

## Reviews

*Gods in the Sky. Astronomy, Religion and Culture from the Ancients to the Renaissance* by Allan Chapman. (London: Channel 4 Books, Pan Macmillan Ltd. 2002), ix + 342 pp., 240 × 155 mm, £18.99.

The author of *Gods in the Sky*, Dr Allan Chapman of Oxford, is an academic historian, well known for his researches in the history of astronomy. The historian's approach is central to the present book, which traces humankind's view of the cosmos from earliest times to the beginnings of modern science. It treats the subject in the context of general cultural developments at each stage, including quite particularly religious ideas and beliefs. It is Dr Chapman's basic premise, outlined in the first chapter, that the rise of monotheism – the belief in one rational, all-powerful Creator of the universe as held in the three great traditions of Judaism, Christianity and Islam – played a pivotal part in the foundation of modern science. He challenges the widely-held notions that science and religion are incompatible, or that in the past the Church was the enemy of scientific progress. He shows that the Middle Ages in Christian Europe were far from 'dark', and describes how centres of learning flourished in northern as well as Mediterranean countries.

The chapters that follow get down to copious historical details, beginning with the ancient civilisations of the Near East two or three millennia BC. These peoples acquired a considerable knowledge of astronomy, constructing calendars, and predicting eclipses, but these activities were carried out purely for the regulation of civil and religious life. The world of human beings was seen as subject to numerous capricious gods who inhabited a cosmos of the vaguest mythological origin. An exception to this primitive cosmology came from the Jews who in the first millennium BC developed their belief in a unique God who created the heavens and Earth from nothing. The story of the Creation in the book of Genesis, "one of the world's most far-reaching and influential narratives", was put on record in the sixth or seventh century BC. The same one God the Creator was carried through in the Old Testament to Christianity. It was also to be fundamental to the faith of Islam, founded in the seventh century AD. Dr Chapman finds it significant that these civilisations from which modern astronomy – and science generally – were to evolve would have in common a belief in one personal Creator God.

The cosmos of the Greeks in their great age of learning (beginning in the sixth century BC) did not include a Creator but was governed by principles of logic and mathematics which were absorbed by their monotheist successors. The Arab world was the principal inheritor of Greek science. Indeed, Arab astronomy, which began as early as the second century AD, was responsible for the longest and most detailed runs of celestial observations of all time, the era AD 900 to AD 1200 being its Golden Age. The fate of astronomy in Europe in the same period was more complex. Popular accounts of the history of science tend to skip from Ptolemy (second century AD) to Copernicus – well over a millennium – in one great leap.<sup>1</sup> Dr Chapman fills in this important interval. Though there was little research, practical astronomy, in the service of the Church, was never neglected. The Council of Nicea in AD 325 fixed the date of the equinox, important for the determination of the date of Easter. Within a few centuries the date had slipped again, and in AD 664 was corrected at the Synod of Whitby in Yorkshire, England. Education was fostered, monasteries flourished, and schools associated with Cathedrals were instituted. The great universities of Paris, Oxford, and Bologna were founded early in the new millennium. All used Latin as the common language, which encouraged the free movement of scholars and of ideas throughout Europe.

The twelfth and thirteenth centuries saw an amazing revival of European learning. The Crusades (c. AD 1100), aggressive though they were, had a beneficial effect on the conquerors, who were thus exposed to Arab culture and learning. Spanish Knights captured the city of Toledo with its magnificent library of Arabic books and of Arabic versions of Greek texts which were now re-translated into Latin and re-introduced to Christian scholars. In the field of science, the Greek and Christian traditions thus brought together appeared at first to be at odds: the Greek cosmos was ruled by a non-personal "first cause" and "prime mover", and was deemed eternal; the Jewish-Christian cosmos was created by God and had a beginning. Great minds endeavoured to reconcile these positions and succeeded in having Aristotle's works accepted as

orthodox in the university curriculum. In the course of time, however, Aristotle's physics with its distinction between terrestrial and celestial matter, and Ptolemy's strict epicycles and crystal spheres, were to be challenged and eventually abandoned. Several factors contributed to this - the great fifteenth century sea voyages of exploration which fostered technology in navigation, geography and geophysics, the invention of printing (the "internet" of the day, as Dr Chapman aptly calls it), the re-discovery of original Greek material through refugee Byzantine scholars from the Ottoman Empire (1543), and to some extent the Protestant Reformation.

It was in the wake of these events that the scientific giants - Copernicus, Tycho Brahe, Kepler, and Galileo - carried out the labours that transformed astronomers' - and humankind's - view of the universe. Copernicus' theory of the Sun-centred solar system (though worked out years earlier) was published when he was on his deathbed (1543). Galileo's championing of that theory gave rise to his famous clash with the Inquisition in 1633 (an episode now candidly regretted by the Catholic Church). Dr Chapman's exposition of the ambiguous status of the Copernican theory at that period, and of the peculiar circumstances of the Galileo affair, provides informed enlightenment of a story that has been prone to bias, if not deliberate distortion, notably by the agnostic movement of the late nineteenth century.

The book ends with a brief look at the development of cosmology from that time until the present, and a recapitulation of the original proposition - that the emergence of a scientific picture of the universe is a result of the fusing of Greek modes of logical thought with monotheism or belief in one Creator God. It is certainly the case that the scientists responsible were all monotheists. The question is whether that revolution could have occurred otherwise. Dr Chapman argues powerfully that it could not; that the belief in a God who designed the universe was what motivated rational human beings, deemed to be created in His image, to observe and to endeavour to understand it. Contrary to popular notions, the scientific revolution of the sixteenth and seventeenth centuries did not represent a revolt against religious belief but against dogmatic classical philosophy. In fact, Church scholars, in late medieval times, had been the first to question that philosophy. On the general question of the relation between science and religion, Dr Chapman provides much food for thought. He counters the modern myth that would present science as "true" and "unprejudiced" by reminding us that science itself is not nature, but rather "a system of investigation which aspires to explore nature's inner logic, but which is itself invented and managed by fallible men and women". Both science and religion are branches of intellectual activity which are not fundamentally antagonistic to each other. He cites the traditional participation of the Catholic Church in scientific research, which is much to the fore in the present day; and the active academic collaboration growing up between modern scientists and theologians. (An example of the latter is the conference of distinguished scholars from Christian, Jewish and Islamic backgrounds held at the Pascal Centre for Advanced Studies in Faith and Science in 1998 whose published proceedings were reviewed in the last number of this journal.)<sup>2</sup> The book, for all that, is by no means entirely metaphysical. It can be read quite straightforwardly as a fascinating and instructive history of the development of cosmology from earliest times until the Copernican revolution. It is written in the author's highly readable jargon-free style, and contains much unexpected information, not encountered in the usual histories - from Egyptian mythologies, Islamic observatories, Gothic architecture, the medieval universities, to experimental physics in England in the Elizabethan age.

There is an excellent bibliography, divided into historical periods; and readers who as a result of Dr Chapman's analysis wish to delve further into, say, medieval science, will find expert "further reading" lists there. The book is well produced, with a set of interesting colour illustrations and some black and white drawings, and is very reasonably priced.

## References

- 1 E. Theodossiou *et al.*, 2002. From Pythagoreans to Kepler: the dispute between the geocentric and the heliocentric systems. *Journal of Astronomical History and Heritage* 5(1):89-98. This excellent account, devoted specifically to the progress of astronomy, says: "The original Ptolemaic geocentric system remained unaltered and largely undisputed for more than fourteen centuries".
- 2 Clive Davenhall. 2002. Review of J.H.Brooke, M.J.Ostler and J.M. van der Meer (eds.) 2001. *Science in Theistic Contexts: Cognitive Dimensions*. *Journal of Astronomical History and Heritage* 5(1):100-101

*Karl Friedrich Zöllner and the Historical Dimension of Astronomical Photometry. A Collection of Papers on the History of Photometry*, edited by Christiaan Sterken, and Klaus Staubermann (VUB Press, Brussels, 2000), 188 pp., ISBN 90 5487 254 3, paperback, US\$30:00, 240 × 155 mm.

The application of spectroscopy, photometry, and photography to astronomy during the second half of the nineteenth century was to have a major impact and lead to the emergence of astrophysics. While Hearnshaw (1986, 1993) has done an excellent job summarizing major nineteenth century developments in astronomical spectroscopy and photometry, it has been left to others to provide more detail on some of the notable contributors.

One of these was Karl Friedrich Zöllner (1834-1882), a German physicist who introduced a new type of photometer in 1858, and this book reports the presentations and discussions that took place at a one-day workshop that was held at the Archenhold Observatory, Berlin-Treptow, on 1997 April 4. This was the first in a new series of workshops dedicated to documenting historical aspects of observational astrophysics in the nineteenth and early twentieth centuries.

The editors of this volume combine an interesting range of expertise and talent: Chris Sterken is a well-known variable star researcher, with a strong interest in historical aspects of astrophysics, while Klaus Staubermann is an historian who has built a working replica of Zöllner's famous 1858 photometer.

This book is divided into four parts. Part I deals with "Instruments of Zöllner's Era", and begins with an excellent review of nineteenth century visual photometers by Hearnshaw, followed by two chapters by Geyer on Zöllner's revision spectrometer and Schwerd's double-beam photometer. Batha provides a listing of Zöllner-type photometers in Hungarian institutions, and Staubermann ends Part I with two chapters relating to his replication of Zöllner's original photometer. The first of these has fourteen co-authors (one of whom is Sterken), and begins with details of Zöllner's original photometer, which is preserved in the Deutsches Museum in Munich.

There are three chapters in Part II, on "Zöllner's Photometric Data", the first two by Sterken and the last by Sterken and Staubermann. Sterken begins with a frustratingly short chapter on the applications of what he terms 'archo-photometry', where he shows that ancient photometric catalogues can provide extremely useful data. For example,

... the historic light curve of  $\zeta^2$  Sco ... shows that two centuries ago the star was about 2 magnitudes brighter than today, while a millenium ago it was only 1 magnitude brighter than now, an indication that  $\zeta^2$  Sco should be regarded as a candidate Luminous Blue Variable." (page 79).

Sterken follows this chapter with a much longer one on the data contents of Zöllner's catalogue of 2216 photometric measures of 26 stars between magnitudes 1 and 6, which was published in 1861. In discussing Zöllner's derived magnitudes, he finds they are "... a consistent set ... [and Figure 8.7] shows that not a single of these stars deviates by more than one magnitude from their values of today and that thus none of these stars exhibits strong irregular variability." (pages 90-91). In another interesting analysis, Sterken compares Zöllner's photometric data for  $\beta$  Lyrae with visual magnitudes provided by other observers. In the third and final chapter in Part II, Sterken and Staubermann reproduce an edited version of Zöllner's catalogue of magnitude estimates, adding a sequence number,  $V$  magnitudes (drawn from the *Bright Star Catalogue*) and JDs.

Part III is about "Zöllner's Personality", and in three short chapters Dick and Münzel provide an interesting insight into Zöllner's contacts with other astronomers through surviving listings of his personal papers, and through letters that he wrote to his Berlin Observatory colleague and friend, Wilhelm Foerster. Some of these letters contain "... irreconcilable attacks on colleagues ... [indicating] an emotionally wounded person." (page 129), and Dick and Münzel conclude that "Many of Zöllner's reactions indeed manifest a narcissism ... which made him especially sensitive for insults. It would surely be helpful, if a psychologist or a psychiatrist with an interest in history could take care of Zöllner's biography ..." (ibid.). Further evidence of this instability comes through in Münzel's chapter on Zöllner's relations with staff at the Leipzig



University Observatory between 1862 and his death in 1882, although his political activism and emerging interest in spiritualism from 1877 may also have been factors in his growing unpopularity. At any rate, the University chose not to appoint a new Professor of Astrophysics following his death.

The final section of this book, "Studies on K.-F. Zöllner", contains just two chapters. The first is by that master astronomical historian and Zöllner expert, Dieter B. Herrmann, who over the years has published a succession of studies on this pioneering astronomer. Herrmann believes that "... Karl Friedrich Zöllner was one of the central figures in the early history of astrophysics in Germany. Without his work the genesis of the new scientific discipline of astrophysics cannot be understood." This is high praise indeed, but sums up Zöllner's vital role in the international development of astrophysics. Finally, Hamel brings this fascinating book to a close with a list of Zöllner's 87 publications, plus key biographical works about Zöllner.

Sterken and Staubermann are to be congratulated on producing a readable volume about one of the key figures in nineteenth century German astronomy – even if he is sometimes misunderstood, and I particularly recommend this book to anyone interested in the history of astrophysics.

Wayne Orchiston

## References

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- Hearnshaw, J., 1993. *The Measurement of Starlight. Two Centuries of Astronomical Photometry*. Cambridge University Press, Cambridge.

*Queen of Science, Personal Recollections of Mary Somerville*. edited and introduced by Dorothy McMillan. (Edinburgh: Canongate Classics 2001), xlii + 434 pp., 195 × 125 mm, £8.99 softback,.

Mary Somerville (1780-1872), mathematician, theoretical astronomer, and writer, is among the most celebrated women in the history of science. The daughter of an admiral in the Royal Navy, Somerville was brought up in a small seaport in Scotland. She received little formal education in her youth; yet she longed to learn and, mainly through her own persistence, became her own principal tutor. Later, with the help of sympathetic Edinburgh academics she mastered the calculus and was introduced to the works of the great continental mathematicians. She was married and widowed young, but in her second husband and first cousin William Somerville, an Army doctor, she acquired a partner who shared her enthusiasm for science and encouraged her studies. The Somervilles began their married life in Edinburgh among that city's liberal intelligentsia, but soon moved to London which was their home for over twenty years. Their English circle included a galaxy of scientists, most influential among whom was John Herschel who became a lifelong personal friend and adviser. Others were William Wollaston, the first to discover dark lines in the Sun's spectrum, and Charles Babbage of calculating machine fame. Early in her career Mary Somerville gained the friendship of the distinguished Paris school of scientists including the great Marquis de Laplace. When Mary was 58, her reputation well established, the family moved to Italy for the sake of her husband's health. There she was to live out the rest of her long life. She died in Naples at the age of 92 and is buried there. Mary Somerville first shot to fame with a theoretical treatise, *The Mechanism of the Heavens* (1831), a rendering in English of Laplace's monumental *Mécanique Céleste*. Two books addressed to a wider educated readership, *The Connection of the Physical Sciences* (1834) and *Physical Geography* (1848), were best sellers that went into several editions. In her old age she tackled a new field (biology) with *On Molecular and Microscopic Science* (1869) published in her ninetieth year. Towards the end of her life she also wrote her Personal Recollections, annotated and published after her death by her daughter Martha. It is from these Recollections that most of our knowledge of Mary Somerville's remarkable life is based. The original edition (1873) is now rare, and a new one is therefore to be warmly welcomed. The present re-issue, with the title *Queen of Science* (a sobriquet given by an obituarist), published in the Canongate Classics series of Scottish writing, is edited and introduced by Dorothy McMillan, head of English and

Scottish literature at the University of Glasgow. It is, however, considerably more than a reprint of the first: it includes not only the text as published at the time, but also Mary Somerville's own earlier drafts. Some passages from Mary's original version were modified by the daughter, evidently in order to give her mother a less forceful and more ladylike character such as would appeal to late Victorian British ideals. On the whole, however, the changes were not numerous or particularly drastic, and Dr MacMillan truly remarks that, even after editing, the *Personal Recollections* had "all the immediacy of a diary" and "the seeming freshness of youth". The editor has supplied explanatory notes to *Queen of Science*, and well over three hundred brief biographies of people – family members, friends, scientists, artists, public figures – recalled by Somerville's amazingly-retentive memory over an unusually long life. An appendix gives helpful translations of interesting letters in Italian or French which are interspersed among the *Recollections*. Thus, through the editor's care and undoubtedly laborious preliminaries, the way is cleared for the reader to enjoy these fascinating memoirs uninterrupted. The Introduction, though occupying only some 30 pages, looks at Mary Somerville the Scot, and surveys her place, as a woman and as a scientist, in the world – or worlds – in which she moved. In addition to its literary interest, *Queen of Science* will be an indispensable aid to students of Mary Somerville's work and an important source of information for historians of nineteenth century astronomy and of science generally.

Mary Brück

*The Roman Cult of Mithras: The God and His Mysteries* by Manfred Clauss, translated by Richard Gordon, 2000 (Edinburgh University Press: Edinburgh) 198 + xxiv pp, ISBN 0 7486 1230 0, hard cover, price £49.50, ISBN 0 7486 1396 X, soft cover, price £16.00, 234 × 158 mm.

Mithras, God of the Midnight, here where the great bull dies,  
Look on thy children in darkness. Oh take our sacrifice!

*A Song to Mithras,*  
Rudyard Kipling

The cult of Mithras was one of a number of 'mystery religions' which flourished under the Roman Empire. It began to spread during the first century AD, was at its peak during the second and was extinct by AD 400. The cult was only open to men and its adherents were mostly soldiers serving in the legions, merchants, freedmen, and slaves. The congregations were kept small and met in distinctive temples, *mithraea*, which have been found *in toto orbe Romano*, throughout the Empire. However, the cult seems to have been particularly strong in Rome itself, its port Ostia and the northern provinces on the Rhine and Danube. The origins of the cult are obscure, though, like some of the other mystery religions, it is usually thought to have come from the East. Attempts, more or less convincing, have been made to link the Roman Mithras with the Persian god of light, Mitra and with Zoroastrianism. Plutarch reports that the Cilician pirates defeated by Pompey in 67 BC worshipped Mithras, though any connection with the Roman cult is conjectural.

The doctrines of the cult were secret (that is, a 'mystery') and were revealed only to initiates. As far as is known they were never written down and thus were lost when the cult died out. Such few written descriptions of the cult as survive are fragmentary and come from authors, mostly Christians, who were opposed to it. However, what has survived are examples of the decorations which adorned the *mithraea*. These ornaments follow a fairly standardized iconography which is both distinctive and suggestive. They are often seen as the key to understanding the cult, though any interpretation of them must necessarily remain speculative.

Much of the supporting mithraic imagery undoubtedly contains astronomical elements: representations of the Sun, Moon, planetary gods, and zodiacal constellations are common. However, the central image of the cult, present in virtually every *mithraeum*, is the *tauroctony* or bull-slaying. Here Mithras, always in his distinctive phrygian cap and always with his eyes averted, slays a bull, usually surrounded by a supporting cast including a scorpion, a serpent, a dog, a raven, a lion and a drinking cup. Various explanations have been offered for the symbolic significance of this enigmatic and striking tableau, and some of these have been

astronomical. In the late nineteenth century the German scholar K B Stark noticed that each of these figures corresponded to one of the Greek constellations and suggested that the tauroctony was a stylized constellation map. This idea fell from favour, but in the past twenty years has been revived by Ulansey, Beck, and others. In Ulansey's sophisticated and ingenious interpretation not only is the tauroctony a constellation map, but also the original inspiration for the motif came from Hipparchus' discovery of precession. These ideas, which remain speculative and controversial, are most fully described in Ulansey's *The Origins of the Mithraic Mysteries*.



THE BIRTH OF MITHRAS FROM HOUSESTEADS  
Museum of Antiquities, Newcastle upon Tyne. Copyright

Mithras born from a cosmic egg. The remains of the eggshell can be seen above and below the god, who is surrounded by an ovoid ring inscribed with the symbols of the zodiacal constellations. The sculpture was found in Housesteads Mithraeum adjacent to Hadrian's Wall. (Courtesy of the Museum of Antiquities of the University and Society of Antiquaries of Newcastle upon Tyne.)

Inevitably the interest of historians of astronomy in the cult of Mithras will concentrate on these astronomical ideas. *The Roman Cult of Mithras* is a useful corrective to this tendency. It is a modern, general introduction to the cult, firmly grounded in the archaeological evidence and with little speculation beyond it. It is similar in scope and intent to Cumont's *The Mysteries of Mithra*, which is now seriously out of date (Cumont's book was first published in 1903 and is still in print, which gives an idea of its significance and influence). *The Roman Cult of Mithras* starts by placing the cult in the cultural and religious context in which it appeared and discussing its possible antecedents and origins. Subsequent chapters cover the external attributes of the cult: its growth and eventual decay, the type of person recruited and the role of the cult in Roman society. Additional chapters describe the physical appearance of mithraea and the utensils found in them. Later chapters cover more internal aspects of the cult, insofar as these can be deduced: its doctrines and rituals and the details of the seven grades of initiate (which seem to have corresponded to the seven planetary deities of antiquity). The final chapters consider the relation of the cult to other cults and religions practiced in the Roman Empire, including Christianity.

*The Roman Cult of Mithras* was originally published in German as *Mithras: Kult und Mysteries* during 1990. Both the author and translator are scholars well versed in the field. The author is now a Professor at Johann Wolfgang Goethe University, Frankfurt am Main. The text has been translated well and reads naturally and clearly. It is aimed at both the general and undergraduate reader and requires no specialist knowledge to follow. The translator has added suggestions for further reading in English. The book is well illustrated in black and white, and the paperback edition, at least, is reasonably priced. It is good on the archaeological evidence, but there is no separate discussion of the written sources, such as they are, which would have



been useful. Because the book was originally published in 1990, and perhaps also because of the author's reluctance to speculate, there is little discussion of the astronomical symbolism of the cult, but the translator has included a section on this material in his suggestions for further reading. In summary, the book is a comprehensive and reliable introduction to the cult of Mithras. It can be read to gain a general understanding of the cult before following the more specialized (and speculative) literature about its possible astronomical symbolism.

Clive Davenhall

## References

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 Ulansey, David, 1989. *The Origins of the Mithraic Mysteries* (Oxford Univ. Press: Oxford).

*Walter Baade. A Life in Astrophysics*, by Donald E. Osterbrock (Princeton University Press, Princeton, 2001), xiv + 270 pp, ISBN 0-691-04936-X, US\$29:95, 240 × 160 mm.

It is a pleasure to read another book from the prolific pen of that master astrophysicist-historian, Donald Osterbrock, Professor Emeritus of Astronomy and Astrophysics at the University of California, Santa Cruz, and former Director of the Lick Observatory. His target on this occasion is Walter Baade, arguably the most influential observational astronomer of the twentieth century, and his aim is "... to present the known facts of Baade's life and scientific career in interesting and readable form and to let the reader draw his own conclusions ..." (page vii).

Wilhelm Heinrich Walter Baade was born in Schröttinghausen, Germany, in 1893, and trained at Göttingen University, receiving his Ph.D. in 1919 for a thesis on the spectrum and orbit of  $\beta$  Lyrae. Shortly afterwards he obtained a post at Hamburg Observatory where he built an international reputation through his photographic studies of variable stars, globular clusters and galaxies, and spectroscopic analyses of gaseous nebulae and selected stars. He also discovered a number of minor planets and a comet.

As an exciting interlude during this research work, Baade spent 10 days in the USA in 1925, visiting observatories in eastern states. This whetted his appetite to return and work there, which he did 1926-1927 when he held a one-year Rockefeller Foundation fellowship, sharing his time between Harvard College, Yerkes, Lick, and Mount Wilson Observatories. After this "Wanderjahr in America", Baade returned to routine duties in Hamburg, but he hankered for a chance to work permanently in the States, using the world's largest telescopes.

In 1931 his dream came true when Adams offered him a post at Mt. Wilson Observatory. Although Baade was unquestionably well qualified for the position, Osterbrock suspects that Adams also wanted another bright, dynamic astrophysicist on staff – but this time a team-player – who could serve as a counterpoise to Hubble. Whatever the facts of the matter, Baade was in his element for "Mountain Wilson Observatory was unquestionably the most important observational astronomy research center in the world. Its 100-inch reflector was the largest telescope in existence; it and its 60-inch were both superb instruments at an excellent site ..." (page 50). Over the next decade he was involved in a range of research projects involving nebulae, globular clusters, supernovae and supernova remnants, clusters of galaxies, and he witnessed progress on the 200-inch reflector at Palomar, an instrument which he was destined to use with distinction.

Never a Nazi supporter but always a German at heart, it is perhaps ironic that Baade did some of his finest research, in America, during the Second World War, including the discovery of the existence of two distinct stellar populations, comprising young and old stars, respectively, which "... opened up the fields of study of stellar and galactic evolution that have made up so much of astronomy in our time, but which were sterile and unproductive before his discovery ..." (page 1).

One of the most interesting post-War phases of Baade's life was his involvement with radio astronomy, and this is recounted by Osterbrock in Chapter 6. From the end of the 1940s, Baade and his friend Rudolph Minkowski worked with Australian and British radio astronomers

in identifying optical correlates for the newly-discovered 'radio stars', producing some fascinating results. While some sources were associated with well-known galactic objects (e.g. Taurus A with the Crab Nebula), others were linked to galaxies. Baade also investigated polarization in the Crab Nebula and the jet in M87, two well-known radio sources. In these critical formative years of radio astronomy, Baade was one of the few leading optical astronomers who from the very start was prepared – nay eager – to work with these strange new bed-fellows, radio engineers who knew surprisingly little about astronomy. With help from Baade, Greenstein, Minkowski, Oort, and a few others they quickly overcame this impediment.

Another of Baade's important post-War research results, and one that endeared him to readers of newspapers and scientific magazines, was his effective "doubling the size of the universe". This brought the apparent ages of Earth and the Universe into closer agreement, but with the benefit of hindsight Osterbrock feels that Baade's new distance scale was probably "... not as intrinsically important as his population concept ..., as his far-ranging work on supernovae, or as his leading the way in the identification of the radio sources ..." (pages 162-163).

Apart from his publications, another way Baade shared his research results with colleagues and interested members of the public was through conferences (including IAU General Assemblies and symposia), seminars, courses, and public lectures. He was an excellent speaker, and the passion of his involvement in forefront research generally rang loud and clear. Through his lectures, discussions, and letters he inspired a generation of graduate students and young astronomers to work on stellar issues, galactic research or nebulae, and he also had a profound impact on his contemporaries, in one way or another touching the lives and hearts of a great many astronomers world-wide. One of the features of Osterbrock's book is the way in which he interweaves research and the social fabric of Baade's relations with his colleagues. And in this context, the major falling out between Baade and Shapley over the new distance scale (pages 171-174) makes compelling reading.

As an Australian-based astronomer I was also fascinated by Osterbrock's account of Baade's six-month sojourn in Australia during 1959, the year after his retirement from the Carnegie Institution. Baade obviously enjoyed discussing forefront research with the optical astronomers at Mount Stromlo Observatory and the radio astronomers at the Division of Radiophysics in Sydney (where I begin work as a lowly Technical Assistant just two years later, straight after leaving secondary school), lecturing at the Australian National University, attending a conference in Perth and a symposia in Canberra, and observing the globular cluster NGC 6522 with the 74-inch reflector at Stromlo (even if this was "the most uncomfortable instrument with which [he] ever observed" – see page 205). But at times he also found the experience exhausting, as when he and Bok, the dynamic new director at Stromlo, spent a hectic week exploring Western Australia in a crowded automobile and sleeping in outback accommodation whilst in search of a suitable observatory site. As Osterbrock says, "Bok was a compulsive talker and doer; his heart was in the right place but he did not realize that he was wearing Baade down." (page 206). This comes through clearly in the photograph of him on page 207, taken somewhere in the Australian desert. He looks a tired old man!

This strenuous Australian experience undoubtedly contributed to Baade's rapid physical decline once he and his wife settled back in Germany in late 1959, and it was not long before he was bed-ridden and unable to write. In 1960 January he underwent an operation in Göttingen but never recovered and died suddenly in June of that year. According to Osterbrock, "Baade was born, lived, and died a German. He never wanted to be anything else. He loved his country, but best of all he loved his native region, Westphalia, where he was born, educated ...[and] buried." (page 212). But for Baade, astronomy always took precedence over his homeland, and this is why he made his greatest discoveries in America. Yet he never chose to become an American citizen, always planning to live in Germany after retirement, and he and his wife always spoke German at home. His death was a loss not just to Germany and America but to world astronomy.

All in all, this is a captivating book with that wonderful mix of science and sociology that we have come to expect from Osterbrock's pen. It is a veritable astronomical adventure, the story of one man's remarkable exploration of the Universe. And for those wishing to delve further into Baade's remarkable achievements there are 27 pages of notes and references.



Beautifully-written and well illustrated, this book is a bargain at just US\$29.95, and it deserves to be on the bookshelf of every astrophysicist or historian interested in twentieth century astronomy.

Wayne Orchiston

*La Carte du Ciel, Correspondance Inédite Conservée dans les Archives de L'Observatoire de Paris (Unedited Correspondence Preserved in The Archives of Paris Observatory)*, compiled by Ileana Chinnici (IAU and Observatory of Paris, 1999). Xviii + 475 pp., 80 plates, ISBN 2-901057-40-3, softcover, 245 × 172 mm.

The invention of the telescope in 1610 and two centuries later the application of photography revitalized astronomy. Warren De La Rue, a pioneer in sky photography at Kew Observatory England, devised in 1857 a concept to obtain photographic star charts and a catalogue of star positions for the whole sky. Realization of this intent was advanced by successful attempts in celestial photography by E C Pickering at Harvard and D Gill at the Royal Observatory, Cape of Good Hope. A permanent international Commission was formed and an astro-photographic Congress held at Paris Observatory in 1871 by invitation of the French Academy of Sciences. A second Congress in 1891 adopted a Working Plan and allocated regions of the sky to observatories in the northern and southern hemispheres to cover the entire sky from +90 to -90 degrees for stars down to around 13th limiting magnitude. This unique international project was from its inception organized by a permanent international Committee, presided over by the Director of Paris Astronomical Observatory, Admiral Ernest B Mouchez. However with the foundation in 1919 of the International Astronomical Union (IAU) for promotion of astronomy, this body assumed responsibility for this first truly international proposal. IAU Commission 23 for *Carte du Ciel* was much later assigned to conclude this effort and during 1964 provided financial support for publication of the entire 24 Volumes of the *Astrographic Catalogue*.

As the title indicates, this publication compiles original correspondence for *Carte du Ciel* received and archived at Paris Observatory between 1880-1923. These 732 letters between participants and Paris Observatory trace the concept and working plans for the *Carte du Ciel*. They reveal the historical development of astronomy in the second half of the nineteenth and first half of the twentieth centuries with improvements in photography and telescope technology, specifically the construction of optical lenses of large aperture and the design of telescopes to suit the particular photographic requirements of the proposed *Carte du Ciel*. An increase in sensitivity of photographic emulsion contributed to recording of fainter stars with shorter exposure times. Measuring equipment was designed and built to derive positions of celestial objects from photographic plates. To establish a Fundamental Star reference system of accurate positions, meridian transit circle telescopes were commissioned. Collaboration was developed between selected observatories to obtain more than 15,000 photographic plate exposures covering the entire sky. Essential elements and requirements were identified and discussed between participants. Each observatory was to secure the best possible observing equipment and to comply as far as possible with identical instruments and methods. They were at the same time to support other participants with advice and planning in order to achieve a library of photographic maps of the whole sky.

The author of this publication, Ileana Chinnici from Palermo University, Italy, received a scholarship to remain one year at Paris Observatory to research historical archived correspondence. She became familiar with the extensive and important *Carte du Ciel* correspondence received between 1880 and 1923. From the immense amount of letters preserved in this archive, she recognized the historical significance of this important first worldwide scientific collaboration. In preference to herself writing about the logistics and turmoil of this extremely large endeavour, the author decided to publish the text of the 732 letters as transcribed correspondence in their original languages. Her primary purpose was to compile material for other researchers. In this way, readers are presented with text of letters disclosing the struggle this venture would endure during the World War and other political and

social uprisings of this historical period. The *Carte du Ciel*, although proceeding very tardily because of its great dimension and many unexpected obstacles, demonstrates that conflict, frustration, and disappointment could not compromise its uniquely-valuable contribution.

Advances in positional astronomy now render *Carte du Ciel* charts somewhat inadequate for most purposes. The *Astrographic Catalogue* has however gained new significance when the measurements of the photographic plates were reduced to the HIPPARCOS Celestial Reference System or HCRS, J2000.0. The United State Naval Observatory in Washington DC disclosed at the General Assembly in Kyoto 1997 its compilation on CD-ROM of the AC 2000 Astrographic catalogue around the epoch of 1900 and its distribution followed shortly thereafter. About two years later the CD-ROM AC 2000.2 was distributed, as a Revised Version of the AC 2000 Catalogue. It contains positions and magnitudes of 4,621,751 stars covering the entire sky at the Mean Epoch of Observation of 1900.0. These positions are also on the Hipparcos Celestial Reference System (HCRS, J2000.0) with improved photometry from TYCHO -2. Thus, the *Astrographic Catalogues* continue to contribute profoundly to present day astronomy.

The reviewed publication, co-sponsored by the IAU, is of great historical interest and therefore recommended to readers curious about the archives of astronomy. *La Carte du Ciel*, a pioneering design, demanded from participants the greatest commitment and endurance. The admirable outcome benefits us all; the historical example of *Carte du Ciel* remains a typical model for collaboration within contemporary extensive proposals.

Ivan Nikoloff

