BOOK REVIEWS

***Sternbilder des Mittelalters und der Renaissance: Der gemalte Himmel zwischen Wissenschaft und Phantasie*, Volume 2, three books by Dieter Blume, Mechthild Haffner and Wolfgang Metzger. (Berlin, Walter De Gruyter GmbH, 2016). Pp. 1,660. ISBN 978-3-11-037601-2 (hardback), 220 x 290 mm, €298.**

The second segment of this enormous contribution to art historical scholarship encompassing illustrated astronomical manuscripts from the start of the thirteenth through the fifteenth centuries has arrived. It is even more comprehensive than the first set of two volumes produced by the same three art historians in 2012; both works are in German. The initial volumes included illustrated astronomical manuscripts created between the ninth and twelfth centuries. Each set provides full details of pertinent information, including commentaries, related essays and a small selection of illuminations from each manuscript.

The most recent publication consists of a voluminous three-volume set; just lifting them is almost a herculean task. The most recent volumes follow the same organizational pattern as the original two-volume set and are printed on high quality paper. All material in the three volumes is collaborative, credited to the trio of authors; none is given individual credit for any of the commentaries or detail work.

The first two books, consisting of 1,031 pages numbered consecutively, begin with eight substantial essays that discuss several key illustrated astronomical manuscript traditions such as Michael Scotus, al-Ṣūfī, and the Germanicus Aratea. The authors' commentaries most conveniently include the illustration numbers in the margin next to the images they are discussing. These initial essays are followed by a listing of surviving astronomical manuscripts, all produced between the start of the thirteenth and the end of the fifteenth centuries; these are held in libraries throughout Europe, the United States, and one in Turkey. Each individual manuscript receives a thorough description including codicology (the study of medieval manuscripts and their place in history and culture), the author of the astronomical text on each folio, a commentary, a complete listing of the miniatures, the provenance, and relevant scholarly literature. The initial volume of this massive work covers 67 different manuscripts; the second volume picks up with number 68 and continues to number 143 and adds a celestial globe produced in the fourteenth century and a celestial ceiling in the Old Sacristy of San Lorenzo, Florence created in the mid-fifteenth century. The third volume of the set contains a selection of illuminations from each described manuscript; the initial illuminations are in color, 38 pages in all; the total comprises 1,237 manuscript illustrations and 22 images of the astronomical globe and frescoed ceiling for an enormous total of 1,259 photographic images. The comprehensive bibliography of pertinent scholarly literature itself it a valuable resource as it covers 38 pages.

These three volumes, in addition to the earlier publications covering astronomical manuscripts from the Carolingian era to the start of the Gothic, obviate the need previously required to visit a large number of libraries to consult astronomical or astrological texts and view the images. This second set of books includes the especially creative and expansive period of astronomical advances that became available to the Latin West after the translation period of the twelfth century in Spain and Sicily. At that time, European scholars acquired an entirely new assemblage of texts thought entirely lost, including Ptolemy, Plato, Aristotle and the Hellenistic astrologers. This convenient and invaluable resource provided a prodigious contribution of ancient and Islamic knowledge and opened a whole new world of research opportunities for those studying scientific data and research. By organizing and cataloging a large quantity of information from the most prominent authors of fundamental astronomical data, the authors have created a new resource tool of great erudition.

Due to the increased interest in astronomical and astrological topics and a wider distribution of wealth at the time, the numbers of illuminated manuscripts that were produced and survive from the later Middle Ages and early Renaissance is shown to be enormously greater than those extant from the earlier Medieval period. These manuscripts are more varied in their textual compositions and much more experimental and creative in their illustrative iconography. The fascination with the Classical past that develops during the Renaissance can now be easily accessed by viewing the evolution and expansion of various authors' writings and illustrations. One can witness why the long-held viewpoint of Fritz Saxl (1890–1948) and others, that the artistic interest during the Renaissance was strictly to recreate images and artworks of the Classical past, has been challenged. The images gathered for this edition prove that patrons and artists commissioning and creating manuscripts in the fifteenth century were extremely creative in designing and implementing entirely new constellation and astrological illuminations.

Some constellation cycles, such as the Aratea of Cicero and Germanicus retained their very traditional images based on Late Antique prototypes and the astronomy of Aratus, derived from Eudoxus, but their poetic text describing the rising and setting of the forty-two to forty-six Ptolemaic constellations became corrupted through the centuries, augmented with myths from Hyginus and overwhelmed with commentaries and scholia.

Other traditions, for example the al-Ṣūfī (903–986) *Kitāb Ṣuwar al-Kawākib al-Thābita* (*Book of Pictures of Fixed Stars*), and its Latin translations, the al-Ṣūfī Latinus manuscripts can be traced through this resource, as the precisely-placed stars of each constellation are carefully recorded. In the original manuscript of al-Ṣūfī (although only early copies survive—see Hafez et al., for details), he plotted the individual stars by name and even devised his own system for indicating their magnitudes (Hafez et al., 2015a, 2015b); he also noted their colors. His writings combined native Bedouin astronomy with his Persian sources that consisted of a consolidation of Babylonian, Indian and Greek astronomical knowledge. The Ṣūfī Latinus copies circulating in the West retained that stellar accuracy, so that by studying these, one could actually locate and identify a constellation in the night sky. By following the series of copies published in these volumes, it is possible to witness the attention continually paid to positioning each star accurately. Identifying a constellation from a manuscript drawing was not possible before al-Ṣūfī's masterpiece became known, for in Latin constellation images, the stars were simply sprinkled at random (except for the Leiden Aratea, c. 820) which had the correct number of stars as per Ptolemy, but not their accurate positioning (see Dekker, 2010). These reference books provide a rich resource to locate numerous diverse astronomical works from the Middle Ages.

Another important group of manuscripts discussed is that of Muhammad Abū Maʿshar al-Balkhī (787–886), who according to John North (2008: 195 traditions – the Greek, the Indian, the Iranian and the Syrian." Abū Maʿshar (Latinized to Albumasar) worked in Baghdad under the Abbasid Caliphate al-Maʾmūn (813–833), as court astronomer and astrologer. His writings on astronomy and especially on astrology reintroduced the 'wretched' topic into Western science and became enormously influential. A mysterious author Georgius Zothorus Zaparus Fendulus is credited with writing an abridged and illustrated version of a Latin translation of *Introductorium maius in astronomiam*, by Abū Maʿshar, completed by Hermann of Carinthia in Toledo about 1140. This translation and interpretation was inspired by Hermann's work, commonly called the *Greater Introduction.* Illuminations from a thirteenth-century manuscript, Paris BN Ms. lat. 7330, are pictured in color in *Sternbilder des Mittelalters* …, including a full-page image of Fendulus on folio 1 wearing the garb of a Muslim potentate; these images and their text help to explain the astrological sources and various aspects of the paranatellonta (stars or asterisms on either side of a constellation that help to identify the zodiacal signs when the constellations are not clearly visible) and decans (used by Egyptians to represent each ten degrees of the zodiacal circle amounting to thirty six).

By the mid-twelfth century manuscript production had expanded far beyond the work of lone monks or scriptoria behind thick monastic walls, to the domain of lay scribes and artists in dynamic urban workshops creating texts for the wealthy and for new urban schools and universities. Each illuminated astronomical manuscript, as a condensed cultural and educative object, tells a fascinating story all its own, constituted by its patron, designer, scribe and artist. Each has complex historical roots with associations that continually change according to time, place and other factors. Every codex requires design choices in organizing text, decoration and illustration—no two are alike. Surprisingly, even when looking at what appears to be an exact copy, there are always slight differences that reveal pertinent information. Because of these complex interactions, medieval illustrated manuscripts provide a window into the beliefs, practical knowledge and particular interests of their patrons and users.

Other than Ptolemy, most authors of astronomical treatises in the Middle Ages included a full cycle of constellation illustrations as well as a celestial map and planetary diagrams. Most illuminated manuscripts were quite labor-intensive and extremely costly to produce when considering the cost of parchment, precious minerals and plant substance for paints, and sheets of gold for enhancements. Of course, the more elaborate the manuscript presentation, the better were its chances for survival. In contrast astronomical manuscripts did not require precious minerals or costly pigments but were still a product requiring significant material and human resources.

Although by far the most popular astronomical treatise in the later Middle Ages, the *de Sphaera* of Sacrobosco (ca. 1195–1244), the English monk, scholar and astronomer, does not appear in this work. His composition was one of the most influential and widely-used textbooks throughout Europe for almost 500 years, remaining popular until its astronomical information became outmoded at the start of the scientific revolution in the seventeenth century, but his manuscripts do not include an illustrated constellation cycle. Sacrobosco's surviving texts are often embellished with astronomical diagrams that helped to clarify his descriptions of solar, lunar and planetary motions; hundreds of medieval manuscripts of Sacrobosco's *de Sphaera* survive, but they are not included.

Among the essays published in this book is a discussion and partial explanation of an outburst of production of illuminated manuscripts containing the Aratea of Germanicus in the fifteenth century. They reveal a fascinating story of an early Germanicus manuscript that had been discovered in Sicily between 1465 and 1467 which was transferred directly to the Kingdom of Naples where King Ferdinand d'Aragon (or Ferrante) then reigned after a contentious takeover by his father Alfonso d'Aragon. A document survives that demonstrates that the ancient astronomical manuscript was copied there almost immediately, in either 1467 or 1468; it was copied at least three more times by humanist scholars and scribes at the court of Naples. A copy of this Germanicus manuscript was then taken to Florence where it was reproduced for the Medici court, Francesco Sassetti and for Frederico da Montefeltro. Unfortunately the original 'newly discovered' manuscript is now lost, but text scholars have determined that it was based on a manuscript now in Madrid, which itself had an earlier exemplar. Thus the twelfth century manuscript was regarded as an extraordinary find, leading to antiquity; it was reproduced multiple times, accounting for many of the twenty-six Germanicus Aratea surviving from the fifteenth century. The explosion of illuminated astronomical manuscripts during the fifteenth century Italian Renaissance was also inspired in part by the rise of humanism.

This set of volumes encompasses the highest peak of medieval manuscript production as well as its conclusion, for the appearance of less-expensive printed books initiated the elimination of those handmade. *Sternbilder des Mittelalters* … provides new and invaluable research assistance for scholars investigating not only the transmission of medieval astronomy and astrology, but also mythology, classicism, history, historiography, education, science and medicine. The authors will be greatly thanked for their efforts many times over.

References

Dekker, E., 2010. The provenance of the stars. In the Leiden Aratea picture book. *Journal of the Warburg and Courtauld Institutes*, 73, 1-37.

Hafez, I., Stephenson, R.F., and Orchiston, W., 2011. ꜤAbdul-Raḥmān al-Ṣūfī and his *Book of the Fixed Stars*: a journey of re-discovery. In Orchiston, W., Nakamura, T., and Strom, R. (eds.). *Highlighting the History of Astronomy in the Asia-Pacific Region. Proceedings of the ICOA-6 Conference*. New York, Springer. Pp. 121–138.

Hafez, I., Stephenson, R.F., and Orchiston, W., 2015a. The investigation of stars, star clusters and nebulae in ꜤAbd al-Raḥmān al-Ṣūfī's *Book of the Fixed Stars*. In Orchiston, Green and Strom: 143–168.

Hafez, I., Stephenson, R.F., and Orchiston, W., 2015b. ꜤAbd al-Raḥmān al-Ṣūfī's 3-step magnitude system. In Orchiston, Green and Strom: 169–177.

North, J., 2008. *An illustrated History of Astronomy and Cosmology*. Chicago, University of Chicago Press.

Orchiston, W., Green, D.A., and Strom, R. (eds.), 2015. *New Insights from Recent Studies in Historical Astronomy: Following in the Footsteps of F. Richard Stephenson. A Meeting to Honor F. Richard Stephenson on His 70th Birthday*. Cham, Springer.

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***The Complex Itinerary of Leibniz's Planetary Theory* by Paulo Bussotti (Birkhauser/ Springer, 2015; Science Networks Historical Studies 52). Pp. x + 188. ISBN 978-3-319-21236-4 (hardback), 240 x 163 mm, €103.99.**

This informative study provides illuminating new insight into an otherwise somewhat dark corner of Leibniz's physical theory.

Leibniz had no problem with the mathematics of Newtonian planetary theory. But he was dissatisfied with its metaphysics. For Newtonian gravitation was at odds with his own conception of the fundamentals of natural philosophy. And so Leibniz wanted a planetary theory very different from Newton's. Along with many other contemporaries he was committed to the idea that all explanation of the processes of physical nature must proceed on mechanical principles. He rejected gravitation and action at a distance because he saw it as fundamentally at odds with his Law of continuity. Accordingly he, like Descartes and others before him, wanted to explain the phenomena of planetary theory by means of vortex theory. This led him to a Kepler-inspired process of 'harmonic circulation' (*circulatio harmonica*). As Leibniz worked out the mathematics needed to implement these physical interactions he developed a neo-Keplerian planetary physics whose 'complex itinerary' is set out by Bussotti with great detail and in close coordination with the Leibnizian texts and with extensive heed of the relevant literature.

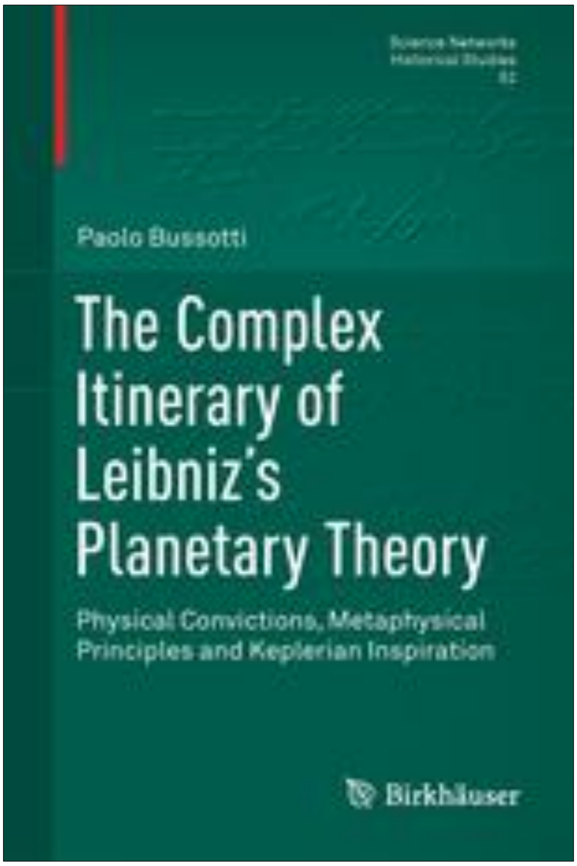
As Bussotti sees it, when Leibniz worked out his theory of planetary motion in the so-called *zweite Bearbeitung*, this led him to maintain: "(1) that 'harmonic circulation' is due to a [global] aether spread throughout the whole solar system; (2) Gravity on earth is due to the [local] aether surrounding our planet. And there are two possible hypotheses as to how gravity acts [viz. either by a 'radiation' due to an expansive impetus (*conatus explosivus*) or by a centrifugal force of an aetherial fluid]; (3) the difference between the specific weights of materials is due to yet a third aetherial fluid, more tenuous than the second [local] one, which, in its turn; is yet more tenuous than that [global] aetherial fluid responsible for harmonic circulation." (Bussotti, p. 98).

The cogency of its mathematical articulation does not altogether compensate for the physical cumbersomeness of Leibniz's planetary mechanics. Why was Leibniz willing to pay this price?

As Bussotti sees it, "… if action at a distance were true, the whole metaphysics of Leibniz would collapse, and not only his physics." (p. 152). Bussotti's reasoning to this conclusion is left somewhere between obscure and missing. But I think it can be supplied. Leibniz and Kepler alike were both influenced by and deeply sympathetic to a neo-Platonic view of cosmic order and harmony which included a commitment to principles like harmony, continuity, and economy. Now contact interaction can be accounted for lawfully via action/reaction, continuity conservation of energy etc. But if there were action at a distance, no reason could be given why it should take this form or that (inverse square rather than inverse cube). And this would violate the most fundamental principle of Leibnizian metaphysics: the Principle of Sufficient Reason.

In the end, Leibniz is prepared to accept the cumbersomeness of his aether-based cosmology because for him the complexity of nature's phenomena (of process) can be more than offset by the elegance of nature's laws (of processuality).

What Bussotti has given us is a highly instructive example of the interplay of technical science and theoretical metaphysics in the rare case of a thinker who was a master-mind in both domains.



In concluding, I give reluctant voice to one minor caveat. It would have been good to have a native English speaker go over the text. Such a helper would have revised such passages as "… the inertia principle in his theory is a significant subject to catch the features of Leibniz's physics, inside which planetary theory is inscribed." (p 32). It is regrettable to have such avoidable infelicities mar so excellent a work of scholarship.

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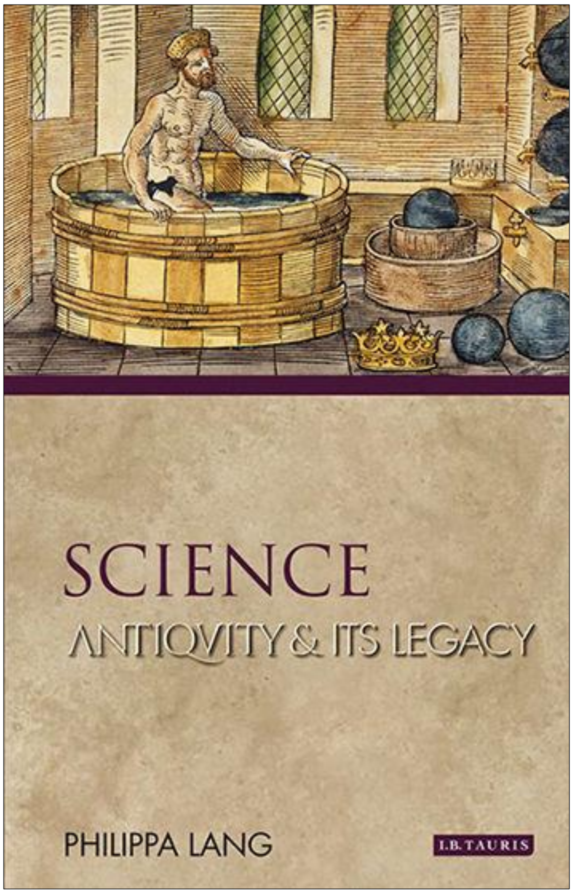
***Science: Antiquity & Its Legacy* by Philippa Lang. (I.B. Tauris, London and New York, 2016). Pp. xiv + 226. ISBN 978 1 78076 171 8 (hardback), 143 x 233 mm, US $95.**

This is part of a series of books in the Ancients and Moderns Series by I.B. Tauris. Other titles have explored such varied topics as Medicine, Gender, Slavery, War and Religion. This volume is written by Philippa Lang, who was Professor of Classics at Emory University from 2004 to 2013.

Her Masters and Doctoral dissertations both focused on medicine in the ancient world, especially Ptolemaic Egypt. That is reflected in this book, where she devotes forty pages to the topic of illness and disease.



She engages with astronomical issues in various places. One is calendar reform. After a rather perfunctory survey of the development of the Julian and Gregorian systems, she offers an important observation on Julius Caesar's reliance on advice from Sosigenes of Alexandria:

> Authority had shifted from religious authority and civic officialdom to the astronomer ... Astronomical and mathematical expertise had created a new international technocracy ... The Julian calendar marks the first moment in Western history in which astronomy superseded other kinds of expertise in defining time (and place). (p. 138).

Lang also does a fine job at relating analog computers to the ancient Greek Antikythera mechanism (which I recently saw on display in Athens). Its 32 bronze gears, and others that may have existed, were able to show the motions of the planets, the phase of the Moon and the rising/setting of certain stars. "A slide rule is an analog computer of a mechanical kind," she explains. "The Antikythera mechanism is much more like a very complicated slide rule than a Mac or PC or a smartphone." (p. 161). She uses the chance discovery of this mechanism to remind us of how we might either underestimate or misrepresent ancient science and technology.

The author identifies attempts to explain the motion of the planets in the sky, both eastwards and westwards, as a prime "… impetus of Greek astronomy." (p. 182). This leads Lang into a discussion of the role of Ptolemy in the development in meteorology and astrology. She argues it "… was the movement of the planets in relation to the fixed stars …" (p. 184) that led Ptolemy to link these to weather and climate. These varying environments, in turn, partially formed a person's character. Ptolemy's version of astrology, says Lang, was a weak one. Even Ptolemy conceded many astrologers were charlatans.

Lang notes that

> It is ironic that Ptolemy, a leading and influential mathematician and theorist of the ancient world, would be hopelessly adrift in cosmology if transported into the present, but could still make a perfectly good living as an astrologer. (p. 188).

This quote offers a good idea of how this book is being pitched. Professional historians of astronomy will find nothing new here; rather, it is a very fine overview of ancient science and how modern culture can relate to it, and vice versa. It could be used as a supplementary text in an advanced high school or introductory university class, to provide an easily readable way for students to put broad scientific concepts in context.

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***The Invention of the Achromatic and Aplanatic Lens With Special Regard to the Role Played by Samuel Klingenstierna*, by N.V.E. Nordenmark and Johan Nordström. Edited by Roger C. Ceragioli; translated into English by Elisabeth Goodwin. (A Special Publication of the Antique Telescope Society: *Journal of the Antique Telescope Society*, Issues 39-40, 2016). Pp. [ii] + 142. No ISBN or ISSN (hardback), 220 x 288 mm, no price.**

For those of us with an interest in the history of the telescope, an important publication was the 2-part paper by N.V.E. Nordenmark and J. Nordström on the invention of the achromatic and aplanatic lens, but this was published in Swedish in the 1930s and in a journal that was not easily available world-wide.

Dr Roger Ceragioli and Elisabeth Goodwin have now solved this problem for us by translating the Swedish paper into English, but they have done more: they have combined the original two-part paper into a single attractive hardcover publication; brought all of the references together as a single listing; and introduced three new appendices. Ceragioli and Goodwin state:

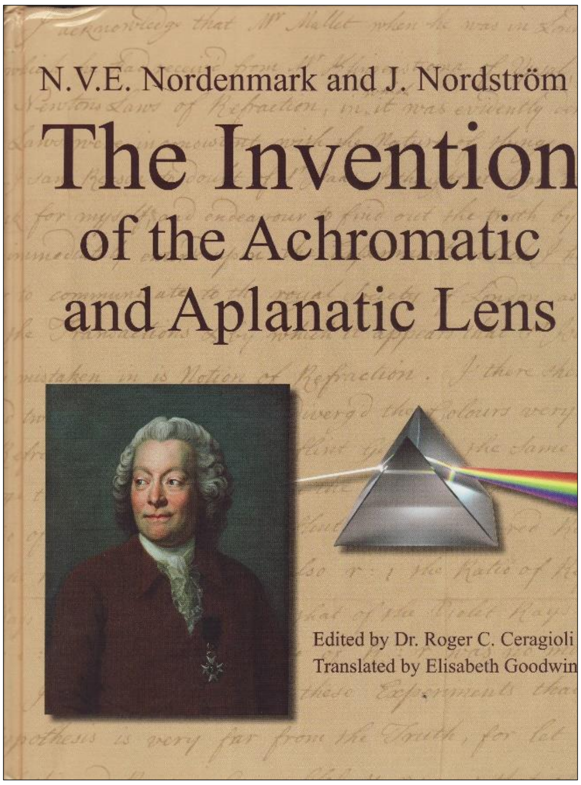
> By performing this labor, we hope at long last to bring Nordenmark and Nordström's paper before a wider audience, so that it will have the impact that it deserves on the scholarship of the telescope. (p. 3).

The 'blurb' on the back cover nicely summarises the contents for this book:

> The invention of the achromatic lens in the 18th century was a watershed event in the history of optical technology, revolutionizing enquiry into the sciences. The invention was, however, long shrouded in confusion, with conflicting claims concerning who did (or knew) what and when.
>
> The present work … presents the first systematic attempt to clear away the confusion. It focuses on the central role of the mathematician Samuel Klingenstierna in the invention. It brings to bear a wealth of documents in the Swedish language – never before available in English translation – stemming from Klingenstierna's network of informants who travelled or were resident in the London area (where the device was invented) and Paris (where it was extensively developed).

The translation of Nordenmark and Nordström's two papers fill pages 8 to 79, and include numerous lengthy quotations drawn from letters and diaries. Along the way we encounter many familiar figures, including Isaac Newton (1643–1727), Chester Moor Hall (1703–1771), John Dollond (1707–1761), Jesse Ramsden (1735–1800), Leonard Euler (1707–1783), Alexis-Claude Clairaut (1713–1765), and of course Samuel Klingenstierna (1698–1765). We learn a great deal about the relationships between John Dollond and Jesse Ramsden and between Dollond and Samuel Klingenstierna. We also find Dollond curiously silent about the fact that Chester Moore Hall invented the achromatic telescope years before Dollond claimed to have done so.

Dollond and Klingenstierna both published hall-mark papers in the *Philosophical Transactions of the Royal Society*, in 1759 and 1761, respectively, and in 1760 Klingenstierna had published an earlier account, in Swedish, in the *Transactions of the Royal Swedish Academy of Sciences*. Yet in 1760, the astronomers of Paris were unfamiliar with the work of either scientist, primarily because the Seven Year's War had prevented regular communication between France and England. Once apprised of these international developments, Clairaut began his own research on refracting telescope optics, and in 1762 and 1764 he published two important papers in the *Historie de l'académie royale des sciences*.



One name that surprised me because it cropped up so often was that of the Swedish Professor of Astronomy, Bengt Ferner (1724–1802) who spent much time in England and in France, and very effectively communicated de-tails of Klingenstierna's work to Dollond and Klingenstierna and Dollond's achievements to the French (and arranged for them to purchase Dollond achromatic refractors). Ferner was an astronomical advocate *par excellence*, and was responsible for prodding Clairaut into action. Although he was not directly involved in optical design, Ferner served as a catalyst, and he deserves a place in the history of the refracting telescope.

Between pages 80 and 126 (inclusive), the book contains twelve Appendices. Most of these are letters that Nordenmark and Nordström included in their original publications, but there are three new ones. Two are letters from the archives of the Royal Society that relate to John Dollond and have never been published before. The third new Appendix is an English translation of a speech about recent improvement in the optics of refracting telescopes that Carl Lehnberg gave at the 17 October 1762 meeting of the Royal Swedish Academy of Sciences. The text of this speech has never before been published in English.

Finally, for those wishing to pursue this topic further, there are nearly 20 pages of References, many in the form of detailed and informative end-notes.

This 142-page book is well laid out and well illustrated. It is an invaluable resource for those with a research interest in the history of the refracting telescope, and is also an enjoyable read for those with a passing interest in the subject. The Antique Telescope Society is to be applauded for taking the trouble to publish this fine book. Copies can be obtained through the Society (http://antiquetelescopesociety.org).

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