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Essays on Astronomical History and Heritage. A Tribute to Wayne Orchiston on his 80th Birthday. S. Gullberg, P. Robertson (eds.). Springer. 719 pgs.

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Over the last decade, several volumes have been published to honor some of the most prominent figures in the study of the history of astronomy and its relationship to culture in various contexts. Among these we may note the volumes celebrate notable cultural astronomers such as Clive Ruggles (Boutsikas, McCluskey, Steele 2022) and the late Lionel Sims (Silva & Henty 2023), as well as others currently under way that may appear shortly. The current volume pays fitting tribute to Wayne Orchiston, one such astronomer who has actively explored the connections between the sky and different cultures worldwide.

Although the sheer variety of themes and size of this book—33 contributions divided into six thematic parts, totaling over 700 pages, including a preface by the editors on the scientific life of Wayne Orchiston—might seem overwhelming, it is just to say that there is something of interest for anyone intrigued by the various relationships between astronomy and society. This diversity reflects the wide range of topics Wayne Orchiston has addressed throughout his career, especially during his roles as president of several commissions and working groups of the International Astronomical Union (IAU), as founder and editor of the *Journal for Astronomical History and Heritage* (JAHH), and as the main editor of the *Historical and Cultural Astronomy* series by Springer, among many other positions.

The volume covers an extensive and wide scope, as expected for a topic as broad as *Astronomy in Culture*. The 33 chapters are written by many of Wayne's former collaborators, students, and acquaintances. The electronic version, which I had the chance to review, is excellent, featuring a detailed list of contributors with bionotes, full-color images for all entries, and functioning links to references in each chapter. Among the 37 contributors, Wayne Orchiston's career interests are well-represented, bringing together professional and amateur astronomers, space exploration experts, historians of science, anthropologists, and archaeologists from countries including New Zealand, Australia, the USA, the UK, and South Africa (nearly 85% of the contributors come from these five countries), as well as Sweden, Germany, France, Belgium, the Netherlands, Canada, and China.

For further improvement for the future, one might be surprised that such a comprehensive book lacks cross-references among the different chapters,

especially when some chapters are closely related and discuss similar issues or people.

The book begins with a preface by the editors on Wayne Orchiston's career and his contributions to the study of the history of astronomy, particularly the Cook voyages and astronomy, the history of modern astronomy, ethnoastronomy in Southeast Asia and Oceania, astronomical education, and the history of radio astronomy, among many other subjects.

As previously noted, the book is divided into six parts: Astronomy and Society; Emergence of Astrophysics; History of Radio Astronomy; Solar System; Observatories and Instrumentation and Ethnoastronomy and Archaeoastronomy. Each part contains between four and eight contributions, which could each have constituted a short volume on their own. Some of the chapters are quite easy to read and are thrilling, with lots of new facts and hind sights, and this makes the reading worthwhile.

The first part, "Astronomy and Society," begins with an ambitious paper by Steven J. Dick, who declares his intent "to examine astronomy's role for humanity, broadly conceived." He then attempts a brief and rapid review (just one and a half pages) on Cultural Astronomy and World Heritage. Dick mentions some academic societies and groups related to this topic, such as the IAU working group on Cultural Astronomy and Archaeoastronomy (soon to become a full commission at the IAU General Assembly in Cape Town in August 2024) and the Inspiration of Astronomical Phenomena (INSAP) conferences. However, he omits mentioning ISAAC (the International Society for Archaeoastronomy and Astronomy in Culture) and SEAC (the European Society for Astronomy in Culture), two of the most prominent academic societies on these subjects after nearly 30 years of work. Dick discusses at length Western philosophical views on the cosmos and the impact of modern astronomy on our culture and others. For example, he highlights the practical roles of astronomy in navigation (positioning), timekeeping (transits), and measuring the universe (Venus transits) over the last three centuries and its reduced practical relevance after new methods for positioning and timekeeping were established. He then questions the role of culture in modern astronomy, emphasizing their mutual interaction, something many astronomers might find shocking at first reading, but nothing new for those acquainted with the anthropology of science (see any paper or book by Bruno Latour, e.g. Latour & Woolgar 1979).

This section includes various other chapters with examples of how different societies respond to astronomical phenomena or sky-related issues, such as the introduction of the Gregorian Calendar reform and its implementation in Sweden (Gislén); the early southern skies star charts by Dutch explorers and astronomers

in Southeast Asia (de Grijs); the SETI program as a social and cultural endeavor and its political interactions, especially during the Cold War (Kellerman); and the influence of Léon Foucault's astronomy-related works on art. However, my favorite chapter in this section is the one on the process of naming lunar features related to the Apollo 8 mission (W. Sheehan). This extensive but well-documented chapter discusses the naming of three lunar features based on proposals by the first astronauts to orbit the Moon and those who took the famous Earthrise photograph, described by astronaut Borman as "the most beautiful, heart-catching sight." As someone not very familiar with lunar exploration, I found this chapter particularly informative and elucidating on the role of politics, science and a bit of serendipity in the naming of heavenly bodies.

The second part, "Emergence of Astrophysics," includes a variety of chapters on the development of the physics aspect of astronomy. As an astronomer, one is often confronted with the question: what is astronomy good for? One then endeavors to answer by advocating the common Big Questions that astrophysics is supposed to address: Where does everything come from? How did all begin? And etcetera. However, one often forgets that modern astronomy had in the past a preeminent practical dimension: determining the location and time at a given moment and place. In this was in the first chapter of this section, Alan H. Batten explores how astrophysics slowly diverged from that practical dimensions of navigational astronomy, geodetic surveying, and timekeeping, the traditional areas of application of astronomy up to mid 19th century. In the 19th century, advancements in physics enabled it to extend its methods and ideas to the heavens, particularly through the pioneering work of Fraunhofer and Secchi, which laid the groundwork for the birth of astrophysics. This transition is well illustrated by the next chapter by David H. DeVorkin and his account of Henry Norris Russell's efforts to transform 19th-century observatories from "factories of observation" into centers of real astrophysics by combining theory and observation to create models explaining astronomical phenomena. These two chapters are worth reading for many would-be astronomers so that they know where their present-day technology dominated and compartmented science comes from in the late two centuries.

John Hearnshaw's chapter provides a personal account of his travels to various Asian countries as part of campaigns to promote astronomy, assess the state of astronomical installations, or serve as an invited scholar at institutions in China, Mongolia, Thailand, Laos, Uzbekistan, Mauritius (included due to its strong Indian influence), Tajikistan, North Korea, and Iran.

Wolfgang Steinicke offers a well-researched account of the discovery of the Coma Cluster of galaxies, which was impossible before the invention and improvement of the telescope and difficult to recognize until recent times.

Trimble and Robertson discuss the parallel lives of the radio astronomer John Bolton and the physicist Joseph Weber, and their contributions mixing elements such as World War II, radio, Navy, radar electronics, and aircraft carriers, while developing radio astronomy and hinting at new fields like gravitational radiation. This is a very interesting comparison on two leading figures of their time, that developed two now forefront areas in Astrophysics, but little known for many astronomers outside those fields.

Part III is entirely devoted to the History of Radio Astronomy, arguably one of the main specialties of Wayne Orchiston. Although the first radio astronomy experiments started in the decade of the 30s of 20th century, it was after WWII that it really expanded and appeared as a new fruitful field of astrophysical exploration, in many cases employing many resources and people developed during the War itself. This section focuses on the contributions of numerous individuals to the birth and development of radio astronomy, with an emphasis on its growth in the Southern Hemisphere, particularly in Australia.

Thus, M. George examines the role of Grote Reber in Tasmania, exploring the lowest possible radio frequencies and opposing the Big Bang theory, which he considered a myth, something that today it may seem almost heresy, but not so much at the time when Reber was active, and something that even in some countries such as France was forbidden to be thought for several years given its suspicious resemblance to biblical accounts on Creation (López-Corredoira 2009). J. Lequeux delves into Wayne Orchiston's work on the history of radio astronomy and the role of the Journal for Astronomical History and Heritage (JAHH) in promoting it, while P. Robertson, one of the volume's editors, explains the intriguing history of the Hole-in-the-Ground Telescope in Australia. This is a fascinating story linked to the discovery of the radio source pinpointing the center of our galaxy, obscured by dust clouds and invisible in the visual spectrum. Here we may know about the instrument itself, and most importantly on the people that designed, built and use such pioneering telescope.

This part includes Harry Wendt's chapter on the remnants of the early radio stations of the Australian radio physics lab, which, in my view, should be a perfect case study to be addressed by the IAU's astronomical heritage in danger working group. Finally, R. Wielebinski presents a "History of Cosmic Magnetic Fields," detailing the research on how these fields are produced, observed, and identified in various sources, from pulsars to the Milky Way, black holes, and beyond.

Part IV focuses on the "Solar System," and includes mostly chapters on the history of modern and ancient astronomy related to the observation of Solar System items, such as the Sun, Venus, Meteors or the Moon. It must be remembered that up to the beginning of 19th century, most astronomical observations had to do with the Solar System, and it was while trying to determine if hazy bodies were comets or else that first Charles Messier and later William Herschel among others started to unveil a space that included much more than 'fixed' stars.

This part begins with S. Cottam's account of Leonard Waldo's role in observing the 1878 solar eclipse from Texas. It also discusses his promotion of detailed data gathering in astronomy at the Harvard Observatory and how society perceived it, for example by including his name as a character in a musical adapted to the observatory at that time. In this sense, it is interesting to note that this is not new nor a characteristic of our time: already Aristophanes included astronomer Meton of Athens in his play the Clouds in the 5th century BCE!

C.J. Cunningham provides an erudite study on the word "meteor" and how its meaning has evolved in English history alongside new interpretations of celestial bodies. J.K. Drummond recounts observations of the Tebbutt comet, discovered by Australian astronomer John Tebbutt in 1881. This comet was soon observed from New Zealand and other countries and whose spectrum was the first to be photographed and studied at the end of the 19th century, also impacting popular culture due to its prominence and visibility.

The late Jay M. Pasachoff gives a short but vivid account of his relationship with Orchiston and their experiences with solar eclipses. Sara J. Schechner discusses John Winthrop's role in the largest scientific collaboration of the 18th century, the observation and recording of the transit of Venus. Winthrop, an American astronomer at Harvard, faced significant political turmoil during the first expedition in 1761 (coinciding with the Seven Years' War and the French and Indian War) and the second in 1769 (preceding the American Revolution). This chapter interestingly combines politics and science, and it elucidates how such environment might have affected the outcome of those scientific tasks.

Stephenson, Morrison, Hohenkerk, and Yanben examine the ancient Chinese Oracle Bones and their potential connection to eclipses, specifically investigating Oracle Bone 11506. This item includes a wording that has been interpreted as a possible solar eclipse or rather a meteorological phenomenon. After performing some calculations, they conclude, based on the supporting evidence, that this bone is not related to a specific eclipse.

In an interesting exercise, Christian Sterken compares two astronomers of slightly different times: Belgian Jean-Charles Hozeau de Lehaie, who fled his homeland for political reasons and observed the 1874 and 1882 Venus transits with a method he

invented, and German Hilmar Willi Dürbeck, who oversaw IAU Commission 41 on transits at the beginning of the 21st century.

Finally, W.T. Sullivan III discusses William Herschel's observations of the Moon, made with his sister Caroline. Herschel believed the Moon to be inhabited and thought he had observed several indications supporting this suspicion. He is credited with discovering several lunar features, including the Transient Lunar Phenomena, which he interpreted as evidence of volcanic activity.

Part V is dedicated to the history of "Observatories and Instrumentation," covering observatories and their history in various regions across the globe. Indeed, modern astronomical observatories in Europe appear by the end of 16th century but were strongly developed when those practical dimensions of astronomy were clear for the rulers of the different states. It is in the late 18th and early 19th centuries that most countries and states founded their National Observatories, with the aim of keeping longitude and time standards for their countries. With the evolution of astronomy into astrophysics some observatories lost their preeminent role, and this is well illustrated in this part of the book.

Thus, Jana Ruth Ford discusses the Dyer Observatory in Tennessee and the three astronomers, Seyfert, Hardie, and DeWitt, who developed it by mid 20th-century, while Ian S. Glass examines the early photometers at the Cape Royal Observatory in South Africa.

I'd like to highlight the chapter by N. Lomb where he recounts the history of the Sydney Observatory in Australia, emphasizing the three attempts to close it down and the preeminent role of local (mostly amateur) astronomers who mobilized against these attempts. It presents a great example on how the perhaps at other latitudes troublesome relationship between amateur and professional astronomers, was otherwise here and worked in advantage for the promotion of astronomy, especially given that the Sydney Observatory was in charge of particularly sensitive global collaborations for charting the southern skies.

Further, G. Rowe explains how the latitude and longitude of New Zealand, a remote archipelago at the time, were accurately determined using a combination of techniques in which astronomy played a key role.

In another very interesting, but quite technical, chapter R. Kinns describes the evolution of visual time signals for mariners during the 19th and 20th centuries. As previously indicated, at that epoch one of the tasks of astronomical observatories across the globe was to determine the precise hour and the way they announced time for everyone to put their watches and chronometers in step with local time were variegated. This chapter presents the different methods and which ones were used at different sites across the 19th and 20th centuries. It should be noted that

this chapter deals only with maritime observatories (landlocked observatories are not considered here), and that many systems that were once in use and later became obsolete, are now being restored, like for instance the one at the Royal Marine Observatory in San Fernando (Cadiz, Spain).

Finally, Part VI is titled "Ethnoastronomy and Archaeoastronomy", and given the extent of the book and of other sections, one might be a little disappointed to find so little number of chapters devoted to these themes especially when part of Wayne Orchiston's research interest included ethnoastronomy in Southeast Asia and Oceania.

However, this section starts with a chapter by Steven Gullberg, one of the editors of the volume and a former student of Wayne Orchiston. Gullberg summarizes his PhD thesis on Inca astronomy, focusing particularly on the light and shadow effects at specific Inca sites in Peru (see Gullberg 2020 for a full account).

Robert S. Fuller and Duane W. Hamacher present a comprehensive and careful study on the astronomy of the Aboriginal Peoples in the Sydney Basin. Using ethnohistorical sources, they document several cultural stories related to astronomical knowledge and the creation of different heavenly bodies, involving the sun (often depicted as female), the moon (male in several stories), other celestial objects like falling bodies, stars and asterisms, and the Milky Way, and their possible connection to some rock art sites.

Further, Trevor M. Leaman and D.W. Hamacher apply a statistical methodology they developed, called Significant Horizons, to assess whether the locations of certain sites with stone arrangements were chosen based on specific horizon conditions that allow for better recognition of particular moments in the sun and moon cycles. They conclude that a significant number of these sites might indeed have been selected with such considerations in mind.

Finally, J. Sauter's chapter explores astronomical phenomena observed in Armenian and Georgian early history and how some local myths might be connected to specific astronomical events such as eclipses.

My overall impression is that this volume as a classical festschrift is an excellent tribute to Wayne Orchiston's career. It covers such a wide range of themes and subjects that it showcases the broad scope of Orchiston's interests. However, it is a massive and diverse (perhaps too diverse?) volume, which means that few readers will be interested in all the topics covered overall.

That said, it likely has something for everyone, and I believe it is an ideal book for those deeply interested in the history of modern astronomy. By modern I mean the astronomy of the last two or three centuries. That is especially true for those with a keen interest in the history of Australian and New Zealand astronomy, particularly

radio astronomy, where Australia was a leading country in developing this branch of astrophysics in the mid-20th century. In this context, the book complements other works (including some by Wayne Orchiston himself) and offers various new perspectives and insights.

The book also covers many other interesting topics such as the politics and sociology of space exploration, how philosophical environments at different times have influenced research ideas, the development of observatories and instrumentation with the advent of astrophysics, the interaction between science and the political milieu to achieve scientific goals, and how ancient societies used myths, location, and timing in ways that may resemble modern astronomical practices.

In summary, the present volume addresses many subjects related to the links between astronomy and culture in the broadest sense, being a perfect mixture of themes to honor an eclectic scientist.

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