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F. G. W. Struve & Imperial Russian Astronomy

by

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Imperial Russian Astronomy

The Great Refractors of Dorpat and Pulkovo

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Besides the Author's footnotes, end-notes by the Publisher (whose shortcomings are not the Author's responsibility) are denoted by bracketted in-text references, using the astronomer's Sun-symbol:

Figure 1: F. G. W. Struve: the German emigre who — through diligence, inspiration, and flexibility — rose to become the leading 19th century astronomer of the Russian Empire. Looking justly proud. And warmly attired.

Romantic Russia Leading
the World in High Empirical Astronomy

M. Meo

A Struve

A1 Friedrich Georg Wilhelm Struve (1793-1864) is best known today as one of the first to measure stellar parallax. He was also the founder and 1st director of Pulkovo [or Pulkowa] Observatory. the largest astronomical observatory in the world at the time — centered on a refracting telescope of 15″.0 aperture [⊙1], and the director of the longest — and still useful — measurement[1] of a meridian arc of the Earth. The acknowledged founder of modern double-star[2] astronomy [⊙2], with 3 published catalogs still in use, he first raised the hypothesis of absorption of light by dust in astronomy. Although born in Germany, he emigrated at the age of 15, and became by far the greatest Russian astronomer of the 19th century. His life & work are described, in English, in Alan H.Batten's 1988 biography of him and his son, the 1st two directors of Pulkovo.[3] In the preface to that work, Dr Batten laments that he was unable to obtain access, in part through linguistic limitations, but also because of the small numbers produced of the 1964 Russian language biography by Zinaida Novokshanova-Sokolovskaia,[4] translated sections of which Batten thanks the writer of these lines for providing. Both of these works made significant contributions to the history of astronomy of the 19th century, and compare well to works published since; this review seeks to sketch the current state of Struve studies, starting with the best biography.

A2 Director of the Dominion Astrophysical Observatory in Victoria, British Columbia, at the time of publication of his Struve biography, Batten not only provides a biographical treatment of Struve's life course and that of his astronomer son, but also gives a circumstantial analysis of Struve's measurements of double stars, quoting extensively from his published surveys of them, on occasion translating from the Latin in order to do so. His acquaintance with the discipline enables him to provide, among other instructive materials, a 2-page (pp.54-55) graphical comparison of Struve's measurements of the positions of the double star 70 Ophiuchi with those of succeeding astronomers, down to 1987, displaying a near-perfect concordance. Each item of Struve's considerable body of astronomical research is carefully evaluated by Batten, providing the reader context available in no other source. I'll have plenty to say below about the minor shortcomings of Batten's work, but it sets a high bar, both for balanced assessment of Struve's astronomical research and geodetic accomplishment, and for recounting the career of an industrious German immigrant.

A3 A complete English translation of Sokolovskaia's pioneering study has since been completed and privately published;[5] for her part, she embeds Struve's career within the

[1] See V. B. Kapsiug *et al*, "Struve's arc of the meridian agrees with first GPS results," *Zeitschrift für Vermessungswesen*, Dec. 1996, *121*:572-576.

[2] Not only does Paul Couteau, in *Ces astronomes fous du ciel, ou l'histoire de l'observation des étoiles doubles*, La Calade, Édisud, 1988, make the claim, but he also counts F. G. W. Struve as "the founder of equatorial astronomy" (that is, he mastered and explained the use of equatorial mounts — among a variety of contributions to improvements in instrumentation). [Translations from French, German, and Russian are my own, unless otherwise specified.]

[3] See Alan H. Batten, *Resolute and Undertaking Characters: the Lives of Wilhelm and Otto Struve*, D. Reidel Publishing, *Astrophysics and Space Sciences Library*, Vol. 139, 1988, 259 pp.

[4] *Vasilii Yakovlevich Struve*, Moscow, *Izdatel'stvo "Nauka"*, 1964, 295 pp. When citing this work, I will be referring to page numbers in the English translation, not the Russian language original.

[5] *F. G. W. Struve*, by Novokshanova-Sokolovskaya, trans. M. Meo, Portland, Oregon, Selbstgedruckt, 2017, 388 pp. M. Meo is also translator of *Karl Marx's Mathematical Manuscripts*, London, NYC, 1983, 248 pp.

astronomical community of the Russian Empire. Fittingly, she subsequently served for many years as Secretary of the Institute for the History of Science and Technology of the Soviet Academy of Sciences (and kindly provided me with updates of its published scientific biographies). The translation offers not only a rendering of Sokolovskaia's account into English, but surveys the current Russian-language sources for background on the academic and disciplinary connexions which assisted and tempered Struve's work.

A4 Both biographies develop the same career path for their subject: born in 1793 in the German-speaking but Danish subject province of Holstein, Struve emigrated to the university town of Dorpat located in the Russian province of Estonia, on the shore of the Baltic, in order to escape [⊙3] forcible impressment into Napoleon's army. Having completed studies in the classical languages of Latin & Greek, Struve then successfully studied astronomy and assumed control of the university observatory in 1813. He succeeded in persuading his bosses to install the largest refracting telescope in the world, with an expertly designed achromat objective of aperture 9″.5. Subsequently, in 1827, 1837, and 1852, he published 3 massive catalogs of double stars, thousands of which he had discovered himself; the first of these won the prestigious Gold Medal of the Royal Astronomical Society of London, and in the preface to the 2nd he published a preliminary finding for the 1st relatively accurate measure of stellar parallax. While carrying a full course of teaching at the university, Struve also conducted during each summer triangulations in order to obtain a precise meridian measurement running in a north-south direction through Dorpat. In 1830 Struve convinced (§I2, below) the Russian tsar to build an up-to-date, comprehensively equipped Central Astronomical Observatory for the Russian Empire, one which the U. S. astronomer Benjamin Apthorp Gould described as "the astronomical capital of the world". Pulkovo Observatory conducted extensive investigations of refraction, precession, nutation, aberration, and — of course — parallactic displacements of nearby stars, in addition to the cataloging of stellar positions. Struve's final original work gave for the 1st time an evidentiary argument for the existence of stellar absorption, extinction of starlight as it passes through interstellar dust.[6]

A5 Historically speaking, the finding of stellar parallax was a significant step in the development of astronomy, not only for the confirmation of the Aristarchan [⊙5] & Copernican world view, but also for its contribution to the cosmological distance ladder.[7] Accounts of its detection agree that, with Bessel's measurement of 61 Cygni, almost simultaneous [⊙6] with Struve's measure of α Lyrae (Vega), the refracting telescope demonstrated its dominance of precision astrometry. The quite different but highly complementary biographies of Batten and Sokolovskaia confirm the fact that these were accomplishments of what Allan Chapman calls "the astronomical revolution":[8] that is, the replacement of British techno-

[6] A concise, accessible discussion of Struve's contribution appears in Chapter 5 of Leila Belkora, *Minding the Heavens. The Story of Our Discovery of the Milky Way*, Bristol, Institute of Physics Publishing, 2003, pp.120-164. Although she provides a biographical account, and describes the Bessel-Struve friendly competition to be the first to detect stellar parallax, from her perspective Struve's most important contribution was his discussion, in his 1847 *Études d'astronomie stellaire*, of the structure of the Milky Way galaxy.

[7] An authoritative, if somewhat dated, treatment is Michael Rowan-Robinson, *The Cosmological Distance Ladder*, NYC, W. H. Freeman and Co., 1985, 355 pp. Recent discussions of the "crisis in cosmology" revolve around exactly this question, the reliability of distance measures, beginning with parallax. Stellar parallax constitutes direct observational proof of the motion of the earth around the Sun, and the failure to detect it, despite extensive effort, had been a strong argument in favor of the immobility of the earth in antiquity, and even as late as the 16th century and [⊙4] into the early 19th.

[8] Allan Chapman, "The astronomical revolution," Chapter 3 (pp.34-77) in John Fauvel, Raymond Flood, and Robin Wilson, eds., *Möbius and his band: Mathematics and Astronomy in Nineteenth-century Germany*, NYC, Oxford University Press, 1993. See also Klaus Dieter Herbst, "Das Wechselverhältnis von Astronomie und Maschinenbau, dargestellt am Beispiel des Werkens von Georg von Reichenbach," *NTM. Schriftenreihe für Geschichte der Naturwissenschaften, Technik, und Medizin*, 1991, *28*(1):61-72, for more technical detail, particularly on the German advance in the manufacture

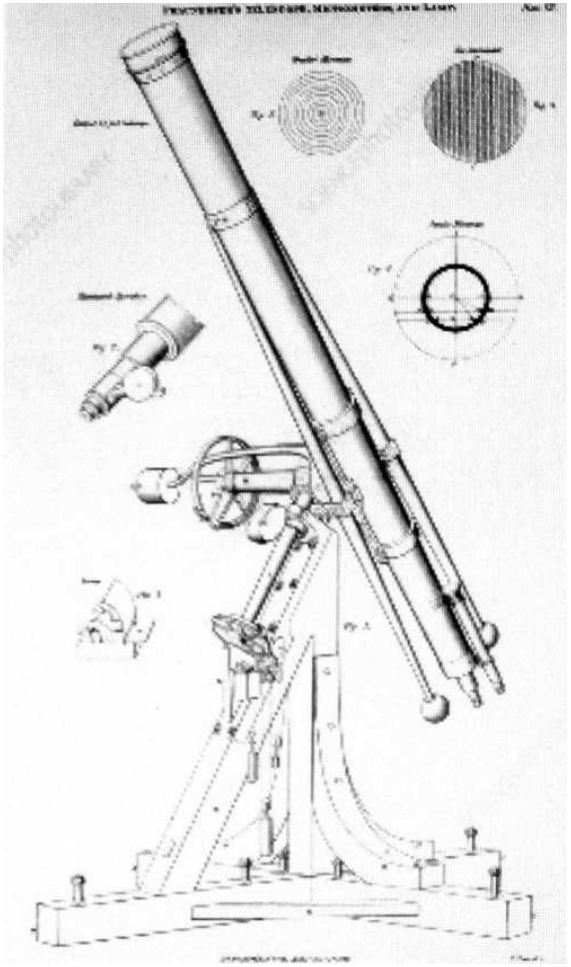

Figure 2: The Great Dorpat Refractor. Designed & produced by the German firm, Reichenbach. Armed with a Fraunhofer objective lens of unequalled achromatic quality, $9''.5$ in diameter, this was the largest refracting telescope in the world 1824-1829. Shares with Bessel's split-lens apparatus — also constructed by Fraunhofer — the honor of 1st detecting stellar parallax.
Latitude $58^\circ 22' 47''$N.
Longitude $26^\circ 43' 18''$E.
Altitude 67m.

logical supremacy in astronomical instrumentation by the German achromatic refractor, set upon a German equatorial-mount, called "the Fraunhofer mount" by contemporaries. Looking beyond the issue of the history of development of specific instruments, however, or that of advances in the empirical basis of the discipline, and addressing the community of scholars within which Struve accomplished and to which he contributed so much, there is an aspect of the history which neither biography emphasizes: he was successful in adapting to a Romantic environment, and skilled in maneuvering within it, while retaining a strictly empirical focus. This observatory director who had the largest refractor in the world entrusted to him *twice* — in 1824 and again in 1839 — this surveyor of the exact measure of the longest meridian-arc ever measured: he was to a large extent an entrepreneur of science to a Romantic audience.[9]

A6 As Batten indicates (he devotes a chapter of the book in question) the existence of stellar parallax, and with it the distance to the nearest stars, was subjected to considerable attention by the English Astronomer Royal James Bradley, who instead of stellar parallax discovered in 1728 the larger and more uniform effect, stellar aberration[10] [⊙7]. The German-born British astronomer William Herschel (from 1782 "the King's Astronomer" following his 1781 discovery of Uranus, the 1st new planet known since antiquity) continued the search for stellar parallax, cataloging some 500 double stars in the process [⊙8]. "Wilhelm [Struve] followed Herschel's pioneer efforts, and he became one of those who succeeded where Herschel and Bradley had failed, the measurement of stellar parallax."[11] — Batten's clear and judicious explanation of the problems important to 19th century astronomy and the instruments with which they were addressed makes his work the most accessible in the Struve literature.

A7 Where the determination of stellar parallax concerned an elite group of astronomical researchers with precious astronomical instruments at their disposal, the study of comets was an altogether different endeavor. Popular interest was high, both among what the historian of comet lore Sara Genuth calls "the subordinate class" and the elite.[12] A small

of precisely machined screws.

[9] In place of my attempting (and very likely failing) to provide an exact definition of Romanticism, given the massive literature on the subject, I limit myself to saying that Romantic attitudes toward the science of astronomy — that it suggested mystery, unattainable profundity, and a sort of trace of the divine — was common in Struve's day, both in Germany and in Russia.

[10] The velocity of the motion of the earth, alternately added to and subtracted from the light from stars, produces aberration, uniform for all stars; the displacement of the image of a star from the opposite points of view of an earth orbiting the Sun, greater for near stars than more distant ones, is stellar parallax. Stellar aberration is a direct proof of the finite speed of light; stellar parallax is a direct observation of the definite distance to a particular star.

[11] Batten, *op. cit.*, p.26. Astronomers call any pair of stars optically close to one another "'double stars"; Herschel's continued observations showed that virtually all the stars he had identified as doubles were gravitationally bound to one another. For the purpose of measuring stellar parallax, what is wanted is a pair that are optically double, with one much more distant than the other. In that pair, the closer one will appear to move with respect to the other as the earth orbits the Sun. Almost all double stars are physical rather than optical doubles.

[12] Sara Schechner Genuth, *Comets, Popular Culture, and the Birth of Modern Cosmology*, Princeton, Princeton University Press, 1997, 365 pp. This chimera of a book, which explicates at length the popular conceptions of comets that became important to 17th and 18th century astronomers, yet provides little to no account of its decline in significance to astronomers, does indeed establish beyond cavil the widespread significance attributed to the lore of comets in the last half of the 18th century. If we look at the western side of the Atlantic, we may note that Harvard College laid plans to build an astronomical observatory in 1806 and 1815, but both attempts failed, as did an unsolicited pledge in 1823 from alumnus (and then U. S. Secretary of State) John Quincy Adams of $1000 toward a college observatory. Only the stimulus of the Comet of 1843 moved the leading philanthropists of Boston to subscribe sufficient funds for the founding of the observatory. Bessie Zaban Jones and Lyle Gifford Boyd, *The Harvard College Observatory, The First Four Directorships, 1839-1919*, Cambridge, Harvard University Press, 1971, pp.48-71. The telescope purchased with the Boston subscription was

telescope of good quality and assiduous observation was all that was required for discovery. The identification and orbital calculation of comets lay at the origin not only of Struve's astronomical studies but also those of a wide selection, indeed a likely majority of early 19th century astronomers. Herschel's sister Caroline won public recognition in her lifetime solely for her discovery of 8 comets, despite the range of her other contributions to astronomy.[13]

A8 The fact that Struve was inspired by comets early in his youth appears in Batten,[14] and it aligns with the fact that Freiherr Franz Xaver von Zach and Friedrich Wilhelm Bessel, both older contemporaries of his, with whom he consulted and conferred, also testified to youthful enthusiasm for astronomy awakened by comets.[15] Historically, observation of comets with small telescopes became more popular in the first decade of the 19th century than ever before or since.[16] Although elite opinion had begun in Britain to dismiss the value of comet observations,[17] that was by no means the case in the Russian Empire, to which Struve emigrated in the summer of 1808, shortly after escaping impressment into Napoleonic armed service.[18]

A9 An instructive example is his treatment of the Great Comet of 1811. Struve's own professor of astronomy at Dorpat University, Johann Sigismund Huth, was too incapacitated by illness to exercise directorship of the newly constructed university observatory, but he made an exception for that famous & brilliant comet. Already well-known for his previous career in Germany as discoverer of comets — he was awarded a gold medal by the Berlin Observatory for his 4 discoveries — Huth made a formal report to the St.Petersburg Academy (of which he was not a member),[19] and he gave as his witnesses to the 4 specified observations his assistant Georg Paucker (of whom more anon: §§B7&E), David Hieronymus Grindel, and (§B) the university rector and professor of physics Georg Friedrich Parrot.[20] Clearly the addition of known professorial witnesses was intended to increase the credibility of the report; indeed, it not only appeared in Johann Elert Bode's *Astronomische Jahrbuch für 1811*, but a complimentary notice of Huth's observations had already been published in a letter to the *Intelligenzblatt der Jenaischen Allgemeinen Literatur-Zeitung*, dated 1811 August 28, less than 2 weeks after the event.

A10 In the Russian Empire's Polish[21] provinces, a Western-educated, declared enemy of Russian suzerainty received the honor of Corresponding Member of the St.Petersburg Academy solely for his accurate observations of the same Great Comet of 1811.[22] In the very year, the director of the astronomical observatory of that same St.Petersburg Academy of Sciences, its academic astronomer Vikentii Karlovich Vishnevskii, won praise from west European astronomers for his observations of that comet long after other astronomers had lost sight of it.[23] And at the other end of European Russia, at Kazan' University not far from the Ural Mountains, the undergraduate Ivan Mikhailovich Simonov, in collaboration with fellow undergraduate (and subsequently world-renowned mathematician) Nikolai Lobachevskii observed the comet of 1811 on August 30, under the direction of Joseph Johann von Littrow.[24] This single observation led the Kazan' school district's curator, S. Ya. Razumovskii, to advance Simonov from a candidate thesis defense to a master's defense.[25]

a duplicate of the one at Struve's Pulkovo Observatory.

[13] The standard recent study is Michael Hoskin, *Caroline Herschel: Priestess of the New Heavens*, Watson Publishing, 2013, 272 pp.

[14] Batten, *op. cit.*, p.10.

[15] In Struve's case it was a comet in 1807; in their case it was that of 1769. See Peter Brosche's surely definitive biography of von Zach, *Der Astronom der Herzogin, Leben und Werk von Franz Xaver von Zach, 1754-1832*, *Acta Historica Astronomiciae*, vol.12, 2nd ed., Verlag Harri Deutsch, 2009, pp.15-16.

[16] The claim is based on Gary W. Kronk, *Cometography: A Catalog of Comets*, vol.2, NYC, Cambridge University Press, 2003, where on p.vii he advises that the top three most successful individual comet discoverers of all time were simultaneously active in 1800.

[17] One Thomas Cooper, in an 1805 critique (in the prestigious *Edinburgh Review*) of the chemical researches of Joseph Priestley, complained that Priestley

> seems to have been entirely forgetful of Bacon's invaluable precepts, that experiments should not be many, but decisive, and that they should be preceded by certain limited hypotheses or conjectures. Without these precautions . . . to make experiments, however numerous or however pretty, was merely to grope in the dark, and could scarcely ever lead to valuable or certain conclusions. The greatest part of Dr. Priestley's experiments are exactly of this description. **There is about as much philosophy in them, as in sweeping the sky for comets.** [emphasis added — MM]

Quoted in Steven Johnson, *The Invention of Air. A Story of Science, Faith, Revolution, and the Birth of America*, NYC, Riverhead Books, Penguin Group, 2009 [1st ed. 2008], pp.226-227.

[18] As with other family affairs, Batten (pp.9-10) provides considerably more detail than Sokolovskaia on this dramatic episode, going beyond Otto Struve's 1895 published account to determine the delay and the planning that Jacob Struve, F. G. W.'s father, put into the departure.

[19] Prior to his accession to the post of professor of astronomy at Dorpat, in 1809 Huth had writtten a dissertion, and submitted it for review by the St.Petersburg Academy, which maintained that the speed of light is infinite. The damning report on that suggestion by the Academy's astronomer pointed out the well-confirmed, known-for-a-century [☉9] phenomenon discovered by Bradley, stellar aberration. Huth's ignorance of it demonstrates the rudimentary knowledge of not a few observational astronomers of the day. See Karin Reich and Elena Roussanova, *Formeln und Sterne, Korrespondenz deutscher Gelehrter mit der Kaiserlichen Akademie der Wissenschaften zu St.Petersburg*, vol.13 of *Wissenschaftsbeziehungen in 19 Jahrhundert zwischen Deutschland und Russland bei der Sächsischen Akademie der Wissenschaften zu Leipzig*, Aachen, Shaker Verlag, 2013, pp.104-109.

[20] Reich and Roussanova, pp.126-127. The communication is dated 1811 August 15 and provides a hand-drawn sketch of the comet; it includes (a transliteration of the entire text is provided by Reich and Roussanova on pp.138-141) some complaint about the inadequacy of the available instruments. Nonetheless, Academy Secretary Fuss had the report published.

[21] After the partitions of Poland in the last decades of the 18th century, Russia occupied the majority of the Polish-speaking lands. Napoleon carved out a French protectorate, the "Grand Duchy of Warsaw" from 1805 until 1812, when following his retreat, the Russians re-occupied Poland. It returned to formal Russian rule in 1815, which lasted until the Revolution of 1917.

[22] I. G. Kolchinskii, A. A. Korsun', M. G. Rodriges, eds., *Astronomy: Biograficheskii spravochnik*, 2nd ed., Kiev, Naukova Dymka, 1986, pp.292-293. I am referring to Jan Sniadecki, whose activity in the field was more that of an organizer than a researcher. Although trained with William Herschel at Slough, helping to observe double stars, he founded the astronomical observatory of Krakow and served as its first director. He participated in the 1794 Kosciusko Uprising (against Russia), following which he emigrated to France. He returned to serve as rector of the university of Vilnius in 1807 — when it was under the protection of France — and remained, teaching astronomy until 1825, 5y before his death. Observation of the comet of 1811 clearly trumped opposition to the Russian Empire.

[23] *Ibid*, pp.64-65. The editors quote Friedrich Wilhelm Argelander praising Vishnevskii's observation of the 1811 comet as of the greatest value; but Finland, Argelander's place of employment, had since 1809 been part of the Russian empire. Although a well-regarded astronomer at the time, and an ethnic German, he might not be considered "western", due to his employment status. Friedrich Wilhelm Bessel, who was a lifelong employee of the state of Prussia, also wrote to the St.Petersburg Academy in praise of Vishnevskii's detection of the 1811 comet after it had been lost to other observers. See Kasimir Lawrynowicz, *Friedrich Wilhelm Bessel*, Berlin, Birkhäuser Verlag, 1995, pp.106-107.

[24] Littrow's career illustrates the danger which Russian political currents held even for competent scholars of the day. The 1st professor of astronomy at the new (founded 1804) University of Kazan', and like Struve an outstanding student of classical literature, he also like Struve (and Bessel) was self-taught in mathematics and astronomy. The politically-motivated purge of "foreign" professors at Kazan' saw him transfer in 1816 to the university observatory in Budapest, Hungary. He was professor of astronomy, and founder of the university's observatory, at Vienna from 1819 until 1840. The first to identify the solar chromosphere, a pioneer in geometric optics, Littrow was a widely-published popularizer of astronomy. His *Wonders of the Heavens* was significant enough to generate a book length comparison of his treatment of the sciences with that of a living Austrian author in 2007. See Thomas Hockey, ed., *Biographical Dictionary of Astronomers*, Springer, 2007, p.700.

[25] G. Ye. Pavlovna, *Organizatsiia nauki v Rossii v pervoi polovine XIX vv*., Moskva, Nauka, 1990, p.142.

B The Romantic Tradition in Russian Astronomy

B1 In addition to its inherently romantic fascination with comets, the intellectual environment in which the young F. G. W. Struve rose to prominence harbored specific Romantic inclinations at the academic, provincial, and national levels.

B2 Friedrich Georg Wilhelm Struve arrived in Dorpat in the summer of 1808, and he took a course from the then professor of astronomy, Johann Wilhelm Andreas Pfaff,[26] previously the chair of the faculty committee charged with the design of the university observatory and quite active in obtaining its instrumentation. In the spring of 1809 professor Pfaff returned to Germany, where in 1816 he wrote **a Romantic defense of astrology**.[27] Much more evidence of the Romantic environment exists, however. The organizer of the commitee for the construction of the observatory, the rector of the university when Struve arrived, the invited witness to Huth's comet observation, and the main sponsor of Struve's astronomical studies,[28] was Georg Friedrich Parrot. Just listen to the rhetorical tone of his speech of welcome to Tsar Alexandar I on 1802 May 22, upon the occasion of the imperial visit to the brand-new university:

> If you had only been present, Sire, at the day of our installation ceremony, at the moment when we swore at the altar of the Divinity our obedience to the most holy of His laws, and to Your Majesty our utmost submission to your will, to consecrate all our energies to the good of humanity. But who can object to a repetition here and now of that sacred moment? Friends! Colleagues! And you, who preside over our labors, let us repeat it all together. Let [Tsar] Alexander be the witness of our solemn vow! God above! [*Dieu supreme*] We swear in Thy presence, in the presence of Thy cherished image, to consecrate our time and our talents to that end which Thou hast confided to us, to labor zealously and faithfully to broaden the scope of useful enlightenment.[29]

[26] Not to be confused with his much more eminent brother, Johann Friedrich Pfaff, the inventor of the "Pfaffian", an invariant polynomial of a skew-symmetric matrix important in differential geometry. The imported instruments arrived and remained in their packing crates, until Struve began working at the observatory.

[27] I know this sounds strange, but in fact it involved not only his book *Astrology* but also 2 other books on the same theme. Both Gauss and the Berlin astronomer Bode were upset (Gauss found it impossible to finish reading), but that did not prevent the open-minded Pfaff — he not only proposed the non-degree-holding Joseph von Fraunhofer (1787-1826) for an honorary degree at the University of Würzburg, but also was one of the first to experiment with stellar spectra — from receiving membership in the St.Petersburg Academy of Sciences. See Gunther Oestmann and Karin Reich, "Olbers und Gauss: Leben und Werk im Spiegel ihrer Korrespondenz", pp.10-31 in Biegel, Oestmann, and Reich, eds., *Neue Welten: Wilhelm Olbers und die Naturwissenschaften um 1800*, *Brauschweiger Beiträge zur Wissenschaftsgeschichte* vol.1, Brauschweig, 2001, as well as http//de.wikipedia.org/wiki/Johann_Wilhelm_Andreas_Pfaff, consulted 2021 October 22.

[28] Struve completed a 1st degree, following his father's wishes, in philology, which is to say classical Greek and Latin. He then continued his studies but in astronomy. Elizaveta Fedorovna Litvinova, writing in 1893, states that Parrot "promised the financially limited young man complete financial security for the near future" if he became an astronomer (the very ill Huth vacated his position in 1813; by 1811 Struve was working by himself in the observatory). See her *Vasilii Struve: ego zhinz' i nauchnaia deiatel'nost*, pp.5-86 of vol.35 of *Biblioteka Florentiia Pavlenkova* [reprint ed., Cheliabinsk, "Ural," 1999], on p.20. Otto Struve, who agrees that Parrot's endorsement of science was a crucial influence on Wilhelm, says only that Parrot made available a small stipend which made it possible for his father to work fewer hours at the tutoring job by means of which he was supporting himself. *Wilhelm Struve: Zur Erinnerung an den Vater, den Geschwistern dargebracht*, Karlsruhe, G.Braun, 1895, p.19.

[29] As quoted in Friedrich Gustav Bienemann, *Der Dorpater Professor Georg Friedrich Parrot und Kaiser Alexander I*, BiblioLife reproduction of original, Reval, Verlag von Franz Kluge, 1902, pp.115-116. The entire speech was in French; the German author comments that it also appears in French in the standard Russian language biography of Alexander. The speech was long remembered: Roderich von Engelhardt, in his discussion of the intellectual heritage of the University of Dorpat, *Die deutsche Universität Dorpat in ihrer geistesgeschichtlichen Bedeutung*, Reval, 1933, also repreduces it in full, and in French, p.39. And it had an immediate positive effect. Alexander wrote the following day, in his own hand, a thank-you note to Parrot, and when later in 1802 Parrot personally went to the capital city to press his case, Alexander gave his support to Parrot's ideas over opposition from high-ranking nobles regarding the framing of the statutes of the university. The two men continued in friendly correspondence for the rest of the life of the Tsar. For the imperial pro-Parrot intervention, see James T. Flynn, *The University Reform of Tsar Alexander I, 1802-1835*, Washington, D.C., Catholic University of America Press, 1988, pp.17-18.

B3 As well as a florid speaking style, Parrot also displayed a Romantic hostility to the use of mathematics in astronomy & physics. A history of 19th century theoretical physics notes Parrot's warning against "the magic power of analysis in solving all problems," something characteristic of "especially the French physicists and especially Laplace" (who with Lagrange harmonized the mathematial description of the solar system). The authors add: "In 1815, he [Parrot] was still critical of the reality of certain common mathematical assumptions, which he viewed as the doctoring of physical assumptions for the convenience of mathematical treatment. In particular, he criticzied [Ottokar von] Feilitzsch for building a hydrodynamic theory on the same error Newton & every theorist after him had made . . . ."[30]

B4 Not only the university, but the province in which the undergraduate Struve resided and acted as tutor[31] to a local nobleman, was a center of Romanticism. The Romantic movement, however defined, began in Germany, and in particular along the Baltic coast, the eastermost portion of the German-speaking world absorbed by and adjacent to Russia. Its most articulate early spokesmen, Johann Georg Hamann and Johann Gottfried Herder — "The true fathers of Romanticism" according to Isaiah Berlin[32] — were both sometime tutors in Riga, the metropolitan center of the Baltic provinces of which Dorpat was the university town. Historical researchers speak of several hundred domestic tutors from western Germany dominating the intellectual life of the Baltic coast.[33]

[30] Christa Jungnickel and Russell McCormmach, *Intellectual Mastery of Nature: Theoretical Physics from Ohm to Einstein*, vol.1, *The Torch of Mathematics, 1800-1870*, Chicago, Chicago University Press, 1990 [1st ed. 1986], pp.44, 127. Hostility to Newton was common among Romantics, scientific as well as poetic — witness William Blake.

[31] As Parrot in his first years in Lithuania. See Bienemann, *op.cit.*, pp.50-56.

[32] The title of Chapter 3 in Berlin's *The Roots of Romanticism*, ed. Henry Hardy, Princeton, Princeton University Press, 1999 [1st ed. 1965], pp.46-67. "Herder really was a direct and faithful disciple of this strange figure [that is, Hamann], who was called 'der Magus in Norden' [the mage of the North]" (p.58). To give a flavor of Hamann's attitude toward astronomy, I will quote an anecdote from Berlin (p.48):

> When his friend Kant said to him that the science of astronomy had finally come to an end, that astronomers knew all they could know and it was a satisfactory thiing that this particular science could now be locked up as having been completed, Hamann felt like destroying it. As if there could be no more miracles in the universe!

[33] Von Engelhardt, *op.cit.*, pp.12-13:

> It is almost impossible to exaggerate the role of the institution of domestic tutor in the intellectual life (*Geistesleben*) of the Baltic lands. It worked as a continually developing intellectual bridge between our homes and Germany . . . . One can only approximately estimate the number of domestic tutors who have come over here — at least three hundred are certain over the last three centuries, but it could be two or three times as many . . . . Since the founding of the university [of Dorpat — since 1802], however, the number of home-produced domestic tutors has increased quite a bit . . . . We can to be brief indicate at this point that, especially in its first years of development, the university was particularly dependent upon domestic tutors for its faculty positions.

And Berlin, *op.cit.*, p.16, adds: "Joseph Nadler, a learned German critic, says that Romanticism is really the homesickness of those Germans who lived between the Elbe and the Nieman — their homesickness for the old Central Germany from which they came, the daydreams of exiles and colonists."

B5 At the national level, we find a similar picture: Romantic tenor dominated Russian literature, science,, and politics of the decades during which Struve attended college and directed the Dorpat University Observatory from 1808 until 1838.[34] The president of the Academy of Sciences from 1818 on and the Minister of Education from 1833, Sergei Semyonovich Uvarov, founded a Romantic group of *litterateurs* in 1815 and outlined a rose-colored history of the growth of "*l'ésprit humain*" in his inaugural address published upon the occasion of his appointment to the Academy.[35] The man who served as the primary advisor to the tsar from 1807 until 1812, Michael Speransky, had previously taught physics at a theological seminary, which topic he taught in Romantic terms, and he later recalled Schelling as his favorite natural philosopher.[36] It would not be difficult to list a host of actions of a clearly Romantic nature by Tsar Alexander I himself, whom we have already seen (§B2) responding positively to Parrot;[37] Alexander's younger brother Nicholas I's

[34] Peter K. Christoff, *The Third Heart. Some Intellectual Ideological Currents and Crosscurrents in Russia 1800-1830, Slavistic Printings and Reprintings*, The Hague, Mouton, 1970, pp.48-49.

> But before the age of literary realism in Russia arrived, German Romanticism, Schellingism, Naturphilosophie had their day. This happened in the first three decades of the nineteenth century. The new monistic view of the universe fostered by Schelling's principle of the unity or identity of the cosmos was often utilized to confront the mechanistic and atomistic notions of the eighteenth century, but an attack upon atomism and materialism could not pass without berating at the same time eighteenth century science, which had "become enticed into dry specialization and had become contaminated by the spirit of formalism and artisanship," Not only science but art and religion had declined and had been "replaced by the utilitarianism of Bentham, the immorality of Malthus, by mercenary calculation . . . ."

The passages in quotes are from Pavel N. Miliukov, *Glavnaia techeniya istoricheskoi mysli*, St.Petersburg, 1913.

[35] Cynthia H. Whittaker, *The Origins of Modern Russian Education. An Intellectual Biography of Count Sergei Uvarov, 1786-1855*, Northern Illinois University Press, 1988, pp.29-33, 45-55. Christoff, *op.cit.*,pp.24-29.

[36] Marc Raeff, *Michael Speransky, Statesman of Imperial Russia, 1772-1839*, The Hague, Martinus Nijhoff, 1957, pp.207-208. Speransky served in the Main Administration of Schools Committee both under Alexander and his younger brother Nicholas, who inherited the throne in 1825. "Speransky was one of the few Russians who had obtained a scientific education," wrote the German academic L. H. Jacob quoted by Raeff (in German), p.12. For an example of the Romantic science which I have shown to be of predominant influence, allow me to quote the standard elaboration of *Naturphilosophie* by the same F. W. J. Schelling, published in 1803.

> It is true that thanks to the application of mathematics one has learned to determine the exact distances between the planets, the periods of their revolutions and of their orbits; but as for the essence or the inner being of these movements there has not been the slightest elucidation yet proposed. The so-called mathematical physics thus rests today on an empty formalism, from which one cannot proceed at all to a true science of nature.

Quoted in George Gusdorf, *Le Savoir Romantique de la Nature*, vol.12 of *Les Sciences Humaines et la Pensée Occidentale*, Paris, Payot, 1985, p.42.

[37] Alexander kept no diary and wrote few letters; his notebooks were destroyed by his brother, who took the throne in 1825. His biographer quotes a close friend, "[Polish prince Adam] Czartoryski [in 1799] doubted Alexander's resolve, though he admired his humaneness and idealism. The future Tsar's style, in the prince's view, was thoroughly Romantic. As they walked together in the countryside Alexander would fly into ecstasies about a flower, the greenness of a tree, or the view over an undulating plain. He loved gardens and fields, the rustic beauty of village girls, the idyll of retiring to a small farm in a wide and smiling landscape — an idyll to which he returned over and over." For an example from his reign, there is his efforts to obtain agreement, at the 1815 Congress of Vienna, to the entirety of Poland as a Russian province. The British foreign minister formed a secret alliance with minor German states, Austria, and France to prevent this, but, as his biographer notes, the combined forces of Russia and Prussia would have dominated any battlefield in 1815. Napoleon, having escaped from Elba, sent

scientific and intellectual policies were those of Uvarov and Speransky (until the latter died and the former was dismissed following the West European revolutions of 1848).[38] A Swedish authority confirms our survey for a slightly different time period: "In fact, Romantic and Idealistic thought completely dominated intellectual life of Russia between the 1820s and the 1840s."[39]

B6 Imagine then what the young Struve, as an unofficial astronomer-observer at an observatory where the research instruments remained in packing crates,[40] chose to do. He established friendly personal terms with the official astronomer-observer, of whom there is in the archives not a single record of any astronomical observation. By himself, with Huth's permission and Parrot's encouragement, he built the brick columns[41] of the transit instrument by hand, cutting into them to allow illumination of the cross-hairs. Simultaneously, starting in 1812, he began taking triangulations of the countryside around Dorpat, an application of practical astronomy which led, a couple of years later, to the commission by the Livland Economic Society[42] for Struve to provide astronomically accurate measurements of the location of points within the province, as a basis for an updated map. It seems quite distant from any Romantic conception of the discipline of astronomy.

B7 This is a feature which emerges from a close analysis of Struve's extraordinarily successful career as an astronomer: he is not only skilled at the tedious technical business

the British plans — Louis XVIII, the Bourbon installed by the allies, left a copy of the treaty behind in his flight from Paris — to Alexander, but [*beau geste* — MM] the latter threw them into the fire in the presence of the intended beneficiary, the Austrian foreign minister. Russia received only two-thirds of the Polish provinces. Allen McConnell, *Tsar Alexander I, Paternalistic Reformer*, NYC, Thomas Y. Crowell, 1970, pp.8-9 and 130-131.

[38] In the matter of the curricula for gymnasia, which was debated in 1828, for example, Uvarov managed to get Nicholas to overrule the majority and institute Greek as well as Latin, and German as well as French. The sitting Minister of Education at the time,

> Shishkov called repeatedly for education limited to that which each class "needs", for the end of "foreign" influence, and for limiting university autonomy by abolishing faculty election of rectors. His views were shared by many, including the tsar. Yet, none of these steps was taken. Uvarov's ideas, not Shishkov's, survived to enactment.

Flynn, *op.cit.*, pp.168-177, quote from p.177.

[39] Susanna Rabow-Edling, *Slavophile Thought and the Politics of Cultural Nationalism*, Albany, State University of New York Press, 2006, p.26.

[40] Huth had appointed his student Magnus Georg Paucker astronomer-observer; Struve had no official position until Paucker took his degree and left Dorpat, in 1813. The instruments had been ordered by Pfaff; Huth, the professor of astronomy who had observed the 1811 comet, never did any other observing (or even came to the observatory). Litvinova, *op.cit.* (pp.45-46), describes a parallel circumstance — in that case, astronomical instruments remaining in their packing crates for over 40^y, in the Academy of Sciences in St.Petersburg.

[41] Otto Struve, *Wilhelm Struve. Zu Errinerung an den Vater den Geschwistern dargebracht*, Karlsruhe, G. Braun'schen Hofbuchdruckerei, 1895, p.20, says they were granite blocks, which the young Wilhelm had to cut into. Batten repeats this (p.20). Sokolovskaia, relying instead on the 1899 history of the university astronomers by G. V. Levitskii, says (pp.34-35) that Huth had ordered massive granite blocks, but they never arrived, and that Struve had to build the supporting columns of brick, by himself. A footnote (p.92) even gives the precision of the transit instrument's observed data over the course of a year as 2 1/2 arc-seconds. It is typical of Batten to provide the reader at this point with a description of transit instruments, explaining how they work, and why they were important; Sokolovskaia gives the costs and specifications of each instrument, but provides no explanation of their workings or their value to contemporary astronomers.

[42] The former president of the Economic Society, and the current governor of the province, was Friedrich Wilhelm von Sievers [Fyodor Fyodorovich Sivers, in the Russian], a reformer and close associate of the Tsar, nobleman and district marshal of the nobility who in 1797 had forwarded an Economic Society report requesting the abolition of serfdom in the province — which Alexander granted in 1808. In the 1790s Parrot had served in the Sievers household as a domestic tutor. The Parrot-Sievers connexion may have been the source of Struve's commission.

of observation and mathematical reduction, but also outstanding in his ability and his talent at keeping on the right side of superiors, particularly Romantic ones, from whom he manages to extract immense sums in support of his activities. One early example is Struve remaining on friendly, even cordial, terms with "astronomer-observer" Paucker, though he and "Professor of Astronomy" Huth do no astronomy, while Struve is without assistance constructing the brick supports for the observatory's central positional-astronomy instrument. A 2nd, lifelong indication of Struve's unRomantic adaptation to a Romantic intellectual environment involves his very infrequent observation of comets. Sokolovskaia's volume[43] includes an appendix with a thorough listing of all of Struve's publications: 16 out of 254 concerned comets. And those 16 were mostly in the 1st few years following his appointment — at the suggestion of Huth, famous for comet-finding — as director of Dorpat Observatory[44] when each year brought a published report of observations of a notable comet. However, from 1824 on, when Struve was in possession of the largest and best-equipped telescopic refractor in the world, a paper on comets becomes very rare. Indeed, Sokolovskaia reproduces a reply,[45] published in the *Journal of the Ministry of Education*, to the criticism by "educated people", that the enormous telescope of Pulkovo, with nearly 3 times the light-gathering power of Dorpat's Great Refractor, had discovered no new comet.[46] Among the reasons given for the lack of comet discovery we find: "Finally, our astronomers' extensive plan of research does not allow them to devote precious time to the thankless effort and *the illusory success of catching comets*" [emphasis added — MM]. The answer may have been both accurate and justified; but its necessity shows how low among Struve's priorities "sweeping the sky for comets" really was [⊙10].

B8 I have alluded to Dorpat's 9″.5 [⊙11] Fraunhofer refractor, referred to as the Great Dorpat Refractor due to its unprecedented size, which Struve persuaded Dorpat University to purchase in 1824. The existing cupola of the university observatory was fixed in place. Fine for transit circle, but for ease of telescope use, a moving cupola would be more appropriate. Sokolovskaia quotes[47] his claim that the extra money had to be provided immediately:

> the celebrated Encke's comet was visible in August of this year [1825] only in the Southern Hemisphere, and this obliged the English government to build two new observatories, at the Cape of Good Hope and in Australia.[48] At its next appearance Encke's comet will be so faint that there is very little hope of seeing it except in the largest and best telescopes. This fact indicates the high degree of urgency that the great refractor be installed by that time in its proper location,[49] since Dorpat Observatory then may be expected more than any other observatory to locate once more this important celestial body.

In evaluating this deceptive and misleading passage, I began by noting that Encke's comet is of short period — about 3 years — so that neither the Royal Observatory at the Cape

[43] In the original Russian edition: since so many if not almost all of the titles were in Latin, French, or German, and the Russian-language titles were primarily translations or popularizations, I omitted it from the English translation.

[44] In 1813 November Huth nominated and the faculty committee approved Struve's appointment to the position of extraordinary professor of mathematics and astronomy and astronomer-observer of its observatory, subsequent to his determination, to a higher degree than previously (naturally: he used much better instruments, ones he unpacked and mounted himself), the latitude and longitude of the *speculum Dorpatensis*, the Dorpat telescope.

[45] Sokolovskaia, *op.cit.*, p.135. The Pulkovo refractor, just as in its day the Dorpat refractor, was at its installation the largest refracting telescope in the world; it retained that title from 1839 until 1852.

[46] Be it noted Dorpat's large refractor hadn't discovered any new comets either.

[47] Again citing the 1899 survey of Dorpat University astronomers by G. V. Levitskii, *Astronomy Yurevskogo universiteta s 1802 do 1894 god*, Yurev, p.104.

[48] In the original, "New Holland."

[49] That is, "proper" in the sense that it is within a movable dome.

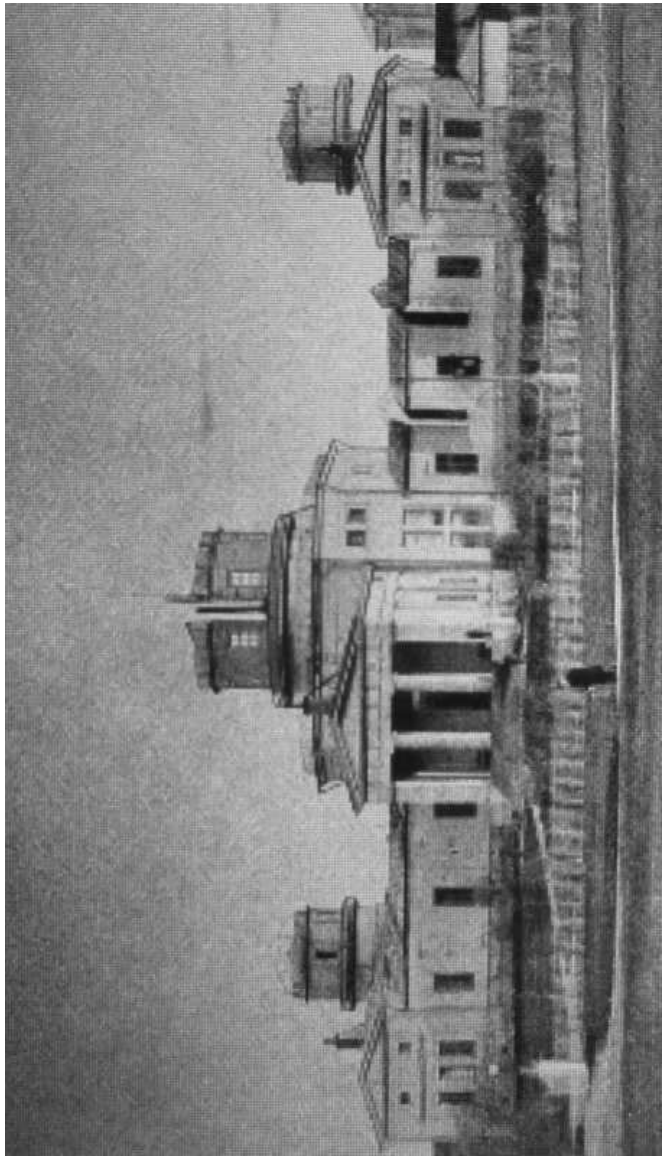

Figure 3: "The astronomical capital of the world" (§A4): Pulkovo Observatory, featuring the then-largest refractor in the world, of 15″.0 aperture — its long profile impressively visible through the cupola-slit at top center.
Latitude 59°46′19″N.
Longitude 30°19′39″E.
Altitude 75m.

of Good Hope, founded in 1820 (for fairly obvious reasons of improving navigation near an isolated British colony), nor the Parramatta Observatory of Australia, founded in 1825 (of equally evident navigational incentive), in both cases the first major observatories of their respective colonies, needed to be founded in 1825 to observe the comet. It would return shortly. Secondly, as Sokolovskaia reports without comment, even though the request for funds was granted, and even though G. F. Parrot produced an excellent plan for the cupola and the work was begun immediately, it still wasn't ready by the time Encke's comet returned. Yet Struve did observe it and published his observations.[50]

B9 Operating in environs awash in Romantics and Romanticism, then, we see our energetic scientific entrepreneur appealing for funding on the basis of the importance of comets and, once he has the money, going his own way. His attitude was in marked contrast to that of the Moscow University Professor of Astronomy Dmitrii Mikhailovich Perevoshchikov, who dismissed Romantic science as "the twittering of birds";[51] rather, Struve was quite willing to appeal to what his listerners wanted to hear him say, but to conduct his astronomical research following a program with little reference to popular expectations.

B10 From 1813 on Struve established a pattern of surveying the countryside in the summer and conducting astronomical research back at the observatory during the winter [⊙12], as well as giving university lectures on astronomy during the school year. By 1819 he had completed a survey of the province, and had proposed to combine with a military officer who had surveyed the neighboring province, and to triangulate a measured meridian-arc [⊙13] from the Arctic to the Mediterranean.

B11 It seems only reasonable at this point to ask [⊙14]: why remote Dorpat University Observatory, or even the Russian Imperial Central Observatory at Pulkovo, had each installed the largest refracting telescope at the time, and each was entrusted to the same man. Close reading suggests the answer, but Sokolokaia, writing at the height of the Cold War, unfortunately succumbs to politics when considering it. Batten makes no efffort, on his part, to explain it.

[50] In the *Astronomische Nachrichten*, published in Germany.

[51] The eminent Russian revolutionary Alexander Herzen, writing his memoirs, recalled how this dismissal shocked him when he had been a student in the 1840s. Alexander Herzen, *Ends and Beginnings*, ed. and intro. Aileen Kelly, *The World's Classics*, NYC, Oxford University Press, 1985 [1st Russian ed. 1913], pp.84-86. "German philosophy had been grafted on Moscow by M.G.Pavlov. The chair of philosphy had been abolished since 1826. Pavlov gave us an introduction to philosophy instead of physics and agriculture . . . . Pavlov would stand at the door of the faculty of physics and mathematics and stop a stuudent with the question. "You want to acquire a knowledge of nature? But what is nature? What is knowledge?" By way of answer to these questions, Pavlov expounded the doctrines of Schelling and Oken . . . carried away by the current of the time, I wrote in exactly the same way, and was actually surprised when Perevoshchikov, the well-known astronomer, described this language as 'the twittering of birds'."

C Archangel Lieven

C1 In recounting his father's career at Dorpat, Otto Struve interrupts his narrative to comment[52] about financial support:

> Prince Karl Lieven [was] the far-sighted and enthusiastically conscientious man to whom, from his appoinment as curator [in 1817] until his appointment as Minister of Education in 1827, the University of Dorpat owed its renewal. . . . The constant and for the time extraordinarily generous assistance which made the Dorpat Observatory for more than a decade — 1824 to 1838 — the best-equipped in the world, can be attributed to his personal advocacy.

Drawing from its annual reports, Sokolovskaia notes[53] that the Dorpat University Observatory by 1839 contained 126 individual astronomical instrumemts.

C2 In his application to undertake the trip to Germany where he encountered the opportunity to purchase Fraunhofer's Great Refractor, Struve met with the opposition of Huth, according to Sokolovskaia,[54] but that was Lieven's 1st year in charge of the Dorpat school district. The university council and the district's educational curator, had the power to overrule Huth's opposition: I suspect it was due to Lieven. Again, when in 1819 Struve proposed a greatly expanded meridian measurement, Litvinova tells us explicitly[55] that it was Lieven who supportcd it.

C3 For Lieven, however, Sokolovskaia has only harsh condemnation rather than appreciative praise: citing the work of a Stalin-era historian, she calls Lieven a "dyed-in-the-wool religious fanatic and bigot." He was "a powerful Baltic landlord who looked after the interests of the nobility." She equally dismisses G. F. Parrot.[56] But it would be by no means a drawback, were you asking for the funding of a new project, that the bureaucrat to whom you are appealing for financial support by a powerful landlord with connexions to the Imperial Russian court (as a matter of fact, Lieven was soon promoted to run the Ministry of Education, responsible for all educational programs of the imperial regime). Yes, he was a wealthy and powerful landlord; but that's why he could increase the budget

[52] Otto Struve, *op.cit.*, p.24. Although he refers frequently to Otto Struve's account, Batten makes no mention of Lieven's part in the funding of the Dorpat Observatory.

[53] Sokolovskaia, *op.cit.*, p.58.

[54] *Ibid*, p.44.

[55] Litvinova, *op.cit.* (n.25), p.27, where she characterizes Lieven as "a zealous partisan" of science.

[56] Sokolovskaia, pp.86-87. Her source is E. E. Martinson, *Istoria osnovaniia Tartuskogo (byvshe Derptskogo-Yurevskogo) universiteta*, Leningrad, 1954. "In reply to the request by G. Ewers to invite the famous scholar Ranke to the university, Levin wrote, 'My heart trembles at the thought that learning and genius mean more to you than Christianity.' In a letter to G. F. Parrot, Levin expressed his belief that 'it would better for the state and for humanity if people tried less to teach and to govern and more to obey and carry out exactly the established laws.' " Of Parrot, Sokolovskaia (p.88) employs a direct quote of Martinson's: Parrot "represented for the tsar the opportunity of having, as his grandmother Catherine II had, his own little Voltaire in the person of the Dorpat professor, all the more so since Parrot was French." Sokolovskaia's dismissal is repeated later, in 1960, in Pavlova, *op.cit.*, p.83, so it is worth refuting. Of course Parrot spoke in French to the tsar, since that was the common language of the Russian court from about 1750. Consider the English-language translation of the title of a 2010 historical study published in Moscow by Elena Grechanaia, "When Russia spoke French — from the 18th to the first half of the 19th century." Secondly, Parrot was German, born in Württemburg, in territory that has since been attached to France. He always considered himself German, even while tutoring in France in his youth. Bienemann's biography makes this evident, down to the farewell his tutee, the young Count Achille d'Hericy, wrote for him on the occasion of his departure from the household, in 1788, for Germany: "Oh! You, whom I will love all my life/ I will no longer embrace you/ For you will be in your own country (*patrie*)." Bienemann, *op.cit.* [fn 29], p.38. Parrot solemnly and repeatedly warned his fellow German scientists not to solve problems in the physical sciences in the "French manner."

of the observatory: were he to have been the impecunious son of a clergyman, such support would never have been approved. All testimony agrees that Lieven was a pious Lutheran, in fact a Pietist, but that was just the sort of Romantic orientation[57] so common [⊙15] among Russian nobility and imperial servitors at the time, with which Struve interacted so fruitfully. Nor would religious views prevent a person from supporting scientific endeavor; Sokolovskaia wraps her distaste for a pious, wealthy man around the issue whether or not he was the main support for the fulfillment of Struve's extraordinary financial demands.

D F. X. von Zach's Celestial Police

D1 If then there is no obstacle to understanding Struve's positive relationship with Lieven, there remains the question of why a powerful Baltic German nobleman would support an astronomical observatory with lavish aid, or promote the measurement of the size & shape of the Earth. It is at best an informed guess, but the essence of the appeal of the enterprise here is that we are finding out something about the mystery of the world. Let me make the appeal more concrete by recalling the outstanding example of Romantic astronomy of the era, the search[58] and discovery of planetisimals (subsequently "asteroids") orbiting the Sun in the gap between Mars and Jupiter.

D2 The story revolves around the figure of Franz Xaver von Zach, whose observatory formed the model for the design of Dorpat University Observatory;[59] here, if anywhere, was a Romantic figure of a German astronomer. As a young man in Austria, he denounced his own employer, J. X. Liesganig, as an incompetent fraud, and he was fired as a result. The king[60] of Austria, Joseph II, confessed to him that no one else in all of Austria wanted to give him a position, so notorious was his reputation. So he went abroad, to England, claiming to have been "exiled" by the Jesuits. Once there, he succeeded, in 1784, in calculating a much more precise orbit for the newly-discovered (1781) planet Uranus, using a 1690 accidental Uranus observation made at Greenwich by the 1st Astronomer Royal, John Flamsteed, while mapping stars via transit instrument, an observation which Bode had identified[61] as Uranus by noting that the "star" 34 Tauri in Flamsteed's star catalog was near where Uranus would

[57] Berlin, *op.cit.*, notes that, after the bloodshed of the Thirty Years War, "German culture drifted either into extreme scholastic pedantry of a Lutheran kind — minute but rather dry scholarship — or else into a revolt against this scholarship in the direction of the inner life of the human soul . . . . Against this background the pietist movement, *which really is the root of romanticism*, became deeply embedded in Germany. Pietism was a branch of Lutheranism, and consisted of careful study of the Bible and profound respect for the personal relationship of man to God. There was therefore an emphasis upon spiritual life, contempt for learning, contempt for form, contempt for pomp and ceremony, and a tremendous stress upon the . . . relationship of the individual suffering soul with her Maker" (pp.35-36, emphasis added). in his admiration for science Lieven obviously violated in that particular instance the description Berlin offers.

[58] The most thorough investigation of the philosophical context is Dieter B. Herrmann, "Hegels Dissertation and die Siebenzahl der Planeten," *Sterne und Weltraum*, 1992, *11*:688-691. Michael Hoskin gives a thorough description of the observation and its prehistory in "Bode's Law and the Discovery of Ceres," pp.35-46 in Jeffrey F. Linsky and Salvatore Serio, eds., *Physics of Solar and Stellar Coronae*, Dordrecht, Kluwer Academic, 1993, without mentioning the storm of indignation (fn 64, below) Herrmann seeks to examine.

[59] According to Otto Struve, *op.cit.*, p.20. This is confirmed in G. A. Zhelin, *Astronomicheskaya observatoriya Tartuskogo universiteta 1805-1948*, *Publikatsii Tartuskoi astrofizicheskoi observatorii imeni V. Struve*, vol.37, 1969, p.23.

[60] And emperor of the millennial Holy Roman Empire. In our time period, Napoleon abolished the Holy Roman Empire, in 1806, but the ruler of Austria declared himself to be also an emperor, of Austria.

[61] Brosche, *op.cit.*, pp.20-27 for the Liesganig episode, and pp.38-42 for von Zach's interaction with Herschel and his new planet. It is to be noted that Zach already had the connexion necessary to have his contribution first published by the Berlin astronomer Bode's *Astronomisches Jahrbuch*.

Figure 4: Joseph von Fraunhofer. Discoverer of stars' spectral lines. Creator of the Great Dorpat Refractor and its equatorial mount.

have been at the time, but there was now no star in the place he'd mapped 34 Tauri, since the object observed back in 1690 was Uranus, which had moved on long since — in fact completing more than a full ciruit of the Sun, from 1690 until its 1781 discovery in Gemini.

D3 After having become an established astronomer, with his own observatory in the small German town of Gotha, Zach learned of an 1801 effort by the aspiring Jena University professor of philosophy G. W. F. Hegel to account for the long-unexplained Mars-Jupiter gap,[62] attention to which had been drawn by Bode in 1772 via "Bode's Law", a well-fitting [⊙16] number scheme for planets' mean distances from the Sun. Hegel's 1801 professorial dissertation [⊙17] discussed Kepler's and Newton's work at some length, and, with regard to the gap, suggested that modifications [⊙18] of a number series in Plato's *Timaeus* produced figures which were very roughly similar to the planets' mean distances from the Sun: a poorer fit than Bode's Law, but it featured the very gap which Bode's Law denied.[63] This roused Zach to a "storm of indignation,"[64] since in 1800 September he had organized along with other astronomers — meeting in the German town of Lilienthal — a "celestial police" to search telescopically for the Bode-implied but as-yet-undiscovered planet between Mars

[62] If you set the radius of the Earth's orbit at 1.0, Bode's Law, which actually was 1st published by J. Titius in 1766 (but Bode's 1772 appropriation ["adoption"] of it made it well known) noted that 0.4 + 0.3 = 0.7 for Venus, 0.4 + 0.6 = 1.0 for Earth, 0.4 + 1.2 = 1.6 for Mars, 0.4 + 2.4 = 2.8 for the "gap", 0.4 + 4.8 = 5.2 for Jupiter, etc. Similar doubling of the addend to the initial 0.4 — which fairly accurately was the orbit-radius of Mercury — also yielded good approximations, in astronomical units (AUs), of the radii of the orbits of Saturn and newly-discovered Uranus.

[63] From the universe-creating Demiurge's data in Plato's *Timaeus*, Hegel obtained (after a special-case alteration) the series of numbers 1, 2, 3, 4, 9, 16. 27. By raising these seven numbers to the 4/3 power, Hegel arrived at a sequence roughly mimicking the sequence of orbital radii of the known planets.

[64] Herrmann, *op.cit.*, p.688.

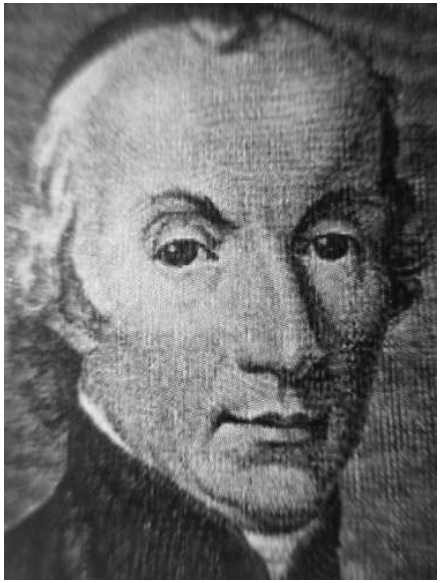

Figure 5: Palermo Observary's Giuseppi Piazzi.
Discoverer of Ceres, the 1st asteroid, 1801 January 1.

and Jupiter. In 1801 June, Zach had the distinct pleasure of victoriously announcing in his own journal *Monatliche Correspondenz*, that an astronomer already nominated for membership in Zach's sky-police ***had ACTUALLY DISCOVERED***[65] ***the gap-planet*** via transit-circle telescope. Auspiciously, it was 1st seen on the 1st day of what was to be the unprecedentedly fruitful 19th century: 1801 January 1, by Giuseppi Piazzi of the University of Palermo [⊙19], whose scrupulous procedure — of repeated-observations of the same star, to ensure tight & reliable positional accuracy — had revealed the object's ***motion*** [⊙20] and thus nonstellar nature, within days. He named the 1st asteroid "Ceres". Subsequent asteroid-discoverers followed Piazzi's lead by naming their finds after goddesses.

D4 Here was a triumph of astronomy as a search into the depths for harmonious connexions, as opposed to "scholastic pedantry of a Lutheran kind."[66] Zach thus belabored

[65] Freiherr Xaver von Zach, "Über einen zwischen Mars und Jupiter längst vermutheten, nun wahrscheinlich endeckten neuen Hauptplaneten unseres Sonnen-Systems," *Monatliche Correspondenz zur Beförderung der Erd und Himmelskunde, 3*, 1801 June, pp.592-623.

[66] To quote Isaiah Berlin, c.f. fn 57 *supra*. The announcement of "a new major planet of the solar system" in 1801 June was distinctly premature; only after observation of the predicted re-appearance of the planetoid, which Piazzi had been able to observe for only a few weeks before it was obscured behind the Sun, could astronomers be sure of its orbital distance, or indeed its planetary nature. Gauss considered Bode's Law to be "empty fiddling with numbers," but still predicted, from a few firm observational data points, an accurate orbit — and thus location — for the new planetoid. His widely-admired accomplishment was so elegant that it has been presented as a means of teaching mathematics to undergraduates. Donald Teets and Karen Whitehead, "The Discovery of Ceres: How Gauss Became Famous," *Mathematics Magazine*, 1999, *72*:83-91. For his dismissal of Bode's Law, see Karin Reich, "Olbers in den Schlagzeilen: Zeitungen berichtem über die Entdeckung der Planetoiden," in Biegel, Oestmann, and Reich, eds., *op.cit.*, pp.90-100, quoted on p.91.

Figure 6: Karl Friedrich Gauss, one of the most magnificent mathematicians, ever.
Recovered lost Ceres (1801) by applying his newly discovered least-squares statistics.

Hegel as one "who ought to learn before he teaches," and even complained of "literary vandalism."[67] We hear the echo of Hanann (§B4) raging that astronomy cannot be finished:[68] there cannot be no more than seven planets (as Hegel had casually affirmed near the end of his dissertation). Insofar as a Dorpat astronomer, in an observatory built on the model of Zach's, could also claim a discovery such as the latter had prompted and publicized, the Russian Empire could show itself in the leading rank of humanity. Indeed, if the German Romantics were anxious to show their ability to transcend the dry rationalism of the Enlightenment French, the Russian Romantics, having just repulsed Napoleon only a decade after the Dorpat Observatory's establishment, were even more so inclined.

[67] Cited by Herrmann, *op.cit.*, p.689. To be candid, it is clear that Zach by no means considered himself a Romantic astronomer: listen to him grumble (Von Zach, *op.cit.*, p.597) following his impetuous announcement: "One can let poets play their game, but we are obliged to irritate that sort of naturalist who sets out to capture Nature on the slippery slope of mysticism, to replace a generally understandable language with incomprhensible jargon, and to explain the obscure by means of the even more obscure (*obscurum per obscurius*)." It didn't help that Hegel was a friend of Schelling, either. But the impact of the astonishing discovery, not only of Ceres but of 3 other asteroids in quick succession (Pallas 1802, Juno 1804, Vesta 1807) was undoubtedly to heighten the destruction of astronomy as a fixed and settled picture.

[68] Cf. fn 29 *supra*.

E Maneuvering

E1 A number of incidents among the supplements provided to the English translation of Sokoloskaia's work reveals a similar ability to maneuver adroitly within the Russian Imperial bureaucracy: not Struve but his former fellow student at Dorpat University (and predecessor as assistant at the observatory) during his 1st years in Russia, Magnus Georg Paucker, was offered the chair of astronomy at the St.Petersburg Academy of Sciences. "In 1825," writes G.Ye.Pavlovna[69]

> Upon the occasion of the announcement of a competition to select a successor to a position in the Academy, the professsor of mathematics and astronomy of the Mitau gymnasium G. Paucker notified the [school administration] of his decision to exclude himself from the list of candidates. Citing the fact that the compensation of an Academician consisted of 2200 rubles a year, he advised the Academy that at the gymnasium he received 5700 rubles a year, and so declined to enter the competition.

E2 In 2013 Karin Reich and Elena Roussanova, publicizing the contents of the Saxon national archive of correspondence to the St.Petersburg Academy, provided more detail.[70] Nikolaus Fuss, the Secretary of the Academy, on 1825 November 11, notified Paucker of the Academy's interest in his availability to fill the vacant position of the recently-deceased Friedrich Theodor Schubert, warning him of the relatively low wage. Prior to a resolution of the situation, Nikolaus Fuss died, and there the matter rested for some years, to be resumed when Paul Heinrich Fuss, as successor to his father in the position of secretary of the Academy, in 1831 May received a letter from Paucker stating that he "would not hesitate for a second to accept the position" of astronomer to the Academy provided the position included a housing allowance. In 1831 June Paucker reported his intention personally to visit Dorpat Observatory, there to consult with Struve regarding the decision; in September he definitively declined.[71] The editors of the correspondence admit that no details of the consultation with Struve survive, but they quite reasonably suggest that Struve had a significant influence on Paucker's decision.

E3 Indeed, after Struve received subsequent election to membership into the Academy, with the proviso that he remain as director of the Dorpat University Observatory, Paucker in 1832 April wrote to Fuss:

> I heard of the election of Professor Struve as Astronomer to the Academy from the man himself, and I am pleased that this position went to such an outstanding and distinguished astronomer. Meanwhile, I acknowledge your wishes, as well as my own expressed wishes, with the warmest of thanks and am therefore persuaded that everything turned out for the best.

E4 The final sentence seems to me to support the interpretation that Paucker declined the appointment with the expectation that Struve would get it. From the point of view of addressing the problem of an unsustainably low salary for an Academician with a family (and without sideline appointments) in expensive St.Petersburg, the arrangement was eminently reasonable: Struve had an excellent reason to remain at Dorpat — his observtory was one

[69] Pavlovna, *op.cit.*, p.39.

[70] Reich and Roussanova, *op.cit.*, pp.320-323.

[71] That is, Pavlovna was 6^y too soon with her date for Paucker's decision (and unaware of his 1831 expression of willingness to accept). One reason this is significant is that in 1827 October Tsar Nicholas I, at the urging of the President of the Academy S. S. Uvarov, doubled academicians' salaries. The issue was not solely the level of remuneration. See M.F.Kartanovich, "Pravital'stvennaia politiika v oblasti nauki na primere deiatel'nosti imperatorskoi Akademii nauk. Pervaya polovina 19. v.", pp.171-190 in Zh.I.Alfyorov, ed., *Akademicheskaya nauka v Sankt Peterburge v 18-20 vekakh. Istoricheskie ocherki*, Sankt-Peterburg, Nauka, 2003, on p.179.

of the best-equipped in Europe, far exceeding the resources of the Academy's observatory — while Paucker's gymnasium observatory was lamentable.[72]

F Perevoshchikov

F1 Another example of Struve's ability to step gracefully around the field of bureaucratic minefields of disciplinary conflict concerned the professor of astronomy at Moscow University, Dmitrii Matveevich Perevoshchikov (unmentioned by Batten) and his struggle with Aleksandr Nikolaevich Drashusov, his successor as head of the Moscow University Observatory.

F2 Perevoshchikov, the son of an infantry corporal who became a minor official in the salt monopoly, joined the staff of Moscow University in 1818 after his graduation from Kazan' University and 7^y as instructor at the Simbirsky gymnasium.[73] In 1835, the same year that he was promoted to full professor and dean of the physico-mathematical section of the faculty, Sergei Grigorevich Stroganov became trustee[74] of the Moscow educational district. The latter, one of the largest landowners of the realm and an intimate friend of Tsar Nicholas I, had been previously appointed by the Tsar to conduct a secret investigation of "that nest of sedition," Moscow University, after the failed attempt at a *coup d'etat* upon the accession of Nicholas I in 1825 December. So he could not but look with a degree of suspicion at a leading member of the faculty with such a low social origin.

F3 In the spring of 1824 Perevoshchikov urged the university council to commit to the construction of an observatory,[75] and in the same season asked for and received permission to travel to Dorpat, where he consulted personally with Struve regarding the details[76] of the planned facilities. War, with Persia (from 1826 June until 1828 February) and with Turkey (from 1828 April until 1829 September), as well as an outbreak of cholera, delayed the completion of construction until the end of 1831. Meanwhile, at the end of 1829 and the beginning of 1830, Perevoshchikov traveled to Mitau (to consult with Paucker)[77] and

[72] Reich and Roussanova, 2013, pp.311-312. Simply to observe the latitude of the observatory at the Mitau gymnasium — which involved exact measurement of the altitude of Polaris, Paucker announced a program of observation, but in 1824 June asked the secretary of the Academy, Nikolaus Fuss, not to publish his results, since he was uncertain of their accuracy. In 1826, the observatory received an instrument from the prominent German firm of Reichenbach and Ertel so that the basic measurement of the latitude of the site appeared in 1829 in the German-language astronomy journal *Astronomische Nachrichten*.

[73] The conflict between the two received the attention of the Soviet historian of astronomy, S. N. Korytnikov, who in 1956 devoted a long and unusually analytical — especially for that era's historical works, so frequently composed of encyclopedic surveys — article to the conflict: "Ukhod D. M. Perevoshchikova iz Moskovskogo universiteta," *Istoriko-astronomicheskie issledovaniia*, 1956, *2*:189-213. A. V. Bugaevskii in 1983, long after Sokolovskaia's volume, narrated the struggles of Perevoshchikov to arrange for an observatory at Moscow University: "Istoria osnovaniia astronomicheskoi observatorii Moskovskogo universiteta," *Istoriko-astronomicheskie issledovaniia*, *16*: 17-38. F. G. W. Struve's influence and authority make frequent appearances in both accounts.

[74] The trustee, or, as it is sometimes rendered, curator, of a school district was an appointee of the tsar; the rector of a university was elected by the members of the faculty.

[75] The 1824 proposal, from the university trustee to the Minister of Education, spoke of replacing the observatory burned in 1812, during the Napoleonic occupation of the city. Bugaevskii points out (p.26) that there certainly was no observatory at that time, citing Drashusov's comment of 1855, that in 1812 a room in the house of the rector of the university held a telescope; The point of the misreprentation, Bugaevskii concludes, was to convince the central government to commit funds to the project, represented as a reconstruction rather than a new installation.

[76] From the striking similarities between the layout of the Dorpat and the Moscow observatories, Bugaevskii considers it highly probable (p.24) that Struve's suggestions for the plan had already been adopted prior to the consultation by Perevoshchikov with the government architect.

[77] It was during this visit that Paucker did Perevoshchikov a great favor. The Ministry of Education had proposed one cost-saving adjustment after another (asking that the observatory be built of wood; not

Dorpat (to see Struve once again) in order to receive advice on the proper instrumentation for the observatory

F4 In the summer of 1830 Struve, who had already published 2 full-scale catalogs of double stars observed from Dorpat Observatory, suggested Perevoshchikov could equip the Moscow establishment with 10,000 rubles; however, upon the submission of this agreed-upon plan to the Ministry of Education, the resulting order was that Moscow University — not the Ministry — ought to spend the money for the desired instruments as the funds became available.[78] When Struve, by contrast, having ordered instruments which Perevoshchikov could not hope to afford, returned from a trip to a personal interview with the tsar, the entire budget for Dorpat Observatory was quadrupled on the spot.

F5 At 1832 September's end, Perevoshchikov presided over an inspection of the new institution by Minister of Education S. S. Uvarov and the recently-elected Academician F. G. W. Struve. It was not long after this ceremonial installation that university trustee S. G. Stroganov began over Perevoshchikov's consistent, vigorously expressed opposition, to prepare A.N.Drashusov for appointment[79] as astronomer at Moscow University.

F6 In contrast to the "adamantine man of integrity"[80] Perevoshchikov, with his scientific position quite independent of political influence, Drashusov's father enjoyed a personal friendshiop with Tsar Nicholas I; he was selected in 1836 December to travel abroad for advanced studies in astronomy by Minister of Education Uvarov in spite of Perevoshchikov's opposition. Even though he was elected rector of the university in 1848 February and Stroganov resigned as university trustee in 1847, Perevoshchikov by 1850 January was writing to Struve to report that the new trustee of the Moscow educational district, V. I. Nazimov, refused him permission to loan a transit instrument to Struve for the purpose of an international measurement of the global meridian, or to pay for its adaptation.[81] Perevoshchikov was clear about the sources of the refusal. As he wrote, Drashusov — who that year had taken his doctoral degree at Kiev, also over Perevoshchikov's opposition — "is attempting by every means at hand to prevent the dispatch of the apparatus to Sweden." The historian Korytnikov writes that "A growing tension with Drashusov runs like a red thread through Perevoshchikov's correspondence with [F. G. W. Struve's new observatory] Pulkovo during 1850."[82]

F7 Despite Perevoshchikov's appeal to the Academy of Sciences to remove Drashusov from his position of interference, an appeal which received the full support of Struve, and despite a personal inspection, followed by the Ministry of Education's judgement, that

providing money for a building site suitable for astronomy), and in 1829 it suggested that a meridian circle, offered for sale by the widow of a Riga gymnasium instructor, be purchased as the main research telescope. Perevoshchikov agreed to the arrangement, but Paucker, upon having examined the instrument in person, judged it too far out of alignment to be of use.

[78] According to Bugaeskii (p.34) the purchase of a scaled-down set of instruments eventually cost over 12,000 rubles.

[79] Perevoshchikov already had his own candidate for the position: Nikolai Efimovich Zernov, the son of a postal officer. After taking his undergraduate degree at the university of Moscow in 1922, Zernov, at Perevoshchikov's urging, took a master's degree in astronomy, on a subject put forward by the latter, and in 1832 he was appointed astronomer-observer at the university observatory. Passed over for the position of astronomer, Zernov succeeded in obtaining the appointment of professor of mathematics at Moscow University.

[80] The description is that of Count A. N. Fanin, recalling in 1880 his impressions of the University of Moscow of 1830, in *Russkaya starina* cited in Korytnikov, p.194. He was also a political nonconformist: while Korytnikov states only that Perevoshchikov had friends on the staffs of the 2 leading progressive opposition literary journals of the late 1840s and early 1850s, a more recent Soviet authority states he wrote articles for them. Kochinskii *et al.*, p.249.

[81] F. G. W. Struve appealed successfully to the Minister of Education to override the refusal.

[82] Korytnikov, p.205. Perevoshchikov was convinced that Nazimov's opposition was a result of ignorance, and that behind the effort stood Drashusov. According to Korytnikov, Stroganov was covertly assisting Drashusov.

Perevoshchikov's responsibilities were competently being fulfilled, in 1851 the university trustees dismissed Perevoshchikov and appointed Drashusov professor of astronomy at Moscow University and director of the observatory[83] that Perevoshchikov had founded. For our purposes, however, the striking aspect of the affair is that F. G. W. Struve, in his capacity of the chair of the commission of geodesy of the Russian Geographical Society, appointed Drashusov in 1847 as the astronomical specialist on a Society expedition to Siberia.[84] With the observations taken on that expedition Drashusov later produced one of his few published scientific articles. Despite, in other words, Struve's vivid awareness that a junior astronomer was engaged in a destructive campaign against a close and valued colleague, he remained open to assisting the career advancement of that very same junior astronomer.

F8 That particular institution, the Russian Geographical Society, was founded, and at first dominated, by Russian scholars of German origin (including Struve himself); however, it soon became popular as a center for the group of younger scholars and civil servants studied by W. Bruce Lincoln,[85] the "enlightened bureaucrats" of the Nicolaevan regime. Further evidence of Struve's capacity for adaptation to native Russian sensibilities appears from the 1859 election of new officers to the Society: Russian scientists took control of all significant posts previously held by ethnic German scholars, with the sole exception of Struve's. Even among a group of assertive ethnic Russians, Struve's authority and flexibility toward his imperial environment sustained his eminence.

F9 Struve did not always get his own way: in the matter of a successor to his position of director of the Dorpat University Observatory, the university council declined to ratify his choice — an Estonian — preferring the judgement of the world renowned Karl Friedrich Gauss [⊙20], who suggested a Berlin-based astronomer.[86] Prior to this bureaucratic setback, Sokolovskaia quotes Struve as presenting, and praising, Johann Heinrich von Mädler's work to the St.Petersburg Academy of Sciences; after Mädler's assumption of Struve's former post, she details (somewhat ideologically — Mädler is described at one point as "reactionary")[87] his strong exception to his proposal of a rotating Milky Way, containing a central source of gravitational attraction. Struve's opposition extended to denying Mädler, who had membership in several foreign academies, membership in the St.Petersburg Academy,[88] even though Struve's predecessors in the post, and Mädler's successor there, were so honored.

G Biographies

G1 The Batten and Sokolovskaia biographies of F. G. W. Struve have the strengths and limitations of their authors: Batten excels in describing the international and scientific

[83] Korytnikov can cite several primary sources which indicate that Drashusov and Stroganov initiated the decision to remove Perevoshchikov, but then admits that, once the decision was appealed to Tsar Nicholas, he cannot say what moved the Tsar to approve.

[84] Sokolovskaia, pp.174-177. While Sokolovskaia devotes a chapter to Struve's work in the Russian Geographical Society, Batten does not mention it.

[85] W. Bruce Lincoln, *In the Vanguard of Reform: Russia's Enlightened Bureaucrats, 1825-1861*, DeKalb, Northern Illinois University Press, 1983, 297pp.

[86] See Karin Reich and Elena Roussanova, "Friedrich Gauss' Correspondents in the Baltics," https://www.ies.ee/iesp/No9/articles/12_Reich_Roussanova.pdf, consulted 2021 October 5. Although the authors describe Karl Eduard Senff, without qualification, as "an Estonian", he was an ethnic Baltic German, son of the Dorpat University drawing instructor, and had an advanced degree in mathematics from the University of Königsberg and a 2nd one, in astronomy, from Dorpat. https://www.muuseum.ut.ee/vvebook/pages/4_4.html, consulted 2021 2021 October 5.

[87] In Soviet parlance this term is used exclusively in its political connotation. It is to be noted that the Struve-Mädler *contretemps* goes without mention in the Batten biography.

[88] Mihkel Joeveer, "Mädler, Johann Heinrich von," pp.723-724 in Thomas Hockey, ed., *Biographical Encyclopedia of Astronomers*, Springer, 2007. "He was not appointed to the Saint Petersburg Academy because his relations with the influential academician Struve were not good."

context of Struve's career, while Sokolovskaia is superior in picturing Struve's place within the astronomical community of Imperial Russia. Taking the two of them together, one gains a deeper view of a giant of 19th century astronomy than has ever been available in English, or in any other language. Either of them, however, excels in balance and reliability the 2 works which have appeared since 1988, and to which I now turn.[89] Simon Werrett's 2010 contribution to the collection *The Heavens on Earth*,[90] "The Astronomical Capital of the World: Pulkovo Observatory in the Russia of Tsar Nicholas I", and Konstantin Vladimorovich Ivanov's 2008 monograph, *Nebo v zemnom otrazhenii*[91] both take Struve's work in the science of astronomy as peripheral to their central interest (even though Ivanov's volume bears the subtitle "The history of astronomy in Russia in the 19th and early 20th centuries"), which is, for the former, the value of a prestigious scientific institution, and for the latter, the state's interest in astronomically precise cartography. Both are centrally concerned with the reason for the lavish financial support provided for astronomy by the imperial government of Russia.

G2 Werrett's brief treatment[92] has the grace, that it concedes a value to the excellence of astronomical research conducted at Pulkovo: to the extent that there were a series of internationally recognized investigations performed by its staff, Werrett states, the institution successfully performed the function for which it was created. However, and this is his main finding — the concentration of financial, scholarly, and instrumental resources towards Pulkovo were such that the university astronomical observatories around the country were starved of the support necessary to conduct significant research. Along the way he describes the institution at Pulkovo as intended to "create an imperial astronomy," by which he means a center of "surveillance technology" similar to the telegraph and railroad.[93] The fact that

[89] Full disclosure: as with Alan Batten and Zinaida Sokolovskaia, so with Simon Werrett and Konstantin Ivanov — my relations with the 4 authors have been nothing but cordial, amicable, and positive. I wrote a brusque note to Werrett accusing him of shortchanging the Romantic inclination of 19th century Russians, and he responded in friendly defense of his point of view. Konstantin Ivanov, for his part, whom I've met in person, went out of his way to make available to me recent numbers of the flagship history-of-astronomy journal of the Russian Academy of Sciences, *Istoriko-astronomicheskie issledovaniya*. I am a friend to Plato, but a greater friend to truth — as Newton once wrote in his student notebook (and which Gale Christianson, in his 1996 biography of Newton, identified as a "revolutionary doctrine": in my review of the book, I pointed out that it had long been a common Latin-language tag, *Amicus Plato sed magis amicus veritas*, commonly attributed to Aristotle). All of the people reviewed here have been nicer to me than I have been to them.

[90] David Aubin, Charlotte Bigg, and H. Otto Sibum, eds., *The Heavens on Earth. Observatories and Astronommy in Nineteenth Century Science and Culture*, Durham, Duke University Press, 2010.

[91] Konstantin Ivanov, *Nebo v zemnom otrazhenii. Istoriya astronomiya v Rossii v XIX — nachale XX veka*, Moscow, Territoiya budushchego, 2008, 480pp.

[92] 19 pages of text.

[93] Werrett, pp.37-38:

> [Tsar] Nicholas I showed much interest in developing technologies of surveillance. Members of the Academy of Sciences at St.Petersburg eagerly helped. Moritz Jacobi designed electomotors to power Russian naval vessels and with Pavel Schilling devised an electric telegraph in the 1830s. Demands for militarized order also led to improved communications, with the construction of Russia's first solid roads in 1834 and its first railway in 1837, intended to accelerate troop movements. Astronomy could also improve imperial surveillance.

If the motive for developing more efficient motors for naval vesels, and roads and railroads in European Russia in the 1840s was indeed "surveillance", the reader might be led to concede the somewhat fantastic conclusion that "Astronomy also could improve surveillance." But — is it true that roads and railroads were "intended to accelerate troop movements"? Other, economic motives were dominant in Western Europe and the U. S.; one would like to know why they were not dominant in the Russian Empire, as well.

Werrett provides a reference — Richard M. Haywood, "The 'Ruler Legend': Tsar Nicholas I and the Route of the St.Petersburg-Moscow Railway, 1842-1843, *Slavic Review* (1978), *37*:640-650, which

uniformed military veterans performed a great deal of the work of maintaining and operating the machinery of the observatory underlined, for Werrett, the military significance of the observatory, since it ran on strictly disciplined lines. He quotes the British visitor Piazzi Smyth, whose account features prominently in Batten's description of Pulkovo as well (although Batten takes care to critically remark on Smyth's tendency to quote long passages of conversation as if he remembered them verbatim); the soldiers offering "support" to the astronomers at the observatory made it "a small-scale model of order which was supposed to characterize [Tsar] Nicholas' empire."[94] From the point of view of the advancement of science, too great a degree of order and discipline may stifle the imagination and innovation present in effective scientific research, but Werrett is clear: "Pulkovo was a spectacle, but a spectacle productive of first-rate science."[95]

indeed discusses in detail the reasoning behind the route taken by the first significant railroad construction in Russia. It does mention troop movements at one point. But it contains this summation (p.643) of motive:

> The arguments that were to recur until the final decision was made centered on the potential economic usefulness of the railway along one route or the other, on the comparative costs of construction and of operation and maintenance, and on the related cost to shippers and passengers. It should be noted that little consideration was given to the possibility that the railway, if built via Novgorod, would serve to develop the economy of that town. **The emphasis was always on ascertaining how well the railroad would serve existing economic needs and how much revenue could reasonably be expected.** [boldface added]

To leap, from a parenthetical comment that troop movement would proceed more rapidly on a railroad which went on a straight path, to the statement that the construction of the railroad itself was "intended to accelerate troop movements" is the sort of special pleading and summary judging that is characteristic of the rest of Werrett's discussion. He never does explain how the study of stellar astronomy "could improve surveillance". Indeed, in a work published a few years after Werrett's unbalanced presentation, Alfred J. Rieber, advertised in the blurb as "a premier historian of Russia," made clear that railroad construction in the Russian Empire, even during the decade following the humiliating defeat of the Crimean War (that is, in the 1860s, reflecting the urgent need for industrial-scale & speed of troop movements), was almost exclusively driven by economic imperatives. See chapter 7, "Origins of the Reutern System," pp.199-234 in Part 2, "Cultural Transfer, Interest Groups, and Economic Growth," in *The Imperial Russian Project, Autocratic Politics, Economic Development, and Social Fragmentation*, Toronto, University of Toronto Press, 2017.

[94] Werrett, pp.49-50.

[95] *Ibid*, p.51. The admission, however, is only a grudging one. In his final passage Werrett suggests that, with the 1855 death of its lavish patron Nicholas I, the 1860s witnessed the decline of Pulkovo. "So the reign of Pulkovo as the astronomical capital of the world was not to be a long one, though the observatory did have a measure of success into the twentieth century. Its real fortunes were bounded by the life and enthusiasm of Nicholas I and the emperor's dual concerns for surveillance and spectacle." The reference provided here is the brief note by the professioal astronomer Kevin Krisciunas, "The End of Pulkovo Observatory's Reign as the 'Astronomical Capital of the World'," *Quarterly Journal of the Royal Astronomical Society* (1984), *25*:301-305, the abstract of which states, "By the beginning of the twentieth century . . . Pulkovo no longer reigned as the 'astronomical capital of the world'." In other words, as proof that the reign of Pulkovo was "not to be a long one" a work is cited which situates the end of its reign at around 1900. How is a reign from 1839 to 1900 not "long"?

Four years later, Krisciunas returned to the topic of Pulkovo in his book, *Astronomical Centers of the World* (Cambridge, University of Cambridge Press, 1988), pp.99-120 of which were devoted to the history of that observatory from its founding until 1895. He demonstrated that the results of measurements made at Pulkovo during that time are almost coincident with the currently accepted values of nutation, aberration, and precession, "Thus it was," he summarizes (pp.111-112), "that the fundamental constants of positional astronomy required for the production of star catalogues of the highest precision, were all determined very accurately at Pulkovo." As for financial support for advanced instrumentation, Krisciunas cites primary sources describing Otto Struve's request for, and approval of, the equipping of Pulkovo with a 30-inch, U. S.-made refractor, once again coming into possession of the largest refracting telescope in the world. This saw first light in 1883, 28y after the

G3 Konstantin Ivanov's contribution to the history of Russian astronomy comes with the highest of endorsements: its 2 editors[96] are A. A. Gurshtein, president of the Commission for the History of Astronomy of the International Astronomical Union, and I. N. Yurkin, a lead scientific associate of the Institute for the History of Science and Technology of the Russian Academy of Sciences, of which Ivanov is himself a member. We have reason to expect an amply-documented, erudite examination of its topic.

G4 Indeed, the perspective of the pursuit of science in the course of the 19th century from the point of view of what is now regarded as "applied" has long been recommended. The leading U. S. historian of science of his generation, Nathan Reinold, leavened his 1964 account[97] of a visiting astronomer from the United States who was at Pulkovo during the U. S. Civil War with a warning of the distortion our histories of science impose upon 19th century studies by unthinking attribution of a separation, so evident nowadays, between "pure" science and its associated "applied" extensions. Astronomically determined geodetic surveys were an essential part of contemporary astronomy in the Russian empire. Vikentii Karlovich Vishnevskii, F. G. W. Struve's senior Academy of Sciences colleague in astronomy, spent his summers during the years 1805-1815 astronomically determining precise co-ordinates of 223 locations, from Libau on the Baltic to Sverdlovsk in the Ural Mountains.[98] Johann Sigismund Huth, when in 1808 he served as professor of astronomy at Kharkov, proposed a meridian measurement for both pragmatic and scientific reasons.[99] And of course Struve himself was engaged, throughout his career, in trigonometric surveys, from the province of Estonia to the North Cape of Norway, to the mouth of the Danube.

G5 Unfortunately, the 100 pages of Ivanov's book devoted to the history of astronomy in Russia during the 19th century, with the practical astronomy enterprise of trigonometric surveys as a central focus, cannot be described as a sober contribution to understanding, but constitutes an unpersuasive effort at mimicking postmodern histories of science in English, stating a thesis in complex, almost inscrutable language and cherry-picking isolated examples to illustrate, rather than persuade what the reader is urged to believe.

G6 Thirty-four pages preface any mention of the topic at hand: rather the book begins with a somewhat repetitive statement of "methodology" which promises never to take historical speakers at their word, since they are by definition unaware of their surroundings: social, economic, and institutional environments which unavoidably color their perceptions.

death of Nicholas I. All of this speaks strongly against Werrett's thesis.

[96] *Retsenzenty*, literally, means "reviewers", but in this context refers to the function of someone who reads and approves for publication, which in English is called editing.

[97] Nathan Reingold, "Cleveland Abbe at Pulkowa: Theory and Practice in the Nineteenth Century Physical Sciences," *Archives international d'histoire des sciences*, vol.17 (1964):133-147. Reingold was a singularly cordial man: he greeted me in 1976 with the words "Hi, I'm Nathan Reingold. Call me Nate."

[98] Kolchiski *et al*., *op.cit.* [fn 22, above], pp.64-65. N. P. Erpylev, "Razvitie zvezdnoi astronomii v Rossii v XIX veke," *Istoriko-astronomicheskie issledovaniya* (1958) *4*:13-252, pp.49-50. Even though Ivanov is asserting the predominant role of trigonometric surveys, he mentions Vishnevskii solely with respect to his connexion with Struve — once, in a footnote which claims that Struve dominated the committee which planned the construction of Pulkovo, and once in passing, that Perevoshchikov consulted both Vishnevskii and Struve (among others) in the planning of the observatory at the University of Moscow.

[99] "I have no idea when a detailed measurement of the meridian will be conducted in Russia — perhaps never — but if one is carried out here at Kharkov it will generate a whole series of advantageous consequences that will accrue to the scientific and scholarly leadership of our university (inasmuch as the other European nations pride themselves in having taught us the techniques of measurement): that of promoting mathematical knowledge in the neighboring provinces as well as within the nation as a whole, and that of developing the capacity for exact measurement." G. V. Levitskii, "Astronomy i astronomijcheskaya observatoriya Khar'kovskogo universiteta ot 1808 po [sic] 1842 god," *Uchenie zapiski Khar'kovskogo universiteta*, 1893, pp.12-13, cited in G. P. Loginova and V. G. Selikhanovich, *Alexsei Nikolaevich Savich*, Moscow, Nauka, 1967, pp.113-114.

Not only are Norbert Elias, Michel Foucault, Emil Durkheim, and Pierre Bourdieu cited in the course of this statement of epistemological aims and procedures, but Ivanov advises the reader of the main ideas of the works and provides quotations. It does not appear to concern our author that all of these authorities are sociologists rather than historians. The upshot is hardly objectionable, in terms of method; so, for example:

> Modern historiography takes it as a fundamental posture [polozhenie] that the position of author of an historical study ought not exactly to coincide with the positions that the participants in the historical process have themselves taken.[100]

Although the company surrounding these statements makes one pause.

G7 Once we begin the examination of the 19th century, and Russian astronomy of that time, Ivanov unveils a stranger and more unlikely framework. Six different studies, all in English, talking about English court astronomers, grace the very first footnote, to the statement that Russian astronomical establishments of the 19th century were built on the model of Western European courts of the 16th and 17th centuries. Turn the page, and we find 4 more English-language sources discussing topics of those times and places remote from Gauss, Bessel, and Struve.[101] There's a delay, our author tells us,[102] between the civilization, apparently including but not explicitly stated as such, the study of science, of Western Europe and that of Russia. No evidence is adduced to establish the truth of the assertion, that the model for 19th century Russian astronomical institutions and organizations in general, and Struve's Pulkovo Observatory in particular, is to be found 200^{y} earlier and 1300 miles to the west.

H Uvarov Advances Russian Science

H1 The fact that while S. S. Uvarov served as president (that is, from 1818 until 1849) of the St.Petersburg Academy of Sciences, out of 46 members raised to the dignity of member, 23 were non-Russian, and that "the academy thus retained the 'German flavor' that it had possessed since its foundation and that the tsar apparently disliked," the fact that German philosophy, German instrumentation, German scientific investigations were crucial and central to 19th century astronomy in Russia — is not addressed.[103] There is instead a

[100] Ivanov, *op.cit.* [fn 91, above], p.15. A reading of Herodotus or Thucydides among the Classical Age Greeks, or Guicciardini among historians of the Renaissance, would have provided a wealth of examples of just that practice.

[101] We learn from the footnote on this page that the classic study by Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*, which appeared in English in 1972, has been translated and published in Russian in 2002-2004. The mind reels at the task of seeing the relevance to Russian astronomy of the 19th century.

[102] Ivanov, p.39.

[103] The numbers are from pp.712-718 of K. V. Ostrovitianov, ed., *Istoria Akademii nauk SSSR*, Moscow, 1964, cited in and its significance explained in Cynthia H. Whittaker, *The Origins of Modern Russian Education. An Intellectual Biography of Count Sergei Uvarov, 1786-1855*, Dekalb, Northern Illinois University Press, 1984, p.188. Rather than giving my own estimate of this contribution to Russian historical scholarship, I quote the review in the premier U. S. scholarly journal devoted to Russian history, *Russian Review* [vol.45, No.1, pp.75-76], by James T. Flynn, himself the author of *The University Reform of Tsar Alexander I*:

> On the universities, the subject nationalities, and possibly other topics as well, there remains much room for debate. Nonetheless, no participant in such debates will be able to proceed without careful consideration of what Whittaker has to say, for her work is so richly informed and cogently argued that more often than not it will provide the benchmark from which others' discussions proceed. Perhaps more important, there are ways in which Whittaker's book ends discussion. She has demonstrated beyond possibility of debate that the traditional picture of Uvarov the reactionary is simply

type of language that leaves the reader wondering what has been said:

> Around this time there was formed a particular kind of relationship characteristic of the entire course of the nineteenth century, with an established set of priorities dividing the spheres of professional competence and administrative influence between the representatives of scientific astronomy and those of general administration. Such an arrangement of research work made it possible, on the one hand, to use the influence of state institutions to develop useful (from the point of view of government officials) forms of knowledge and, on the other hand, to allow the assertion of the relative autonomy of researchers within their own professional fields.[104]

Setting aside the problem of precisely who "use[d] the influence of state institutions to develop useful forms of knowledge" — "useful from the point of view of government officials" well predated the 19th century, when as far back as the 1720s the remit of the member for astronomy of the Academy of Sciences had been to help develop accurate maps of the empire: he was simultaneously director of the Academy observatory and head of its geography department, commissioned to produce an astronomically accurate map of the country.[105] He fell afoul of court intrigues, admittedly, but court intrigues remained a danger at every point of the history of science undertaken in Russia. This was certainly true during the 19th century. In 1821, under pressure for his progressive views, S. S. Uvarov resigned as curator of the St.Petersburg School District, retaining his position as president of the St.Peterburg Academy of Sciences. Four of the professors he had appointed were then condemned by the Central School Board,

> Galich, for instance, stated in his lectures that philosophy provided the methodology and insights necessary for investigating and understanding religious truths; however, he asserted, it could not fathom all the secrets of the human condition because "the source of all existence is God". For those who believed that the sole principle in education was faith, these teachings were blasphemous. Hermann and his disciple, Arsenev, believed that statistics should not be taught as the memorization of facts but as a method for probing and analyzing a nation's economy, finances, and politics, which critical spirit was considered "dangerous". Hermann and Arsenev were also indicted for the assertion that free laborers were more productive than bonded serfs. In politics they agreed that monarchy, in particular the British model, was the best form of government, but were condemned for pointing out that monarchs were not "angels" and were therefore susceptible to human error. Raupach taught world history and was a well-known German dramatist with a doctorate in theology. He was accused of leading students to atheism and materialism because he contended that pagan theogony contained elements of the Jewish and Christian religions. His "disrespect for religion" was also "proved" by his mention that abuses did indeed exist in the Church at the time of the Reformation.[106]

This is very far from the "assertion of the relative autonomy of researchers within their own professional fields." It was during this very period, while political reactionaries were demanding dismissal for professors who denied that monarchs were angels, that the overriding reason why Struve suffered no such indignity at the Dorpat University Observatory was due to Dorpat School District curator Karl Lieven and his solid court connexions:

> Addressing the faculty at the opening of the academic year in September 1817, Lieven called for not only "academic training, but also the moral formation which can prepare [students] to be responsible servitors of tsar, state, and mankind . . . ." By 1818 spring he successfully obtained a completely new budget for his university that nearly tripled the total, and more than doubled the income of professors. Shortly, he began work on a new statute . . . . In January 1820 Lieven submitted to the Main School Administration of the Ministry his proposed new statute. At the same time that the statute proposals made by Uvarov for St.Petersburg were subject to vicious criticism, and never did gain adoption,[107] Lieven's very similar proposal easily passed, confirmed into law by the Tsar in June 1820 . . . . [A few years later] Lieven warded off a serious effort to limit the academic freedom of the university by the provincial governor, Paulucci.[108]

Later (p.93) Ivanov backtracks somewhat on this "relationship . . . of established sets of priorities" said to be "characteristic of the entire nineteenth century", and invokes the same century as "a series of reforms followed by periods of reaction." As he approaches his main subject, the advance in the role of astronomy in Russia that took place during the years of revolutionary change, the narrative sets aside this theme of "salon science" supported by "powerful patrons" for the purpose of "sophisticated entertainment" adopted after the examples of Louis XIV of France and Charles II of England,"[109] and talks more cogently

wrong.

Ivanov could not possibly have been unaware of the existence of this work; 5^{y} prior to *Nebo v zemnam otrazhenii*, in an article devoted to "government policy with respect to science within the Imperial Academy of Sciences in the first half of the 19th Century," M. F. Khartanovich cited Whittaker's work twice, once in Russisn translation (dated 1999) and once in the English original. See Zh.I.Alfyorov, ed., *Akademicheskaya nauka v Sankt-Peterburge v XVIII-XX vekakh*, Sankt-Peterburg, Nauka, 2003, pp.171-190. Yet it appears in neither the index nor the bibliography. And, as we shall see, its evidence is ignored.

[104] Ivanov, p.38.

[105] Joseph-Nicolas Delisle, the Academy's first astronomer, held that position between 1725 and 1747, although he was relieved of the direction of the Geography Department in 1740. A recent survey of his correspondence is Eric Chassefière, "Obstacles encountered by four major European astronomical observatories belonging to academies in the 18th century," *Journal for the History of Astronomy* (2021), *52*(4):414-441.

[106] Cynthia H. Whittaker, "From Promise to Purge: the First Years of St.Petersburg University," *Paedagogica Historica* (1978) *18*(1):148-167, quote on p.164. Uvarov protested vociferously. In a personal letter he hand delivered to Alexander I (the reigning Tsar, who appointed and maintained him as president of the Academy of Sciences):

> If one said that in the middle of the nineteenth century, in the twentieth year of the reign of Your Imperial Majesty, thirty paces from Your royal lodging, one dared to deploy in the middle of the night a dangerous apparatus, to compromise the honor of an institution created by Your Majesty, to threaten to make soldiers of peaceful students, to speak of prison and Siberia, to take derisive oaths; if one adds that all these scandals took place in a procedure established by the University council in which everything including human respect was violated — would not one be right in asking from whence comes this prodigious passion in preventing the free and legal development of the defense of the professors' rights up to the throne of Your Majesty? (*ibid*, p.165)

[107] They not only were not adopted, but within 1^{y} their critics succeeded in getting Uvarov to resign.

[108] Flynn, *op.cit.* [fn 29, above], pp.124-125. The budgetary increase obtained from Alexander I by Lieven was from 120,000 rubles, the budget since 1802, to 337,710 rubles. Friedrich Busch, *Der Fürst Karl Lieven und die Universität Dorpat unter seiner Oberleitung*, Dorpat, E.J.Karow, 1846, p.39.

[109] Ivanov, *op.cit.*, pp.37-38; 46-47. In the first pages (412-413) of his Conclusions, Ivanov repeats the interpretation of the origin of Pulkovo Observatory as a step toward the bureaucratic pursuit of scientific research, one connected to the centralization of the topographic determination of the territory of the Empire, but does not mention the patronage-client relationship which he deems central to creation of Pulkovo in the chapter before us.

about specific actions by individuals within Russia. The history of astronomy in the 19th century, unfortunately, occupies in this monograph the position and significance of a straw man invoked in order to display more dramatically the changes wrought by the Bolshevik seizure of political, social, and economic power.

H2 Lacking competence in 20th century Russian history, let alone in the history of Russian astronomy of the period, I look forward to learning more about the subject from Ivanov's treatment, while remaining wary of his tendency to apply an unpersuasive (frequently unreasonable) framework. A striking example appears in Batten's biography, using Struve's discussion of his (and General Karl Tenner's) meridian measurement.

> Results of other surveys in Lapland [Russia's Kola Peninsula (& northern Scandinavia)] had been published in 1738 by the French astronomer Maupertuis and in 1805 by the Swedish astronomer Svanberg. These gave discordant results for the length of a degree in those latitudes, and von Lindenau, director of the Seeberg Observatory, proposed in 1814 to the chief of the Imperial General Staff, Prince Volkonskii, to measure an arc as far north as possible on the coasts of the White Sea [enclosed by the Kola Peninsula], to resolve the discrepancy (as Wilhelm [Struve] later did). Volkonskii at first agreed, subject to the Tsar's approval, but when Lindenau insisted on using exclusively instruments made by [the Munich, Bavaria instrument-maker] Reichenbach, the Prince refused to recommend the project until all instruments required were made in St.Petersburg.

The head of the Imperial General Staff[110] in the midst of the campaign against Napoleon might be excused for an inappropriate hostility to foreign astronomical instruments. Batten continues directly,[111]

> Ironically, Wilhelm [Struve] learned this story from Lindenau himself when they met in Gotha in 1820 as Wilhelm was returning home from Munich — where he had ordered a Reichenbach meridian [transit] circle for Dorpat, to be used in his own geodetic work.

Please note the frame here. The incident is not very important, however striking the irony is, but Batten provides a background to the offer by Lindenau and mentions the connexion to the triumph of Struve's and Tenner's massive meridian measurement.

H3 Here, by contrast, is how Ivanov treats the same item:

> ["Toward the end of the 18th century."] A negative attitude towards too strong a seigneurial dependence begins to form and, accordingly, there arises the need for an anonymous source of authoritative influence — an institutional mechanism that would average the individual predilections of specific rulers and leave them with only the function of compensation for material costs. In other words, in the intellectual field instances appear that are homologous to the political conjuncture of the bureaucratic environment, instances in the process of forming a new type of relationship between knowledge and power.[112] The right to speak the truth, granted by the patronage of a wealthy and powerful sovereign, is replaced by evaluative procedures conducted by various forums and councils, consisting of representatives of various, nominally uninterested parties, focused not so much on a long (and, in fact, insoluble) dispute, but on more or less controlled consensus.
> This gives rise to new ideological oppositions. For example, dependence on a specific person begins to be interpreted as an interest detrimental to objective research. Conversely, the impossibility of isolating an unambiguously definite individual center in the machine of the bureaucratic apparatus creates a positively perceived illusion of the impartiality of research conducted by this anonymous performance.[113] At this time the strategies of individual lobbying begin to be considered insufficiently reliable. In particular, the success of geodesic undertakings begins to be determined not so much by orders from higher authorities as by the balance of relations [konyunkturoi otnoshenii] between various rival groups interested in securing the optimal arrangement [stsenariya] for themselves of the implementation of geodetic and cartographic work. Let us note simply one of numerous examples. In 1814 the director of Seeberg Observatory, Lindenau, proposed to Prince Volkonskii . . . [there follows the narration of the incident][114]

[110] The Russian-language Wikipedia credits Vokonsky with founding the institution of the Imperial General Staff, incidentally. He was head of the Military Topographic Department between 1816 & 1823: that is, he did not head the military service devoted to topographic measurement when he turned down Lindenau, but he did run the service when Struve ordered a Reichenbach instrument for geodetic use.

[111] Batten, *op.cit.*, p.37. The Seeberg Observatory is in central Germany in the city of Gotha.

[112] Ivanov loses me too at the "political conjuncture of the bureaucratic environment", but that's what it says in Russian. This is just one of many like passages.

H4 In other words, when we encounter the exact same incident in Ivanov's work that appeared in Batten's[115] the frame — given above with surely sufficient context — soars into the empyrean, full of abstract entities and passive constructions, and when it comes to specifics the author is certain that Volkonskii's refusal reflects "not so much orders from higher authorities" as "the balance of relations between various rival groups", when the overwhelming likelihood is exactly that it does reflect a higher authority, an authority approached, not because he was the official in charge of cartography — he assumed that office 2^y later — but because he was an intimate of the Tsar, and his recommendation was very likely to be accepted simply because he was the one making it.[116]

[113] A footnote here directs the reader to the previously cited (by Ivanov) article by Linda Sarasohn on Thomas Hobbes and the Duke of Newcastle. The time period under discussion is explicitly stated in the previous paragraph, as the end of the 18th century. Hobbes lived 1588-1679, and William Cavendish, the Duke of Newcastle, lived 1592-1676. The reader is expected automatically, at this point, to map 17th century English scientific norms and behaviors onto early 19th Russian ones.

[114] Ivanov, *op.cit.*, pp.49-50.

[115] But not Sokolovskaia's.

[116] Volkonskii was named in 1810 to His Imperial Majesty's Suite, the group of the Tsar's closest military advisors. He accompanied Alexander in 1814 to the Vienna Congress. In a footnote Ivanov makes an effort to explain Volkonskii's decision but his suggestion raises even more doubt in the reader. "This choice," he writes,

> may have been dictated in this case by the cost of geodetic instruments. As a rule, the instruments prepared in the workshops of the Academy of Sciences cost about a third less than imported ones. We have, from the correspondence of the administrative [upravlyayushchii] Chancellor of the Academy I.D.Schumacher to I.K.Kirilov during the first ever surveying of Moscow [in 1733]: "We can in our own workshops produce in two weeks an instrument capable of excellent work, equal to those from England or France, but at considerably less cost. Esling in Berlin sells all sorts of astrolabes for 50 rubles, while we can make clean and serviceable ones for 35." (quoted in L. A. Gol'denburg and A. V. Postnikov, *Petrovskie geodezisty i pervyi pechatnyi plan Moskvy*, Moscow, 1990, p.53).

Johann Schumacher was Peter the Great's personal physician and librarian of the Academy of Sciences: his judgement regarding scientific surveying instruments may be questioned. But the most striking thing about this citation is that it speaks of astrolabes, which are from 20 to 50 miles in error for a terrestrial position, according to specialists; they would be useless in precise geodetic work; indeed, Alexander Vucinich cites F. G. W. Struve as asserting "it was not until 1745 that Russians prepared the first map of their country based on the astronomical determination of longitude." Alexander Vucinich, *Science in Russian Culture. A History to 1860*, Stanford, Stanford University Press, 1963, p.62; for

H5 However disorienting such a presentation is, there follow the long quotation, 3pp later (p.53) in which Struve explains the procedure employed by Tenner and himself of mailing their observations of the meridian measurement to the prominent Prussian and Danish astronomers F. W. Bessel and H. C. Schumacher for a completely independent review regarding their mathematical reduction and concordance: "In this passage one can sense the atmosphere of the intellectual tournaments of the first years of European absolutism." Right after, in words, Ivanov cites a passage for its purported proof of "success . . . determined not so much by orders from higher authority" where the passage instead shows an arbitrary higher authority at work, he follows this strange lack of connexion with a quotation from Struve which displays rather striking "evaluative procedures conducted by various forums and councils, consisting of representatives of various, nominally uninterested parties" [§H3], only to scorn the effort displayed as something out of "European absolutism", which, given the context, is to be considered obsolete![117]

H6 Not only Batten's presentation but also Sokolovskaia's, gives a more balanced and more reliable conception of the relationship between the military cartographers and academic astronomers. Where Ivanov is persistent in speaking of "rivalry" and tension between 2 different institutions of the Nicolaevan bureaucracy, Struve worked intimately and successfully with the military. Sokolovskaia quotes (at that time Colonel, later General) Tenner, writing in 1828 to the head of the Lithuanian military district, as follows:

> During a visit to the city of Dorpat I examined all the results of the meridian measurement in Livonia and found, to my utter delight, that this meridian measurement, in its variety of instruments and in the method of the use by a certain astronomer, Mr Struve, exceeds in my opinion any previously performed meridian measurement. Mr Struve accepted my proposal to join the Lithuanian meridian measurement with the Livonian one and took upon himself the most difficult part of the work required to complete the unification . . . . Astronomer Struve has promised me he will complete all the work for which he has taken responsibility this summer; for my part, I will make every possible effort, within reason, not to fall behind him.[118]

The 2 men collaborated harmoniously for the next 15^{y}, but Ivanov is pleased (pp.73-74) to point out that Struve in the final report damns Tenner with faint praise — which might just have been an accurate critique.

H7 Quartermaster A. I. Verigin, of the Imperial General Staff, reports Sokolovskaia, in 1861 "encapsulated F. G. W. Struve's contributions" in this retrospective:

> On 31 December 1824 Mr Struve, who was at that time professor at Dorpat University, was named instructor of astronomy to the officers of the General Staff and Corps of Topographers. Since that time he has uninterruptedly and with exemplary zeal undertaken to fulfill that responsibility, the observatory in his charge [at the time of writing, Pulkovo Central Observatory] has become the breeding ground of young Russian astronomers whose many useful activities in government and geodetic work give sufficient testimony to the understanding of fundamentals imparted to them by their former professor. In addition to providing the General Staff and Corps of Topographers useful services in the discipline of astronomy. Mr Struve has either by his personal participation or by his sage advice, contributed a great deal to the success of quite a few scientific projects of the General Staff and Military Topographic Office.[119]

astrolabe accuracy see Robin Knox-Johnson, "Practical Assessment of the Accuracy of the Astrolabe," *The Mariner's Mirror*, 2013, *99*(1):67-71, which concludes the accuracy may be as good as 15 miles.

[117] Ivanov speaks on the same page of the "pathos" in the passage he is about to quote.

[118] Sokolovskaia, *op.cit.*, p.272.

[119] *Ibid*, p.148. Admittedly, an encomium of a long-serving colleague near the end of his career

H8 More germane to the purpose of this review is to state clearly, distinct from Ivanov's scheme, distinct, that is, from his image of Nicholas I as seigneurial patron and F. G. W. Struve as successful courtier, an explanation of how and why Tsar Nicholas I in 1839 founded the best-equipped, most lavishly funded observatory in the history of the world. Let us begin with some account of the person who ordered it. In 1825 December, when he ascended the throne following the death of his admired older brother Alexander I[120] he confronted an attempted revolution in the form of 3000 elite Russian troops, led by some of the most highly aristocratic younger sons of the Empire, assembled in the Senate Square near the royal palace, demanding a constitution.[121] They only broke after Nicholas ordered cannon to open fire on them. Nicholas' father, Tsar Paul I, had been assassinated in his bed in 1801 by aristocratic conspirators; investigation — pursued obsessively by Nicholas himself — revealed that the 1825 Decembrists had among themselves prepared to kill Nicholas and members of his family as a part of the planned revolution. No wonder, then, that his biographer writes that "Those who became well acquainted with Nicholas 1 were struck by the disclosure of the other side of his allegedly monolithic personality . . . . In fact, the two were indissolubly linked . . . Nicholas I's insistence on firmness and stern action was based on fear, not on confidence; his determination concealed a state approaching panic, and his courage fed on something approaching despair."[122] He had to find a way to consolidate aristocratic support for the Romanov autocracy.

H9 The legacy of admired elder brother Alexander included an Academy of Sciences in no condition to conduct research[123] and universities in Kazan' and St.Petersburg that had

(Struve died in 1864) is not the place to complain of past differences; however, what is shown is that the military officers were quite pleased, if not grateful — the rhetoric is unreserved in its praise — to have worked with Struve on geodetic projects. It is a data point of Struve's ability to establish and maintain warm and cordial personal and professional relations.

[120] "[I]n the ideology of Official Nationality . . . Alexander I was presented as an ideal Christian as well as a great ruler, Nicholas I himself in particular almost worshipping his elder brother." Nicholas Riasanovsky, *Nicholas I and Official Nationality in Russia, 1825-1855*, Berkeley, University of California Press, 1959, p.115.

[121] When Nicholas sent the Governor-General of St.Peterburg, Count Mikhail Miloradovich, to negotiate with them, the rebels — including their elected leader Prince Yevgeny Obolensky — murdered him. Miloradovich was at the time the most hughly decorated officer in the Russian army. Nicholas commuted Obolensky's death sentence to 25^{y} exile in Siberia, https://en.wikipedia.org/wiki/Mikhail_Miloradovich, accessed 2022 January 15.

[122] Riasanovsky 1959, p.4.

[123] As characterized by Vucinich, *op.cit.*, p.203:

> [The 1803 charter of the St.Petersburg Academy of Sciences] reflected the liberal mood of the Russian government [under Alexander I], but it provided no effective remedy for the ills visited upon the Academy during the troubled 1790s. The depleted libraries and neglected laboratories were not quickly attended to; and the roster of scholars was unimpressive. The rising nationalist tide [what Flynn calls "The Bible Society Decade" in his study of the universities from 1802 to 1835 — MM] discouraged eminent Western scholars from coming to Russia, and the number of outstanding Russian scholars was actually smaller than it had been a generation earlier. Furthermore, despite the promises of this charter, the financial state of the Academy during the first decades of the 19th century was uncertain, largely as a result of the Napoleonic wars, which drained the state treasury of funds that would have otherwise gone to scholarly endeavors. Many Academic institutions could not reverse the process of deterioration, and some, including the astronomical exhibit room, disappeared altogether. The Academy Museum was turned into a warehouse, and most of the other buildings were in need of extensive repair.

The observatory of the Academy of Sciences had been completely destroyed by fire in 1747, and had not been rebuilt. The academician for astronomy used his own room or some high building from which to sight his telescope as the need arose. An alternative, followed by Euler's student Theodor von Schubert, academician from 1789, and from 1803 the head of the astronomical observatory, was to publish solely

been stripped of some of their most prominent scholars, under the Ministry of Education headed by a religious eccentric.[124] Both of these serious failures resulted from Alexander's having "lost interest" in domestic affairs during the last decade of his life, delegating important responsibilities to subordinates incompetent to perform them.[125] Prominent public figures besides president of the Academy of Sciences S. S. Uvarov strongly protested. The Imperial Historiographer since 1803 and the author of an (incomplete, but 12-volume) *History of the Russian State*, Nicholas Karamzin, had for decades[126] insisted that the most effective support of the tsar's rule was a highly educated aristocracy. The Ministry of Education that forced Uvarov in 1821 to resign was for Karamzin, "The Ministry of the Eclipse."[127]

H10 Uvarov couldn't agree more.[128] His first appointments, as president of the Academy of Sciences (in 1818), had been of Karamzin and of the liberal former Romantic physics teacher (temporarily exiled to Siberia) Imperial Secretary to Tsar Alexander, Michael

works of theoretical mathematical astronomy. F. A. Shibanov, "Akademik Fyodor Ivanovich Shubert (biobibliograficheskii ocherk)," *Istoriko-astronomicheskie issledovaniya*, 1972, *11*:237-253.

[124] Almost all of the professors harangued by the Ministry of Education for their lack of sufficient adherence to religious and politically reactionary dogmas, including all of the 4 from the University of St.Petersburg unsuccessfully defended by Uvarov, were subsequently hired by the government in other responsible posts. Grand Duke Nicholas, not yet considered in line for the throne, exclaimed to Uvarov's successor at St.Petersburg University, "We badly need such people, so please throw some more of them out of the university. We have places for them all."

[125] The quote is from Alexander Polunov, *Russia in the Nineteenth Century. Autocracy, Reform, and Social Change, 1814-1914*, eds., T.C.Owen and L.G.Zakharova, transl. M.S.Shatz, Armonk, NY, M.E.Sharpe, 2005, pp.34-35. See also Allen McConnell, *Tsar Alexander I. Paternalistic Reformer*, NYC, Thomas Crowell, 1970, pp.205-211 for a more charitable portrait.

[126] As early as 1792 Karamzin

> argued against Rousseau and proclaimed that "Enlightenment is the palladium of good behavior." More than any other, this treatise was a defense of knowledge and moral standards which, in Karamzin's opinion, were the only means by which man could fulfill his desire to "live calmly and pleasantly." Equating the term "enlightenment" with "education", he concluded that, far from subverting civil order, enlightenment had strengthened [the ruling Russian Empress] Catherine's state.

He repeated the theme that education allowed the Russian autocracy to "function more efficiently" in an 1803 essay, "The Best Way to Have Satisfactory Teachers in Russia," published in his own journal, *Vestnik evropy* (The Messenger of Europe). See J.L.Black, *Nicholas Karamzin and Russian Society in the Nineteenth Century. A Study in Russian Political and Historical Thought*, Toronto, University of Toronto Press, 1975, pp.23-24, 49-50.

[127] *Ibid*, p.84. For the university curator who brought the charges, Karamzin "had only contempt" (p.88). Even the arch-conservative Admiral Alexander Semyonovich Shishkov, who denounced Karamzin's importation of foreign words and acceptance of spoken vocabulary in literary works, joined him in denouncing the religious dogmatist dismantling the 2 universities of Kazan' and St.Petersburg. Alexander M, Martin, *Romantics, Reformers, Reactionaries. Russian Conservative Thought and Politics in the Reign of Alexander I*, Dekalb, Northern Illinois University Press, 1997, *passim* but esp. p.199.

[128] In 1815 together with another well connected Russian bureaucrat Uvarov founded the Arzamas Literary Circle; meetings were held at Uvarov's apartment (Whittaker, *Uvarov*, p.29). At a meeting of the Arzamas, Karamzin, whom the members not only admired but presented with a "diploma" they all signed — an English translation is provided in Black, *op.cit.*, pp.255-256 — read drafts from the first volume of his *History*, a reading which inspired Uvarov (according to Whittaker, p.52) to formulate his first version of Official Nationality, the leitmotif of his later administration of the Ministry of Education. Karamzin returned the admiration: in a private letter of 1816, he wrote, "Convey all our friendship to the Arzamas leaders S. S. Uvarov and D. N. Bludov. Let them love me as much as I love them; one could ask no more." (Black, p.68) At this time Uvarov wrote to then-exiled (but gentle exile: Speransky served as Governor of Siberia until his 1821 return) friend Speransky the lament that "our literature grows worse very day. Politics devours everything." (Black, p.80)

Speransky. As with Uvarov, so with his friend Speransky,[129] the Romantic element was combined with an emphasis on the essential value of scientific education.[130]

H11 "[Nicholas's] first principal advisor was Karamzin, who, until he died in 1826, counseled the young, inexperienced monarch on the beauty of national traditions and on the necessity of autocracy for Russia . . . . To supplement this viewpoint, Karamzin recommended his Arzamas 'brothers' to Nicholas."[131] Karamzin and Speransky coauthored Nicholas's coronation address. As one of the "brothers", Uvarov was immediately given a position on the new Committee on Schools. In 1825 Karl Lieven became Minister of Education, and Uvarov deputy minister.

H12 All of them — Karamzin, with his "undisputed moral authority,"[132] Speransky, appointed in 1826 to His Imperial Majesty's Own Chancellery with the task of codifying Russian law, but especially Uvarov — advised Nicholas that the best way to avoid another Decembrist Revolt was to give nobly-born Russians a quality education. "Four months before his appointment as acting Minister [of Education], Uvarov reported on conditions in Moscow University. Although representative of his long-held views, his observations shrewdly played upon Nicholas's fear of another revolt and his search for an educational ideology that offered positive measures to prevent a recurrence."[133]

I Pulkovo's Origin & Uvarov's New Star

I1 Let us now turn to the reason why Pulkovo was founded, and at such extravagant expense. In 1827 G.F.Parrot, Struve's onetime sponsor at Dorpat University in astronomy and since elevated to membership in physics in the St.Petersburg Academy of Sciences, proposed the construction of a new observatory for the Academy.[134] In that same year Parrot had put forward, in the General Committee on Schools, a grandiose plan to replace all the faculty of the 4 "Russian" universities with new men, specially trained in Dorpat as undergraduates and sent to Germany for graduate work; the plan was successfully amended to reasonable form by Uvarov: 20 selected graduates of Russian universities would go to Dorpat's "Professors' Institute" for 2^y of training, prior to stays in Berlin or Paris. Here was the first instance of a collaboration of Parrot and Uvarov for the accomplishment of a major contribution to the improvement of scientific institutions in Russia.[135]

[129] In 1810 Uvarov and Speransky were members of the same Masonic temple in St.Petersburg. Whittaker, *Uvarov*, p.53.

[130] Marc Raeff concludes the chapter of Speransky's "Philosophical Views and Political Theory" thus:

> His closeness and debt to the romantic and conservative spirit of the early 19th century were unmistakable. His epistemology and metaphysics were strongly influenced by Schelling's *Naturphilosophie* and *Identitätlehre*: his ethical and social concepts bore the impress of [contemporary German idealist philosopher] Fichte, and in his respect for national traditions and historical evolution he stood close to Herder and Savigny. (p.226)

[131] Whittaker, *Uvarov*, op.88.

[132] Polunov, p.26. Karamzin was "easily the most widely read author" in Russia and the first Russian author ever to be translated into Western European languages, according to Black, *op.cit.*, p.60.

[133] Whittaker, *Uvarov*, p.129.

[134] Sokolovskaia, *op.cit.*, pp.66-68. The Parrot proposal receives notice neither in Batten (who, typically, devotes a long paragraph to a well-informed discussion on the high regard Struve had for Nicholas and the openness Nicholas had to reforming initiatives early in his reign) nor in Ivanov, who, as we have shown (§H3), characterizes Nicholas's attitude toward Pulkovo as that of a seigneurial absolutist and toward Struve as his successful courtier. The Parrot proposal is also noted in V. K. Abalakin, ed., *Glavnaya Astronomicheskaya Observatoriya v Pulkovo, 1835-1917*, Sbornik dokumentov, Rossiiskaya Akademiya Nauk, St.Petersburg, Nauka, 1994, p.35.

[135] "The single most important action taken to prepare the renaissance of Russia's universities was the establishment of the Professors' Institute at Dorpat University . . . . The experiment proved an

I2 In 1820 Struve was awarded the Gold Medal of the Royal Astronomical Society of London, for his pioneering work on double stars. "This award has a prestige among astronomers similar to that of the Nobel Prize . . . . Thus, before he was forty years old, Wilhelm was recognized as one of the leading astronomers of his day."[136] In 1830 December, having returned from an eventful trip to Germany, Paris, and London,[137] he received an audience with the Tsar in the company of Minister of Education Lieven; it was there that Struve, asked to comment on the state of the Academy of Sciences' observatory, said it was in a deplorable condition, and that Nicholas then ordered Lieven to prepare a plan for a new one.

I3 Karl von Lieven, witness to the foregoing exchange, had strong court connexions which ought to be emphasized. His mother had had charge of Nicholas when he was an infant — Nicholas joked about being a "crib-brother" to Karl and his brother Christoph — and he in 1826 had been promoted to the State Council, the highest advisory body of the Russian Imperial government. Karl's brother had been named ambassador to England in 1812, at a time when Russia needed assistance more than at any time in a century, he held the post until 1834, when he returned to Russia and was named tutor to Nicholas's son and heir Alexander. I mentioned above (§§C1-C2) the unstinting support Lieven had provided Struve's constant requests for more instruments for the Dorpat Universiy Observatory; there could be little doubt, both that Lieven had made Nicholas aware of Parrot — the former rector of Dorpat University, of which Lieven was the former curator — having proposed a new observatory for the Academy, and of Lieven's firm support for the proposal.

I4 Here was Struve, whom Lieven had more than generously aided, returning from a trip where in London he had been invited to join the Royal Commission to reform the *Nautical Almanac*, and thanked for his contribution. He had been given as a gift, from the hand of John F. W. Herschel, a complete set of the papers of his recently-deceased (1822) father William, the discoverer of Uranus. While in Germany Struve had addressed the annual congress of German naturalists, by invitation. In a country where personal patronage was crucial, Lieven's backing of whatever Struve advised was sure, and decisive.

I5 The one concrete decision taken at this point was the quadrupling of the budget of the Dorpat university observatory.[138] "At first, no one intended to buy completely new equipment for the observatory. The 20-foot Herschel telescope, a 4-inch achromatic refractor and a recently bought Ertel meridian circle, all belonging to the Academy's old observatory[,] were to be re-housed at Pulkovo at a cost of between 300,000 and 350,000 assignat rubles."[139] In 1832, as we have seen, Struve received appointment as corresponding

unqualified success. The two sets of institute graduates, those enrolled in 1828 and 1832, produced twenty-two first-rate professors in a variety of specialities, and each university dated its revitalization from the time these young men entered the lecture halls." Whittaker, *Uvarov*, p.160. "By offering a compromise, Uvarov secured the support of men who earlier found the proposal unacceptably extreme." Flynn, pp.173-174, quote on p.174.

[136] Batten, *op.cit.*, p.58. Having received from the Tsar a diamond ring for successfully assembling in 1824 Fraunhofer's 9 1/2 inch refractor for Dorpat University, he received a 2nd one for having won the RAS gold medal.

[137] Our 2 authorities differ on the reason for the trip, and both of their offers are doubtful. While Sokolovskaia asserts (p.62) that he went to Germany to purchase instruments needed for the newly-approved scheme to increase the scope of his and Tenner's measurement of the meridian into Lapland-Finland, she adds that "in connection with the project to construct a new observatory at Pulkovo, he was commissioned to inspect the best observatories of France and England." But this is impossible, since the interview with the Tsar took place upon his return, and even then, the site was yet to be determined. She later (p.65) quotes from Struve's report to the Dorpat University senate, stating that the trip was "in connection with the meridian measurement." In Batten's account, no reason for the trip to Germany appears, beyond the visit to German relatives, while the reader is told (p.59), "Wilhelm made this a working holiday. After two weeks [at his parents' home] he left the family in Altona and visited Paris and London" — an unlikely scenario in a period where every trip abroad by government employees involved explanation beforehand for the need and a report — in this case before the Tsar himself — afterwards: this was by no means a "working holiday". In Paris, Struve witnessed the 1830 French Revolution; in Batten's memorable phrase, with its extensive personal connexions,

> He had to stay at the Observatory until July 30, when its Director, Alexis Bouvard, one of Laplace's former students, the first to study the irregularies in the motion of Uranus that led [☉21] to the discovery of Neptune, and, above all, a staunch republican, guided this loyal servant of the Tsar of All the Russias through the barricades to his hotel.

As for the trip to London, Batten claims that "Wilhelm, as we have seen (Chapter 4), said that the main reason the Russian government sent him was to secure an English standard measure." I've read and reread the chapter and can find no mention of a standard measure: possibly Batten found such a passage and left it out of the book. On balance it appears the trip was undertaken purely for instrumentation for the meridian measurement.

[138] A fact only provided by Sokolovskaia (p.67), and which tends to support the influence of what appears to be a Dorpat University "old-boy network" in action. To engage in a bit of *Quellenkritik* on the question of accounts, in English, of what all agree is a highly significant conversation for the founding of Pulkovo Observatory, Batten's account is superior to Krisciunas', and Sokolovskaia's is superior to Batten's. Although in his 1988 work (fn 95, above) Krisciumas states "All subsequent accounts of the history of Pulkovo derive from" F. G. W. Struve's 1845 *Description de l'Observatoire astronomique central de Poulkova* — he lists 5 accounts doing so, including Sokolovskaia — he himself, in his account of this conversation, quotes instead from Cleveland Abbe's report, "Dorpat and Poulkova," for the *1867 Annual Report of the Regents of the Smithsonian Institution*, published in 1872; Abbe — without specific attribution — includes (pp.373-374) in Struve's "own account of this interview" the passage,

> Finally, His Majesty condescended to direct his attention to the choice of the location for the institution to be erected. The minister [of Education, Lieven] having mentioned the site to the north of the city and offered as a gift to the Academy, the Emperor condescended to express himself in the following terms, "How? The Academy thinks to place the new observatory quite near the city [of St.Petersburg] on the north side, and upon a sandy and marshy soil? That is hardly advisable. I would suggest another position. It is upon the heights of Poulkova that the observatory should be placed." Then His Majesty condescended to address to me the following words: "Sir Astronomer, you perhaps think it strange that the Emperor should wish to correct the Academy in a scientific matter. But do you know Poulkova, and what do you think of the site?" My reply was that in 1828, passing for the first time by Poulkova in the company of the Baron von Wrangell, I had been so struck with its position that I had, as if prophetically, exclaimed: "There upon the hill of Poulkova it is that we shall one day behold the observatory of St.Petersburg."

Perhaps in explanation of his use of Abbe's account in place of Struve's, Krisciunas observes regarding the *Description* in an endnote, "This work is quite rare. One set of two volumes sold in 1982 for $1850," and directs the reader to an article in which Alan Batten reported having obtained the book for his Victoria, British Columbia Dominion Astrophysical Observatory.
Batten, who, as we have seen, could consult the *Description* original, in 1988, the same year as Krisciunas, repeats in greater detail Nicholas's objections to the site originally proposed, and then writes (p.68)

> Cleveland Abbe added that when William first saw Pulkovo hill in 1828, he turned to his companion, Baron Wilhelm Wrangel, and exclaimed that upon that hill the new St.Petersburg observatory would one day be built.

Batten makes it quite clear that the Wrangel anecdote is not in Struve's *Description*.
Twenty-four years before, however, Sokolovskaia, whose account ought to be regarded as definitive, had already published the Wrangel passage and sourced it to F. G. W. Struve, "Notice historique sur la foundation de l'Observatoire central de Russie par ordre de Sa Majesté l'Empereur Nicolas I," St.Petersburg, 1855, pp.8-10.

[139] Batten, *op.cit.*, p.68. Inflation necessitated by the war against Napoleon had diminished the value of the assignat ruble to something less than 1/3 that of the specie silver ruble. Walter MacKenzie Pintner, *Russian Economic Policy under Nicholas I*, Ithaca, Cornall University Press, 1967. Citing the *Description*, Sokolovskaia informs us (p.104) of the eventual total cost of Pulkovo at 600,000 silver

member in astronomy to the St.Petersburg Academy, in intriguing circumstances. No specific action was taken by Lieven, however, who retired for reasons of health in 1833.[140] At that point Uvarov, who had been, in addition to serving as president of the St.Petersburg Academy of Sciences and an influential member of the General Committee on Schools, deputy Minister of Education, was now named as acting Minister. In that capacity he paid a visit to Dorpat University, where he inspected the observatory.

I6 Sokolovskaia details an amusing, but also revealing, story about the interaction between Uvarov and Struve during this observatory inspection, from the reminiscences of the eminent surgeon Nikolai Ivanovich Pirogov,[141] who was then at Dorpat as student of the Professors' Institute. Struve's tactic would only have had an effect on a person of large ego.[142] Naturally, Uvarov asked to look through the eyepiece of the famous Fraunhofer refractor.

> "Unfortunately," Struve said to him, "for some time the weather has been so bad that I did not dare to trouble you to look through our refractor during the night-time. Right now looking at it may only be good for giving you an idea of the extraordinary sensitivity to the slightest impulse."
> Uvarov stepped up and looked.
> "All the same, let me say I see something: it seems like a star to me."
> "It can't be, Hohe Excelenz!" exclaimed Struve.
> "Yes, look at them yourself," replied Uvarov.
> Struve looked in turn, said nothing, looked again, then assuming an awed, thunderstruck expression, said gravely:
> "Allow me to present my congratulations, Hohe Excelenz, on the discovery you have made. It is extraordinary, even incomprehensible, how this has happened, that you were destined to be the first to see an unknown fixed star. From now on it will be included in the list of newly discovered fixed stars."
> And that very evening at an assembly of professors at a seminar to which the minister was also invited, Struve announced the discovery by His Excellency of the new star.
> I still don't know whether Struve gave the star the name of Uvarov, as he gave a mineral that name (uvarovite)[143] or whether it remained nameless. Uvarov himself was in seventh heaven, but never imagined, indeed he didn't even want to imagine, that he was by no means an accidental discoverer and that his star had already been noted beforehand by the shrewed diplomatic genius Struve.

I7 The entire shadow-play of an accidental discovery of some hitherto unknown celestial object, arranged by "the shrewd diplomatic genius" while the plan to found a large new observatory was awaiting approval does display who holds the power in the relationship — namely, Uvarov. Transparently artificial praise had its effect. When the acting Minister of

rubles, which she estimates to equal 2,110,000 assignat rubles.

[140] He died in 1844; the actual reason may be different from the official one.

[141] The source is N.I.Pirogov, "Dnevnik starogo vracha" in *Sochineniya* volume II, Kiev, 1910, p.544, quoted in Sokolovskaia, pp.204-205.

[142] Whittaker (p.127) quotes, approvingly, from Riasanovsky's citation of the Moscow University professor of history Sergei Solov'ev saying (among other, more deprecatory things), "When talking to this person, often in the course of an intellectually brilliant conversation, one was struck by his extreme egotism and vanity." She admits "the portrait is astute." Riasanovsky's citation is to an edition of Solov'ev's reminiscences which is without publisher or publication date.

[143] A few seconds on the internet will reveal the overestimate here of Struve: uvarovite was discovered and named in 1832 by a fellow Dorpat University graduate, like Struve from German-speaking Central Europe, promoted in 1830 to the St.Petersburg Academy of Sciences by Uvarov.

Education returned to St.Petersburg, in the report to Tsar Nicholas on his Dorpat University visit he singled out Struve as "the ornament of Dorpat university."[144]

I8 Upon Uvarov's return to the capital city he received from his Academy subordinate, Perpetual Secretary to the Academy, Paul N. Fuss, the worked-out plan[145] prepared, according to Sokolovskaia, by G. F. Parrot. But, again according to Sokolovskaia, the plan was by this time "obviously languishing," and Fuss included with it a cover letter, dated 1833 October 28, only available to her in a 1960 scholarly article of unpublished correspondence,[146] pleading rather desperately with the Academy president and Acting Minister to take action. "He recalled," Sokolovskaia writes, "how many times [Academicians] F. I. Shubert[147] and [Paul Fuss's] father N[icolaus] Fuss,[148] had raised the question of the need to establish a new observatory in [St.Petersburg]." The letter continued:

> Although you are embarrassed by this problem, I — joined by the members of the mathematical section,[149] including those who have not personally concerned themselves with urging the establishment of any observatory — implore you to recall the enthusiasm with which Struve has argued in its favor, even before he became an Academician . . . . By an unforeseen fortuitous accident the Emperor himself has approved of our petition.[150] Mr. President, the Academy, through me, beseeches you to seize the opportunity before it is too late. To postpone this matter is to give it up, and in the case it would be better to close the old observatory and to strike practical astronomy from the roll of the sciences of the Academy.

"This letter obviously clinched matters, for on that very same day, 28 October 1833, Uvarov obtained the Tsar's 'command' to begin construction of the observatory."[151] On 31 October Uvarov created a commission to oversee the creation of the observatory, chaired by Admiral A.S.Grieg[152] and staffed by Academicians Vishnevsky, Struve, Parrot, and Fuss. It was this commission which inflated the needs of the new observatory far beyond the original 300,000 assignat rubles of the Parrot plan. And it is overwhelmingly likely that it was Uvarov who decided to devote some 7 times (fn 139, above) the resources called for in that original plan.

I9 Whittaker recounts[153] how Uvarov had already persuaded Nicholas to sponsor, in 1829, an exploration of Central Asia conducted by the famous explorer Alexander von Humboldt, who then praised Uvarov as one who "patronizes and aids in everything that leads to the expansion of our spheres of knowledge"; Uvarov in 1827 sponsored, and in 1832 presented the results of Academician Paul Stroev's search for archival documents

[144] Sokolovskaia, p.204.

[145] The text of this plan is available in Abalkin, *op.cit.* (fn 134, above), pp.31-35. It is signed by P. N. Fuss and not dated. Abalkin notes that it cannot have been submitted any later than 1833 October 27.

[146] P. G. Kulikovskii, "Pisma V. Ya. Struve k S. S. Uvarov i P. N. Fussu," *Istoriko-astronomicheskie issledovaniya*, 1960, vol.6, pp.406-407, quoted in Sokolovskaia, pp.69-70.

[147] The deceased member of the Academy for astronomy (see fn 123, above) whose chair Struve now occupied.

[148] The previous Perpetual Secretary of the Academy, who died in 1826. See fn 72, above.

[149] The section devoted to mathematics, astronomy, geography, and navigation.

[150] The reference is to the 1830 inverview: §I2, above.

[151] *Ibid*, p.70.

[152] Aleksey Samuilovich Grieg had in 1816 established the Nikolaev Astronomical Observatory for the use of the Black Sea fleet, which he commanded; the protocols of the session of the commission available in Abalkin, *op.cit.*, however, show him signing agreement to documents other commission members had arrived at in his absence (a not unusual bureaucratic procedure for governments then and since). Parenthetically, Simon Werrett misdates this commission by 3^{y}, counts Uvarov as a member, and cites Sokolovskaia and Whittaker as sources. We have seen Sokolovskaia's dating; Whittaker not only gives none, she makes no mention (p.186) of the commission.

[153] Whittaker, *op.cit.*, pp.185-186.

throughout 200 different libraries within the empire. Nicholas, according to Uvarov, read the resulting 4 volumes "from cover to cover." Whittaker summarized,[154] "Uvarov gained support for a policy of expansion because it caught the mood of a public — and a tsar — even more hungry for establishing Russia's place in the world. [I]n areas of strategic importance, such as the sciences, technology, Eastern studies, and jurisprudence, Uvarov intended to create intellectual foundations for teaching and research so that instruction in these fields would reach modern standards and provide the personnel so desperately needed."

"The crown of the new endeavors was the Pulkovo Observatory."[155]

If, after all of the framework explicated by Whittaker and the many details corroborating it provided by Sokolovskaia, the reader retains a suspicion that Struve's "enthusiastic" appeals for the support of astronomy were more influential with Nicholas I than Uvarov's well-articulated program for both education in general and the Academy in particular, Sokolovskaia reproduces extracts of a letter[156] written by Parrot to Nicholas on 1834 February 8 which in the strongest, most urgent terms denounced the pace of construction for the observatory which Parrot had proposed, and on the commission directing creation he was presently serving. He specifically complained that "Mr Struve, despite the grief that has befallen him — the death of his wife — wanted to return to work in the latter part of January . . . but a directive from the Ministry of Education informed him that he could defer his arrival[157] until the beginning of March. Plans will not be finalized until then!" Parrot referred to his role in initiating the project for a new observatory, pleaded with Nicholas to excuse his age, and repeatedly urged the tsar to call Uvarov to book about the delay in construction, with Struve as a judge of the minister's answer. The conclusion was, Sokolovskaia reports[158] in French: "Demander à Ouwaroff de la part de l'Empereur où en est de la bâtisse, sans dire que c'est de Parrot que nous avons de les nouvelles." Ask Uvarov, in the Name of the Emperor, how things stand with the construction, without telling him that Parrot told you about it.

I10 Sokolovskaia comments dryly, "It is entirely probable that it was due to this very letter that on 4 August 1834 Parrot was required to hand in his resignation and withdraw from the commission."[159] Nicholas had placed, and he maintained, his confidence in Uvarov, whom several independent lines of documentation show to have directed the founding of Pulkovo Observatory. Alerted by Fuss's letter of the threat of the neglect of the project, he took immediate action; he appointed the commission — which would hardly have acted in any way contrary to his wishes — to direct the construction, and he was confirmed some months into the construction as the one enjoying the confidence of the tsar. Of course Struve had control of the instrumental details; the initiative and direction for the foundation came from Uvarov.

[154] *Ibid*, p.155.
[155] *Ibid*, p.186.
[156] M. Martar'ev, "Imperator Nikolai I i akademik Parrot: Pulkovskaya observatorii," *Russkaya starina*, 1898, pp.389-393, quoted in Sokolovskaia, *op.cit.*, pp.72-74.
[157] Struve was in Dorpat, the only Academician allowed to live outside St.Petersburg. This made it possible for him to direct the work of the Dorpat University Observatory.
[158] In her endnote, on p.103.
[159] *Ibid*, p.74.

Figure 7: Russia's Minister of Education Sergei Semyonovich Uvarov. The guiding soul behind Russia's astronomical ascendancy.

⊙ End-Notes:

⊙**1** [Note to §A1.] A twin of the 15″.0 Pulkovo telescope was later installed at Harvard University, Cambridge MA.

⊙**2** [Note to §A1.] As their orbits were tracked by early observers, double-stars showed that the laws of Kepler, Hooke, & Newton held outside the Solar System.

⊙**3** [Note to §A4.] Does the double-evidence suggest that draft-dodging correlates with the intelligence and boldness of a mind that seeks new scientific frontiers? Whatever: Germany's two losses in cannonfodder became England&Russia's scientific leaders — and unique astronomical gifts to all humanity.

⊙**4** [Note to §A5.] **A STUDY IN EPISTEMOLOGY**: Historically&popularly, stellar parallax's proof was the final nail in Ptolemy's coffin. But standard textbooks invariably ignore the obvious: ***PLANETARY*** parallax (those familiar huge retrograde loops) is just as solid a proof of heliocentricity as stellar: *DIO 1.1* ‡7 (www.dioi.org/j117.pdf). And it had quintuply been in clear, untelescopic view since evolution produced eyesight! Ancient&DarkAges apologists for self-flattering geocentricity conjured and threateningly (even LETHALLY) insisted upon Ptolemy's elaborate, contraOccam epicycles&deferents. To evade planet-heliocentricity's VISIBILITY — ***especially*** plain for Mercury&Venus — required Ptolemy's crackpottest figleaf (spoofed at *ibid* §§B1&B5): it only LOOKS LIKE Mercury&Venus are going around the Sun, but Ptolemy insisted that ACTUALLY they each go around a point BETWEEN Earth&Sun! Had any of those ineducables survived to be confronted with Bessel-Struve's discoveries, they would've joyfully announced — not confirmation of heliocentricity but — of geocentricity's ingenuity (*ibid* §F): we are now able to see that even the stars exhibit our epicycles! Historical&ecclesial footnote: as imminent confirmation of stellar parallax's reality loomed in the 1830s, the ever-myth-peddling Roman church nimbly faked a memory-lapse: geomobilist works were quietly dropped from the Vatican *Index of Prohibited Books*. Just in time? Not quite: Bradley's discovery of stellar aberration ***over a century earlier*** (§A6) established just as valid proof of heliocentricity as stellar parallax. And a far larger, more easily measurable physical effect.

⊙**5** [Note to §A5.] In the 3rd century BC, the 1st heliocentrist, Aristarchos of Samos, predicted stellar parallax, correctly claiming the stars must be at least 10000 AUs distant since the parallax was not visible even though the human eye's discernment limit is 1/10000 radians: www.dioi.org/je02.pdf; www.dioi.org/g841.pdf.

⊙**6** [Note to §A5.] These 2 unRomantic discoveries' proximity was not only temporal but spatial. Both were Baltic, the center of Romanticism, the antithesis to mathematical-physical empiricism: below at §§§B3-B4.

⊙**7** [Note to §A6.] Stellar aberration is the projection upon the celestial sphere of the earth-motion velocity-vector. It has no relation to stellar distance, to which stellar parallax is inversely proportional.

⊙**8** [Note to §A6.] Herschel's double-star search was for a fake double where the 2 stars are at different distances & are just by chance nearly in line with the Earth, so the nearer star might show plainly visible parallactic oscillation vs the more distant. He never found what he was looking for.
While comets were sought using low-power wide-field telescopes, Herschel searched for fake doubles at very high magnifying power, thus when by chance encountering Uranus 1781/3/13, he recognized it as a non-punctal object, leading on to his immortal glory. Classic serendipity. Though Astronomer Royal Nevil Maskelyne's daily records show he realized within days that Herschel had discovered a new planet, Herschel himself clung for awhile to his original opinion that Uranus was a comet: his own *PhilTrans* paper on his discovery was titled "Account of a Comet".

⊙**9** [Note to fn 19.] Huth should also have been aware of Rømer's earlier Paris Observatory proof, from Jupiter's satellites, that light's speed was finite and estimable.

⊙**10** [Note to §B7.] A high-power instrument such as Dorpat's or Pulkovo's refractors would be inept&inapt for skysweep-chasing after comet-discoveries since the field of view is way too tiny. Low-power richest-field telescopes (RFTs) are much better-suited to such adventures. The great German observer and theorist Heinrich Wilhelm Matthäus Olbers used a low-power "cometseeker" telescope not only for the nominal quarry but to discover asteroids Pallas&Vesta in 1802&1807. The 2 discoveries were 5^{y}01^{d} apart in time, and improbably ***in the same square degree*** of northwest Virgo at which Olbers had also re-captured Ceres. The spatial coincidences (and the high orbital inclinations of Ceres & especially Pallas) could be related to Olbers' theory that the asteroids were the regularly-returning-to-point-of-origin remains of a destroyed planet. See www.dioi.org/cot.htm#btpn for discussion&map of Olbers' fruitful Virgo square-degree. He also conceived "Olbers' Paradox": why is the sky not glowing?

⊙**11** [Note to §B8.] The Great Dorpat refractor subsequently had a twin of 9″.5 aperture at the Berlin Observatory. Checking the bold&brilliant French astronomer-mathematician Urbain Leverrer's public 1846/8/31 French Academy prediction (based on laborious calculation), that an unknown giant planet lurked near the Capricorn-Aquarius boundary, that telescope — operated on the night of 1846/9/23 by J.Galle&H.d'Arrest — ocularly captured the planet Neptune.
Full dramatic, sinuous story at www.dioi.org/j911.pdf.

⊙**12** [Note to §B10.] Struve's seasonal research-pattern was likely related to a natural imbalance: Dorpat being so near the Arctic Circle, summer nights were far shorter than winter ones.

⊙**13** [Note to §B10.] The earliest recoverable meridian-arc measurement was via camel, over the Egyptian desert: 14°1/4 or 855 nautical miles long, to an accuracy of better than 1%, by Timocharis of Alexandia c.300 BC. See www.dioi.org/jL09.pdf §F.

⊙**14** [Note to §B11.] That Russia, a nation so primitive in so many respects, should lead the world for decades in astronomy, may initially seem incongruous — until we consider Russia's wellknown contemporaneous contributions to literature, music&ballet: Tolstoi, Pushkin, Glinka, Mussorgsky, Tchaikovski, Rachmaninov. All built upon a grossly nonegalitarian (e.g., §C3) and cruel social order that nonetheless created eternal culture & wisdom reared upon exploitation of its temporary serf-misery. See parallel consideration at www.dioi.org/jw07.pdf fn 1.

⊙**15** [Note to §C3.] Did Russian 19th century Romanticism contribute to seeding the Romanovs' early 20th century demented occultism? E.g., [1] Czar Nicholas II's uncle Konstantin ("Kostia") Romanov's dreamily hyper-Christian 1912 mystery play, *King of the Jews* (to which secular composer Alexander Glazunov in 1913 wrote the heavenliest music of his career), publicly unstageable since steeped in the Romanovs' traditional-Christian hatred of Jews; [2] druggie Czarina Alexandra's & her just-as-retardedly-credulous family&circle's nationally-fatal subjugation to her&sundry-others' notorious lover, illiterate eroto-pious-conman and politician-monk: Grigori Rasputin.
[The main paper's Author, an expert on Russian history and language, takes particular exception to this note since he rightly points out that some of it entails severe & ugly condemnations partly based upon unproven speculation. DR's view that Rasputin&Alix were probably physical lovers is based on context and is retained here primarily because it constitutes a potential historical advance, being contrary to every other modern historical analysis.]

⊙**16** [Note to §D3.] Bode's Law yields planets' distances in Astronomical Units, as a function of planet number n, starting with $n = -1$: Distance = $(4 + 3x2^n)/10$. So Mercury is 0.55; Venus 0.7; Earth 1.0; Mars 1.6; Ceres 2.8; Jupiter 5.2; Saturn 10.0; Uranus 19.6; Neptune 38.8. Fails for Mercury (often fudged by taking $n = -\infty$) and for Neptune.

⊙**17** [Note to §D3.] The Hegel dissertation's absurdly numerological — virtually-occultist — attempt to overturn Bode's Law asserted the emptiness of the Mars-Jupiter gap, while Bode&Zach both sought a planet filling the gap. The dissertation is dated 1801/8/27 (his 31st birthday — he was no young neophyte), though Ceres' discovery *had been publicly announced months earlier* (1801/5/6) by astronomer Bode in Hegel's own hometown Jena literary journal. But this spectacular embarrassment did not prevent Hegel from epochal national — ultimately international — success in academe! Which tells us how seriously one should take the ambitious eminences produced by the politics of such soft academic fields.
Perhaps his supergoof explains Hegel's wise later saying: "The fear of error is already itself an error." Further information&comments at www.dioi.org/j129.pdf fn 60 & www.dioi.org/cot.htm#mnfp.

⊙**18** [Note to §D3.] For the math of Hegel's scheme, see www.dioi.org/cot.htm#gwfj.

⊙**19** [Note to §D3.] For an unexceedably complete history of Piazzi's serendipitous Ceres encounter (copiously adorned with beautifully-reproduced illustrations of Piazzi, his discovery-transit-circle, the goddess Ceres, and a great deal more), see Clifford J. Cunningham's labor of affectionate dedication to the history: *The First Asteroid: Ceres 1801-2001: Historical Studies in Asteroid Research Volume 1* ©2002 Star Lab Press, Box 547232, Surfside, FL 33154. (Followed by further entries in CJC's asteroid-history series.) Published (like *DIO*) as a public service and contributed to (thus available at) top libraries.

⊙**20** [Note to §D3.] Just as Herschel before him: Piazzi initially reported he'd found a comet. Ceres was temporarily lost behind the Sun, but Gauss used his determination of the orbit's elements to demonstrate the utility of his discovery of least-squares statistics. And by the end of 1801 Ceres was permanently recaptured telescopically by Olbers [⊙10] and Zach.

⊙**21** [Note to fn 137.] *DIO* led the appeal that unlocked England's RGO file (hidden for over 1 1/2 centuries) on Neptune's discovery, which yielded revelations that changed the history: www.dioi.org/j911.pdf.

Figure 8: Heinrich Wilhelm Matthäus Olbers.
Recoverer of Ceres.
Discoverer of Pallas&Vesta.
All 3 in the same square degree [☉10] of Virgo. Also the conceiver of Olbers' Paradox.

DIO

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