Reviews

Science in Theistic Contexts: Cognitive Dimensions, J.H. Brooke, M.J. Osler and J.M. van der Meer (eds), 2001, Osiris, **16**, second series, (University of Chicago Press: Chicago) 376 + xii pp., ISBN 0-226-07564-8, hard cover, price $39.00 and ISBN 0-226-07565-6, soft cover, price $25.00, 261 × 179 mm.

In response to Napoleon's question about the place of God in his cosmology, Laplace famously retorted that he had "no need of *that* hypothesis." Newton saw things rather differently: for him the "most beautiful System of the Sun, Planets, and Comets, could only proceed from the counsel and dominion of an intelligent and powerful being." Though writing in a very different astronomical and religious context, the fourteenth century Islamic astronomer and theologian al-Sharīf al-Jarjānī expressed similar sentiments: "the characteristics of the celestial orbs and the Earth, and of what they reveal of subtle wisdom and wondrous creation–things that overcome whoever apprehends them with awe, and facing him with the glory of their Creator, prompt him to say: "Our Lord, thou has not created this in vain."' The remarks of both Newton and al- Jarjānī seem to echo the Old Testament, where "the heavens declare the glory of God; And the firmament sheweth his handiwork" (Psalms 19:1).

Both science and religion traditionally purport to provide ways of understanding the world. Further, modern, western science developed during the Renaissance and Early Modern times in societies whose philosophy, culture, and world-view were dominated by Christianity. In these circumstances it is inevitable that religious ideas would influence scientific ones. The traditional narrative has an emergent science slowly but inexorably pushing back the boundaries of ignorance and superstition, whilst organized religion is reluctantly forced to yield ground. Hostilities were joined over astronomy, in particular Copernicanism, but in later centuries the battleground shifted to geology and biology. This triumphalist narrative derives from nineteenth century accounts, such as Draper's *History of the Conflict between Religion and Science* (1875) and White's *A History of the Warfare of Science with Theology in Christendom* (1896). Whilst there is certainly some truth in it: modern science constitutes a vastly more rigorous, powerful, self-consistent, and accurately predictive method of understanding the world than any previous system, the notion that these advances were gained in the face of opposition by organized religion oversimplifies a complex interaction. Simply recall, for example, that the Catholic Church has long been a patron of science. Further, such a notion is ahistorical: the boundaries of 'science' and 'religion' were not the same in previous centuries as today. Renaissance and Early Modern scholars did not partition their intellectual activities using modern categories. Indeed, the word 'scientist' was not coined until the nineteenth century. Further, the influences are not necessarily one-way and can take any number of forms:

> ...the variety of relationships is much richer and more complex than the notions of conflict and harmony can convey. For example, one cannot neglect such other possibilities as separation, dialogue, integration and subordination. Even within the concept of conflict, we should add the notion of (peaceful) competition to that of warfare, and within the notion of harmony it is extremely important to distinguish the direction of influence, whether from religion to science or from science to religion. And in any case there are several different kinds of influence: presupposition, sanction, motive, prescription, and substantive source (Finocchiaro, quoted from the volume under review, p. 115).

It is in the nature of religious convictions that, when deeply held, they will often underpin a person's approach to many aspects of life, and it is almost a commonplace that if a scholar adheres to such beliefs then they might affect his scientific work. Even in the absence of any conscious influence, the syllogism runs that his religious beliefs influence his standpoint on metaphysical questions, which, in turn, inform his approach to scientific issues.

The purpose of *Science in Theistic Contexts* is primarily to examine in detail instances in which religious beliefs have influenced scientific thought. It is the eponymous proceedings of a conference held in July 1998 at the Pascal Centre for Advanced Studies in Faith and Science, Redeemer College, Ancaster, Ontario and is published as a volume of *Osiris*, the annual companion to the journal *Isis*. Most of the contributors have a background in the history and philosophy of science. Geographically most hail from North America, but with a few from the UK and two from Israel. The volume is divided into two sections: an introduction and a series of case studies. The introduction comprises two essays on more general topics: 'Religious Belief and the Content of the Sciences' by Brooke and 'Religious Beliefs, Metaphysical Beliefs and Historiography of Science' by Wykstra. Manuscript versions of these essays were circulated before the conference to provide a context for the subsequent discussions. The case studies examine individual instances in which scholars' religious beliefs and attitudes have influenced their scientific work. There are fourteen case studies, of which six are on astronomical topics.

The case studies are arranged broadly chronologically, with most of the astronomical material occurring in earlier rather than later contributions. The first investigates the way in which Islam changed the Hellenistic astronomy adopted in the Arab world from the eighth century. The second discusses the reception of Copernicanism amongst Jewish scholars. These two contributions are the only ones which consider religions other than various forms of Christianity. Subsequent entries consider the religious influences on Kepler, Galileo, and Newton. Kepler, of course, is always an ambiguous figure, seemingly poised between mediaeval and modern modes of thought. Barker and Goldstein argue that his discoveries in planetary motion were informed and under-pinned by his religious convictions, particularly that God had constructed the world according to an intelligible plan, discernible by man. Finocchiaro reconsiders the trial of Galileo. Snobelen excavates evidence of Newton's heretical Unitarianism hidden in the General Scholium to the *Principia*. In the final astronomical case study Crowe provides four examples, two from the eighteenth century and two from the nineteenth, in which religious concerns influenced astronomical ideas about extraterrestrial life. Of the non-astronomical case studies, two concern Early Modern natural philosophy and the rest address nineteenth century topics, mostly related to the development and reception of the theory of evolution.

Science in Theistic Contexts is not an easy read. The contributions are detailed, careful, closely-argued disquisitions in the style of modern scholarship. However, they are uniformly stimulating and thought-provoking. Some provide fresh insight into familiar ground while others cover less well-known material. The volume has the usual problem of conference proceedings that it is a collection of disparate papers which will be of varying interest. On the one hand, this consideration is augmented by fewer than half the contributions being on astronomical topics, but, on the other, is mitigated by the very reasonable price. Anyone with a serious interest in the influence of religion on the history of astronomy should find much food for thought in the astronomical contributions and would need to be narrowly focussed indeed not to find something of interest in the non-astronomical ones. The volume is physically very well produced and the contributions are uniformly well-written, with few, if any, typographic errors. The authors, editors and publishers are all to be congratulated in these regards.

Clive Davenhall.

New Observations of Heavenly & Earthly Objects [Made] with the Aid of Optical Instruments Devised by Him and Brought to Perfection, by Francesco Fontana (Naples, 1646), translated from the Latin with annotations by Peter Fay and Sally Beaumont (privately printed, available from the authors at 18 Orchard Avenue, Sonning Common, Reading RG4 9LT, UK), 130 pp. + numerous plates, spiral bound, £12.00.

Novae Coelestium Terrestriumque Rerum Observationes, by Francesco Fontana (Naples, 1646), a transcription by Peter Fay and Sally Beaumont (privately printed, available from the authors at 18 Orchard Avenue, Sonning Common, Reading RG4 9LT, UK), 81 pp., spiral bound, £12.00.

Everyone with an active interest in the history of telescopic astronomy will have heard of Francesco Fontana. His blurred, spiky drawings of the crescent Venus accompanied by a big spherical satellite, or of Saturn surrounded by a narrow oblique ring terminating in a pair of large round objects, appear in a variety of histories of astronomy, as do his much better drawings of the Moon. Yet the book from which they came, Fontana's *Novae Coelestium Terrestriumque Rerum Observationes (New Observations of the Heavenly and Earthly Objects)* published in Naples in 1646, is not only extremely rare but has never, until now, been available outside its Latin original. It is for this reason, therefore, that Peter Fay's and Sally Beaumont's translation is so significant and deserves notice by the astronomical community. It is an indictment of the modern publishing industry, moreover, that neither academic nor commercial publishers were willing to take *New Observations* ..., making it necessary for the authors to issue their translation in spiral-bound, photocopied format, into which high resolution photographs of Fontana's original engravings have been individually glued in the appropriate places in the text.

One of Fontana's most memorable and unverified claims is that he not only developed telescopes before Galileo, in 1608, but that he was using the 'Keplerian' optical configuration (in which both object glass and eyepiece were convex lenses) several years before Kepler himself. Indeed, it is clear that Fontana was an accomplished lens-grinder, for one of the most important sections of his book is his description of how to grind and polish telescope lenses and conduct simple optical tests to ascertain their quality. What is clear, however, is that some of these instruments, such as the refractor containing no less than *eight* lenses in its tube, could produce severely aberrated images which no doubt generated the large

satellites of Saturn and Venus, and the round spots that appeared in the middle of the bright image of Mars – engraved images of all of which are photographically reproduced in the text.

In spite of these now-recognized mistakes, Fontana's text is fascinating to read and is full of important asides on classical and contemporary astronomy. For instance, he describes the ancient technique of improving naked-eye images by looking at the stars through long, narrow tubes, which of course cut out stray light and improve the resolving power of the unaided eye. Fontana also reviews the optical writings of his older pre-telescopic contemporary, Giambatissta della Porta, and makes the prescient observation that the angular diameter of Mars varies in relation to the planet's position *vis-à-vis* the Earth and the Sun when viewed through a telescope.

Yet one cannot help noticing that, amidst his descriptions of the Moon, planets and stars, Fontana says nothing about sunspots, yet sunspots were the controversial bodies which Galileo had used as evidence both of the Sun's flawed surface and of its axial rotation. Both were contrary to the teachings of Aristotle, and Galileo pressed them into service as evidences for the Copernican theory. Fontana, however, kept well away from any discussions about Copernicanism. No doubt this was occasioned in part by the recent condemnation of Galileo, but more likely, I suspect, it derived from Fontana's close friendship with many figures in the Roman Catholic hierarchy within the Jesuit scientific community. For like the Jesuits, Fontana seems to have felt (quite rightly, considering the evidence available in 1646) that there were still no clear physical proofs of the Earth's motion, and that the Tychonian Theory (in which all the planets rotated around the Sun, but the Sun in turn rotated around a fixed Earth) still provided the most extensive and connected explanations of both celestial and terrestrial phenomena.

Fay and Beaumont present us with a fascinating book that is both accurately and elegantly translated from the Latin. It opens up an astronomical world scarcely touched upon in the existing accessible literature, which is primarily concerned with the radical impact of Galileo and largely ignores non-Copernican telescopic astronomers such a Fontana. And in order to support their translation and place the whole evidence before those whose interests in Fontana are academic as well as practical or astronomical, the authors also offer a transcription of the complete Latin text and engravings as a separate volume. Peter Fay and Sally Beaumont must be warmly congratulated for making this valuable text more readily available, and it deserves notice from all people who have a serious interest in the history of astronomy.

Allan Chapman

Agnes Mary Clerke and the Rise of Astrophysics by Mary Brück (Cambridge University Press 2002), x + 275 pp., 220 × 140 mm.

To the loss of the majority, probably rather few working astronomers now read Agnes Clerke's books, although historians of astronomy still find them valuable for reference. Of particular value is her best-known book, *A Popular History of Astronomy in the Nineteenth Century*, published in 1885 with a fourth edition appearing in 1902, only a few years before its author's death. Mary Brück's biography makes clear, however, that Agnes Clerke wrote much more than this one book. She was the author of three other astronomical books, many articles for periodicals, major articles for the *Encyclopaedia Britannica* and biographies of most of the major British astronomers for the then new *Dictionary of National Biography*. Much of her writing had some connection with astronomy, but she also wrote on other scientific topics and even occasionally tackled non-scientific subjects. The title of her best-known book should not mislead modern readers into thinking of Agnes Clerke as simply a popularizer. Her work was respected by many of the eminent astronomers of her day (not only British ones) who became her friends, and her opinions on astronomical matters, including possible future directions of research, won her further respect in those quarters. All this was achieved by a woman who, like many of her generation, received no formal schooling as a girl.

The Clerkes were an Irish family and Agnes, born in 1842, spent her childhood and adolescence in Ireland, first in a small town in the south, later in Dublin. She was the second of three children, having an elder sister, Ellen, and a younger brother, Aubrey. The brother received the schooling and university education that the girls were denied, and became a lawyer. None of the three married and they remained close until the last one, Aubrey, died in 1923. The girls' education at home seems to have been primarily the responsibility of the father and, to judge from the results, he was a first-class teacher. Ellen also became a prolific writer for periodicals and published a volume of her own poetry. The family moved to Dublin at about the time that Aubrey entered Trinity College in that city but, a few years later, they went to Italy for ten years, a sojourn that perhaps partly accounts for the two sisters' facility with languages. Finally, in 1877-8, the family moved to London, all living under one roof, where they remained for the rest of their lives. Agnes herself died in 1907.

It was in London, when they were each in their thirties that the two sisters embarked on their literary careers. Mary Brück follows both careers to some extent but the spotlight is, of course, on Agnes. Her first articles were for the *Edinburgh Review* and drew on her recent experiences in Italy, but she soon began to concentrate on astronomical or other scientific topics. Her articles were well researched and their success gave her the confidence to attempt her first book, the *Popular History*. Already, before that book was published, Agnes had been in correspondence with the American astronomer E S Holden. (One of the attractive features of this biography is the pleasanter side of the controversial first Director of the Lick Observatory that it reveals.) The success of her book was to bring her a much wider circle of astronomical friends: Campbell, Keeler, Hale, Newcomb, Gill, and Lockyer were all members of this circle, but the most significant friendship was with Margaret Huggins, the wife and colleague of Sir William Huggins. It was, no doubt, particularly the influence of William and Margaret Huggins, on the one hand, and the scientifically different influence of Lockyer, on the other, that brought Agnes to a realization of the importance of the new astrophysics. David Gill was also a strong influence, however: he actually persuaded Agnes to spend two months at the Cape, where she acquired her only significant observing experience under his direction.

As Agnes learned more and found that leading astronomers listened to her opinions, she ventured beyond the mere recording of history into summaries of current knowledge and suggestions for future research. Two later books: *The System of the Stars* (1890) and *Problems in Astrophysics* (1902) exhibit this trend. As Mary Brück points out, Agnes was sometimes rash in committing herself to an opinion, when more experienced observers tried to urge caution on her. This trait was particularly evident in her conviction that the spiral nebulae must be part of the one stellar system – there were no "island universes" for her. Even here, however, she was representative of a substantial body of the professional opinion of her time and the matter was not settled until decades after her death. The principal lesson we should draw from her misplaced confidence is not so much that she was mistaken, but that we might be just as mistaken about some matters of which we are just as sure. Inevitably, she got caught in the cross-currents of academic disputes: some criticized her friendship with Holden, while her closeness to William and Mary Huggins led to strains in her relations with supporters of Lockyer. She never lost the friendship of Lockyer himself, but the pages of *Nature*, to which she had once been a welcome contributor, were closed to her by his former pupil and successor, Richard Gregory, a severe critic of her books.

Mary Brück has established herself as a leader in chronicling the lives and work of nineteenth-century women astronomers and she is at pains to place Agnes Clerke in the context of the times. A chapter of the book is devoted to the status of women in late nineteenth-century British astronomy. Although there were then considerable obstacles to women's advancement, they seem to have arisen more from the general attitudes of contemporary society than from any animosity on the part the men who would have been colleagues. We learn that Agnes Clerke was among the first women to be offered a temporary post (all that was possible at the time) at the Royal Observatory. She declined for personal reasons. She did not live long enough to see women elected to Fellowship of the Royal Astronomical Society, but she was allowed to attend meetings and became one of the few women to be elected honorary members.

Reviewers are expected to make some criticisms, if only to show that they have actually read the book. Misprints are few, but the omission of one zero from the value of the velocity of light (page 40) is unfortunate (it will probably mortify the author more than anyone else). Less serious, is the reference to a 60-inch telescope at Yerkes Observatory in 1902 (page 154). Of more substance is the discussion of Agnes Clerke's view of novae on page 118. She had initially been attracted to the idea that novae were the result of a collision between two stars, but, correctly, she eventually abandoned the hypothesis. Neither she nor any of her contemporaries could have foreseen the connection we now make between the nova phenomenon and membership in a particular type of binary system. Mary Brück adds a brief explanation of the nova phenomenon as the expulsion of an outer shell from a star, but adds a categorical comment "No second star is involved.", which is misleading. Finally, the comparison between the relations of light-curves and velocity-curves of Cepheid and eclipsing variables (page 168) is rendered unclear by the implication that in the latter, light and velocity minima should coincide.

These are small blemishes, however. After all the focus of the book is on the life and work of Agnes Clerke, not on modern astronomy. Mary Brück has succeeded in painting an attractive portrait of a woman who was obviously not only highly intelligent but must also have been a pleasure to know. Perhaps the biography is successful because author and subject share so much in common: both are women working in astronomy, both are Irish and both practising Roman Catholics. The reader feels that the biographer is really in sympathy with her subject, but she does not descend to hagiography and is ready to offer criticism where it seems to her to be merited. Agnes Clerke was a significant figure and we should not have had to

wait nearly a century after her death for an account of her life. Perhaps, however, Agnes' spirit thinks the wait worthwhile, since this biography is a model of what a scientific biography should be.

Alan H. Batten.

The Transit of Venus. The Quest to Find the True Distance of the Sun, by David Sellers (Maga Velda Press, Leeds, 2001), 222 pp., ISBN 0-954-1013-0-8, paperback, £12.95, 234 × 155 mm.

The upcoming 2004 and 2012 transits of Venus are eagerly awaited events and as such have attracted a number of recent books on these rare and historically-important events, so the appearance of yet another could be greeted with dismay. But *The Transit of Venus* is different. Although designed to appeal to astronomers, this book is also written for the general reader who might be intrigued to know how it is possible to measure something as intangible as the distance to the Sun.

David Sellers has done an excellent job, taking us through the mandatory introductory chapters on Greek and Roman astronomy and the ideas of Copernicus, Brahe, Galileo, Kepler, and other luminaries, before launching into the pioneering transit of Venus observations made by Horrocks and Crabtree in 1639. Next are chapters on "Predicting transits of Venus" and marine navigation, before we are introduced to the genesis of the idea that transits of Venus could be utilized to determine the solar parallax – hence the Astronomical Unit. Following this come those all-too-familiar sagas associated with the all-important 1761 and 1769 transits.

The next chapter, "Venus Abandoned", is the only weak point in the book in that Sellers is unduly dismissive of the 1874 and 1882 transit results. These transits, too, had their human dramas – just like the two eighteenth century transits – but Sellers does not share these with us, and while it is true that other methods were used to investigate the solar parallax, Dick *et al.* (1998), among others, have clearly demonstrated that the 1874 and 1882 transits did produce meaningful results. Having said that, Sellers' account of Gill's expedition to Ascension Island to observe the 1877 opposition of Mars is captivating!

The final two chapters drag us into the twentieth and twenty-first centuries. In "Venus Reclaimed" we read of how radar observations of Venus led the IAU in 1976 to adopt a value of 8.794148″ for the solar parallax, while Chapter 15 discusses the 2004 and 2012 transits.

Although the contents of *The Transit of Venus* is predictable, Sellers writes in an entertaining style, which makes this book enjoyable reading. For example: "The quest to find the Sun's distance—the so-called 'Astronomical Unit'—runs like a bright thread through the entire tapestry of astronomical history. Its story spans two millennia and reveals the extraordinary efforts which have been devoted to discovering the true place of our earthly home in the solar system" (page 14). Many other examples could be given, and in this regard I found shades of Sobel's *Longitude* in Sellers' book. I hope it, too, will reach and be appreciated by a wide lay audience, but I can also recommend it for historians of astronomy, especially those seeking an easy-going refresher course in preparation for 2004 and 2012.

Wayne Orchiston

Reference

Dick, S.J., Orchiston, W. and Love, T., 1998. Simon Newcomb, William Harkness and the nineteenth century American transit of Venus expeditions. *Journal for the History of Astronomy*, **29**:221-255.