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The rise and fall of small astronomical observatories: a case study Dorpat/Tartu Observatory

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Abstract
The history of the Astronomical Observatory of Dorpat/Tartu University is outlined in terms of the activities of its most outstanding astronomers and interpreted, in particular, with allowance for some background factors. Some emphasis is laid on describing and analysing the role of Ernst Öplk, whose life and heritage has so far not been treated adequately by historians of science. The problem of preserving the treasures of the Observatory is reviewed.

Keywords: *Dorpat/Tartu Observatory, F G W. Struve, J H Mädler, E J Öplk.*

1 INTRODUCTION

Present-day scientific research is concentrating more and more at big institutions, the small ones often having become obsolete. Typically, this is the case with astronomy. Many of the small observatories which once flourished have given up astronomical research to become a museum or, in some instances, have closed. Their stories form completed chapters in the annals, and their past role and contribution to the development of ideas and instrumentation are awaiting evaluation. This article is devoted to one of those modest institutions which has changed direction.

The retrospective assessment of the heritage of the lost observatories has at least two important aspects. Firstly, if an observatory building together with its equipment and archives is still extant, its museological value can and is to be determined. Secondly, if leading astronomers happened to work there, their meaning for the history of astronomy can be best explained by identifying them with 'their' institution.

Among small astronomical observatories which functioned in the late nineteenth and the first half of the twentieth centuries, the University Observatory at Tartu (former Dorpat in the autonomous province Livonia of Tsarist Russia) presents a remarkable case. This is so because the activities of as many as three leading pioneers can be related to it. The story of Dorpat/Tartu Observatory, if told on the level of world science, can essentially be reduced to describing and evaluating the work and life of three outstanding astronomers: Friedrich Georg Wilhelm Struve (1793 Altona, Denmark – 1864 Pulkowa, Russia), Johann Heinrich Mädler (1794 Berlin, Prussia – 1874 Hannover, Prussia) and Ernst Julius Öpik (1893 Port Kunda, Province Estonia – 1985 Bangor, Northern Ireland). Each of them spent their most fertile working years (20 - 30) at Dorpat/Tartu Observatory.

Struve's and Mädler's lives, together with their contributions to science, have recently been documented after a critical revision of their respective earlier biographies (Batten, 1988; Eelsalu and Herrmann, 1985). Surprisingly, no full-scale biography has so far been devoted to Öpik [some biographical details may be found in Lindsay (1972) and Öpik (1977), Ed.]. To overcome this, we shall focus some attention to him, while we try to describe the rise and fall of Dorpat/Tartu Observatory as a university institution in broad terms with particular reference to the activities of all three astronomers.

In 1979, Kenneth Lang and Owen Gingerich published a carefully-selected collection of those articles which, to their minds, had brought about the most important changes in our understanding of astronomy, astrophysics, and cosmology (Lang and Gingerich, 1979). The collection contains 160 articles issued between 1900 and 1975; Dieter Herrmann subjected the body of references annexed to these articles to a statistical analysis (Herrmann, 1984).

From the relative frequency of the authors quoted in this collection, Herrmann deduced a list of the 24 leading astrophysicists and cosmologists of this century, or, more strictly speaking, of its first three-quarters. Since then, astronomy is becoming more and more impersonal and anonymous with every decade due to the growing importance of teamwork based upon the use of modern super-equipment such as space observatories and global interferometry. Therefore, 1975 may have been a reasonable milestone indeed.

As expected, the list includes such names as Hans Bethe, Arthur Eddington, Albert Einstein, Enrico Fermi and Fred Hoyle, all known far beyond the community of scientists. Edwin Hubble has later joined this group by means of the space telescope named after him. The remaining names are familiar at least to everyone concerned with astronomical research. Ernst J Öpik belongs to that group.

In Estonia, and probably in Northern Ireland, Öpik's name is known to a wider community since it was in those two countries that he spent most of his life and wrote the bulk of his works. His life was rather dramatic because twice he had to change his country of residence under menacing circumstances. This happened first in 1921 when he reached the newly-independent Estonia from his temporary work place in Central Asia, a region controlled by the Russian Bolsheviks. In 1944 he left Estonia hurriedly to the West together with tens of thousands of his compatriots in the face of the anticipated invasion by the Red Army.

It is interesting to note that so far nobody has attempted to draw up a full-scale biography of E J Öpik. He seems to have been a genius sometimes difficult to get along with, whose personality and philosophy can best be reconstructed without mythologization of the hero by questioning his former colleagues and critics. Öpik made a number of 'strong' emotional statements extending to expressions of "wishful thinking" recalled in some obituaries. All these should be evaluated against a balanced historical background. With every year, the number of his contemporaries diminishes, thus rendering the task of writing a critical biography more difficult.

Öpik was a prolific writer (Öpik, 1972; Astronomy and Geodesy ... ,1969; Öpik, 1989) with these lists adding up to more than 800 books, papers, articles, and short notes. The Armagh bibliography (Lindsay, 1972) is systematic, the publications being divided between 11 subject matters. Seven of these cover original astronomical research. which can be characterized by the following labels:

a) Small bodies and diffuse matter in the Solar System;
b) Major bodies of the Solar System;
c) Movements and collisions of the bodies of the Solar System;
d) Stars, interstellar medium, and stellar systems;
e) The structure and evolution of the Sun and the stars;
f) Palaeoclimatology and solar-terrestrial relationships; and
g) Cosmology, cosmogony, and astrobiology.

As we see, this classification is entirely based upon the classes of all the objects in the universe. The ideal suitability of the adopted object-bound classification to Öpik's heritage speaks of his physically, not mathematically, orientated approach to astronomy. However, since his pre-university years, he was able to adapt probability theory to the needs of meteor and, later, stellar statistics. He summed up his contribution to statistical methods in a lecture course (Öpik, n.d.).

Öpik was guided by a practical philosophy which departed from the understanding that mankind's life and future is ultimately determined by the Sun. He summed up his early studies of the nature of the Sun in a monograph written in the popular style. The book was entitled *The Sun in the Light of the Latest Investigations* and was published in Russian twice (in 1922 and 1927) and also in Estonian (1928).

Consequently, he gave clear priority to investigations into the fate of the Sun. Hence it follows that the system of Öpik's written heritage or, at least a substantial part of it, might be rearranged to assume the form of a pyramid of studies with the Sun on the top.

By the time Öpik decided to leave his homeland, he seems to have already accomplished his life's main mission. This can be explained best by resorting again to Herrmann's conclusions. After having arranged the major astronomical discoveries of the period 1900 to 1975 into a time series, he could single out six definite peaks. The 1938-1942 peak was clearly identifiable with the time span where the internal nature of the stars, in particular that of the Sun, was explained in terms of nuclear reactions. From among the leading 20, H A Bethe, G Gamow, and E Öpik (together with C F Freiherr, C F v Weizsäcker, and R Oppenheimer) were the independent main contributors to that major breakthrough in astrophysics, as well as in physical science as a whole.

Öpik published his investigations into stellar structure, energy sources, and evolution in the publication series of the Tartu University Astronomical Observatory. Obtaining access to prestigious international journals seems not have been a priority for him, while at Tartu unlimited publishing space was available to him.

Although Öpik was not unknown to some circles in the English-speaking community since his participation in the 1928 General Assembly of the International Astronomical Union in Leyden, and his stay at Harvard as visiting lecturer and research associate between 1930 and 1934, it took a long time for him to make his mark in that community.

It is noticeable that the forerunner of Lang's and Gingerich's *Source Book* published by H Shapley in Harvard as late as 1960 still ignored Öpik (Shapley, 1960). There may have been political deliberations behind that. Indeed, Öpik's fiercely anticommunist attitude was, without doubt, known to Shapley, until 1952 Head of Harvard University Observatory [Shapley's politics were regarded as left wing by his contemporaries and compatriots and he advocated a more co-operative attitude towards the Soviet Union at the beginning of the Cold War period. Ed.].

If Öplk had stayed at Tartu, instead of fleeing to the West, he probably would have remained a somewhat exotic figure for the western astronomers. Already in 1932, he had declined an offer by Shapley for a permanent professorship in Harvard. So, paradoxically, Öpik's *bête noire*, the Soviets, rendered him a service by forcing him to emigrate, which eventually brought him out of the provincial dullness. On the other hand, between the two World Wars Öpik saved the sinking renown of Tartu Observatory, above all as the main contributor to the its Publications and the only member of the International Astronomical Union from Estonia. At Tartu he conducted astronomical classes, where a new generation of astrophysicists were trained. These were capable of taking over after Öpik had left. Nevertheless, after his departure the Observatory fell back to almost obscurity, where it had remained for a long time before him. The eclipse of Dorpat Observatory began in the 1870s with its failure to carry out the measurement of the Dorpat zone of the prestigious astrometric general catalogue of the Astronomische Gesellschaft.

Paradoxically again, at Tartu Öpik was not the Observatory's Director, a post coupled with a professorship, but carried only the observer's modest title. It has been argued that a directorship would not have suited his character anyhow. His merits were yet recognized by the Estonian State in 1938, when, together with a dozen of other leading scientists, he was invited to create the (unfortunately short-lived) Estonian Academy of Sciences.

The old Dorpat University, closed in 1710 and refounded in 1802 as a German language institution, built its Astronomical Observatory (Figure 1) at the beginning of the 1810s. The famous founder of the Struve astronomical dynasty and an alumnus of

Figure 1. The Tartu Observatory, *circa* 1825. (Courtesy of Tartu Observatory.)

Dorpat University F G W Struve (Figure 2) was charged with equipping and running it. In the early 1820s it was turned into the centre for training the Russian Imperial Army and Navy officers in the matters of geodesy and cartography (Dick and Eelsalu, 1996).

The quick rise of the Observatory is attributed, on the one hand, to Struve's extraordinary scientific and diplomatic abilities and, on the other hand, to the military experience gathered by the Tsar and his supreme military command. Obviously, the 1812 war against Napoleon together with campaigns in Central Asia and elsewhere showed the importance of military optics as well as all kinds of instruments for and skills in mapping and topographic positioning. In Struve, the Tsar's Headquarters discovered a man who could be trusted with training the officer corps in those matters.

When returning from the 1814/1815 Vienna Conference, the Tsar, Alexander I, and his wife visited Munich, famous for its optical workshops. These were inspected by the Empress, a German by birth[1]. In 1824, the Observatory, generously financed by the Tsar, was equipped with an achromatic and equatorially-mounted refracting telescope produced by J v Fraunhofer in his Munich workshop to become the largest and most modern instrument of its kind at that time (Sang, 1987). A year later, Fraunhofer provided his telescope with an excellent ocular micrometer.

However, in the early 1830s the Imperial St. Petersburg Academy of Sciences decided to establish a central astronomical observatory. Struve together with his colleagues chose the Pulkowa (Pulkovo) hill to become its site. This decision implied moving the officers' training centre closer to the capital St. Petersburg. In Pulkowa, Struve seized opportunities to strengthen his collaboration with the Imperial Headquarters. Notably one of Struve's earliest pupils F W R v Berg (1794 Sagnitz, Livonia – 1874 St Petersburg), later a Count, a Field Marshal, Chief of the Tsar's Headquarters and his vice ruler in Poland and Finland, became his close friend and a vigorous promoter of his geodetic activities (Dick and Eelsalu, 1996).

Beginning with the 1840s, Dorpat Observatory became inevitably eclipsed by the Imperial Main Observatory at Pulkowa and was doomed to provinciality. After having shuttled between Dorpat and St. Petersburg for almost a decade, Struve left Dorpat definitely in 1839 together with his lieutenants. He did so without having secured a successor to himself. The University succeeded in reviving the activities of its Observatory a year later when J H Mädler (Figure 3) agreed to take it over. In the late 1830s he had become world renown as a selenographer in Berlin, where he, together with W Beer the owner of a private observatory, had published a full set of extremely accurate maps of the moon (Maurer, 1999).

Figure 2. Friedrich Georg Wilhelm Struve. (Courtesy of Tartu Observatory.)

Mädler succeeded in slowing down the decline of the Observatory for a quarter of a century. Like Struve, he made micrometric measurements of double stars and planets with the Fraunhofer telescope (Figure 4). However, his greatest service to Dorpat University is to be seen in his literary campaign of making Dorpat Observatory known all over Europe. He not only published a considerable number of astronomical books, but also flooded the major German language journals with hundreds of his writings about astronomy and Dorpat's contribution to this science (Eelsalu and Herrmann, 1985; Eelsalu, 1999).

Did Struve and Mädler also belong to the leading astronomers of their time as Öpik did? No comparable investigation seems to be available. The list of the prominent astronomers of the 1800s drawn up by F. Kempf (1911) includes some 50 of their contemporaries. A comparison of those with the name index of

Figure 3. Johan Heinrich Mädler. (Courtesy of Tartu Observatory.)

D B Herrmann's (1975) authoritative review of 19th century astronomy shows that a few names do not appear in the latter book at all, while most of the others are mentioned less frequently than Struve and Mädler. Although Mädler's achievements in selenography were performed earlier in Berlin, in Dorpat he laid the foundations of what became later known as stellar dynamics. Struve had accomplished his fundamental investigations into double star astronomy and stellar parallaxes with the Fraunhofer micrometer before leaving Dorpat for Pulkowa.

Struve's and Mädler's visions of the role of Dorpat Observatory differed radically. Wilhelm Struve and his son (and successor in Pulkowa) Otto were of the opinion that Dorpat's decline was caused above all by Mädler's inability to use the Observatory's potential properly and they successfully tried to discredit him (Eelsalu and Herrmann, 1985). Their clumsy pressure upon Mädler's successors, loyal to them, to revert to positional astronomy, was a failure, as mentioned above. Their conservatism later led them even to a clash with their Swedish speaking colleagues in Pulkowa, who had arrived there with a different philosophy and who later took Pulkowa over (Krisciunas, 1984). A similar ideological conflict later flared up in Babelsberg Observatory presided over by Herrmann Struve, a grandson of Wilhelm Struve working in Germany (Dick, 1997).

The successful attempt by Struve to demonstrate the possibility of measuring relative parallaxes of stars remained the culmination point for the whole history of

Dorpat/Tartu Observatory. No serious astronomical history can avoid mentioning this milestone in astronomy. Yet the parallax story, above all the problem of how the priority in that achievement should be shared between Struve, and F W Bessel in Königsberg, who both accomplished the same task almost simultaneously, seems to have become more or less exhausted only recently after the publication by W R Dick (1988) of their correspondence about that matter. One inevitably has to agree with A H Batten (1991), who says "Although at least one of the earlier measurements (Bessel's on 61 Cygni) was partly or entirely stimulated by Struve's work, the time was ripe, the instruments were available and someone would have succeeded at about that time." This is true all the more so because by that time more than one type of exact instruments were elaborated; while Struve used an ocular micrometer, Bessel resorted to a so-called heliometer consisting of two half-lenses mutually shifted by a micrometric screw.

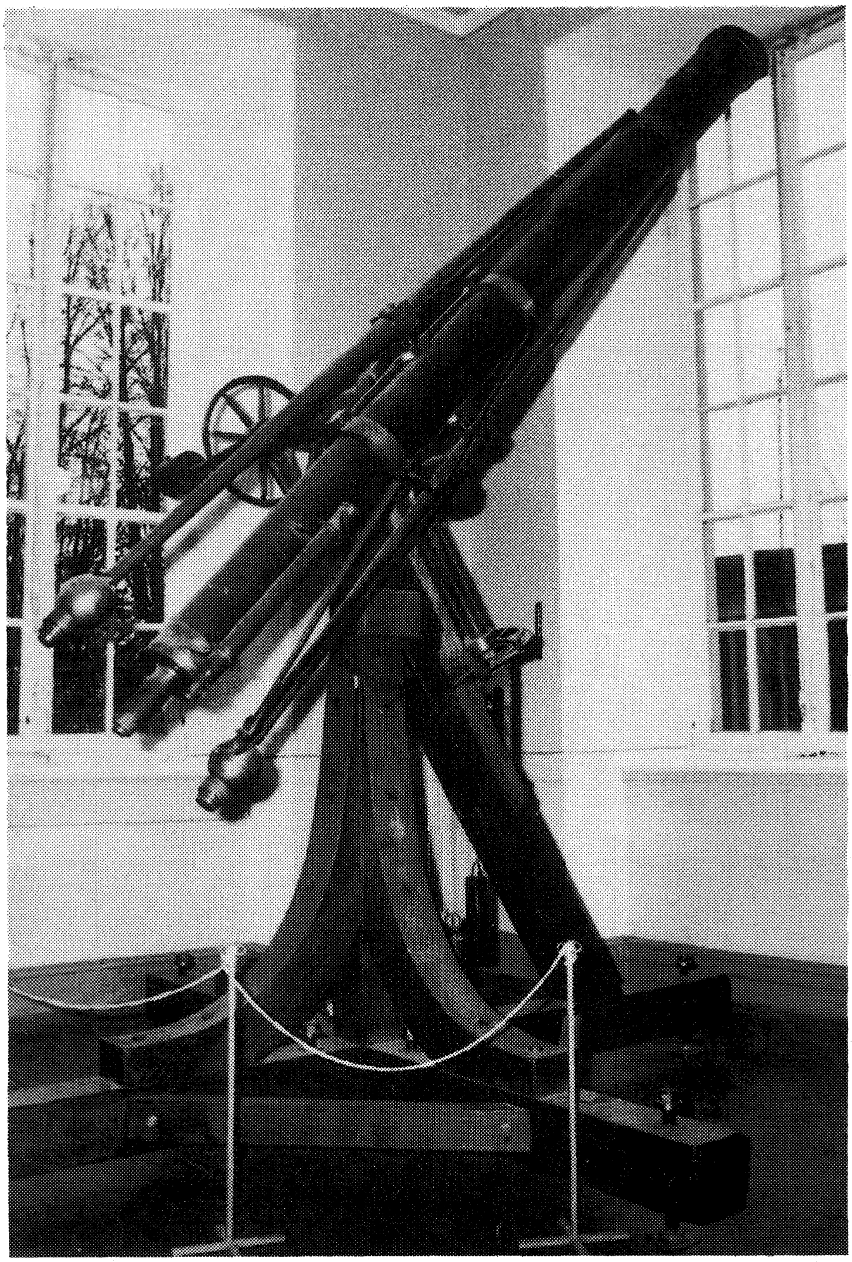

Figure 4. The 9-inch Fraunhofer refractor. Courtesy of Tartu Observatory.)

Later in the 1800s, astronomical activities at Tartu came to almost standstill due to the outdated equipment, while the Observatory became the ground of considerable geodetical and seismological undertakings. In the 1860s, the Tsarist central authorities gradually started to introduce a new policy line in respect of the Baltic Provinces with the aim of reducing their domination by the Baltic German elements. The German-speaking Dorpat University was chronically under-financed because it staunchly resisted the russification by sticking to its (outdated) autonomy (Siilivask, 1985).[2] In the 1890s the resistance was broken and the German-speaking professors were ousted. Among others, W Struve's grandson Ludwig, who held at Dorpat the observer's post and was expected to assume the directorship, had to go. These steps were reminiscent of the purge in Pulkowa, where W Struve's son Otto was forced to leave together with the German-speaking part of his staff.

The russification was accompanied by an improvement in the financing of the University. A project for reconstructing the Observatory was proposed and subsequently approved by the State (Traat, n.d.). The work was to begin in 1915. Unfortunately, World War I forced the University to shelve its ambitious projects. However, already in 1911 it had received a Zeiss refracting telescope coupled with a Petzval-type wide-field camera. It was in the 1920s that Öpik made a long series of micrometric double star measurements with this telescope, so reviving the tradition of his distant forerunners.

In 1938, Öpik submitted to the Estonian Academy of Sciences not only a list of his papers (Öpik, 1989), but also his curriculum vitae including a classification of his printed scientific production since 1912 (Akadeemik Ernst Julius Öpik, 1988). Although the bulk of his papers belongs to his Tartu period begun with 1922, some are to be associated with his four-year stay in Harvard. The following is a translation of this classification outlining Öpik's contribution to the Tartu Observatory in an abbreviated and slightly-modified form:

1. Telescopic observations of planets, 1912-1937, 43 pp.;
2. Observations of meteors and the treatment of observations, 1913-1937, 444 pp.;
3. Meteor physics, meteor craters, meteor flight dynamics, 1916-1937, 160 pp.;
4. Visual and photographic photometry, etc., 1912- 1935, 258 pp.;
5. Theoretical photometry and spectrophotometry, photometric catalogues, stellar colour parallaxes, brightness distribution on the planets' and the Sun's disc, 1914- 1931, 346 pp.;
6. Measurements of double stars, determinations of positions of comets, observations of solar eclipses, etc., 1914- 1932. 99 pp.;
7. Determination of stellar spectroscopic parallaxes, 1931-1932, 76 pp.;
8. Star counts from copies of Carte du ciel maps, 1924-1933, 223 pp.;
9. Stellar statistics, 1922-1933, 348 pp.; and
10. Theoretical astrophysics: densities of double stars, distances to spiral nebulae, dust dynamics, stellar interiors, subatomic energy sources stellar evolution differences in chemical composition of stellar atmospheres, 1915-1938, 274 pp.

The list deserves at least the following comments:

(i) Works classified under Items 1 and 7 were performed entirely outside Tartu;
(ii) Most of the Items were initiated before Öpik's return from Russia;
(iii) Item 8 representing the use of one particular method of stellar statistics need not be separated from Item 9;
(iv) Item 10 is to be split into two separate items because the distances to spiral nebulae and galactic dust concern dynamics of stellar systems, while the rest deals with stellar physics;
(v) Those works which secured to Öpik a place among the leading 20 in the above sense belong to Item 10 or, rather, to its stellar and solar part;
(vi) While the Armagh classification of Öpik's printed heritage, discussed at the beginning of this paper, was object-bound, Öpik's own classification was method-bound, so that it is not easy to juxtapose the two; and
(vii) One notices that the theoretical tools used by Öpik did not include quantum mechanics.

As already pointed out, Struve succeeded because of his skilful co-operation with the Tsarist military authorities. Öpik attempted to proceed similarly, although on a scale commensurable with the small dimensions of the Republic of Estonia and its defence forces. As a patriot, Öpik joined the paramilitary Defence League after the abortive Komintern-led bloody Communist coup in 1924, where he was put in charge of the local anti-chemical unit. Öpik as schoolboy had used the facilities of his gymnasium (secondary school) at Reval/Tallinn) to make lots of chemical experiments.

Öpik's research relevant to defence forces brought him grants, which he could also use for astronomical research. Defence against gas warfare required knowledge of the evaporation properties of liquids, as well of the evaporation conditions and turbulence parameters of poisonous gas clouds. Öpik had encountered evaporation problems in his research of meteor flight in the atmosphere. His investigations into defence problems can be illustrated by quoting an extract from a letter which he sent in 1938 to a Canadian scientist. The extract goes as follows:

> ... your reprint: 'Evaporation from Free Water Surfaces' ... is of considerable value from the standpoint of defence in chemical warfare, a question which perhaps is of more vital interest to us than to the Dominion of Canada.
>
> As to my Universal Hand Anemometer and my pamphlet referring to the diffusion of gas clouds, the subject is indeed intimately related to your problem. I have a more extensive manuscript 'On the Diffusion of Gas Clouds', where I treat the subject theoretically, and which I never intend to publish; a copy of it has been sent to the Chemical Warfare Service, London, at their request. (Eelsalu, 1988)

In 1967, Öpik (Figure 5) recalled his pre-war defence research in a memoir (Öpik. 1967).

The fierce battles of 1944 miraculously saved the building of the Observatory as it had been the case with the battle of 1941, when the Red Army was driven out. Unfortunately, the looting accompanying the chaos caused considerable damage to the collection of old instruments. The Soviet style science left for the universities only a secondary role. That style copied and refined the Tsarist tradition of centralized science. In pre-revolutionary Russia science was dominated by the St. Petersburg Academy. In particular, its Pulkowa Observatory had initially been given a supervisory status over all the astronomical institutions (e.g. see Krisciunas, 1984) In practice, as Mädler once recalled, this role turned out to be inapplicable (Eelsalu and Herrmann, 1985). Yet in the Soviet Union, the Astronomical Council of the Soviet Academy of Sciences achieved this goal. The Academy, as an instrument of a totalitarian state, carried out its control through the puppet academies created in the so-called Soviet Republics, the Soviet Estonia included, while the universities were degraded, except that of Moscow. In 1948, the newly-founded Academy of Sciences of the Estonian SSR. took over the premises and inventory of the University Observatory, which thereby ceased to exist as such.

After having recruited a number of astrophysicists, among them a few disciples of Öpik, the Soviet Estonian Academy, strongly backed by the USSR Astronomical Council, built its own observatory outside Tartu in the early 1960s. The choice of the site was inspired by Öpik's pre-war search for a future observatory. A pretext for the rebirth of observational astronomy was found in the launching of the Soviet Earth satellites and their eventual telescopic monitoring for military purposes. As a propagandistic argument for achieving an approval to build the Academy's observatory, a Struve-myth was created and his name assigned to it, while, of course, Öpik's name was a taboo at that time. Now the trends have reversed since attempts are made to mythologize Öpik in the interests of national pride (e.g. Jõveer, 1993).

While the Academy used the premises of the old Observatory as a springboard to its own observatory, its historical instrument collection, library, and archives were

Figure 5. Ernst Julius Öpik. (Courtesy of Tartu Observatory.)

neglected. The first step in dissipating its treasures began in the 1960s with the transfer of its library to the Academy's observatory. The story of how the partially unsuccessful fight for appraising and saving the treasures went on until the end of the 1980s has already been told (Eelsalu, 1991).

At the beginning of the 1990s, the present writer launched an international campaign for overhauling the Big Fraunhofer Telescope. The operation was successful thanks to support from abroad (Eelsalu, 1994; Ruusalepp and Pehk, 1994). The completion of the repair coincided with an international conference in 1993 at Tartu devoted to Struve's and Mädler's bicentenary and Öpik's centenary (Geodeet, 1994). The conference produced two resolutions to the effect of (a) ensuring the future of the Big Refractor and (b) preserving all the relics of the Meridian Arc Measurement from the Arctic to the Danube 1818-1848, including the building of Tartu Observatory. The latter resolution, proposed by Finnish geodesists and later submitted by A H Batten to the 1994 General Assembly of the International Astronomical Union in The Hague, was passed there, but, apparently, has so far remained ineffective.[3]

A heavy blow to the efforts of preserving the treasures of the Observatory was caused by the disorderly return of the building of the Observatory to the University in 1996 without any stock-taking or agreement between the University and the Academy's observatory about the future of the treasures. The interests of Tartu City Museum, which earlier had contributed to the preservation of the inventory, were ignored altogether. The University has expressed no desire to preserve the treasures as a museum. The library and the archives have been dissipated further, and. the same fate may be eventually shared by the minor instruments. There seems to be no certainty about the whereabouts of, for example, such documents as Struve's travel report of 1820 (Raudsepp, 1987), his MS of *Mensurae micrometricae* (Eelsalu, 1987), or Öpik's personal files (Jõeveer, 1987).

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NOTES

1 Tsar Alexander's short visit to Munich is mentioned on page 336 of his biography: Russkii biograficheskii slovarj, vol. 1, St-Petersburg, 1896 (in Russian). In a private communication to the present author, Mr Rolf Riekher has called his attention to Joseph v. Utzschneider's diary, who was in charge of the Munich workshops at that time. According to the diary, quoted by Mr Riekher, the workshops were visited only by the Empress Luise Marie, while the Tsar himself had given up his plans to drop in on Munich on his way back from Vienna.

2 V K Abalakin (in his introduction to the Russian language review book "150 years of Pulkovo Observatory", Leningrad, 1989) recalls that the Tsar quadrupled the budget of Dorpat Observatory in connection with his order to start erecting Pulkovo Observatory. From V Lewitzky's monograph "Astronomers of Yuryev University 1802-1894" (Yuryev, i.e. Dorpat, 1899, in Russian) one gets the impression that Struve used this money mainly in the interests of his Meridian Arc Project. At the same time Struve replaced his order to the instrument-maker Repsold in Hamburg for a new meridian circle for Dorpat by a similar order for Pulkovo.

3 As a result of the 1993 conference, the Director of Armagh Observatory together with E Öpik's son, Uno, arranged the transfer of a photocopied set of Öpik's writings to Tartu. The set, bearing the title *The Collected Works of Ernst Julius Öpik*, had originally been produced in Armagh between 1983 and 1985. It consists of the following volumes:

Vol. 1, 1912-1921, 145 pp.;	Vol. 5, 1960-1969, 979 pp.;
Vol. 2, 1920-1929, 645 pp.;	Vol. 6, 1970-1980, 664 pp.;
Vol. 3, 1930-1949, 591 pp.;	Supplement, 1910-1976, 259 pp.
Vol. 4, 1950-1959, 915 pp.;	

The collection contains neither the copies of the two Russian editions of the above-mentioned monographs "The Sun ..." nor the posthumous editions of Öpik's writings in Estonia.

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