

BOOK REVIEWS

THE HERSCHEL FAMILY

The Herschels of Hanover. Michael Hoskin (Science History Publications, Cambridge [www.shpltd.co.uk], 2007). Pp. x + 182. £35/\$70. ISBN 978-0-905193-07-6.

As many readers of this journal will recognize, *The Herschels of Hanover* is in effect the third volume of a trilogy, the earlier volumes of which are Hoskin's *The Herschel partnership: As viewed by Caroline* and *Caroline Herschel's autobiographies*, both published in 2003. In a larger sense, it is part of a series of books that began forty-nine years ago, when Hoskin's *William Herschel: Pioneer of sidereal astronomy* debuted, and continued in 1963 with his *William Herschel and the construction of the heavens*. In the interim, Hoskin enriched Herschel scholarship with dozens of important journal publications.

The present volume studies twelve Herschels: William Herschel's parents, Isaac and Anna, and their ten children. Thus William's son, John Herschel, and his large family are not included. Setting aside Anna and Isaac, who share the first chapter, each Hanoverian Herschel receives a chapter, though four chapters, for the children who did not survive to adulthood, consist of only a paragraph giving what little is known of them. Hoskin appropriately devotes the two longest chapters to William (fifty-five pages) and Caroline (thirty-two pages). An important bonus chapter, "The Herschelian Revolution in Astronomy", synthesizes Hoskins's five decades of research on Herschel's astronomical achievements and practices. Excellent illustrations, some in colour, enhance the attractiveness of this volume.

Because *The Herschels of Hanover* is designed as a work of reference, it may not be the page-turner for most readers that it will be for those fascinated by the Herschels. The latter will delight in finally learning more of such Herschel siblings as Jacob, who died by strangulation; Alexander, who collaborated at times in William's musical and technical endeavours; and Dietrich, whose passion for terrestrial natural history may have significantly influenced William's efforts to do the natural history of the heavens. Among the many gems revealed in the book, my favourite is a story from a frosty February evening in 1783, when Herschel had as yet taken little interest in the Messier's nebular patches. His sister Caroline, who was just learning to observe using an elementary telescope, noted a nebulous object, she and William concluding (erroneously) that "Messier has it not." Shortly thereafter, she spotted another, this time concluding correctly: "Messier has it not". Hoskin remarks: "The consequences of this night's work were little short of epoch-making: [Caroline] had demonstrated to her brother that the mysterious nebulae and clusters were so numerous that specimens could be discovered by an inexperienced observer using the most rudimentary of instruments. And so, a week later, on 4 March William recorded the momentous decision 'to sweep the heaven for Nebulas and Clusters of stars'. Astronomy was soon to be transformed" (p. 110).

A number of other features of this book deserve attention. It is heavily based on manuscript sources, which frequently open up points of view otherwise unavailable. For example, we are taken behind the scenes to see how William, as he grew older and more frail, strove to bring his list of new nebulae to a total of 2500 (pp. 138–40). Despite the modest size of this volume, it contains over eight hundred references, thereby enabling scholars to check and follow up on Hoskin's claims and sources. It is significant that the great majority of these references are either to Herschel's writings, published and unpublished, or to the publications of Hoskin himself. This could give the impression that few other scholars have studied William and Caroline, whereas the contrary is the case. It is certainly true that much more research needs to be done. For example, despite all that this book reveals about the Herschels, it largely leaves aside the question of William's religious ideas and practices.

Michael Hoskin deserves congratulations and appreciation for making yet another important contribution to Herschel scholarship and thereby to our understanding of the foundational period of modern stellar astronomy.

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MICHAEL J. CROWE

ASTRONUMEROLOGY AT PALENQUE

The Apotheosis of Janaab' Pakal: Science, History, and Religion at Classic Maya Palenque. Gerardo Aldana (University Press of Colorado, Boulder, 2007). Pp. xxiv + 230. \$55. ISBN 978-9-87081-866-0.

Gerardo Aldana might have entitled this book "The agency of science at Palenque" in the sense that Mayan science, or "astronumerology" as he terms it, was used as a proprietary tool by the ruling élite of Palenque. This is an interesting and complex hypothesis which he explores in great detail and with considerable success, despite problems with clarity and presentation that better editing and greater intellectual distance from the source dissertation might have corrected. His book, he explains, "recovers a calendrically based language used in the construction of some of Palenque's most important texts" (p. xix).

The first section provides background on the standardized orthography of Mayan languages which Aldana uses. While correct, such use still confuses those who know the old, less phonetic names. Two tables here list the "old" and "new" names of five Maya rulers and thirteen sites, followed by a brief introduction to calendrics, and the transcription of hieroglyphic script in the book.

The introduction dismisses the many scholars who have associated astronomical events with specific dates in the Maya Calendar system known as the Long Count, which records the number of days since creation, 12 August 3114 B.C. Aldana argues that since there is not total agreement on the correlation between Christian and Maya

calendars such associations are impossible. He does not note that all but a handful of scholars have agreed on the correlation for more than four decades, nor that the generally rejected variant correlation differs by only two days. Nevertheless, Aldana has achieved an enviable liberation in deciding to ignore historic dates. Instead he concentrates on predictable solar, lunar and planetary cycles and their relationship to the Long Count.

The first chapter, in presenting historical background for Palenque, considers and criticizes many well-known historical and epigraphic reconstructions presented at the Palenque Round Tables (1974–93). It is appropriate that such initial interpretations be challenged. John Teeple, who worked out the implications of the Long Count documentation of moon phases, and Floyd Lounsbury, linguist and mathematician, both escape Aldana's criticism. In the 1970s Lounsbury noted that Long Count dates in the Temple of the Cross were separated by synodic periods, "contrived intervals", that involved multiples of the important numbers 9, 7, 13. Such intervals and the 819-day cycle are the focus of Aldana's book in which he develops an algorithm to generate "the intervals between all pairs of dates in the three tablets in the Temple of the Inscriptions". Eleven factors (calendric, planetary, lunar, 819-day cycles) were sought in the 7000 intervals generated. Once sifted for historical relevance fourteen pairs of dates contained them (Table 2.2). He contends these were not random (pp. 60, 61).

Aldana has constructed an intriguing explanation for the invention, deployment and historical associations of the 819-day count. The Long Count dates from the Temple of the Inscriptions, above the Tomb of Pakal, have the earliest known contrived intervals (p. 74). With a complex argument that relies on his controversial reading of glyphs on the eastern tablet (partly illegible), Aldana postulates that the astronumerology involved in contrived intervals was created, at least in part, by three named scribes in the court of Pakal (*Janaab' Pakal*) and his successor son *K'an Bahlam*. The purpose was to relegitimize and resanctify Palenque after its disastrous defeat by Calakmul (*Kalak'mul*) on the day 13 *Ahaw* 18 *Mak* 9.8.17.9.0 (24 November 610 A.D. Gregorian in generally accepted correlation).

Aldana names the 819-day count, which involves the four world directions and colours, *K'awiil-nal*, in reference to the four-sided ritual circuit and the emblematic personification of royal blood (p. 109). His "*k'awillian* astronomy" involves the association of the principal characters in the millennial *Popol Vuh* epic with deities with astronomical bodies invoked at Palenque and with Palenque rulers (chap. 6). The esoteric language of Palenque astronumerology he names *Zuyuathan*, after the secret knowledge of colonial Mayan priests (chap. 7). Throughout, much of Aldana's dense discussion of dynastic history is just as esoteric, intended for Maya initiates spawned by the Palenque Round Table meetings. Aldana ascribes the invention of the 819-day count to Palenque, from its first known written record. However, Robert Hall (1997) believes this cycle was a factor of the Epi-Omec Tuxtla Count, recorded on the "Tuxtla Statuette" (Gulf Coast, Mexico) in the second century A.D., and Saburo Sugiyama (1993) suggests it was a factor in the measurements of Teotihuacan's

layout, evident at the central point of the four directions at the same early period in Central Mexico.

There are production problems with this handsome, compact book. Aldana's drawings of glyphs seem to have a coloured wash which obscures them in black and white. His drawn inscriptions are excerpts that lack identifying coordinates and so are difficult to locate within an inscription. In chapter 1 endnote numbers 13–18 are missing in the text, in chapter 2 endnote numbers 14–19 are misnumbered, and the book has many typos. References in the text and endnotes frequently lack page numbers. Orthographic guidelines are inconsistently followed; Mayan names are untranslated and difficult to retain (e.g. *Ahkal Mo' Naab'*, *K'an Joy Chitam*).

On the whole, the creative premises of this ambitious, often difficult, book present original interpretations that will be contested by specialists in the history of Palenque and Mayan epigraphy; yet it may also invigorate study of this crucial site.

Boston University

CLEMENCY COGGINS

MORE ON THE STAR OF BETHLEHEM

The Star of the Magi: The Mystery That Heralded the Coming of Christ. Courtney Roberts (New Page Books, Franklin Lakes, NJ, 2007). Pp. 223. \$15 (paperback). ISBN 978-1-564-14962-6.

The story in Matthew's gospel of the star that led the Magi from "the east" to a meeting with a worried King Herod in Jerusalem, and then on to Bethlehem to pay homage to the newborn Jesus, is one that has surely received more attention from astronomers than any other astronomical passage in the Bible. Most of those who attempt an astronomical solution focus on the nature of "the star", ignoring the many textual and historical problems that need to be solved first. Courtney Roberts adopts a more intelligent order, and indeed her book might well have been given the title *The magi of the star*, since more than half of it discusses what we know of the μάγοι as an ethnic group, 'magi' in a general sense. Although Roberts often allows her admiration for Persia to lead her off track, she does make several useful points that are not new but that are too rarely heeded. The magi were a tribe of Medes who, over a long period of time, provided Persia with a largely Zoroastrian priesthood, a sort of sacred caste. (Herodotus is our first important source, from the fifth century before Christ.) Why was Matthew not averse to introducing this pagan group into a story that was intended to support belief in the divine nature of Jesus? Why, if there is reason to believe the story, is it found in no other New Testament gospel?

This latter question would have taken Roberts too far afield had she made a serious attempt to answer it, but to the former she offers some tentative answers. The Jews of the time were not as hostile to the Persians and Chaldaeans as one might think.

Many Jews had remained in Persia after the exile. Attention has often been drawn to a Persian tradition that a saviour would be born of a virgin. Many of Matthew's early readers would no doubt have known that when speaking of magi from the East, say from the Parthian regions of Persia, he was speaking of people who shared the widespread Jewish desire to throw off the Roman yoke. Not all communities of magi were in the east, however. There were others in Cappadocia to the north, and Roberts, with scraps of information about magi and about many other cultural and geographical situations from more than fifteen centuries, should have been less casual in her references to "Matthew's Magi". It is true that Jewish attitudes towards the magi, in a very broad sense of the word, at the beginning of the first century A.D., were ambiguous rather than hostile. The ambiguity can be seen, for instance, from the writings of Philo Judaeus, a contemporary of Christ but a generation older.

After her over-ambitious beginning, Roberts provides a potted history of the handling of astrology by magi and the Jews. She has little new to add to her sources — Edward Kennedy is a well-chosen favourite — as she underlines the importance of great conjunctions and millennial theories in the type of astrology the magi were likely to have practised. Her argument is not easy to follow, however, since she frequently heads off on tangents and jumps back and forth in time from Zurvan Zoroastrianism to New Age moderns. (Christianity she portrays as "the original New Age religion", with its Virgo, Pisces, great conjunctions, and so forth. It should not be necessary to spell out the reasoning here.) One of her central goals is to correct a modern tendency to undervalue Persian contributions to astrology and to Jewish Messianism. She usefully draws attention to the generally unhistorical analyses, astronomical and astrological, of the "star of the Magi", offered by many recent authors, and she is reasonably cautious in offering her own (historically unsupported) conjectures.

Those who are looking to Courtney Roberts for a new astronomical insight into the nature of "the star" will be disappointed, and that is not altogether a bad thing. One would like to think that her account will move historians' interest in this influential New Testament story away from astronomical conjectures that grow wilder and wilder as the years go by, but I am rather afraid that the shortcomings of her book will prevent its being taken very seriously by either astronomers or historians. Its extensive bibliography and references are slapdash in the extreme. Greek passages are printed without any accents, breathings, or subscripts. The author's understanding of astronomy is shaky. The illustrations are poorly chosen and so badly reproduced that some are impossible to make out. Most seem to be 'screen grabs' from the more dubious parts of the internet, which is also the source of much of the text. Making sense of the internet is indeed often as difficult as understanding the second chapter of Matthew's gospel, and Roberts's principal virtue is her frank and honest way of admitting how hard this is. But for all its shortcomings, her book will have served a useful purpose if it persuades its readers that the story is indeed worth thinking about.

THE TELESCOPE IN HISTORY

Der Meister und die Fernrohre: Das Wechselspiel zwischen Astronomie und Optik in der Geschichte. Edited by Jürgen Hamel and Inge Keil (*Acta historica astronomiae*, xxxiii; Verlag Harri Deutsch, Frankfurt am Main, 2007). Pp. 462 + 16 colour plates. €39.80. ISBN 978-3-8171-1804-5.

In 1957 Rolf Riekher, an optical engineer by training and profession, published *Fernrohre und ihre Meister* (a revised edition appeared in 1990). Like Henry C. King's *The history of the telescope*, Riekher's book is one of the classics of the field and remains indispensable for all those interested in the history of the telescope. In May 2007, on the occasion of Riekher's eighty-fifth birthday, a colloquium was held in his honour at the Archenhold Observatory in Berlin-Treptow, close to his home and place of work. The volume under review, appropriately titled *Der Meister und die Fernrohre*, is a Festschrift.

The editors, Jürgen Hamel and Inge Keil, have brought together twenty-two essays of quite diverse lengths. In one of the shorter, four-page essays, Peter Louwman announces the discovery of a Huygens lens in Rome that awaits further study. In the longest article (or perhaps better, with its nearly 100 pages, short monograph), Rolf Willach aspires to nothing less than a revision of our standard narrative of the pre-history and the invention of the telescope. The scholarly ambitions of the essays are also divergent. Some essays shed light on Riekher's biography, as one might expect in a Festschrift. The editors are, however, to be applauded for their efforts to gather a range of essays which, with the exception of the more biographically inspired contributions, are chronologically ordered, and which together provide the reader with a sort of history of the telescope from the invention of the instrument (and before) to the post-World War II production of optical instruments in Jena. A few of the essays on the earlier history of the telescope are in English, but most are in German, with English abstracts.

Riekher's *Fernrohre und ihre Meister* emphasizes the materiality of the telescopes and the material processes of the making of optical instruments. The Festschrift pays tribute to Riekher by adopting the same focus. The best essays in the volume reveal the possibilities created by merging the study of the material culture of science with other perspectives more typical of academic history of science. Several contributions show the importance of access to telescopes for certain types of astronomical research and investigate the historical processes that allowed astronomers access to instruments. Klaus-Dieter Herbst describes how the German astronomer Gottfried Kirch acquired his instruments. Klaus Schillinger shows that in the late eighteenth century, Johann Gottfried Köhler negotiated access to the instruments in the Mathematisch-Physikalischer Salon in Dresden before being appointed inspector, which allowed his continued use of the Salon's instruments for astronomical observations. Yet as discussed in Günther Oestmann's excellent paper, a reflecting telescope acquired for the Dorpat Observatory was, in fact, never used. Other essays analyse the material

constraints that instruments impose on astronomical research. Felix Lühning argues that in the early twentieth century construction problems with the meridian circle for the Kiel Observatory led to the failure of the associated research program. Hilmar W. Duerbeck shows that the results of the use of photography during the German expeditions for the observation of the transit of Venus in 1874 were so disappointing that it was decided not to use it on subsequent expeditions.

Several essays, such as the pieces by both editors on representations of telescopes in eighteenth-century German Baroque architecture, employ visual evidence to document the history of the telescope. Marvin Bolt and Michael Korey also take their lead from an engraving to consider early seventeenth-century trumpet-shaped telescopes.

The emphasis on the material culture of science, to which many papers in the volume testify, is best seen in Rolf Willach's revisionist narrative on the invention of the telescope. Willach studies the quality of preserved eyeglasses from the period between the fourteenth and sixteenth centuries, and uncovers improvements in lens-making that explain why, from the viewpoint of lens-making technology, the telescope became possible only in the later part of this period. Touching on such issues that inform our standard narratives on the history of astronomy and of science more generally, this *Festschrift* should interest not only the narrow circle of telescope aficionados but also historians of all stripes. And by drawing such grand conclusions from the close study of the material culture of science the book offers valuable lessons for historians of astronomy and of science.

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SVEN DUPRÉ

GERMAN SUNDIALS

Inventar der historischen Sonnenuhren in Mecklenburg-Vorpommern. Jürgen Hamel (*Acta historica astronomiae*, xxxiv; Verlag Harri Deutsch, Frankfurt am Main, 2007). Pp. 205. €19.80. ISBN 978-3-8171-1806-9.

Focusing on sundials in the Mecklenburg-Vorpommern region of Germany, this book gives details of some 188 dials in 108 places. The entries are arranged geographically, according to the *Landkreise* in which they are found. The dials range from simple scratch dials to elaborately carved or painted instruments, dating from the medieval to modern periods. The inclusion of all types of dial — however simple or elaborate, however early or late, and however well or badly preserved — gives a good sense of the range of dials surviving in this region. Each instrument is illustrated with a photograph, and the accompanying text gives details of its location and date, a description of the dial and its condition, and references to relevant literature or to other listings in which the dial has been included. At the back of the book, an

alphabetical register (by location) gives brief information about the date and type of the dial. This makes it easier to use the book to find, for example, all the polyhedral dials in the region, or all the medieval dials.

As the author notes both in the entries for individual dials and in the Introduction, some of the dials in the book are at risk of deterioration or loss; some have already been lost. There are a number for which it was not possible to provide a photograph, or which could be illustrated only with an old photograph, rather than with one taken by the author. This issue is particularly striking in the case of one dial (Kühlingsborn 1, pp. 28–29). Here, the author illustrates the entry with a photograph taken in July 2006, and another taken in 1985. The all-too-visible deterioration of the dial in the intervening twenty years provides a stark reminder of the importance of preserving this immovable heritage alongside the preservation in museums of portable time-keeping instruments. Hopefully, this inventory will, as well as providing valuable information to those studying the sundials in this region, raise awareness about the need to protect these objects for future generations.

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CATHERINE EAGLETON

EARLY RUSSIAN ASTRONOMY

Astronomiya drevnei Rusi [*Astronomy of Ancient Russia*]. Daniil Svyatskiy, edited by M. L. Gorodetskiy (Russkaya Panorama, Moscow, 2007). Pp. 663. RUB 350. ISBN 978-5-93165-102-0.

D. O. Svyatskiy's thoroughly researched *Astronomy of ancient Russia* is a welcome reference work for anyone interested in the development of astronomical knowledge in Russia and for historians of astronomy seeking additional eye-witness observations of astronomical phenomena in the Middle Ages. His editor, M. L. Gorodetskiy, has done a great service by updating and extending Svyatskiy's work.

Descended from several generations of Russian Orthodox priests, Daniil Osipovich Svyatskiy (1881–1940) received a classic religious education but found himself more interested in the natural sciences, particularly astronomy. In the first decades of the twentieth century, Svyatskiy was one of the most active members of the Russkoe Obshchestvo Lyubitelei Mirovedeniya [ROLM, the Russian Society of Amateur Astronomers], serving as editor of the society's journal until 1930. Given his family background, it is not surprising that Svyatskiy took an interest in the chronicles that were written in Russian monasteries beginning in the tenth century with Russia's acceptance of Orthodox Christianity from Byzantium.

The present volume reprints Svyatskiy's two most important works. *Astronomical phenomena in Russian chronicles*, originally published in 1915, likely would have remained unknown outside the Soviet Union had it not been discovered by an émigré astronomer, A. N. Vyssotsky, who published an English translation in 1949

(“Astronomical records in the Russian chronicles from 1000 to 1600 A.D.”, *Meddelande fran Lunds Astron. Obs.*, Ser. II, no. 126 (1949), #22). For this work Svyatskiy combed the *Full collection of Russian chronicles* for descriptions of astronomical phenomena, which he presents by type and date beginning with 49 solar eclipses. Some of the chronicle accounts are very detailed; frequently they posit connections between astronomical and historical events. For example, an account of the total solar eclipse of 1 May 1185 links that eclipse with Prince Igor’s unsuccessful 1185 campaign against the Polovetsians and describes what must have been solar prominences. Svyatskiy provides similar case-by-case analyses for lunar eclipses, comets, meteors, sunspots and auroral displays, and other phenomena.

The second of Svyatskiy’s works is *An outline of the history of astronomy in ancient Russia*. First published in instalments in the 1960s (over twenty years after Svyatskiy’s death) in a Russian history of astronomy journal, only now is the *Outline* being published as a whole. This work gives a sweeping account of astronomical knowledge and folklore at all levels of Russian society from ancient times until Peter the Great. Svyatskiy tells us about the solstice holidays of pre-Christian Russia; we learn that the Moon god Volos was seen as a shepherd who watched over his flock of stars. Svyatskiy’s history of the ancient Russian calendar will be of great help to anyone trying to make sense of the confused chronology of pre-Petrine Russia. Although Russia received the Julian calendar along with Christianity, in fact a mix of Julian and lunar calendars remained in use. The Russian lunar calendar consisted of twelve 29-day months, a 13th month being inserted every third year to keep the calendar roughly in line with the solar year. There was no agreement on when the year began, with some Russian principalities observing the new year in March and others in September.

Outline also provides a thorough discussion of Russian medieval cosmology. Compared with Western Europe, Russian conceptions of cosmology were primitive. The most influential views were those expounded by Kosma Indikoplov, a sixth-century merchant and traveller from Alexandria whose *Christian topography* remained important in Russia up to the seventeenth century. An opponent of the Ptolemaic system, Kosma saw the Earth as an unmovable flat rectangle; in his view, angels move stars across the sky.

It is a misconception, however, to think that Russian intellectual development was entirely stagnant in the centuries before Peter I. Svyatskiy devotes an entire chapter to the “Judaizer heresy” that appeared in Moscow and Novgorod in the late fifteenth century and flowered briefly until it was outlawed in the sixteenth century. The leaders of this heresy believed in the preeminence of the Old Testament and denied the existence of the Trinity. Well-educated, they were responsible for Russian-language translations of many Greek, Latin, and European works, and they came to accept the Ptolemaic system as promulgated in Europe at that time.

In the chapter on “Astronomy on the eve of Peter’s reforms”, we find that the latitudes of Moscow and Novgorod were determined for the first time in the sixteenth century and that Russian translations of almanacs and calendars began to appear in

the seventeenth century. We also learn about navigation techniques used by coastal sailors from Arkhangelsk. *Outline* concludes with a chapter on the rapid development of science under Peter I that led to the founding of the Russian Academy of Sciences and the building of Russia's first astronomical observatory.

Gorodetskiy adds to Svyatskiy's works a *Catalog of astronomical information in Russian chronicles*, listing the astronomical phenomena chronologically and the specific chronicles in which the events are described. Also included is a short biography of Svyatskiy's difficult life written by the historian V. A. Bronshten.

M. L. Gorodetskiy has done a great service by republishing and extending Svyatskiy's works that otherwise would have continued to sink into obscurity. Unfortunately for most readers of the *JHA*, a good knowledge of Russian will be required. Although Svyatskiy's writing style is very accessible, the same is not true of quotations from the chronicles, which are in Archaic Russian or Old Slavonic. This problem was noted even by Vyssotsky, a native Russian, when he prepared his English translation of *Phenomena* in 1949. Thus, although Gorodetskiy has done an excellent job of adding commentary to Svyatskiy's *Phenomena*, the average non-Russian reader may wish to consult Vyssotsky's translation before deciding whether the difficulty of wading through Old Slavonic is worth the effort. Unfortunately for historians of astronomy, Svyatskiy's *Outline* has yet to be translated. It should be. Meanwhile, it is to be hoped that this book — a work that does more than anything this reviewer has yet read to illuminate the state of astronomical knowledge and folklore in Russia before Peter the Great — finds an appreciative audience among historians of medieval Russia.

ROBERT A. MCCUTCHEON

TREASURES OF THE DRESDEN KUNSTKAMMER

The Geometry of Power / The Power of Geometry: Mathematical Instruments and Princely Mechanical Devices from around 1600. Michael Korey (Deutscher Kunstverlag, Berlin, 2007). Pp. 64. €12.80. ISBN 978-3-422-06726-4.

The geometry of power offers an introduction to the mathematical instruments and mechanical devices that the Electors of Saxony collected at their court in Dresden in the late sixteenth and early seventeenth centuries. It is not a full catalogue of the gizmos in the royal Kunstkammer, but rather a judicious selection of particularly wonderful items, with explanations of the underlying science and technology and accounts of the social and cultural contexts in which they were made and used. At one level, these objects show what artisans could accomplish with costly materials and wealthy patrons. At another, they show that the Electors, like other European rulers of the period, appreciated the importance of practical mathematics for the development and maintenance of their states.

Historians of astronomy will appreciate the ways in which the instruments acquired

by Elector August, the founder of the Saxon *Kunstammer*, reflect astronomical activities of the period. The oldest instrument, a brass celestial globe that was probably made in the Persian city of Maragha around 1300 and that has Arabic text and Ptolemaic stars, inlaid in silver, clearly represents the transmission of astronomical knowledge from classical Antiquity to medieval Islam and then to Renaissance Europe.

August acquired two astronomical instruments in 1658. One is an amazing astronomical clock with eight dials and celestial globe on top that was made by Eberhard Baldewein in Marburg. The dials representing the motions of the several planets are constructed with Ptolemaic deferents and epicycles. Noting that the stars on the globe are positioned according to the most recent observations made by Wilhelm IV, the Landgrave of Hesse, Korey argues that this globe “was in a literal sense the first means of publication for the astronomical activity in Kassel” (p. 51). The other instrument from 1568 is a brass astrolabe made by Johannes Praetorius in Nuremberg.

August’s successor, Christian I, acquired another gorgeous, gilded, multi-tasking object, this one made by Reinhold and Roll in Augsburg. Its central feature is a celestial globe that, by means of a clock inside, rotates on its axis once every 24 hours. Above the celestial globe is an armillary sphere, and below is a terrestrial globe that can be adjusted for the viewer’s latitude. The horizon ring carries several calendrical tables, and the base plate carries four small sundials, each suitable for a different latitude. Accompanying the globe is an account of its “High artistry and striking use” written by Roll.

Electoral August was also fond of odometers, boasting that they enabled him to travel from any place to another and then find his way back home. Korey describes a particularly ornate example made in 1584 by Christoph Treschler, the first notable mathematical instrument maker in Dresden, as well as an amazing paper roll documenting the route between Mühlberg on the Elbe River and Regensburg in Bavaria.

As evidence of the Electors’ interest in cryptography, Korey describes two cipher machines that, apparently, are the only two such machines known from this early period. One, made in Saxony in 1633, is an elegant set of dividers so designed that the distance between the points correlated with specific letters. Thus one could write a message as a series of line segments that could be read by a receiver with a similar instrument. The other consists of a series of concentric discs that implement a polyalphabetic encryption scheme. It is not dated, but has been on the record books since 1587.

Korey also discusses sundials, sectors, geometric squares that could be used to survey above ground, a curious instrument that could be used to measure horizontal and vertical angles under ground, gunners’ levels, automata, and a magnetic compass with illustrations indicating connections to astronomy and mineralogy. Finally it should be noted that a German edition of this book is also available.

COPERNICUS'S *OPERA OMNIA* COMPLETED

Mikołaj Kopernik Dzieła Wszystkie, iii: *Pisma Pomniejsze* [Minor Works]. Edited by Andrzej Wyczański (Polish Academy of Sciences, Warsaw, 2007). Pp. xx + 240. 50 zł. ISBN 978-83-7059-801-3.

With the publication of this vol. iii of the Polish “complete works of Mikołaj Kopernik”, the ambitious multilingual effort begun on the eve of the 1973 Copernican quinquacentennial year at last comes to an end. The series was the vision of Paweł Czartoryski (1924–99), scion of a noble Polish/Lithuanian family perhaps best known today for the Czartoryski Library and the Czartoryski Museum in Cracow, which hold among other treasures a dozen autograph letters of Copernicus and Leonardo’s “Lady with an Ermine”. The series opened in 1972 with a splendid colour facsimile of the holograph *De revolutionibus* preserved in the Jagiellonian Library, a volume that was issued in Polish, English, Latin, French, and Russian editions. In this volume’s tidy and well-proportioned diagrams and carefully lined tables we can truly perceive an artistic hand at work.

A second volume, the text of *De revolutionibus*, appeared first in the Latin edition in 1975 with Ryszard Gansiniec as editor; it was not without controversy, for the editorial policy, more relevant for a literary text than a scientific one, was to get back to the original manuscript text rather than the published edition, which contained many corrections to make the numbers in the tables more consistent with the textual discussion. In the following year, with Jerzy Dobrzycki as editor, the Polish translation appeared, and in 1978 Edward Rosen’s long-awaited English translation was published, followed in 1986 by the Russian translation. Each of these was vol. ii of its respective edition.

Meanwhile the French moved ahead on what was intended to be the material of vol. iii, Copernicus’s minor works. Under Rosen’s tutelage in 1975 they independently published French translations of the *Commentariolus* and the *Narratio prima* (which was not to be included in the English, Polish, or Latin editions). By 1982, however, the French scholars were prepared to strike out on their own with an upgraded version of the *Narratio prima*, published in *Studia Copernicana*, xx, which became the edition of choice. But no corresponding French vol. ii or iii ever appeared.

At this point the series almost stalled; the Copernican anniversary was fading into the past, and other issues were engaging the Polish scholars. However, in 1985 the English vol. iii appeared, with Rosen’s translation of Copernicus’s minor works, this time without a set of edited Latin texts. The volume was valuable, both because of its notes and because the texts were previously very scattered. The work was not without its problems, however. A new manuscript of Copernicus’s *Commentariolus* had been recognized by Dobrzycki, but its publication had been reserved for the still unpublished Latin vol. iii. And in the meantime Noel Swerdlow had published an excellent and well-annotated translation of that work, thus encroaching on what Rosen regarded as his own turf. In the English vol. iii Rosen adopted some of Swerdlow’s

expressions with only partial and grudging acknowledgement.

The series then went into hibernation, with only a fleeting breath of fresh air when in 1992 a lovely vol. iv appeared, containing facsimiles of all the remaining Copernican manuscripts — his letters, annotations in his books, copies of his treatise on currency, all three sixteenth-century manuscripts of the *Commentariolus*, and so on, as well as facsimiles of the books printed his lifetime. Thus these facsimiles related to vol. iii (Minor Works) just as the vol. i facsimiles related to vol. ii (*De revolutionibus*). Vol. iv appeared in Polish, English, Latin, French and Russian editions. Owing to very poor distribution, however, this volume appears to be rather rare in Western libraries.

The importance of the *Nicholas Copernicus complete works* series is well demonstrated by the fact that this journal published three magisterial critical essay reviews of the English volumes: ii by Gerald Toomer (*JHA*, xii (1981), 198–203), iii by Wilbur Knorr (*JHA*, xxi (1990), 203–11), and iv by Emmanuel Poulle (*JHA*, xxvii (1996), 75–78).

With Paweł Czartoryski's death in 1999 and Dobrzycki's in 2004 the series seemed doomed to be forever incomplete, in that the Latin texts for the minor works had never appeared. This gap is now at last corrected, though not in the most obvious way. The newly published Polish vol. iii is approximately half composed of original Latin (or German) materials. Finally Dobrzycki's Latin edition of the *Commentariolus* is available (along with a Polish translation). Copernicus's texts on currency reform are here, together with the "Letter against Werner" and his other correspondence. It is almost an act of heroism that the small band of surviving historians of astronomy and Copernicana in Poland have brought closure to this distinguished series. It is, however, rather sad that most libraries will regard this volume as an obscure Polish text rather than as a critical adjunct to the English *Nicholas Copernicus complete works*. The proper working group of volumes comprises the four English language texts (including the scarce vol. iv) plus the Latin vol. ii and the Polish vol. iii.

We can only hope that Jerzy Dobrzycki's Polish introduction to the astronomical minor works will soon appear in English in a volume outside the now-completed series. And the Latin *Opera omnia*, like an Unfinished Symphony, is forever beautiful even without one movement.

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EDDINGTON THE QUAKER

Practical Mystic: Religion, Science, and A. S. Eddington. Matthew Stanley (University of Chicago Press, Chicago, 2007). Pp. 313. \$37.50. ISBN 978-0-226-77097-0.

Most of the extensive scholarship about the history of science and religion focuses on the interaction of scientific facts and theories with religious beliefs. Matthew

Stanley's splendid biography of Arthur Eddington, one of the greatest cosmologists of the twentieth century, is an outstanding exception. Taking a cue from Robert Merton's seminal study of the influence of Puritan values on early modern science, Stanley writes with some eloquence about what he calls "valence values" that link religion to science, largely independently of specific theological doctrines and scientific conclusions. This fresh approach is potentially quite fruitful for understanding the history of science and religion in the modern period. Although the increasing privatization of religion "makes it difficult for historians to assess the religiosity of the authors of scientific works after the late nineteenth century", as Ronald Numbers has recently noted,¹ in some cases evidence may be more abundant for a scientist's religious values than for his beliefs. The historian who is prepared to analyse those values in relation to scientific practices and attitudes may still find much grist for his mill.

Certainly that is true in this instance. Eddington was an active Quaker with very liberal theological beliefs; like fellow Quaker Silvanus P. Thompson, he disavowed natural theology. It is significant that the word "God" is not found in the index. Yet the Quaker values he imbibed from birth and embraced as an adult — mysticism, internationalism, pacifism, and experience — led him decisively to reject both atheism and Marxist materialism, while affirming genuine human freedom and the overall complementarity of science and religion. The chapter on Eddington's pacifism, heavily based on newspapers and archival sources, is especially interesting for its rich coverage of wartime Cambridge and the ways in which the British government and Eddington's scientific colleagues tried to marginalize and demoralize him. Stanley also provides a detailed account of how the "Quaker Renaissance" that began in Manchester in 1895 influenced Eddington, who as a Manchester student lived at Dalton Hall, a Quaker residence directed by a friend of his late father. The careful attention given throughout the book to the larger context within which Eddington worked is commendable.

Eddington is probably best known today for his central role in planning and carrying out the expedition to observe the solar eclipse of May 1919, which confirmed Einstein's prediction that gravitation bends starlight. Stanley shows how Eddington's interest in this project was substantially driven by his pacifism and internationalism; he wanted to showcase the work of a German pacifist (Einstein) and to help heal the wounds that the Great War had inflicted on the European scientific community. In the process, Stanley denies the common claim that Eddington "fudged the results" of the observations (p. 122), underscoring the fact that science is not neglected in this study of an astrophysicist's religion.

Significant attention is also given to Eddington's many popular books about science, whether or not they included an overtly religious component. Some of his writings provoked heated responses, especially from fellow pacifist and one-time admirer Bertrand Russell, who scathingly dismissed Eddington's Gifford Lectures. Other materialists echoed Russell's tone, including Chapman Cohen, editor of the atheist newspaper *Freethinker*, who was apparently "infuriated" by the very fact that Eddington was both a religious believer and a scientist (p. 234). Ironically, Eddington's

liberal religious attitude and beliefs did not correspond to the traditional understanding of God and nature that both Russell and Cohen wrongly thought he represented. The bipolar view of religion and science implicit in the views of Eddington's harshest critics is precisely what Stanley rejects. "Values are not a zero-sum game the way Genesis versus Darwin purportedly is," he concludes, "and it is difficult to sustain an a priori expectation of the conflict between science and religion when the battlefield has room for many parties" (p. 243). Readers convinced of the value of values will likely find this book invaluable.

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REFERENCE

1. Ronald L. Numbers, "Epilogue: Science, secularization, and privatization", in Nicolaas Rupke (ed.), *Eminent lives in twentieth-century science and religion* (Frankfurt, 2007), 240.

THOMAS HARDY AND ASTRONOMY

Thomas Hardy's Novel Universe: Astronomy, Cosmology, and Gender in the Post-Darwinian World. Pamela Gossin (Ashgate, Aldershot, 2007). Pp. xvii + 300. £50. ISBN 978-0-7546-0336-8.

Virginia Woolf once noted that *Two on a tower* (1882) "contrast[ed] the stars with minute human loves".¹ In this lesser known Hardy novel, the astronomer Swithin St. Cleeve details for his future wife Viviette the "[t]wenty millions" of stars and great "voids and waste spaces of the sky" visible with a powerful telescope.²

Swithin explains that even the stars eventually "burn out like candles" to become "invisible cinders".³ Hardy's point, for Woolf, seemed clear. In comparison to the stars' eons, our minute lives take on significance only through human connection and love. In the work under review, Gossin eloquently argues that Hardy infused his fiction with astronomical references in order to suggest how broadly astronomical phenomena, cosmological narratives both ancient and modern, and Darwinian evolution have powerfully shaped human experience.

Thomas Hardy's novel universe fills a significant gap in Hardy scholarship. This well-researched study contributes to interdisciplinary investigation of literature and science and demonstrates the importance of astronomy and cosmology to new critical assessments of Hardy's work. In Part I, Gossin charts Hardy's lifelong fascination with astronomy. He knew the ancient and classical cosmological and mythopoetic narratives, owned a telescope, read popular astronomy articles and books, and throughout his life crafted sundials. While drafting *Two on a tower*, Hardy wrote to arrange a visit to the Royal Observatory at Greenwich, wanting to understand better its architecture. When someone asked whether he was constructing an observatory, Hardy replied that he was "sketching plans for one", purposely omitting, Gossin

reports, that his would exist solely in fiction (p. 158). Citing from his extant reading notebooks filled with passages from an eclectic range of sources on astronomy, geology, evolution, entomology, anthropology, and mythology, Gossin observes that Hardy's interest spanned the long history of cosmology from "the prehistoric and primitive, [to the] agrarian, early industrial and near modern" (p. 123).

Part II offers insightful readings of a number of Hardy's novels. Cosmological tropes, allusions, and plot devices as well as references to contemporary discoveries in astronomy, evolution, and the geological record pervade these texts. In *Far from the madding crowd* (1874), for instance, Hardy's narrator describes a wintry night sky, noting "the brilliancy of Sirius", the Pleiades, Orion, and Vega, and that "Aldebaran and Betelgeux shone with a fiery red" (pp. 138, 140). The narrator imagines feeling the Earth turn as it rolls through space and considers it remarkable "that the consciousness of such majestic speeding is derived from a tiny human frame" (p. 139).

William Herschel doubled the expanse of the known solar system in 1781 with the discovery of Uranus. This, along with his catalogues of hundreds of double stars and thousands of nebulae, profoundly shaped Victorian cosmology. Hardy's literary tropes of eclipsing binary stars, Gossin claims, were drawn from William and John Herschels' discoveries of binary and multiple star systems, made known via the popular science texts of the British astronomer Richard A. Proctor. In *The return of the native* (1878), Hardy compares the married couple Clym and Eustacia to "those double stars which revolve round and round each other, and from a distance appear to be one" (p. 151). And in *Two on a tower*, Swithin, an amateur astronomer like William Herschel, is writing a "great work on variable stars" (p. 168). Gossin subsequently reads the characters Swithin and Viviette as "eclipsing binaries changing over time their relative positions on personal, social, even geographical planes" (p. 175).

Gossin may confuse readers, however, when she at times equates variable stars with eclipsing binaries and does not distinguish between extrinsic and intrinsic variables. And while she asserts that Proctor's texts "were, by far, for Hardy, the most important sources of astronomical ... information" (p. 113), Gossin focuses almost exclusively on Proctor's *Essays in astronomy* (1872), leaving readers to wonder whether other Proctor texts may also have been important to Hardy.

In the strongest and most multilayered chapter, Gossin argues that Hardy (like Tennyson) drew on the cosmological myth of Danaë to challenge Victorian meta-narratives of supposed male superiority. Hardy's female characters, though like Danaë often subject to men, at times gain greater personal agency by reading the narratives writ large in the heavens and in the fossil record and by finding ways to question, if not subvert, unforgiving Victorian gender constraints. As Hardy knew, humans share a common dilemma, *viz*, the sheer survival of the species. But any hope of surviving far into the future requires, as Hardy and Gossin contend, that we are "*ad astra aspirare, ad amorem aspirare*" (p. 192).

REFERENCES

1. Virginia Woolf, *A passionate apprentice: The early journals 1879–1909*, ed. by Mitchell Leaska (San Diego, 1990), 386.
2. Thomas Hardy, *Two on a tower* (London, 1964), 31–33.
3. *Ibid.*, 34–35.

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NOTICES OF BOOKS

It's Part of What We Are: Some Irish Contributions to the Development of the Chemical and Physical Sciences. Charles Mollan (*Science and Irish Culture*, 3; Royal Dublin Society, Dublin, 2007). Pp. liv + 1770 in 2 vols. £35. ISBN 978-0-86027-055-3.

These massive volumes offer popular biographies of 118 men and women who were either born in Ireland or had Irish connections. Entries are laced with lengthy quotations from the subjects' works and enriched by plates illustrating instruments, laboratories, observatories and portraits. Selected astronomers and astronomical writers include, in chronological order, John Brinkley, Edward Sabine, Thomas Maclear, Thomas and Howard Grubb, William and Laurence Parsons (the third and fourth Earl of Rosse), William Henry Stanley Monck, Robert Stawell Ball, Anges Mary Clerke, John Ellard Gore, Margaret Lindsay Huggins, William Edward Wilson, John Louis Emil Dreyer, and Kenneth Essex Edgeworth.

Simon Newcomb: America's Unofficial Astronomer Royal. Bill Carter and Merri Sue Carter (Mantanzas Publishing, St. Augustine, FL, 2006). Pp. xiv + 213. \$27. ISBN 1-59113-803-5.

Drawing heavily on Newcomb's autobiographical memoir and unpublished correspondence, this popular biography of one of America's best-known astronomers often reads like an historical novel, providing rich details and verbatim conversations. The authors suggest that Newcomb, as he pursued his career at the U.S. Naval Observatory and the Nautical Almanac Office, adopted George Biddle Airy, the British Astronomer Royal, as his role model for organizing astronomical research on a national scale.

Instrumentos de Topografía y Geodesia: Catálogo del Museo Nacional de Ciencia y Tecnología. Petro Castell, Gema Hebrero Domínguez and María José Martínez Pérez (Ministerio de Educación y Ciencia, Madrid, 2007). Pp. 172. €14. ISBN 978-84-369-4536-2.

This small catalogue offers crisp colour photographs and short descriptions of some one hundred instruments in Spain's National Museum of Science and Technology,