuors (FU Ori type variables) are quite different from the variables mentioned above, their characteristic feature being a medium time-scale (neither abrupt, nor secular) brightness increase accompanied with blueward motion on the HR diagram. For example, V1057 Cygni – a former T Tauri star – showed six- magnitude brightness increase during 300 days in 1969-1970, meanwhile its spectrum altered to A-type (Hoffmeister *et al.*, 1984). The new position on the HR diagram is also above the main sequence, and this means that the fuor-phenomenon is an episode in the life of the pre-main-sequence stars.

Amplitude variations

Regular observations enable one to determine the amplitude of the light variation (if variability is more or less regular). Changes in the amplitude are good tracers of alteration in the internal structure of the stars, i.e. stellar evolution. A continuous decrease in the amplitude of brightness and pulsational radial velocity variation was pointed out for Polaris, a well known Cepheid variable (Arellano Ferro, 1983; Dinshaw *et al.*, 1989). Extrapolating the damping rate, pulsation of Polaris is expected to die out within a few years. Another Cepheid, Y Oph is also subjected to secular decrease of the light variation amplitude (Fernie, 1990), but in this latter case the time-scale is longer than that for Polaris. In addition to Cepheids, Spica, previously pulsating as a β Cephei type variable has ceased its pulsational variation. It is intriguing that each star mentioned in this context (Spica, Polaris and Y Oph) is a component of a binary (or multiple) system. The effect of the companion on the pulsational behaviour of the star has to be studied carefully.

There are more obvious cases where the amplitude variation is due to the binary nature. Development of periodic, Mira-like oscillations of ever increasing amplitude, eventually leading to a symbiotic nova outburst was detected in RR Tel (Robinson, 1975). A quite different variable, V651 Mon, the binary central star of the planetary nebula NGC 2346 shows eclipsing variations with variable minimum depths that may be caused by the changing structure of circumstellar matter.

The amplitude variations are not necessarily secular in nature, any other kind of amplitude variation is a valuable piece of information about the underlying physical mechanism. Two typical examples are the complicated behaviour of RR Lyrae discussed below, and the low dimensional deterministic chaos that characterizes the pulsation of the RV Tauri star R Scuti, as derived from the available (mostly visual) observations covering more than a century (Kolláth, 1990).

Period changes

It is the period that can be determined most accurately for any kind of variable stars. Therefore subtle period changes can be detected with relatively minor observational effort and the extension of the time-base of the observational series facilitates such a discovery. The use of the O–C diagram for deriving period changes is only possible if prior observational data are available. Period changes are produced by various causes, *e.g.* by

- stellar evolution,
- mass transfer in binaries,
- apsidal motion in binaries,
- effects causing other cyclic phenomena,
- effects causing other sudden phenomena.

Evolutionary period changes have been mostly observed in Cepheids (*e.g.* Szabados, 1983), whose O–C diagrams are of parabolic shape indicating either redward crossing of the instability strip (continuously increasing period, *e.g.* η Aql) or blueward crossing (decreasing pulsation period, e.g. δ Cep). For these two particular Cepheids, the O–C diagram covers more than two centuries. Another kind of evolutionary period change is observed in some RR Lyrae stars (*e.g.* V15 in M15, Barlai, 1982), due to the mixing episode occurring in the semi-convective layer of the variable.

Mass transfer occurs almost in all binaries for which orbital period has been determined (i.e. the period is short enough to be measureable). This implies that, in addition to the two stellar components, at least one more component – the circumstellar matter – has to be taken into account. It is not extraordinary that each of the three classical prototypes of binary stars (according to the phenomenological classification), Algol (β Per), β Lyr and W UMa shows very strong period changes.

As to the *apsidal motion*, a useful compilation about the binaries showing this phenomenon was published by Hegedüs (1988). Apsidal motion causes characteristic, periodic modulation in the orbital period of the binary star, which can be easily recognized from the O–C diagram of the binary system. With the help of this effect the structure of the components forming the binary can be deduced, in addition to the possibility for checking general relativity theory.

With the help of accurate photoelectric observations very *subtle (either periodic or non-periodic) period changes* can also be determined. The O–C diagram of the best studied RR Lyrae variable, RR Lyr itself, reveals important facts concerning the physical characteristics of this star (Szeidl, 1976). The amplitude and phase relations of the O–C residuals of the 40.8 day Blazhko period suggest that a 4-year cycle, analogous to the solar magnetic cycle may be present in this variable. This behaviour could be followed back to 1935, using old visual and photographic observations. While the phase shift for the Blazhko period occurs at the beginning of the new activity cycle, the phase shift observed in the O–C diagram of several Cepheid variables is of different origin. In the case of Cepheids, the phase jump occurs exclusively in variables belonging to binary systems, e.g. FF Aql, SU Cyg (Szabados, 1991).

Other phenomena

Various other phenomena can also modify the behaviour of the variable stars, and these effects can be revealed, provided the time-scale is adequate. All of these discoveries are impossible without previously existing observations. The pulsation driven outburst of RR Telescopii has been mentioned in the section on the amplitude variation. The shell ejection episode in P Cygni and in Be type stars also belongs to this category. The periodic variation in the maximum brightness and in the depth of primary minimum of β Lyrae was discovered during the careful analysis performed twenty years after the observational data were obtained. This 275 ± 20 day periodicity may arise from pulsations of the B8II component or from changes in the geometry of the disk component (Guinan, 1989).

Stellar activity also has various consequences that can be pointed out observationally. Detection of migration waves due to spots on the surface of differentially rotating stars requires a long series of observations (*e.g.* Patkós, 1982), and in fact, the periodic nature of the distortion in the light curve of RS CVn stars outside eclipse was discovered not sooner than in the early seventies (see Hall's (1976) review). The position, motion and other properties of the starspots (spot groups) can be determined by model calculations based on the observed light and colour curves. With sufficient observational data being given, important new results can be achieved, *e.g.* the presence of an active longitude on the spotted component of HK Lac (Oláh *et al.*, 1991).

Existence of activity cycles (analogous to the solar one) is wide-spread among the stars. In addition to the rotating spotted variables and RR Lyrae, recently the whole class of cataclysmic variables has turned out to be candidates showing magnetic activity. Ex-novae, dwarf novae and nova-like variables show cyclic brightness variations with a cycle-length of 6 - 13 years if the magnitude during quiescence is investigated. In addition, the outburst frequency of dwarf novae is modified with the same cycle-length, and the orbital period of the cataclysmic variables shows alternate changes again with this cycle (Hall, 1990; Bianchini, 1990). All these pieces of evidence can be explained with the magnetic cycle coming into being in the cooler component of the cataclysmic binary, because the variable magnetic field modifies the stellar radius, therefore alters the mass outflow through the inner Lagrangian point. For our present purpose it is not the mechanism that is important but the fact that these observational results have been deduced from a huge amount of brightness data collected during several decades.

Last but not least, our Sun is also a variable star that has been observed for centuries. One of the characteristic features of solar activity is the temporary quiescence, the latest one (so called "Maunder minimum") lasting from 1645 to 1715. Curiously enough, this phenomenon was only discovered at the end of the 19th century, again based on the published records concerning sunspot numbers, occurrence of aurora, shape of solar corona during eclipses, *i.e.* using the observational data typical of the given epoch. It is worth mentioning that the counterparts of the Maunder minimum have been detected in solar type stars with the help of deliberate, long-term spectroscopic and photometric monitoring of carefully selected candidate stars (Baliunas and Jastrow, 1990).

In conclusion, we are able to answer the second question put in the introduction. If we wish to make observations with the hope that they will also be useful for the succeeding generations, the observations are to be performed using up-to-date equipments, and making the data easily accessible is also of primary importance. Otherwise the generations yet to come will forget about our work.

Acknowledgement

The author is indebted to the staff of Konkoly Observatory, especially to Drs. Zoltán Kolláth, Mária Kun, Katalin Oláh, Magda Vargha and Endre Zsoldos for fruitful discussions and useful advice.

References:

Arellano Ferro, A. 1983, Astrophys. J., **274**, 755.
Baliunas, S., and Jastrow, R. 1990, Nature, **348**, 520.
Barlai, K. 1982, Comm. Konkoly Obs. Hung. Acad. Sci., No. 83, 223.
Bianchini, A. 1990, Astron. J., **99**, 1941.
Detre, L. 1969, Lecture delivered at Eötvös University.

Dinshaw, N., Matthews, J., Walker, G.A., and Hill, G.M., 1989, Astron. J., 98, 2249.
Fernie, J.D. 1990, Publ. astr. Soc. Pacific, 102, 905.
Guinan, E.F. 1989, Space Sci. Rev., 50, 35.
Hall, D.S. 1976, in "Multiple Periodic Variable Stars", Proc. IAU Coll. No. 29, Ed.: W.S. Fitch, Akadémiai Kiadó, Budapest, Vol. I, 287.
Hall, D.S. 1990, in "Active Close Binaries", NATO ASI C319, Ed.: C. Ibanoglu, Kluwer, p. 95.
Hegedűs, T. 1988, Bull. Inform. CDS, No. 35, 15.
Hoffmeister, C., Richter, G., and Wenzel, W. 1984, Veränderliche Sterne, J.A. Barth, Leipzig.
Kolláth, Z. 1990, Mon. Not. R. astr. Soc., 247, 377.
Oláh, K., Hall, D.S., and Henry, G.W. 1991, Astron. Astrophys. (in the press)
Patkós, L. 1982, Comm. Konkoly Obs. Hung. Acad. Sci., Budapest, No. 80.
Robinson, E.L. 1975, Astron. J., 80, 515.
Szabados, L. 1983, Astrophys. Space Sci., 96, 185.
Szabados, L. 1991, Comm. Konkoly Obs. Hung. Acad. Sci., Budapest, No. 96 (Vol. 11, part 3).
Szeidl, B. 1976, in "Multiple Periodic Variable Stars", Proc. IAU Coll. No. 29, Ed.: W.S. Fitch, Akadémiai Kiadó, Budapest, Vol. I, p. 133.
Tang, T.B. 1991, Nature, 352, 25.
Zsoldos, E. 1986, The Observatory, 106, 156.

* * *

ASTRONOMICAL INSTRUMENTATION OF THE ERA KONKOLY THEGE IN RESPECT TO THEIR SIGNIFICANCE OF ASTROPHYSICS

GUDRUN WOLFSCHMIDT
Deutsches Museum
8000 Munich 26, P.O. Box 260102, Germany

Beginning of Astrophysics

The classical astronomer Simon Newcomb (1835 - 1909) wrote in 1888:

> *"that the age of great discoveries in any branch of science had passed by, yet so as far astronomy is concerned, it must be confessed that we do appear to be fast reaching the limits of our knowledge."*[1]

But he was wrong. The main point of research had transferred from classical positional astronomy and celestial mechanics to "The New Astronomy". Around 1860, the new epoque of astrophysics had started. Already in the next two decades many new discoveries were made and astrophysics advanced quickly with new discoveries, although the classical astronomers didn't take any notice.

> *"Then [1862] it was that an astronomical observatory began, for the first time, to take on the appearance of a laboratory. Primary batteries, giving forth noxious gases, were arranged outside one of the windows: a large induction coil stood mounted on a stand on wheels, so as to follow the positions of the eye of the telescope, together with a battery of several Leydan jars; shelves with Bunsen burners, vacuum tubes, and bottles of chemicals, especially of specimens of pure metals, lined its walls. ... In February 1863 the strickly astronomical character of the Observatory was further encroached upon by the erection, in one comer, of a small photographic tent, furnished with baths and other appliances for the wet collodion process."*[2]

The English astrophysicist William Huggins (1824 - 1910) describes here very well the change in the instrumentation of his observatory. In the 1870s only a few centers of astrophysics existed in the world: Germany, England, Italy, France, and a little bit later United States. The beginning of astrophysics was characterized by three new topics: spectroscopy, photometry, and photography, all strongly related with instruments and techniques.

1. PHOTOMETRY

Throughout Europe two kinds of visual photometers existed. The most important was the Zöllner photometer which existed in a lot of observatories (for example Potsdam). It has been improved since the time of Karl Friedrich Zöllner (1834 - 1882) who invented it in the 1860s in the Leipzig Observatory.

Besides the Zöllner polarisation photometer the astronomers used the wedge photometer.[3] It measured not only magnitudes of the stars but also determined colours. For this a blue and a red wedge was used. The Potsdam Observatory staff developed spectralphotometers to estimate the stellar temperatures. In scientific exchange with the Potsdam astronomers Miklós von Thege Konkoly (1842 - 1916) at Ógyalla built in his observatory workshop several photometric and spectroscopic devices.

2. SOLAR PHYSICS AND PHOTOGRAPHY

The second important record of astrophysics was the photography which can be combined with photometry and spectroscopy. It was e.g. useful for solar physics.

In 1854 John Herschel (1792 - 1871) stressed the importance of regularly photographing the sunspots. In 1858 Warren De la Rue (1815 - 1889), at Kew Observatory near London, constructed the first heliograph (aperture Ø9 cm, focal length f = 1.3 m, solar picture of 1 cm diameter). One of the very first users of heliograph was Konkoly Thege.

Early Heliograps (refractors and reflectors)

Year	Name	Ø[cm]/f[m]	Site
1858	W. De la Rue	9 cm/1.3 Dallmayer	Kew, London
1861		15 cm/2.4 m Merz	Wilna, Lithuania
1871	H.C. Vogel	29 cm/4.9 m Schroeder	Bothkamp near Kiel
1872	N. Konkoly Thege	15 cm/1.8 m Steinhell	Ógyalla, Hungary*
1873	W. Maunder	10 cm/1.5 m Dallmayer	Greenwich
1876	P.J. Janssen	14 cm/2 m	Meudon/ Paris
	A. Secchi	15 cm Cauchoix	Rome, Italy
1879	H.C. Vogel	16 cm/4 m Schroeder	Potsdam APO
1876	W. Huggins	46 cm A.A. Common, Cassegrain	Tulse Hill/London
1882	J.N. Lockyer	60 cm Newall	Kensington/London

* Today[1992]: Hurbanovo, Slovakia.

3. SPECTROSCOPY

But the most important part of astrophysics was spectroscopy: The first professor of astrophysics Julius Scheiner (1858 - 1913) told in 1890 about the topics of astrophysics:

> *"Es kann nicht zweifelhaft geblieben sein, dass die Spectralanalyse hierbei die erste Stelle einnimmt und auch für absehbare Zeiten behalten wird, um so mehr, als durch die letzterwähnten Forschungen der Beobachtungs-Thätigkeit ein neues Feld eröffnet worden ist, welches in der Zukunft noch eine reiche Ausbeute verspricht."*[4]

The first step in spectral analysis was done by Gustav R. Kirchhoff (1824 - 1887) and Robert W. Bunsen (1811 - 1899). They were able to interpret the dark lines in the solar spectrum, discovered by Joseph Fraunhofer (1787 - 1826): Kirchhoff and Bunsen proved that the sane elements were in the heavens as well as on Earth. The astronomer Arthur Auwers (1838 - 1915) of the Berlin Academy of Sciences judged in 1892 when Hermann Carl Vogel (1841 - 1907) was elected to the Academy:

"Was vor vierhundert Jahren der alten Welt Columbus' Entdeckung America's war, das ist in unseren Tagen für die Astronomie Gustav Kirchhoff's Begründung der Spectralanalyse gewesen."[5]

In the following he compared detection of spectral analysis with the revolution made through the invention of the telescope.[6]

3.1 Solar spectroscopy

Astronomers started first to explore the Sun spectroscopically. J. Norman Lockyer (1836 - 1920) had a private observatory near London. He got the first spectra of sunspots. Hermann Wilhelm Vogel (1834 - 1898) at the Berlin - Babelsberg Observatory succeeded to get the first photograph of the solar spectrum with his spectrograph of 1874.

Three pioneers in England, France and Italy were interested in solar spectroscopy. They got very interesting results about the atmospheric layers of the Sun.

Pierre Jules C. Janssen (1824 - 1907) at Paris and Lockyer constructed the first prominence spectroscopes after the solar eclipse in 1868 when "Helium" was discovered. Now it was possible to study the structure and velocities of the protuberances. Especially Angelo Secchi (1818 - 1878) at Rome made a classification of the prominences in 1870.

Another field of solar physics was started by Hermann Carl Vogel (1841 - 1907), director of the Bothkamp Observatory near Kiel. His spectroscope was made by Hugo Schroeder, Hamburg. In 1871 Vogel measured the Doppler shifts in the spectra of Sun and determined the solar rotation spectroscopically. Thus he confirmed the earlier measurements of Richard C. Carrington (1826 - 1875) who investigated the motion of the sunspots in order to get the solar rotation.

3.2 Stellar Spectroscopy

For stellar spectroscopy Angelo Secchi (1818 - 1878) invented the spectroscope "à vision directe", later widely spred by Merz, Munich. At least three instruments of this type are preserved: Deutsches Museum, Munich (Inv. - Nr. 1991 - 114). Two others are in the Gothard Observatory in Herény/Szombathely, Hungary and in the Technical Museum Budapest; formerly these instruments came from Konkoly Observatory.

Secchi invented the object lens prism (Deutsches Museum, Munich, Inv. - Nr. 24039-41). He used it to catalogue stellar spectra. Based on the colour, he distinguished with his object lens prism prototype three classes of stellar spectra or three colours of stars (blue-white, yellow and red): Sirius (α Canis Maioris), the Sun, and Betelgeuze (α Orionis) were the prototypes. Edward C. Pickering (1846 - 1919), director of the Harvard Observatory, Cambridge, Massachusetts, tested the object lens prism. This important instrument enabled him to get about 100 spectra at the same time, like a single one with a spectrograph. The Harvard staff used the object lens prism to get the photographic plates at the Arequipa Observatory, Peru. The photography started in 1885 based on a donation by Henry Draper (1837 - 1882). The first classification, based on the photographs, was published in 1901. The result in 1920s was extensive "Henry Draper" spectral catalogue, compiled by the Harvard women. Besides the object lens prism for getting better dispersion, Jenő (Eugen) von Gothard (1857 - 1909) at Herény Observatory, Hungary, used also spectrographs for the investigation of several important celestial objects.

William Huggins (1824 - 1910) with his wife Margaret Lindsay Murray Huggins (1848 - 1915) made astronomical observations in their private observatory Tulse Hill near London from 1862 on. They were able to study successfully stars as well as comets and nebulae with spectroscopes.

Hermann Carl Vogel at the Potsdam Astrophysical Observatory got his spectroscopical skill at the Bothkamp Observatory near Kiel. He started measuring radial velocities of stars with a Schroeder spectroscope in 1871 (Deutsches Museum, Munich, Inv. - Nr. 51164) - but without success. In order to measure the very small Doppler shifts in stellar spectra, he introduced the new technique of photography into spectroscopy.

> *"Meine in vorigen Bericht ausgeschprochene Vermuthung, dass die Anvendung der Photographie bei der Lösung dieser Aufgabe wesentliche Vortheile bieten würde, hat sich im vollsten Masse bestätig. ... Ich glaube daher, in Anbetracht der ausserordentlichen Wichtigkeit der Beobachtungen überhaupt, aussprechen zu können, dass diese hier zum ersten Male gemachte Anwendung der Photographie eine der bedeutsamsten ganannt werden kann.* [7]

For the first time photography was used as measuring method.

> *"Es is bekannt, welche epochenmachende Förderung die Astrophysik, und in besonderen die Spectralanalyse der Fixsterne durch die Anwendung der Photographie erfahren hat. Unter Benutzung derselben optischen Hülfsmittel gewährt die Spectralphotographie etwa die zwanzigfache Genauigkeit der Messung gegenüber der directen Beobachtung am Fernrohr, ..."* [8]

In cooperation with the company Otto Toepfer, Potsdam, Vogel constructed in 1888 the first stellar spectrograph (Modell A) to measure radial velocities. This spectrograph is still conserved in Potsdam Astrophysical Observatory. For the comparison spectra he used a Geissler tube like Jenő von Gothard. Vogel made also measurements with spark-spectra. Examples of the whole equipment can be seen at the Gothard Observatory.

In the following two decades, he and the Potsdam staff improved further the spectrographs: For avoiding temperature oscillations, they built a heating equipment for the spectrograph Model III (1898). The spectrograph Model IV (1900) with improved accuracy spread all over Europe as far as Pulkovo (Deutsches Museum, Munich, Inv. - Nr. 1990-908, originated from Bonn Observatory; one exists also in Potsdam Astrophysical Observatory). The spectrograph may not be flexible during the long exposures. To get a stable but not a heavy instrument, they used for Modell V (1905) a cast-iron framework construction. In addition, Vogel built a quartz spectrograph in 1903 to study stellar light also in UV region. Remarkable results were obtained with these instruments, for example, the first catalogue of 51 stellar radial velocities in 1892, the discovery of the spectroscopic binaries in 1889, and Johannes Hartmann's (1865 - 1936) discovery of interstellar gas in 1904.

4. THE FIRST MIRROR TELESCOPES

Refractors are not very suitable for spectroscopy and photography, because they were corrected for two (or three) colours only. The new glass mirror telescopes (reflectors) were developed in the 1850s independently by Justus von Liebig (1803 - 1873)[9] in cooperation with Carl August von Steinhel (1801 - 1870) (only apertures of Ø10 cm) in Munich and by Léon Foucault (1809 - 1868)[10] in Paris (large apertures Ø33 cm - 80cm).[11] The reflectors had better light gathering possibilities, and less image defects. Especially the mirror telescopes of John Browning (1835 - 1929)[12] in England were famous; they had apertures up to 38 cm.

Pioneers in field of glass mirrors were:

A. Ainslie Common (1841 - 1903) in Ealing near London (46 cm reflector) got in 1883 a gold medal from Royal Astronomical Society for his photograph of the Orion nebula (exposure time 37 minutes).[13] Isaac Roberts (1829 - 1904) took also a picture of the Orion nebula at Crowborough Hill, Sussex with his 51 cm reflector.[14] Henry Draper (1837 - 1882), New York photographed the Orion nebula M 42 with his 71 cm reflector (exposure time two hours).[15]

After some failures with large reflectors (aperture up to 1.2 m)[16], astronomers were no more interested in the mirrors. The first real success was reached with the 91 cm "Crossley" reflector made by A.A. Common. It was presented to the Lick Observatory, California, in 1895. With this instrument James E. Keeler (1857 - 1900) observed nebulae since 1898.[17]

As early as in 1870s, Konkoly Thege recognized the importance of the mirror telescope for astronomical research, when he got a 26 cm Newton reflector (focal length nearly 2 m) from Browning, London.

In the private observatory in Herény, Szombathely, Hungary, Jenő von Gothard (1857 - 1909)[18] was working with Konkoly Thege's 26 cm reflector. He himself constructed an outstanding camera. For example in 1886 he shot a picture of the ring nebula in the constellation of Lyra on which he discovered the central star. Furthermore he took photographs of spectra of gaseous nebulae, and in 1892 he recognized the similarity between their spectra and the spectra of novae.

CONCLUSION AND OUTLOOK

Without any doubt astrophysical research became first rank in astronomy and within a foreseeable time there will be no change. In the first four decades of astrophysics a variety of astrophysical instruments such as photometers, heliographs, and spectral apparatus was developed. They opened new possibilities of observation and caused a quick scientific advance.

As it is well known, the use of photography has promoted astrophysics in an epoch making way, especially spectral analysis of the stars. Using the same optical resources, the spectral photography yields twenty times the precision of direct observations with a telescope. At the end of the 19th century astronomers recognized the essential advantage of reflectors instead of refractors.

There existed several centers of astrophysics in the world. Because of his instrumental equipment Konkoly Thege's observatory in Ógyalla belonged to the early observatories in this field. The close cooperation of the Hungarian with the German astronomers should be examined. A wellknown picture shows Konkoly Thege and J. Hartmann observing the comet Halley in 1910.

But in the beginning of the 20th century the American observatories with their remarkable instrumentation became very successful and thus gradually the significance of the Ógyalla and Potsdam Observatory declined.

1 Newcomb, S. : The Place of Astronomy among Sciences. Sidereal Messenger 7, 1888, p. 14 - 20, p. 65 - 73. Quotation from: Smith, Robert, W.: The Expanding Universe. Astronomy's Great Debate' 1900 - 1931. Cambridge/England 1982 on p. 6.

2 Huggins W.: The New Astronomy. In: Nineteenth Century. London 1897. Quotations from Huggins, W; Huggins, M.: An Atlas of Representative Stellar Spectra. Publications of Sir William Huggins's Observatory, Vol. 1, London 1899, p 8-9. "Damals [1862] begann ein astronomisches Observatorium zum ersten Mal wie ein Laboratorium aufzusehen. Batterien, die schädliche Gase ausströmten, standen draussen vor dem Fenster; eine grosse Induktionsspule war auf einem Wagen so montiert, dass sie der Bewegung des Okulars folgen konnte; daneben stand eine Reihe Leidener Flaschen; Regale mit Brunsenbrennern, Vakuumrähren und Flaschen Chemikalien ... füllten die Wände. ... Im Februar 1863 verlor die Sternwarte noch mehr ihren streng astronomischen Charakter, als in einer Ecke ein kleine photographisches Zelt aufgebaut wurde, dass als Dunkelkammer mit Bädern und anderem Zubehör für die Entwicklung der feuchten Kollodiumplatten ausgestattet war."

3 For example, in the Gothard Observatory still exists a wedge photometer with registration equipment.

4 Scheiner, Julius: Die Spectralanalyse der Gestirne. Leipzig, 1890, p. 35.

5 Auwers, Arthur (Antworf auf die Antrittsrede von H. C. Voge): Sitzungsberichte der königlich preussischen Akadeimie de Wissenschaften zu Berlin, math. - phys. Classe, 1892, p. 604 - 606, on p. 604.

6 "Von ihr gilt gleichmässig A. v. Humboldt's Wort: sie vergrösserte mit einem Male die Gesammtmasse der Ideen, welche bis dahin den Besitz der gelehrten Forschung bildeten - noch eimal überraschte die Beobachter die Wirkung, durch welche 250 Jahre worden die Erfindung des Fernrohrs ihre Vorgänger in tägliches Erstaunen versetz hatte." In: Auwers, A.: (Antwort auf die Anrittsrede von H.C. Vogel). Sitzungsberichte der königlich preussischen Akademie der Wissenschaften zu Berlin, math. - phys. Classe, 1892, p. 604 - 606 on p. 604.

7 Vogel, H.C.: Jahresbericht für 1887, Potsdam. Vierteljahrschrift der Astronomischen Gesellschaft 23, Leipzig 1888, p. 122 - 135 on p. 122 - 123.

8 Vogel, H.C.: (Antrittsrede). Sitzungsberichte der königlich preussischen Akademie der Wissenschaften zu Berlin, math. - phys. Classe, 1892, p. 601 - 604, on p. 602.

9 Vaupel, Elisabeth C. : Justus von Liebig (1803 - 1873) und die Anfänge Silberspiegelfabrikation. Wissenschaftliches Jahrbuch 1989, Deutsches Museum, München, 1989, p. 189 - 226.

10 Foucault, Léon: Note sur un télescope en verre argenté. Comptes Rendus hebdomaires des Séances de l'Academie des Sciences 44, 1857, p. 339 - 342.

11 Tobin, W.: Foucault's Intervention of the Silvered-Glass Reflecting Telescope and the History of 80 cm Reflector at the Observatoire Marseille. Vistas in Astronomy 30, 1987, p. 153 - 184.

12 Browning, J.: A Plea for Reflectors. London, 1867.

13 Common, Ainslie A.: Note on a Photograph of the Great Nebula in Orion and some new stars near ϑ Orionis. Monthly Notices Royal Astronomical Society 43, 1883, p. 255 - 257. First reflector Ø46 cm, 1876, G. Calver (1834 - 1927); second reflector Ø91 cm, 1879. 1885 sold (footnote 17) Photograph of the Orion nebula 30. Jan. 1883, exposure time 37 minutes.

14 Roberts, Isaac : Reflector Ø51 cm f: 5 focal length 2.4m, Howard Grubb, Dublin 1885 (today in Science Museum in London) Robers, Isaac: Photographs of Stars, Star - Clusters, and Nebulae, Vol. I, II, London 1893 [1899, 1928].

15 Draper, Henry: Wasburn Observatory 25, 1880, App. I, p. 226. [Draper's mirror telescopes: Ø39 cm, 1862; Ø71 cm, 1866 1872].

16 Danjon, André: Couder, André; Lunettes et Télescopes. Paris 1935.

17 Keeler, James E. : The Crossley Reflector of the Lick Observatory. Astrophysical Journal 11. 1900, p. 325 - 349, on p. 345 and p. 348. [Crossley reflector Ø91 cm, focal length 5.3 m, 1:6, A.A Common 1879, 1885 sold to Edward Crossley (1841 - 1905) in Halifax/Yorkshire, 1896 Lick Observatory, Mt Hamilton; 1910 new mounting: three prism spectrograph, each prism 60°, aperture 2″ and Quartzspectrograph].

- The Crossley Reflector, Observatory 22, 1899, p. 437 -440.
- The Photographic Efficiency of the Crossley Reflector.

Publication of the Astronomical Society of the Pacific 11, 1899, p. 199 - 202.

- Photographs of Nebulae and Clusters, made with the Crossley Reflector. Publications of the Lick Observatory Vol. 8, 1908, p. 11 - 43, p. 45 List of illustrations. Plate 1 - 70.

18. Konkoly Thege, Miklós von: Eugen von Gothard, Edler von Herény. Vierteljahrschrift der Astronomischen Gesellschaft 45, 1910, p. 43 - 50, on p. 45. Gothard, Eugen von; Bemerkung zu Astronomische Nachrichten 2749 betr, den Ringnebel in der Leyer. [Zentralstern]. Astronomische Nachrichten 115, 1886, No. 2754, p. 303 - 304.

- Ueber das Spectrum der Nova Aurigae verglichen mit Nebelspectren. Astronomische Nachrichten 131, 1893, No. 3129. p. 141 - 144. [mirror telescope of E. v. Gothard: 26 cm Newton reflector, focal length 1.97 m, John Browning, London 1882].

* * *

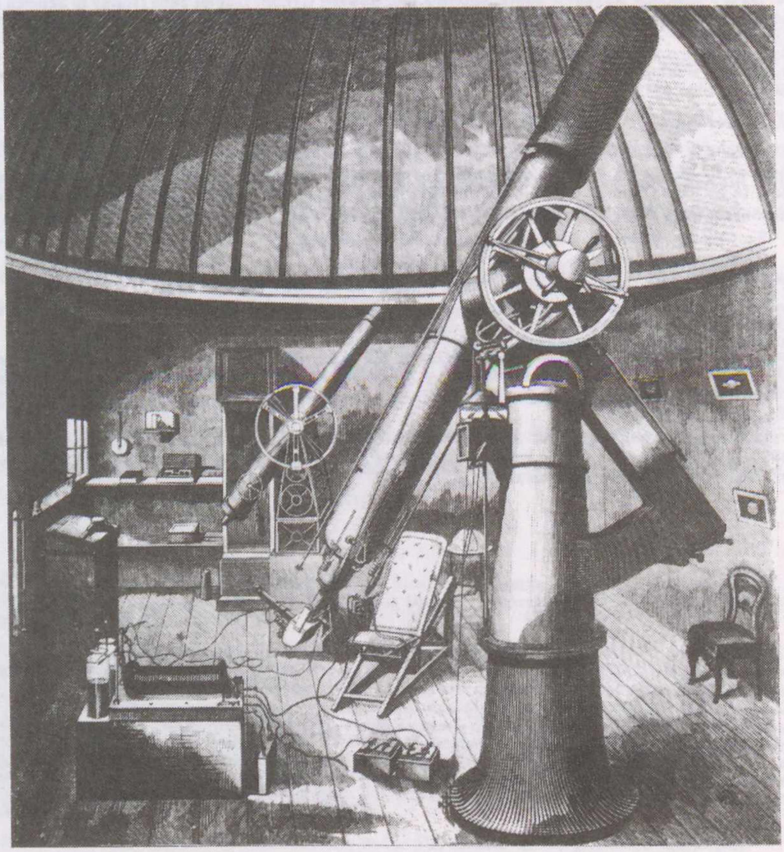


Fig. 1 Huggins' Astrophysical Observatory

Interior of the observatory as an astrophysical laboratory of William (1824-1910) and Margaret Huggins (1848-1915) in Tulse Hill, England in the 1860s.

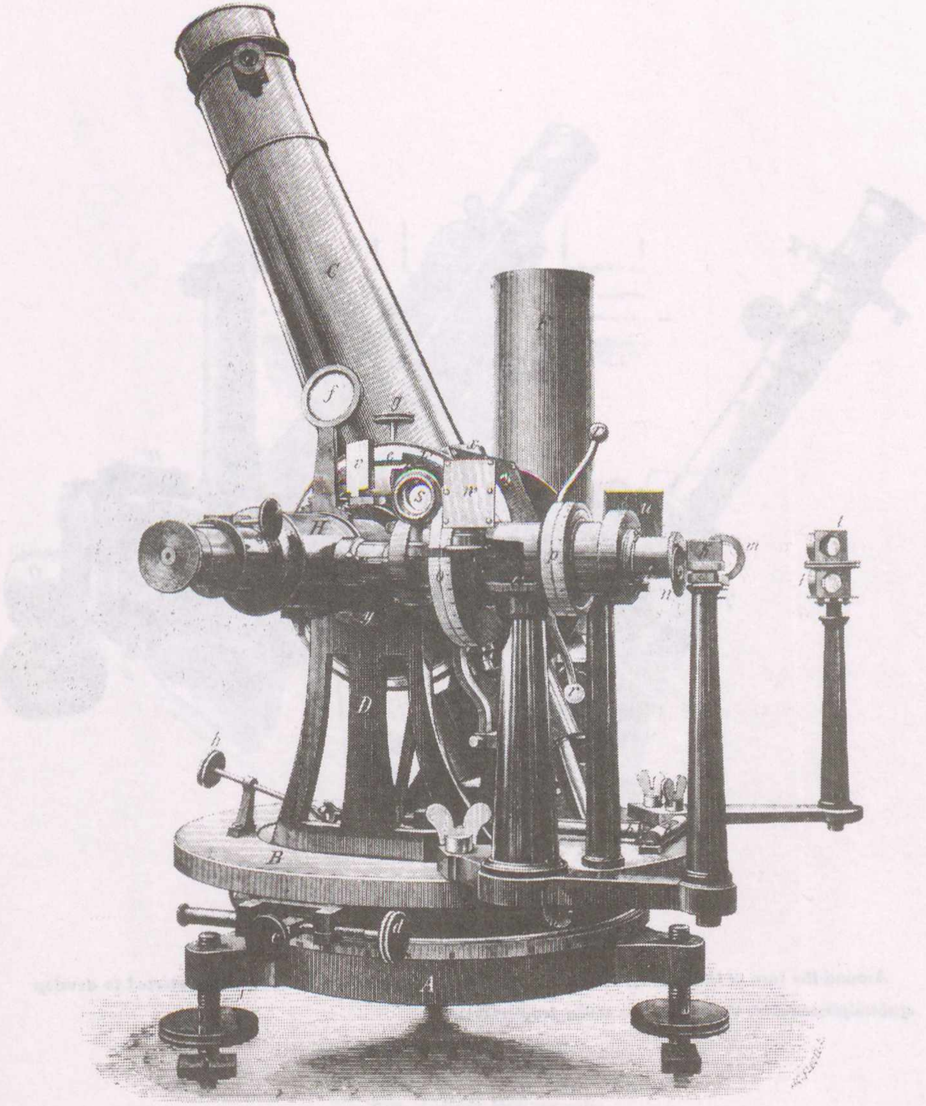


Fig. 2 Zöllner Polarisation Photometer

Karl Friedrich Zöllner (1834-1882) developed around 1861 in Leipzig a polarisation photometer, produced by Ausfeld, Gotha. As a comparison light source for the measurement of stellar brightness ("artificial star") a gas lamp was used. Its brightness can be changed by turning a Nicol prism (polarisation by double refraction). The brightness of the star and the lamp are compared in the ocular. With a third Nicol prism the colour of the star can be determined. In this further development of the Zöllner Photometer in the 1880s a bulb was already used as a comparison light source and three changeable objectives for stars of different brightness.

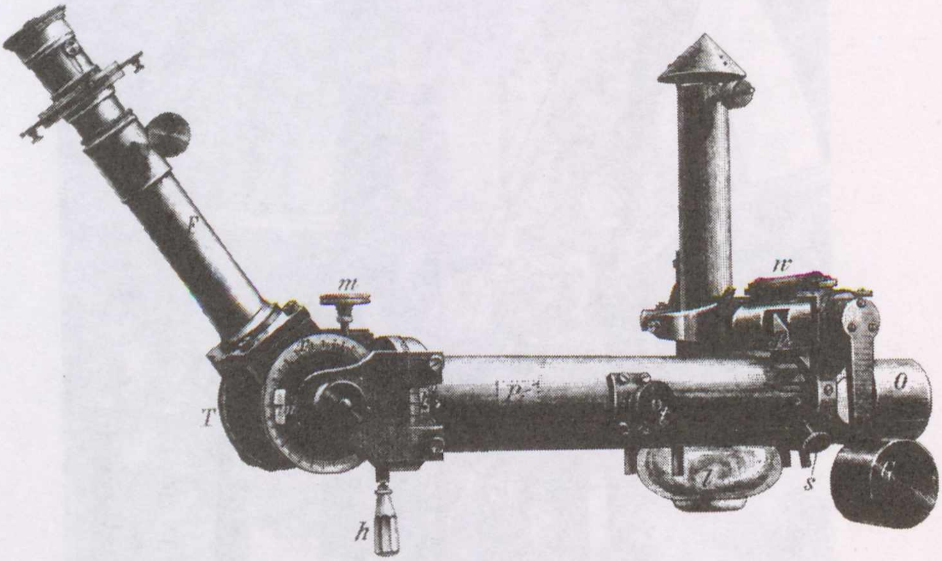


Fig. 3 Spectralphotometer

Around the turn of the century, the staff of the Potsdam Astrophysical Observatory started to develop spectralphotometers to estimate the stellar temperatures.

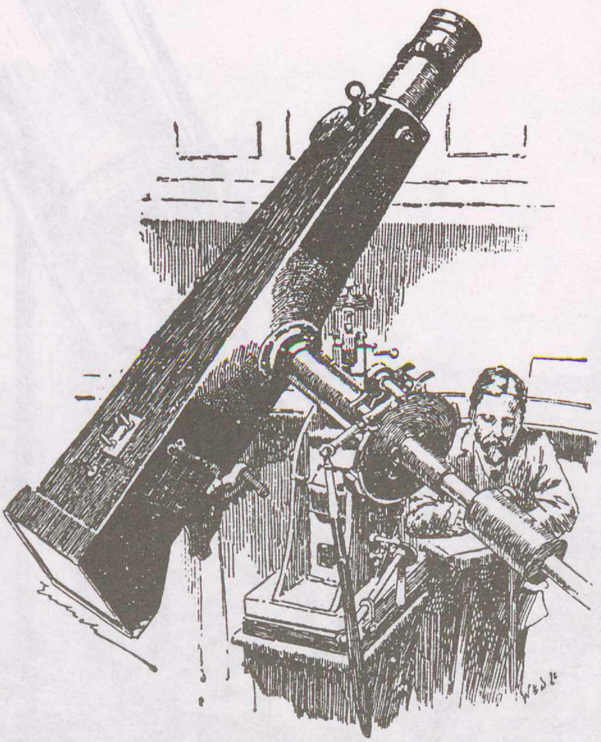


Fig. 4 Kew Heliograph

Warren De la Rue (1815-1889) used the first heliograph in 1858 at the Kew Observatory near London to photograph regularly the sunspots. The optics of the instrument (aperture Ø9 cm, focal length 1.3 m) were made by Dallmeyer, producing a solar image of 1 cm diameter.

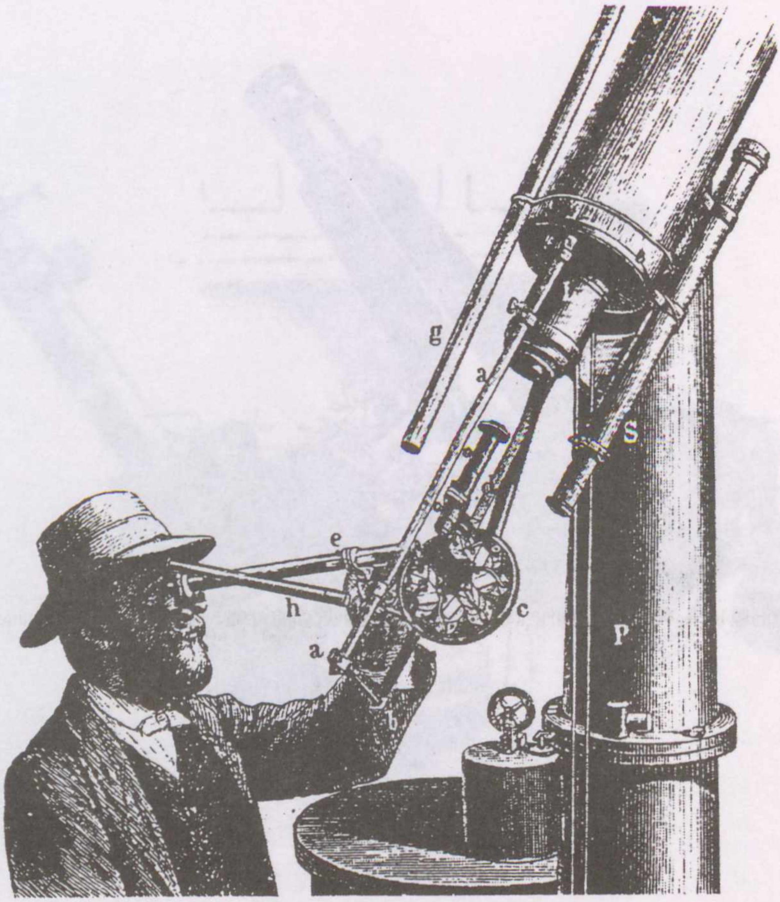


Fig. 5 "Telespectroscope"

Joseph Norman Lockyer (1836-1920) observing the Sun spectroscopically in his private observatory near London.

Fig. 6 Astrophysical Observatory in Potsdam

The director Hermann Carl Vogel (1841-1907) got his spectroscopic skill at the Bothkamp Observatory near Kiel. In order to measure the very small Doppler shifts in stellar spectra, he introduced the new technique of photography into spectroscopy. A famous development of spectrographs started in Potsdam.

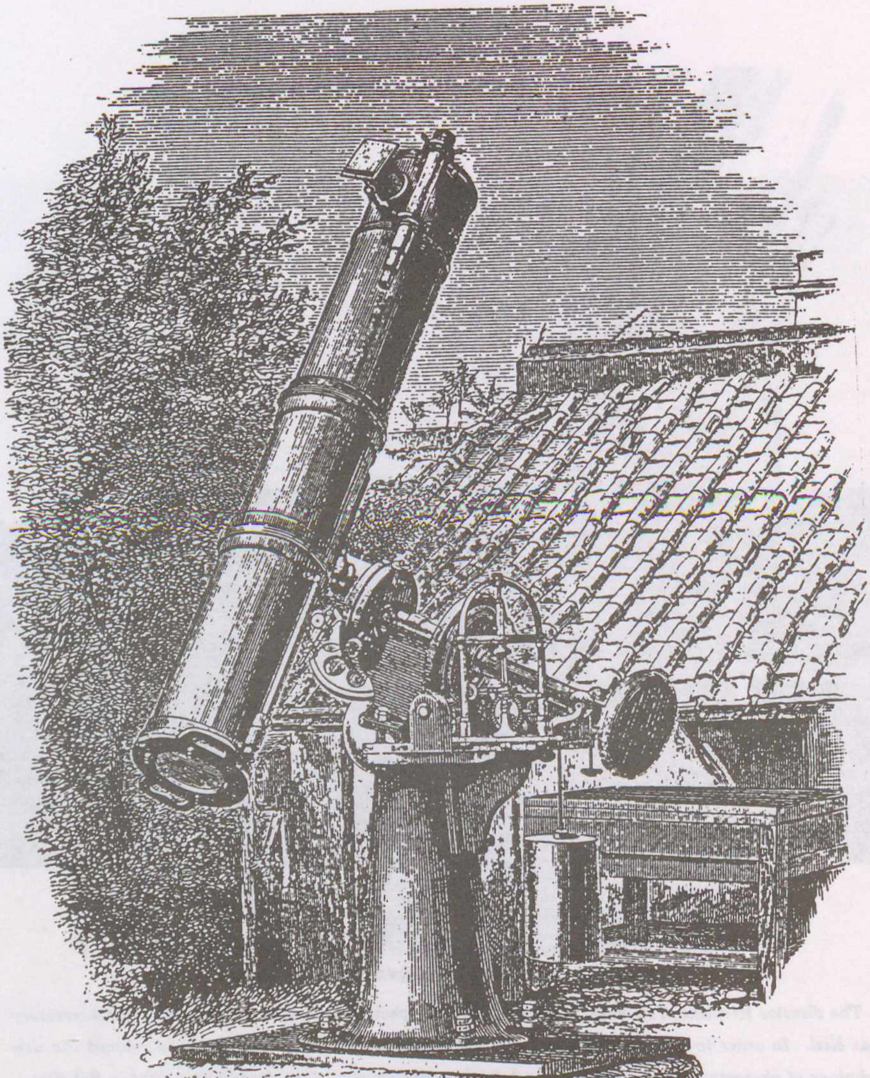


Fig. 7 Tennant's Photographic Reflector

John Browning (1835-1929) in England was one of the pioneers in developing glass mirror telescopes. The reflectors had better light gathering possibilities and less image defects. This 9′ = 23 cm reflector was made Browning and With in 1868.

THE ÓGYALLA OBSERVATORY TODAY

László Druga
Slovenské Ústredie Amatérsky Astronómie
94701 Hurbanovo, P.O. Box 42, Slovak Republic

With this paper about the Ógyalla observatory - on the occasion of the 120th anniversary of its foundation - I would like you to get acquainted with its history and development from Dr. Konkoly Thege till our days, illustrating it with a video-film about the observatory itself.

As it is already known from the previous papers of my colleagues about the life and work of Dr. Miklós Konkoly Thege, at the end of the last century the Ógyalla observatory with its large-scale astronomical, meteorological and geophysical professional activity counted among the distinguished scientific institutions of Middle-Europe. In fact, from the foundation of the first Czechoslovakian Republic, the idea of Miklós Konkoly Thege is lively and active, that has coordinated the research work of the three bordering fields of science preserving the results and improving them, and all these in the humble service mankind. Dr. Konkoly Thege's wide circle of friends, his previous co-operation with the Prague observatory - especially with its director Ladislaw Weinek - and none the less the fact that there was a general public interested in astronomy and meteorology in Slovakia whom Dr. Konkoly Thege tried to connect with the observations; all these contributed to the success. Thus he encouraged the wide interest in astronomy and the observation that became the driving spirit of the development in this direction in the newly formed Czechoslovakia. In the year 1919 the observatory belonged to the state astrophysical observatory under the direction of the Ministry of Culture and Education. In spite of the fact that at that time some thousands of booklets, notes, maps and photos as well as some auxiliary instruments could remain in Ógyalla, the observatory was without a main instrument. This, of course, influenced the further direction of the scientific work. Beside the observation of the Sun and the variable stars with minor instruments, the theoretical work became of primary importance. Here we have to mention the prime number - and numerical function-tables of Dr. J. Kavan and the profound work of professor A. Dittrich in the fields of relativistic theoretical physics, mathematics, philosophy and history of astronomy.

In the year 1927 Dr. Bohumil Sternberk arrives at Ógyalla with the task to put the new 600 mm Zeiss refractor into operation and thus renew the astronomical observations.

The new telescope was the biggest and the most important instrument of Czechoslovakian astronomy for forty years. In spite of his manyfold activities - among others he professionally renewed and reorganized the library, entered the international exchange service, restarted the mechanical and optical workshop, built up the observatory's own power station and water system - Dr. Sternberk made maximal use of the telescope.

The recordings in the observation diary tell about this. In 1930 he - first in Europe - determined, with the help of this telescope, the position of the planet Pluto recently discovered at that time. In Czechoslovakia this was the first position determination by photographic method and the results could compare with the most precise observations of the world. Another important work of Dr. Sternberk was the measurement of the photometric diameter of the Comet Finsler. This was the first attempt in the world to examine the surface brightness distribution of a comet-nucleus. Dr. Sternberk was dealing with chronometrical questions as well and instead of the conventional photometric observations he used a photomultiplier.

He came with the idea to measure the oscillation of the photon -stream coming from the different places of the Moon, from the planets and the stars, and to make it audible through a speaker. His "radio reports" made about the Moon and the Vega met with success. The British Broadcasting Corporation (BBC) even made a record of them.

Right before his death Dr. Sternberk confessed in one of his articles in Rise Hvezd (which means the Empire of the Stars) - a scientific magazine for the general public - that he had a high opinion of Dr. Konkoly Thege's work and personality. He knew the man and the scientist not only from his scientific work but also from the extent correspondence of Dr. Konkoly Thege with the outstanding personalities of the scientific and cultural life. At the beginning of the thirties - like Dr. Konkoly Thege - Dr. Sternberk proposes a scientific research program, the basis of which should be the research work in the boundary zones of meteorology, geophysics and astronomy - according to the trends of the institute. In accordance with this program together with Dr. B. Novakova he began to build a Halle-type spectrohelioscope.

Unfortunately the events of 1938 made it impossible to continue the scientific research work. Then the instruments were taken to the astronomical research institute of the Academy at Ondrejov near Prague and to the observatory in Skalnate Pleso (in the High Tatras).

During the World War II geomagnetic, seismologic and meteorological observations were carried out in Ógyalla. After the war the work in the observatory could begin in 1962 thanks to Ladislav Valach. Astronomical observations were started and the observatory for the general public was founded. As a result of the hard work the fame of the local observatory spread and it became a matter of great importance, first in the district, later in the region and finally in the whole Slovakia. In 1969 the Ógyalla observatory is the central observatory of Slovakia which coordinates professionally and methodologically the scientific , professional-observatory and popular-scientific activity of the network of Slovakian observatories.

The Ógyalla observatory starts as early as 1969 its study circle for the vocational training in astronomy, undertakes the production of school telescopes, and in 1970 the first Slovakian astronomical periodical, the *"Kozmos"* was published. The confederation of the Slovakian amateur astronomers is founded.

According to Konkoly Thege's spirit, from the very beginning of its activity the observatory pays close attention to informing the general public about the new results and knowledge in astronomy, helps those who are interested in this science and gives support to astronomical institutions. The number of these has increased from 13 to 27 in the last 20 years. Accordingly the number of astronomical clubs and circles has also increased, from 105 to more than 1100. In 1990 the number of members amounted to 18000. As examples for the popular scientific educational work of the Ógyalla center we can mention the organization of all-Slovakian professional and methodological seminars, thematic excursions and the meetings of young astronomers, even with international participation. From the foundation of the Ógyalla observatory there were altogether more than 140 thousand visitors to the planetarium, for the observation of the sky and as participants of the organizations, talks and study courses.

An important means of the technical-methodological work is the publication activity. First of all we have to mention the periodical "*Kozmos*" which has an important role internationally as well, but also the publication of books and manuals for observations and for the building of astronomical devices, astronomical maps, calendars, yearbooks, conference-booklets, photos, films and other representation material.

The observatory has a significant work in the production of technical devices. From 1969 more than 500 pieces of MDN 120 type school-telescopes have been made for schools and amateurs. There are different types of competitions concerning the problems of man's relation to science:those organized for children and youngsters on astronomy and even bordering arts (e.g. "The Universe through children's eye", "What do we know about the stars ?"), but also others requiring more profound expertness e.g. "We are looking for sundials", or "Astrophoto". Recently these events have become more and more international.

The main observation program of the Observatory is the examination of the photosphere and the chromosphere of the Sun. Within this field we perform the photographic observation and the drawing of the Sun's photosphere as well as the spectrohelioscopic observation of the solar eruptions. After appropriate reduction the results get to international data-banks and are published in foreign bulletins (e.g. Solar Geophysical Data).

In 1982 the possibilities of our section dealing with the Sun were enlarged when we got hold of a horizontal solar telescope produced by Zeiss Jena together with the Hungarian company Vilati. Now this instrument is used for the examination of the active fields in the given band of the spectrum. The solar activity is examined by the help of Dellinger-effects. The astronomers of the observatory report the results of their observations during the regularly organized Czechoslovakian solar seminars. The Ógyalla observatory is an active participant of the state basic research project. The title of the research subject is: "Astrophysical processes and the description of the dynamics of solar activity".

On the field of solar-terrestrial physics the discovery of the significant connection between the changes of the green corona and the geomagnetic storms can be considered an important result. The effect of the solar activity to the Earth's atmospheric electricity has also been mapped.

Gradually quite an amount of material has been gathered from the observatories around the word, that is being processed. On the field of solar physics we have studied the movement of magnetic and non magnetic plasmas. We have analyzed the sunspots and their photospheric surroundings according to their positions.

We have observed the local oscillations of the solar photosphere and the morphologic alteration of solar spot-groups. The aim of these works is to collect and analyze the most possible observation material. The research of the corona is connected to the expeditions of total solar eclipses, that the Observatory has already organized in 1936. The organization of recent expeditions - to Chukotka (Eastern Siberia) in 1990 and in 1991 to La Paz (Mexico, Californian Peninsula) - is the continuation of this noble tradition.

Beside the observation of the Sun we have to mention the photographing of the bolides, the observation of lunar occultations and of extraordinary astronomical events like the passage of the Mercury in front of the Sun, lunar and solar eclipses, etc.

In 1984 the professional observation of the interplanetary matter has also been revived which was aimed mostly for the visual and photographic observations of comets and asteroids. Considering the restoring work of the historical building of the Observatory, our colleagues made use of the possibilities of foreign co-operations and staying abroad. The co-operation with the Hungarian observatories is a good example for this. Thanks to the hospitality of the colleagues and especially to Béla Szeidl, director of the Konkoly Observatory in Budapest, our colleagues could discover three new asteroids which they named after important Slovakian cultural personalities. We would like to take this opportunity to express our thanks in the name of the Ógyalla observatory.

In compliance with the intellectual, professional and human inheritance of the founder of the 120 years old Ógyalla observatory we are inspired not only to preserve values but to achieve new scientific results. We continue Konkoly Thege's work.

From 1984 - after gradually putting into use the horizontal solar spectrograph, the planetary building and the further equipments - we could start the renovation of the historical building of the Observatory and the surrounding park. Our aim is to establish a well-equipped, modern astronomical working place in the light of historical importance of the Ógyalla observatory and making use of its various possibilities, a workplace which will be at the same time the technical-methodological and scientific-observatory center of the Slovakian astronomer-movement.

Konkoly Thege's oeuvre has already been valued several times in the past in different publications. On the 100th anniversary of the Ógyalla Observatory we awarded the Konkoly Thege-prize and medal to Slovakian amateur astronomers and groups who became worthy of it.

Next year, on the 150th anniversary of Dr. Konkoly Thege's birth we award the prize again and on the occasion of this anniversary we organize a seminar with international participation. In the course of this we will declare open the renewed historical building of the observatory, we will found the Konkoly Thege Miklos Society, we publish a book in commemoration of his life and work. We do this with the purpose so that the 150th anniversary of Dr. Konkoly Thege's birth and the present 120th anniversary of the foundation of the Observatory should be not only an expression of respect to Konkoly Thege's personality but first of all a new significant milestone in realizing his scientific aims and plans.

* * *

DR. MIKLÓS KONKOLY THEGE THE POLITICIAN

SAROLTA KONKOLY THEGE
Budapest

The name of Miklós Konkoly Thege is well known in the history of natural sciences as that of an outstanding astronomer and meteorologist as well as a famous sponsor of projects and foundations. He was less known as a politician, as a reformer who also made "propaganda" for the distribution of land from large feudal estates among landless peasants.

75 years after his death and on the 120th anniversary of the establishment of his Institute this paper is an attempt at portraying Miklós Konkoly Thege the "public personage". Already as a student he became distinguished for his practical sense for technology as well as for generosity.

"In 1858 Miklós Konkoly Thege, a university student aged 16, presented the physics laboratory of Pannonhalma Secondary Grammar School a few important parts of a steamship engine made by himself. The school's physicslaboratory had just begun to be equipped with new acquisitions owing to the generous efforts of Abbot Mihály Rimely and to the devoted work of Physics master Krizosston Kmess" (Komáromi Lapok, 1858)

At the age of 17 Miklós Konkoly Thege is an assistant of Professor Ányos Jedlik at the Institute of Physics, University Budapest. He receives no payment for his work which he considers a special privilege. In the same year he gives a piano concerts in Komárom for the benefit of the Calvinist Church.

At the age 19 he is working at Laboratory in Berlin. One year later (at the age of 20) already a holder of MSC and doctor's degree, he is engaged at various observatories, physics and chemistry laboratories and at workshops, in Göttingen, London, Paris and other cities doing not only theoretical work but also manufacturing precision instruments. His reward, again, is not financial but the gathering of experience and knowledge.

Parallel with his studies in natural sciences he completed his legal studies. After graduating from Faculty of Law he undertook municipial activities in one of the counties of Hungary to comply with the request of his parents. But soon he gave that up and joined a ship cruising on the River Danube. The volunteer soon became the ship's captain and in this capacity he mapped up the Vaskapu region, still "unregulated". He did this again without pecuniary reward, in order to make the depths of river bed and thus facilitate transportation of goods by ships on waterways.

In 1878 he decided to donate his private observatory to the Hungarian State. This astronomical observatory, which he equipped entirely by means of his own financial resources, was one of the most modern observatories of Europe whose other countries already possessed National Observatories. Konkoly Thege was aware of the fact that in his day and age only government financed national observatories could keep pace with the rapid development of natural sciences. This handover took a lot of time, energy and persuasion and could be the subject of another paper.

But it was certainly one of the many deeds which had proved his initiative and imagination talent for organization, and led to the Academy of Sciences recommending him to be appointed Head of the Institute of Meteorology and Geo-magnetism, in spite of the fact that he had had little to do with meteorology, with his reasonable ideas he managed to turn that Institute into one of international magnitude and renown in a short time.

In the 19th century such activities and attainments naturally led to a political "career" as well. In 1896 Miklós Konkoly Thege was elected Member of Parliament and was later requested to serve a second term in the same constituency. He had earned the respect of people, who trusted him; It was surely not expectations of benefiting from his generosity, that made him popular, as he offered his landed estate for the public good only after this second election. his first term convinced his electors about his abilities, his versatility, his patriotic feelings and his love for his people. On 10 October 1896 the Liberal Party nominated Miklós Konkoly Thege as his candidate. On 31 October 1896 Konkoly Thege was elected as a representative in Parliament.

He accepted the nomination hoping that as a "politician" he would be able to do even more for the promotion of science and industry. He wished to do something in the interest of public welfare by using the experience he had gathered as river captain, and to continue his researches in sciences, especially in astronomy.

As a member of the Public Transport Committee he made his first speech on 9 February 1897. In it he urged the allocation of higher sums to the development of "railway transport" in the annual budget. He argued with facts referring to each of the bridges in need of reconstruction he called for the expansion of the rail-road network and for the changing of the existing "zone system". He also gave new ideas concerning the modernization of dining of sheeping cars. He expressed his approval of the products of the Machine Manufacturing Company of Hungarian Railways and called for higher sums allocated in the National Budget for its development: he pointed out that this was necessary if the Company was to become selfsufficient and cover the needs of Hungarian Railways. Talking about shipping he raised the problem of Vaskapu the "Irongate", to make the lower reaches of the Danube navigable. He stressed the importance of waterways saying that shipping was in a disadvantageous position as opposed to transport by rail, these two should work together instead of competing with one another. He deplored the primitive conditions of winter ports and called for the establishment of a National Shipping Company as well as the flying of the red-white-green national flags on the ships of the Austro-Hungarian Monarchy. He accepted the Commercial budget, nevertheless he would have preferred more money allocated for this important branch of the national economy.

In the parliamentary session of 26 February 1897 he intervened for the foundation of a National Observatory, which "he had found missing from budget for many years", adding that even the development of the one he had given the nation was neglected, though all the other European countries were keen on building and equipping observatories. He insisted on astronomy having "absolutely practical purposes" and many "public benefits".

On 4 February he raised the problem of Vaskapu once more. He considered those commentators of newspapers "ignorant" who alleged that the regulation of Vaskapu would led to seagoing ships calling at Budapest. He does not see that as a threat; on the contrary he would welcome such ships especially if they were flying Hungarian flags. He set the following tasks before the nation: our waterways should be developed as they are in industrialized foreign countries; the education of the officials of the Hungarian Shipping Company should be improved. In another contribution to the debate in 1899 he called attention to the problems of the River Police: there are a lot of policemen in a lot of different places but they know very little about sailing and rescuing: "I've seen with my own eyes three policemen almost capsizing a lifeboat - he said.

Miklós Konkoly Thege was interested in arts and music too, and made valuable suggestions for improving conditions in this field: e.g. he suggests that the Opera House and the Hungarian Royal Academy of Music should belong to the Ministry of Education and Culture: music, singing and acting being arts. The Academy of Music should educate Hungarian singers for Opera House so as we should not be dependent on foreign singers most of whom are unable to cope with our language however hard they may try to learn it for many years.

In 1899 Miklós Konkoly Thege deals with the problem of transport and communication again. This he considers of greatest importance, and makes the following statement about Vaskapu-canal: " Despite its many enemies this is a successful accomplishment of human efforts admired by experts and by laymen." He puts in a word for people working in transport as well: "The welfare and happiness of guards and railroad workers must be ensured and the prestige of guards must be restored. All trains should be provided with non smoker compartments because smoke is unpleasant, and what is more, harmful for a lot of travellers."

On 5 March of the same year he rose again to spoke on the state of the Hungarian industry, quoting some words from a preciding "interpellation". "Let us built up a palace wherein peasants, craftsmen, and business men can praise God in equal well-being...". He adds to this the following statement: "... the welfare of peasant, middle and upper class people cannot be realized without the well-being of industrial workers, of manual labourers". Talking about industry and commerce he points out: "Unfortunately Hungarians prefer foreign products to home made ones. Many people think that hens abroad lay larger eggs than those at home. It often happens that Hungarian products are exported and then imported to Hungary under foreign names and tags only to sell better."

He considers it important to limit the scope of enterprises in order that small industries and enterprises can survive, and also to impose mercyless taxes upon imported goods.

To make his argument for the development of home-manufactures more poignant he ends with another statement proving his sense of humour and creating hilarity in the House: "Let those, who wish to boast about foreign things pay for them; let us prefer 'boasters' like Count Jenő Zichy is who said his tailcoat was made of wool grown of the backs of his own sheep in Gács." As so often in his parliamentary speeches he dealt with the problem of the railway again in his next interpellation. Now he calls for the rationalization of time tables for the prevention of accidents. He also made proposals for the more efficient cleaning of trains putting German Railways before his audience as an example: there the Railway Company employs people who walk around the carriages during the journey dusting the compartments, as soon as they are vacated when the train stops at different stations. He stresses again the necessity of guards and engine drivers being paid higher wages, and their number being increased: "overworked and tired people are prone to cause accidents". And, of course, he speaks again about the earliest possible extension of water traffic suggesting that a greater number of rivers should be made navigable.

His reelection for a second term by and overwhelming majority of voters indicates that he represented his county in the right way.

"On 10 August, 1901 the Liberal Party of Tata constituency held a meeting in the stateroom of Hotel Griff where Miklós Konkoly Thege, present Member of Parliament for the constituency of Tata was renominated, about which event Baron Frigyes Podmaniczky, leader of Liberal Party was informed with great enthusiasm. Miklós Konkoly Thege accepted the renomination." (Tata-Tóvárosi Hiradó, 1901.)

On 5 October 1901 Miklós Konkoly Thege was reelected by a majority of 333 votes.

As a human being Miklós Konkoly Thege was natural, polite and kind, there was no trace of rhetorics or theatricality in his speeches. He restricted himself to facts and never criticised anything without immediately giving ideas for correction. He kept repeating that science and culture belonged together, where science could progress culture would flourish and develop too. When he thought it fit, he cracked jokes.

Serving his second term of office as an MP on 10 June in 1904 he pointed out in one of his speeches: "Engine drivers are similar to meteorologists. If the latter come up with mistaken forecast they are abused by farmers, because they cannot make rain; people on holiday by the lakeside or at spas, on the other hand, blame them for rain and cold weather. Similarly, engine drivers are blamed for the train being late. Engine drivers should be paid more, and no comparisons should be made between their earnings and those of white collars workers, clerks. Engine drivers should enjoy high wages because they perform highly responsible work."

Miklós Konkoly Thege was a highly respected person, a dynamic manager of the public affairs of his constituency. The newspaper "Komáromi Lapok" documents his ingenious, practical ideas. Yet, he did not consider himself a politician, nor did his close acquaintances do so. When Jenő Gothard, a close friend of his resigned his post as director of an industrial establishment, he said jokingly to Konkoly Thege:

"I feel as comfortable and happy as you must have felt when the Prime Minister dissolved Parliament and thus you were relieved from your troubles as Member of Parliament."

Konkoly Thege quoted these words of his friend in a speech he delivered on the anniversary of the death of Gothard. We can suppose that he did not use to comment to enthusiastically on his political career. Even a family gathering "commemorated" his reluctant attitude to this side of the life of a scientist. One of his kinsman Miklós Konkoly Thege (1873 - 1949) stated in 1929:

"There was nothing he was less interested in than politics".

Yet, this great scientist did more for the welfare of his country and people than many professional politicians have ever done.

* * *

APPENDIX

Miklós Konkoly Thege's gift-deed

Ajándékozási szerződés.

~~(Tervezet.)~~

Mely egyrészről a magyar államkincstár képviseletében a vallás- és közoktatásügyi m. kir. minister, másrészről dr. Konkoly Thege Miklós miniszteri tanácsos, országgyűlési képviselő között, az ó-gyallai csillagda- és melléképületeinek, valamint ezek összes berendezésének a magyar államkincstár örök tulajdonába átbocsátása iránt köttetett.

1.) Dr. Konkoly Thege Miklós a jelen okmány aláírása napjától fogva, a magyar államkincstárnak kizárólagos és örök tulajdonjoggal odaajándékozza, a magyar államkincstár nevében pedig a vallás- és közoktatásügyi m. kir. miniszter ajándék gyanánt elfogadja az ó-gyallai 11 sz. tjkvben A I. 14 sorszám 81 hrsz. alatt felvett telken fekvő csillagda főépületet, továbbá az ahhoz tartozó melléképületeket, úgy mint 3 forgóházat, valamint a fotorefraktort és a foto-heliografot magukban foglaló épületeket kupoláikkal s a jelen okmányhoz fűzött, annak kiegészitő részét képező leltárban elősorolt összes belső műszer berendezéssel, úgy szintén összes bútorfelszereléseikkel együtt abból a célból, hogy mindezek az elősorolt épületek és berendezéseik astrofizikai observatorium gyanánt a magyar tudományosság gyakorlására és fejlesztésére szolgáljanak.

Ebből a célból az ajándékozó dr. Konkoly Thege Miklós megengedi, hogy a magyar tudományos egyetemnek csillagászattani hallgatói a jelzett épületekben és az azokban levő műszerekkel a szükséges tudományos gyakorlatokat bármikor végezhessék; és ugyancsak az említett célból az ajándékozó beleegyezik, hogy a vallás- és közoktatásügyi m. kir. miniszter az ó-gyallai csillagdát a csillagászattan, illetőleg az ezzel összefüggésben álló tudományszakok követelményeinek megfelelő újabb épületek fölállításával, vagy akár a meglevők kibővítésével és átalakításával, úgyszintén a megkívántató műszereknek bármikor leendő beszerzésével saját belátása szerint állam költségen tovább fejleszthesse.

2.) Ehhez az ajándékozáshoz azonban az ajándékozó a következő föltételeket köti ki, s viszont a magyar államkincstár nevében a vallás- és közoktatásügyi m. kir. miniszter ezeknek a feltételeknek betartására kötelezi magát:

a.) Az ó-gyallai csillagda mindenkor „Konkoly Thege Miklós alapítvány" csillagda nevet visel.

b.) Az ó-gyallai csillagda igazgatója fizetésre, vagy tiszteletdíjra való igény nélkül az ajándékozó dr. Konkoly Thege Miklós marad életfogytig, azaz mindaddig, amíg munkaereje vagy munkakedve engedi.

c.) A csillagda Ó-Gyalláról az ajándékozó életében csakis az ajándékozó beleegyezésével szállítható el máshelyre.

d.) A csillagda fő és melléképületeit, úgyszintén az ezekhez vezető, közhasználatra átengedett utakat és pavillonokat kerítéssel körülkeríteni, valamint a csillagda körül elterülő díszkert fáit megnyesni az ajándékozó életében csak az ajándékozó beleegyezésével szabad.

e.) Az ajándékozó fenntartja magának azt a jogot, hogy a saját költségén megkérdezés, vagy bejelentés nélkül bármikor és bárhová álon föl a csillag

lithasson föl a csillagdához tartozó, illetőleg annak czéljaira szolgáló épületeket, vagy helyiségeket is szerezhessen be műszereket, de viszont az ajándékozó kiköti, hogy amíg maga, vagy felesége él, a magyar államkincstár által államköltségen emelni kivánt épületek elhelyezésére szükséges terület kijelölésénél mindenkor meghallgattassék.

f.) A csillagdánál alkalmazandó hivatalnokok kinevezésénél az ajánlás jogát az ajándékozó életfogytig a maga számára tartja fönn oly értelemben, hogy minden hivatalnoki állásra három egyént hozhat javaslatba, kik közül a kinevezés joga a vallás- és közoktatásügyi m. kir. minisztert illeti.

g.) Az ajándékozó kiköti, hogy igazgató helyettessé dr. Kövesligethy Radó m. kir. egyetemi r. k. tanár neveztessék ki.

h.) A jelen ajándékozási szerződésből keletkezhető perek esetére a felek közös egyetértéssel alávetik magukat a jogügyi igazgatóság székhelyén levő, szabadon választandó sommás bíróság illetékességének.

i.) A jelen szerződésből kifolyólag felmerült bélyeg- és illetékkiadásokat, a m. kir. államkincstár vállalja magára.

A jelen szerződést a felek két példányban állították ki.

Kelt:

Előttünk:

Rónafy [illegible]
mint tanu.

Keller Károly
mint tanu.

Aláírások:

N. Konkoly Thege Miklós
miniszteri tanácsos, orsz. képviselő

34353 szám

„Elfogadom"

Budapesten 1899. évi május hó [illegible]

Wlassics

[illegible]
mint tanú

Nagy Árpád
mint tanú.