



HISTORY OF ASTRONOMY

Welcome to the summer solstice edition of the newsletter of IAU Commission C3 (History of Astronomy). This issue begins with news of Commission C3 and the results of the recent election for members of the Organizing Committee. This is followed by updates from the Inter-Union Commission for History of Astronomy and the Working Group for Archaeoastronomy and Astronomy in Culture. After the updates, readers can peruse copies of the triennial reports of the Commission and its three Working Groups.

The Making History section includes a sober account of the ongoing rescue of historical materials at Arecibo Observatory since the collapse of the dish in late 2020. In a lighter vein, we also have an essay on astronomy on postage stamps and an announcement of a new website devoted to the history of radio astronomy in France. The newsletter also contains news from members, an obituary, a list of notable publications, and tables of content from two journals devoted to the history of astronomy.

The COVID-19 pandemic has continued to disrupt normal business. Most of us are still working remotely, social distancing, and masking. Lucky individuals have gotten vaccinated, but conferences, when not postponed, have continued to be held virtually, taking advantage of video-conferencing technologies such as Zoom. The

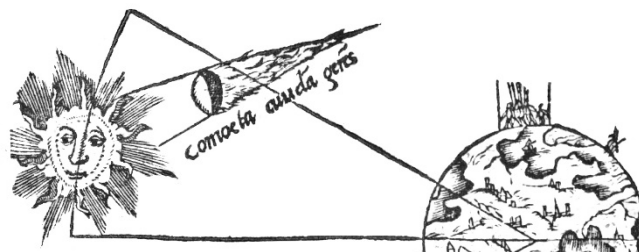
pandemic regrettably has delayed the C3 Secretary's preparation of this issue, and we thank you for your forbearance. We wish everyone health and safety, clear skies and open archives in the coming autumn.

This is the last issue of the newsletter prepared by the outgoing officers. The next issue of the newsletter will be published in December 2021. Please send the new Secretary any news you would like to see included.

Sara Schechner, Secretary
Wayne Orchiston, President
Christiaan Sterken, Vice-President

TABLE OF CONTENTS

Summary Report of C3 and Election Results	2
Progress Reports of ICHA and WGAAC	4
Triennial Reports of C3 and Working Groups	9
Making History	25
News from Members	33
In Memoriam	34
Notable Publications	35
Journal Contents	37



IAU COMMISSION C3 TRIENNIAL SUMMARY

Wayne Orchiston, President
Christiaan Sterken, Vice President
Sara Schechner, Secretary

IAU Commission C3 (History of Astronomy) kicked off the triennium with a stunning Centennial Symposium (IAU S349) organized by a dozen of our members. Thirteen members delivered papers at the Symposium, and an excellent volume was published the next year (C. Sterken, J. Hernshaw, and D. Valls-Gabaud, eds., *Under One Sky: the IAU Centenary Symposium*, IAU Symposium 349 (Cambridge: Cambridge University Press, 2019).

Commission C3 also supported five international seminars and conferences in China, Italy, Thailand, and helped to organize an international symposium in the Czech Republic. This is a symposium of 20 papers on “Art, Image, and Astronomical Knowledge.” It will be held virtually in Prague in July 2021 at the quadrennial international congress of the International Union of History and Philosophy of Science and Technology (IUHPST). Commission C3 took the lead in planning this symposium because we are the IAU’s liaison to the IUHPST through a joint body, the Inter-Union Commission for History of Astronomy (ICHA). This relationship with the IUHPST also provides C3 with funding to help early career scholars defray the costs of attending meetings relevant to the history of astronomy.

Members of C3 and its Working Groups published so many research papers and books that a full list would fill more than 30 pages. A list will be published in a forthcoming issue of the *Journal of Astronomical History and Heritage*.

Commission C3 has three Working Groups: Inter-Commission C1-C3-C4 WG -- Archaeoastronomy and Astronomy in Culture; Inter-Commission C1-C3-C4 WG -- Ethnoastronomy and Intangible Heritage; and the Inter-Union (URSI), Inter-Division B4-C3 WG -- Historical Radio Astronomy. Summaries of their excellent activities are given separately. Here we wish to report that C3 has also organized informal “Project Groups” to facilitate research projects and international collaborations at Commission level: Asian Astronomy; Biographical Encyclopedia of Astronomers; Historical Instruments, Archives, and Observatories; Indian and Southeast Asian Stone Inscriptions; and Johannes Kepler. Reports of these Project Groups appear in the Commission C3 Newsletter, which can be found on the Commission’s website.

Our colorful Commission C3 Newsletter was inaugurated in 2020 and is published in June and December. Each issue is packed not only with reports from the Commission, its Working Groups, and Project Groups, but also with bulletins of upcoming conferences, reports of those past, lists of publications, announcements of research and PhD opportunities, news from members, awards, and obituaries. There is also a “Making History” section covering news such as the Astronomy Genealogy Project (AstroGen), an “Oral History” section, and an “Art & Exhibitions” section. With this Newsletter, C3 serves as the major international clearinghouse for history-of-astronomy research, programs, and opportunities.

In the next triennium, we look forward to planning an engaging symposium or focus meeting for the Cape Town GA. We also hope to make the Project Group on Historical Instruments, Archives, and Observatories into a functional Working Group whose mission will be to promote the research, documentation, and preservation of historical astronomical and astrophysical instruments and archives, the observing sites in which they were used, and related material culture.

ORGANIZING COMMITTEE FOR NEXT TRIENNIUM

ELECTION RESULTS

President

Christiaan L. Sterken (Belgium)

VP (elected)

Sara Jane Schechner (United States)

At-large members (elected)

David M. Baneke (Netherlands)

Thomas Arnold Hockey (United States)

Ioannis Liritzis (Greece)

Virginia Trimble (United States)

Second-term members

Ileana Chinnici (Italy)

Eun Hee Lee (Republic of Korea)

Pieter C. van der Kruit (Netherlands)

Advisor (Past President)

Wayne Orchiston (Thailand)

Inter-Union Commission for History of Astronomy

Summer 2021 Report

Sara J. Schechner (President)

The Inter-Union Commission for History of Astronomy (ICHA) is a joint commission of the International Astronomical Union (IAU) and the International Union of History and Philosophy of Science and Technology (IUHPST)/ Division of History of Science and Technology. ICHA receives financial support from the IUHPST and makes its home base in that Union. Its connection to the IAU is through Commission C3 (History of Astronomy).

General Meeting

The ICHA held its most recent business meeting during the 26th International Congress of History of Science and Technology, which was held 25-31 July 2021 virtually in Prague, Czech Republic. During this meeting, officers were elected for the next quadrennium. Sara Schechner became President, and Christiaan Sterken, Treasurer.

Grants for Early Career Scholars

In 2021, ICHA gave out four grants to early career scholars and graduate students to defray the costs for registering for the Prague Congress. The recipients were Saliha Budak Bütün, Turkey; John Drummond, New Zealand; Susanne Hoffmann, Germany; and Maribel Moreno Ochoa, Mexico.

Some funds are still available for upcoming meetings relevant to the history of astronomy. Preference will be given to those presenting a paper or poster at the meeting. If you wish to apply for a grant, please send an application email to Sara Schechner, President of ICHA (schechn@fas.harvard.edu) describing the meeting you wish to attend and your role in it. The application process will be managed by the Organizing Committee of IAU Commission C3.

Conference Symposium

ICHA and the IUHPST Commission on the History of Ancient and Medieval Astronomy (CHAMA) jointly organized a symposium at the Prague Congress on the theme of *Art, Image, and Astronomical Knowledge*. The topic of the Symposium was inspired by Chris Sterken's essay "Bruegel's Winter Landscapes: Some Reflections on Climate Change" (NASA ADS 2019ABB....90...63S), which addresses the question of whether stand-alone images of art can serve as reliable and quantifiable evidence for explicating past natural phenomena. We originally had twenty papers divided into five 2-hour sessions, but a few speakers could not attend because of the pandemic. The in-person symposium was pivoted to a remote symposium held on a Zoom platform, which enabled live discussion. The final list of speakers is given at the end of this report.

Future Business

It was agreed at the general meeting that ICHA would create new email mailing list and a website. We are looking for an institution to host the site.



Art, Image, and Astronomical Knowledge

Symposium organizers:

Sara J. Schechner (Harvard University)

Shi Yunli (University of Science and Technology of China)

5 sessions of papers

1. Chair, Sara Schechner

- Richard G. Strom (ASTRON & University of Amsterdam), "What can Neolithic imagery convey about bright stellar transients?"
- Anna Jerratsch (Max Planck Institute for History of Science), "The Many Face(t)s of Comets in Early Modernity."
- John Drummond and Wayne Orchiston (University of Southern Queensland), "Mount Taranaki, the Great Comet of 1882, and the Genesis of Cometary Photography in New Zealand."

2. Chair, Yunli Shi

- Katie Boyce-Jacino (Arizona State University), "Star Atlas: Ancient Astronomy in the Planetarium."
- Christiaan Sterken (University of Brussels), "Some Thoughts on Stellar Constellations in Rock Art."
- Susanne M. Hoffman (Independent scholar), "Reconstruction of Historical Constellations."
- Stamatina Mastorakou (University of Zurich), "The Hellenistic Constellations through Words and Images."

3. Chair, Katie Boyce-Jacino

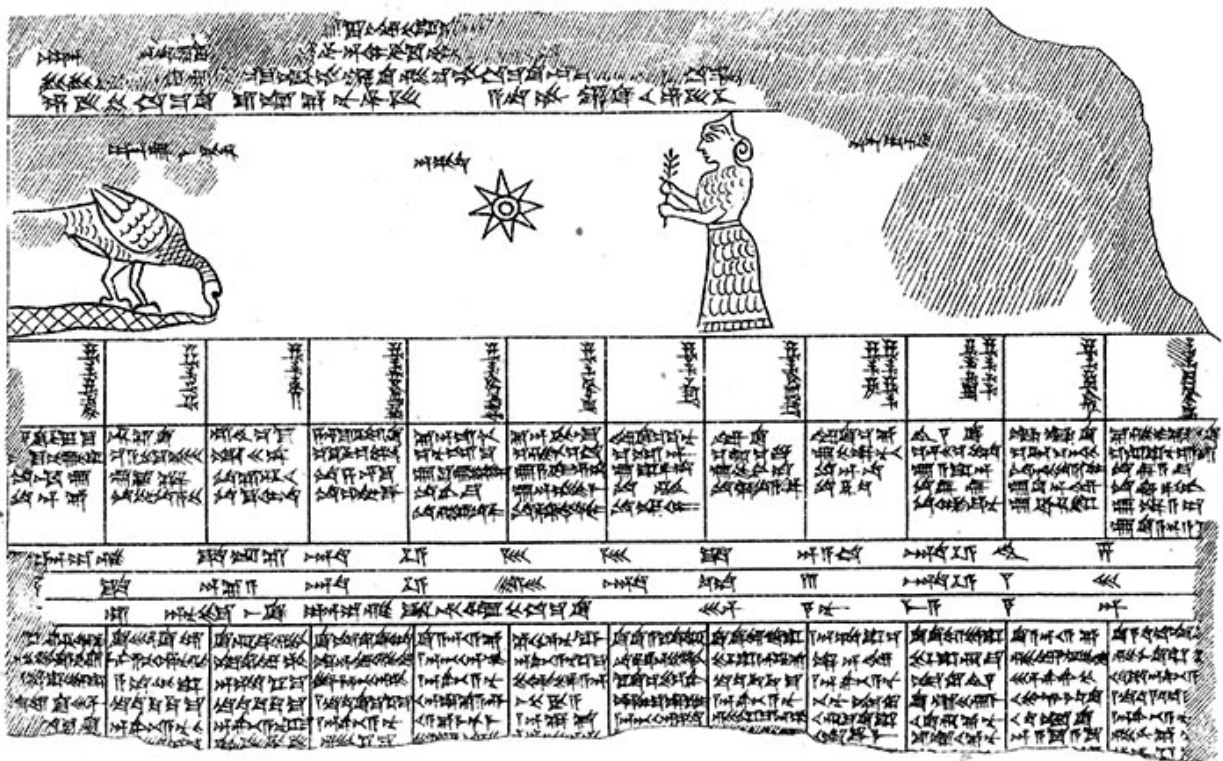
- David DeVorkin (Smithsonian Institution), "Well Then, Who Dug 'Them' Canals on Mars?"
- Huichih Chuang (Jiangsu Normal University), "Re-discussion about the Two Celestial Images Unearthed in Nara, Japan."
- Rosalind Park (Independent scholar), "Art and Astronomical Knowledge at Dendera in the 1st Century BCE."

4. Chair, Susanne Hoffmann

- Elizabeth Minor (Wellesley College) and Robert Minor (UC Berkeley), “An Early Representation of a Star Pattern on an Ancient Egyptian Coffin of the First Intermediate Period (2181-2040 BCE).”
- Mathieu Ossendrijver (Free University of Berlin), “Iconography and the Cross-Cultural Transformation of Zodiacal Astral Science in Antiquity.”
- John Steele (Brown University), “Images in Babylonian Astronomical and Astrological Texts.”

5. Chair, Christiaan Sterken

- Sonje Brentjes (Max Planck Institute for History of Science), “Knowledge, Art and Politics in Copies of 'Abd al-Rahman al-Sufi's Book of the Star Constellations.”
- Yunli Shi (University of Science and Technology of China), “Charting the Chinese Sky with Western Observations: The Star Maps Made by Jesuit Astronomers in the Late Ming Dynasty Revisited.”



Astrological tablet from Seleucid Uruk with a depiction of the planet Mercury, labeled Šiḫṭu, as a star in between the constellations Raven and Virgo. Reverse of fragment AO 6448 from the Louvre, Paris, transcribed in F. Thureau-Dangin, *Textes Cunéiformes du Louvre VI. Tablettes d'Uruk* (Paris, 1922).

IAU Division C Inter-Commission C1-C3-C4 Working Group for Archaeoastronomy and Astronomy in Culture

News Spring 2021

Steven Gullberg (Chair) Javier Mejuto (Co-chair)

Organizing Committee

Beatriz Garcia, Duane Hamacher, Jarita Holbrook
Alejandro Martin Lopez, Rosa M. Ros, Christiaan Sterken

The WGAAC is in part a discussion and collaboration group for IAU members regarding Astronomy in Culture, and as well for others with interests in this area. A primary motivation is to facilitate interactions between researchers, but the WG also has significant interest in promoting education regarding cultural astronomy in all respects. The WGAAC is the focal point within the IAU for both vigorous research in the field of Astronomy in Culture and in public education for how astronomy has been used in many societies. The WG works to:

- Advance the field of archaeoastronomy/cultural astronomy
- Promote research and publication
- Promote strong initiatives for educators on different levels for multiple aspects of cultural astronomy to include the exploration of literature, poetry, music, films, etc.
- Promote public outreach to educate regarding astronomy in culture
- Use the fascination with astronomy in culture to inspire youth interest in pursuing any aspect of astronomy in their futures
- Increase the understanding of how astronomy was used in cultures within developing nations where such has not yet been fully explored
- Facilitate interactions with other members and groups within the IAU
- Facilitate interactions between researchers in the field
- Encourage engagement in this research by additional IAU members
- Promote collaboration between the IAU and other organizations such as ISAAC, SEAC, SIAC, and SCAAS for the advancement of archaeoastronomy and astronomy in culture
- Promote the inclusion of archaeoastronomical research in other fields, such as Archaeology, Anthropology, Indigenous Studies, and Native American Studies

The work of our first five committees outlined in the previous C3 newsletter continues to advance. These committees are to: (1) write and publish an eBook survey of Astronomy in Culture; (2) develop initiatives for Astronomy in Culture public outreach; (3) develop educational initiatives regarding cultural astronomy in contemporary society; (4) gather knowledge of Astronomy in Culture in developing nations; and (5) develop initiatives to promote strong cultural astronomy research and publication to include researchers in related fields as well.

Our sixth committee is a joint collaborative initiative with the Royal Astronomical Society and the American Astronomical Society. The initiative addresses cultural sensitivities at world astronomical

sites. Objectives include better educating astronomers as to Indigenous concerns, developing outreach materials that will provide insightful information to the public, and developing best practices guidance that can be used proactively when future observatory sites are considered.

We are off to a great start! Our initial educational efforts were a plenary presentation at CAP 2021 followed by presentations for AAS 238 and the RAS National Astronomy Meeting, with more to follow this year and the next. IAU members presently serving on this critical joint committee are: Megan Argo, Rick Fienberg, Steven Gullberg, Duane Hamacher, Saeko Hayashi, Jarita Holbrook, Alejandro Lopez, Javier Mejuto, Steve Miller, Wayne Orchiston, Rosa Ros, Oana Sandu, Steven Tingay, and Gudrun Wolfschmidt.

Several WGAAC members are promoting the development of cultural astronomy education. One of these efforts is at the University of Oklahoma where it continues to advance its program on both the graduate and undergraduate levels. The program developed by Steve Gullberg and Andy Munro now offers seven graduate courses and five undergraduate courses in Archaeoastronomy and Astronomy in Culture. Coursework is online so as to be available to anyone anywhere.



The June solstice sunrise over the Chankillo Archaeoastronomical Complex, a site in Peru newly inscribed on UNESCO's World Heritage List. Watercolor by Jessica Gullberg.

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COMMISSION C3

PRESIDENT
VICE-PRESIDENT
SECRETARY
ADVISOR
ORGANIZING COMMITTEE

HISTORY OF ASTRONOMY

Wayne Orchiston
Christiaan L. Sterken
Sara Schechner
Xiaochun Sun
Ileana Chinnici, Eun-Hee Lee, Jay M.
Pasachoff, Piet van der Kruit

COMMISSION C3 WORKING GROUPS

Div. C, Inter-Commission C1-C3-C4 WG	Archaeoastronomy and Astronomy in Culture
Div. C, Inter-Commission C1-C3-C4 WG	Ethnoastronomy and Intangible Heritage
Inter-Union (URSI), Inter-Division B4-C3 WG	Historical Radio Astronomy

TRIENNIAL REPORT 2018–2021

1. Introduction

IAU Commission C3 (History of Astronomy) started in 2015 as a natural continuation of the previous IAU Commission 41 for History of Astronomy which was established in 1948 and which was extremely successful in supporting research on the history of astronomy, organizing and sponsoring workshops and conferences, promoting research collaborations, forming specialist working groups and fostering the publication of members' research.

2. Activities of IAU Commission C3 during 2018-2021

2.1 Conferences and Workshops

Undoubtedly, one of the highlights of the Vienna General Assembly in August 2018 was the Centennial Symposium (IAUS349), where the following C3 members presented papers: David Baneke, Alan Batten, Jean-Louis Bougeret, Suzanne Débarbat, David DeVorkin, John Hearnshaw, Rajesh Kochhar, Wayne Orchiston, Jay Pasachoff, Christiaan Sterken, Virginia Trimble, Roland Wielen and Valeria Zanini. In addition, the following C3 members were on the Organising Committee: Suzanne Débarbat, Owen Gingerich, John Hearnshaw, Rajesh Kochhar, Ray Norris, Wayne Orchiston, Jay Pasachoff, Christiaan Sterken, Xiaochun Sun, Virginia Trimble, David Valls-Gabaud and Gudrun Wolfschmidt.

Members of the Commission normally are quite active in organising national and international conferences, but through the impact of COVID-19, this aspect of our operations was severely curtailed (although we did gain valuable expertise in arranging and participating in e-conferences). Instead what we aimed to do, where possible, was to network with other institutions and support or co-sponsor their conferences and workshops. Thus, during the triennium the following collaborations were arranged:

- *Silk Road Workshop*, October 2018, Beijing, China
- *Mercurio in Sole Visus*, 11 November 2019, ICRANet Coordinating Center, Pescara, Italy
- *The Third International Conference on SE Asian Astronomical History*, 3–5 February 2020, Chiang Mai, Thailand
- *Gerbertus 2020: The Moon of Gerbert*, 5 May 2020, ICRANet Coordinating Center, Pescara, Italy

- *Celestial Mechanics in Light of Conjunctions and Solstice*, 21 December 2020, ICRANet Coordinating Center, Pescara

Other international conferences and workshops scheduled for 2020 and 2021 that were to have involved C3 either were postponed or were cancelled.

Following the success of the Vienna Centennial Symposium, C3 proposed two Focus Meetings for the Busan GA, one hosted jointly with Commission C4 and about UNESCO's involvement in astronomical heritage, but both bids were unsuccessful.

2.2 Research and Publications

During the triennium many C3 members were research-active, which resulted in the publication of a large number of research papers, books and chapters of books. The full lists of the published output will be included in a detailed C3 Report published in the *Journal of Astronomical History and Heritage*.

2.3 The C3 Newsletter

In 2020 Commission Secretary, Sara Schechner, produced two attractive-looking C3 Newsletters (both exactly 57-pages long) packed with information and illustrations.

3. C3 Working Groups

The Division C Steering Committee agreed to the formation of three C3 WGs, but all of these were to be shared with other Commissions. WGs were a key factor in the success of C3 and its predecessor C41 for more than two decades (see Orchiston, 2019).

Notwithstanding these setbacks, the three C3 WGs (on Archaeoastronomy and Astronomy in Culture, chaired by Steve Gullberg; Ethnoastronomy and Intangible Heritage, chaired by Duane Hamacher; and Historical Radio Astronomy, chaired by Richard Schlizzi) were successful in fostering research and publications, organizing meetings, and maintaining up-to-date lists of publications in their respective fields since the Vienna IAU GA. Each WG will submit its own short Triennial Report to the IAU, while full-length accounts of the achievements of the three WGs will be published in the *Journal of Astronomical History and Heritage*.

4. Project Groups

Commission C3 organised informal 'Project Groups' in order to facilitate research projects and international collaborations at Commission level: *Asian Astronomy*, chaired by Wayne Orchiston; *Biographical Encyclopedia of Astronomers*, Third Edition, chaired by Thomas Hockey and Jennifer Bartlett; *Historical Instruments, Archives, and Observatories*; chaired by Sara Schechner; *Indian and Southeast Asian Stone Inscriptions*, chaired by B.S. Shylaja; and *Johannes Kepler*, chaired by Terry Mahony. Progress reports for each of these PGs will be published in the *Journal of Astronomical History and Heritage*, including up-to-date lists of publications.

5. The IUHPST

IAU Commission C3 is also the primary constituent of the Inter-Union Commission of History of Astronomy (ICHA) based in the International Union of History and Philosophy of Science and Technology (IUHPST), which holds International Congresses every four years. The next one is scheduled for Prague (Czech Republic) from 25 to 31 July 2021, and because of COVID-19 has ended up as an e-conference.

Unlike the IAU situation where the General Assembly meeting slots are hotly contested, the IUHPST requires that every Commission hosts at least one research Symposium at each Congress. Consequently, Commission C3 has taken the initiative through ICHA to organize and co-sponsor a Symposium in Prague with the IUHPST Commission on the History of Ancient and Medieval Astronomy (CHAMA). The Symposium contains 20 papers on "Art, Image, and Astronomical Knowledge." The IUHPST has also provided some funding that Commission C3

can distribute to early career scholars to defray the costs of attending this meeting and others relevant to the history of astronomy.

6 International Awards for C3 Members

During the Triennium, C3 members received their fair share of international awards. Commission Secretary, Sara Schechner, received the 2018 *LeRoy E. Doggett Prize for Historical Astronomy* from the American Astronomical Society. Awarded biennially to an individual who has significantly influenced the field of history of astronomy through a career-long effort, it is the most prestigious prize internationally in the discipline. Sara was the first woman to receive this award. Then in 2019 she was the recipient of the *Paul Bunge Prize* from the Hans R. Jenemann-Stiftung, Gesellschaft Deutscher Chemiker (German Chemical Society), and Deutsche Bunsen-Gesellschaft für physikalische Chemie (German Bunsen Society for Physical Chemistry) for her curatorial work and research concerning historical scientific instruments.

Virginia Trimble received the 2019 *Andrew Gemant Award* from the American Institute of Physics. This annual award recognizes contributions to the cultural, artistic, and humanistic dimensions of physics.

C3 President, Wayne Orchiston, along with former US graduate student Stella Cottam, received the 2019 *Donald E. Osterbrock Book Prize* from the American Astronomical Society for their 2015 Springer book, *Eclipses, Transits and Comets of the Nineteenth Century: How America's Perceptions of the Skies Changed*. The 2021 Osterbrock Book Prize recognized the work of C3 OC member Ileana Chinnici. Her award-winning book is *Decoding the Stars: A biography of Angelo Secchi, Jesuit and Scientist* (Brill, 2019).

In 2020, the following C3 members were elected inaugural Fellows of the American Astronomical Society: Jennifer Bartlett, Brenda Corbin, David DeVorkin, Steven Dick, Terry Oswalt, Jay Pasachoff, Iain Reid, Sara Schechner, Patrick Seitzer, Woodruff Sullivan, and Virginia Trimble.

7. Fond Farewells

We are sad to report that since the Vienna GA we have lost the following C3 members: James Caplan (1942–2020, France), A.E.L. Davis (1929–2020, England), William Liller (1927–2021; Chile), Yukio Ôhashi (1955–2019, Japan) and Tiberiu Oproiu (1939–2020, Romania).

8. Closing Remarks

Despite restrictions caused by COVID-19 and the delays in forming Working Groups, the Commission was able to make good progress during the Triennium, as reflected in the list of books published by C3 members, symposia organized and supported, and the activities of the Working Groups and Project Groups. That said, we believe that the future prosperity of C3 lies not just with its members, but also with a supportive Divisional President and Steering Committee.

9. References

- Orchiston, W., 2019. "The IAU C41 Working Groups and their contribution to international history of astronomy research." In Sterken, C., Hearnshaw, J.B., and Valls-Gabaud, D. (eds.), *Under One Sky: The IAU Centenary Symposium*. (Cambridge: Cambridge University Press). Pp. 357–380.
- Sterken, C., Hearnshaw, J., and Valls-Gabaud, D. eds., 2019. *Under One Sky: the IAU Centenary Symposium, IAU Symposium 349* (Cambridge: Cambridge University Press).

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INTER-UNION (IAU–URSI) HISTORICAL RADIO ASTRONOMY INTER-DIVISION (B4–C3) WORKING GROUP

**CHAIR
VICE-CHAIR
ORGANIZING COMMITTEE**

**Richard Schilizzi (UK)
Leonid Gurvits (The Netherlands)
Past-chair – Richard Wielebinski (Germany)
Secretary – Kenneth Kellermann (USA)
Web manager – Ellen Bouton (USA)**

TRIENNIAL REPORT 2018–2021

1. Purpose of the WG

The WG was first established in 2003 as an IAU Commission 40 WG, and continued as a Joint Commission B4-C3 WG. Since the URSI General Assembly in 2014 it has been a joint WG of the IAU and URSI. Its aims are to

- maintain an ongoing bibliography of publications relevant to the history of radio astronomy,
- document the careers of deceased radio astronomers in biographical memoirs, and
- document and preserve surviving historically-significant radio telescopes and associated instrumentation.

WG has 43 members from 15 countries, amongst whom are 14 “national reporters” responsible for keeping track of developments of relevance to the WG in their respective countries or regions.

2. Publications and research

2.1. Publications

The Master List of Publications in the field of Historical Radio Astronomy can be found on the Working Group’s website (<https://rahist.nrao.edu>) under the heading Resources – History of Radio Astronomy.

Table 1 includes five books in the Master List dealing with the history of radio astronomy published since the 2015-2018 report and one that was omitted from the previous report.

The Master List also includes more than 30 articles published in various journals and conference proceedings since the 2015-2018 triennial report.

Presentations on historical radio astronomy topics were given at a number of conferences or in conference sessions in 2018 and 2019, see Table 2.

Table 1. Recent books published on historical radio astronomy

Authors/Editors	Title
Breus, T.K. and Gurvits, L.I. (eds.)	<i>Intelligence, Life, the Universe: a collection of memoirs on I.S. Shklovsky</i> , Moscow: Russian Academy of Sciences, (in Russian), 2019
Kellermann, K.I., Bouton, E. N., and Brandt, S.S.	<i>Open Skies: The National Radio Astronomy Observatory and Its Impact on US Radio Astronomy</i> , Springer, 2020
Orchiston, W., Robertson, P., and Sullivan, W.T.	<i>The Golden Years of Australian Radio Astronomy: An Illustrated History</i> , Springer, 2021
Pariiskii, Yu. N.	<i>Pages From My Life</i> , , SPb Publications, (in Russian), 2017
Strom, R., Van Ardenne, A., and Torchinsky, S. (eds.)	<i>50 Years Westerbork Radio Observatory– A Continuing Journey to Discoveries and Innovations</i> , (Proceedings of Science (pos.sissa.it) and AS-TRON, Dwingeloo, The Netherlands), 2018
van der Kruit, P.C.	<i>Jan Hendrik Oort – Master of the Galactic System</i> , Springer, 2019

Table 2. Presentations at conferences or in conference sessions on historical radio astronomy topics in the 2018–2021 triennium

2018	<i>The history of large single dish projects and lessons learned</i> , IAU GA, Vienna (8 talks) <i>Jas Fest: A Celebration of Jasper Wall at 75</i> , Univ British Colombia, Vancouver (25 talks)
2019	<i>The History of the Square Kilometre Array, 1980s-2012</i> , SKAO, Jodrell Bank (49 presentations and 7 discussion sessions)

2.2. Research projects

Wayne Orchiston has carried out research into aspects of early Australian, Indian, Japanese and New Zealand radio astronomy, in collaboration with international colleagues, and published a number of articles.

Rebecca Charbonneau (Cambridge University) has been working on the PhD thesis entitled “Mixed Signals: Intelligence and Communication in Cold War Radio Astronomy”. Over the reporting period she gave several presentations at relevant colloquia and conferences. Completion of the study is expected in 2021.

Tim Robishaw has contacted relatives of a number of deceased Canadian radio astronomers in a successful attempt to collect archival material from their families. Rooms at the Dominion Radio Astronomy Observatory (DRAO) have been named in honour of three of these former colleagues - Jack L. Locke, Norman W. Broten, and Gladys A. Harvey. Robishaw is writing historical sketches for each.

He is also indexing over 200 boxes of archival material at DRAO and compiling a list of all previous staff and students. He has been working with Joe Tenn (Sonoma State

U., retired) to populate the Canadian radio astronomy family tree on the AAS AstroGen database. In the process he has found that the UK and German radio astronomy family tree is extremely incomplete on AstroGen. He plans to rectify this by working with colleagues in the UK and Germany.

3. Preservation of historical radio-astronomical equipment

The Horn-Reflector used by A. Penzias and R. Wilson in 1964 to discover the Cosmic Microwave Background radiation is located at the Nokia Crawford Hill site in New Jersey (USA). The site has been sold by Nokia to a New Jersey property developer who has promised to leave the Horn Reflector in place and maintain public access. However, the plans for the site as a whole have not been made public. The situation will be monitored by WG members.

The Jansky historical landmark at Holmdel, New Jersey, has not been maintained as expected, and WG members have contacted local government authorities in an effort to remedy the situation.

4. WGHRA Website

The WG website <http://rahist.nrao.edu/> is a repository of a considerable amount of historical material including WG contributions to the IAU Triennial Reports from 2006 to 2018; reports from the Commission J (Radio Astronomy) Business Sessions to URSI for 1946-2017 (not complete), triennial reports from Commission J to URSI from 1994–2017; presentations on the history of radio astronomy at conferences since 2009 (not complete); a list of Grote Reber Medalists; biographical memoirs of deceased radio astronomers; related resources; and access to the NRAO/AUI archives (<https://www.nrao.edu/archives/>) and the CSIRO Radio Astronomy Image Archive <https://www.atnf.csiro.au/ImageArchive/index.html>. New material in the NRAO Archives includes papers of Bernard Burke, Martha Stahr Carpenter, NRAO-ALMA, and over 8,000 digitized images. The CSIRO archive holds a collection of over 15,000 images that relate to the early history of radio astronomy in Australia taken between 1943 and 1996 by professional photographers at the CSIRO Division of Radiophysics and the CSIRO Australia Telescope National Facility.

Sadly, twenty-two of our colleagues have passed away since the General Assembly in 2018.

5. Future activities

A 3-hour session on Historical Radio Astronomy will take place during the URSI General Assembly in August 2021. The topic will be The Impact of Radio Astronomy on Technology and Society and include talks on The Story of WiFi; VLBI, Navigation, and Geodesy; Cold-War Diplomacy at the Jodrell Bank Observatory; Radio Interferometry and Medical Imaging; Deep Space Navigation; and The Parkes Dish and the First Moonwalk.

The WG plans to include a Business Session and some talks as part of the Division Days during the IAU GA in Busan in 2022. Topics for talks are under discussion.

Other activities planned include

- continuation of the research projects mentioned above,

4

DIVISIONS B & C/ COMMISSIONS B4 & C3

– monitoring progress on the preservation of historical instrumentation issues also mentioned above, and

– maintaining and augmenting the WG website.

A number of books are in press or in preparation, see Table 3.

Table 3. Books on historical radio astronomy in press or in preparation

Authors/Editors	Title
Campbell, D.	<i>History of the Arecibo Observatory</i>
Gregorini, L., Ferretti, L., Giovannini, G., Mantovani F., Parma, P. and Vettolani, G	<i>Why don't you build a radio telescope? 40 years of Radio Astronomy in Bologna</i> (in Italian). (In press, Bologna University Press). The English translation is in preparation.
Goss, W. M., Ekers, R. D., and Hooker, C.	<i>From the Sun to the Cosmos, J.L. Pawsey, Founder of Australian Radio Astronomy</i> (in press, Springer)
Gurvits, L. I., Hirabayashi, H. and Schilizzi, R. T.	<i>Space VLBI – Radio telescopes Larger than the Earth</i> (to be published by Springer)
Kellermann, K. I. and Bouton, E.	<i>Star Noise: Discovering the Radio Universe</i> (to be published by CUP)
Wall, J. V., Griffin, E., and Jarrell, R.	<i>A Young Science in a Young County: The Origins and History of Canadian Radio Astronomy</i> (to be published by Springer)
Schwartz, R. and Zensus, J. A.	<i>History of the Max Planck Institute for Radioastronomy</i> (English translation)
Schilizzi, R. T., Ekers, R. D., Crosby, P. and Dewdney, P. E. D.	<i>The Square Kilometre Array: a mega-science project in the making, 1993-2012</i>
Vanden Bout, P. and Dickman, R.	<i>The ALMA Radio Telescope – Birth Pangs of a Megaproject</i>

IAU Division C Inter-Commission C1-C3-C4 WORKING GROUP FOR ARCHAEOASTRONOMY AND ASTRONOMY IN CULTURE (WGAAC)

CHAIR
CO-CHAIR
WG OC

Steven Gullberg
Javier Mejuto
Beatriz Garcia, Duane Hamacher, Jarita Holbrook,
Alejandro Martin Lopez, Rosa M. Ros, Christiaan Sterken

TRIENNIAL REPORT 2018-2021

The WGAAC presently has 89 members - 58 Working Group Members and 31 Working Group Associates. *Astronomy in Culture* is interdisciplinary, and the Associates make valuable contributions from backgrounds in fields other than astronomy.

Working Group Members

Alan Alves-Brito (Brazil), Elio Antonello (Italy), Megan Argo (UK), G.S.D. Babu (India), Ennio Badolati (Italy), Juan Belmonte (Spain), Kai Cai (USA), John Carlson (USA), Brenda Corbin (USA), Milan Dimitrijevic (Rep. Serbia), Steve Durst (USA), Marta Folgueira (Spain), Jesus Galindo-Trejo (Mexico), Alejandro Gangui (Argentina), Beatriz García (Argentina), Rita Gautschy (Switzerland), César González-García (Spain), Steven Gullberg (USA), Duane Hamacher (Australia), Abraham Hayli (France), Dieter Herrmann (Germany), Bambang Hidayat (Indonesia), Thomas Hockey (USA), Susanne Hoffmann (Germany), Jarita Holbrook (South Africa), Andrew Hopkins (Australia), Matthaios Katsanikas (Greece), E. C. Krupp (USA), Ioannis Lirizis (Greece), Alejandro Lopez (Argentina), Claudio Mallamaci (Argentina), J. McKim Malville (USA), Javier Mejuto (Honduras), Areg Mickaelian (Armenia), Eugene Milone (Canada), Simon Mitton (UK), Andrew Munro (USA), Raymond Norris (Australia), Wayne Orchiston (Australia), Robert Preston (USA), Michael Rappenglück (Germany), Rosa Ros (Spain), Clive Ruggles (UK), Sara Schechner (USA), Irakli Simonia (Rep. Georgia), Magda Stavinschi (Romania), Christiaan Sterken (Belgium), Linda Strubbe (USA), Woodruff Sullivan (USA), Virginia Trimble (USA), Ana Ulla (Spain), Johnson Urama (Nigeria), David Valls-Gabaud (France), Iryna Vavilova (Ukraine), Tiziana Venturi (Italy), Murli Verma (India), Gudrun Wolfschmidt (Germany), Georg Zotti (Austria).

Working Group Associates

Bryan Bates (USA), Patricio Bustamante (Chile), Nicholas Campion (UK), Brian Davis (USA), Margaret Davis (USA), Sona Farmanyan (Armenia), Roslyn Frank (USA), Robert Fuller (Australia), Cecilia Gomez (Argentina), Akira Goto (Japan), Liz Henty (UK), Stanislaw Iwaniszewski (Mexico), Olaf Kretzer (Germany), Trevor Leaman (Australia), Flavia Pedroza Lima (Brazil), Monica Martinez-Borravo (Mexico), Steve Miller (UK), Armando Mudrik (Argentina), Gregory Munson (USA), Cristina Negru (Romania), David Pankenier (USA), Fabio Silva (UK), Emilia Pasztor (Hungary), Manuel Pérez-Gutiérrez (Spain), Eduardo Rodas (Honduras), William Romain (USA), John Saul (France), Ivan Šprajc (Rep. Slovenia), Doris Vickers (Austria), Alexander Wolf (Russian Fed.), Mariusz Ziółkowski (Poland).

1. Objectives

The Working Group for Archaeoastronomy and Astronomy in Culture (WGAAC) is in part a discussion and collaboration group for IAU members regarding *Astronomy in Culture*, and as well for certain others with interests in these areas. A primary motivation is to facilitate interactions between researchers, but the WG also has significant interest in promoting education regarding cultural astronomy in all respects. The WGAAC is the focal point within the IAU for both vigorous research in the field of *Astronomy in Culture* and in public education for how astronomy has been used in many societies.

This field is also serviced by non-IAU organizations such as *International Society for Archaeoastronomy and Astronomy in Culture* (ISAAC), *Société Européenne Pour L'Astronomie Dans La Culture* (SEAC - *European Society for Astronomy in Culture*), *Sociedad Interamericana de Astronomía Cultural* (SIAC - *Inter-American*

Society of Astronomy in Culture), and *Society for Cultural Astronomy in the American Southwest* (SCAAS). However, it is the IAU WGAAC that focuses on cultural astronomy within mainstream astronomy with its mission to:

- Advance the field of archaeoastronomy/cultural astronomy
- Promote research and publication
- Promote strong initiatives for educators on different levels for multiple aspects of cultural astronomy to include the exploration of literature, poetry, music, films, etc.
- Promote public outreach to educate regarding astronomy in culture
- Use the fascination with astronomy in culture to inspire youth interest in pursuing any aspect of astronomy in their futures
- Increase the understanding of how astronomy was used in cultures within developing nations where such has not yet been fully explored
- Facilitate interactions with other members and groups within the IAU
- Facilitate interactions between researchers in the field
- Encourage engagement in this research by additional IAU members
- Promote collaboration between the IAU, ISAAC, SEAC, SIAC, and SCAAS for the advancement of archaeoastronomy and astronomy in culture
- Promote the inclusion of archaeoastronomical research in other fields, such as Archaeology, Anthropology, Indigenous Studies, and Native American Studies

As well as facilitating internal interactions between the WGAAC and other IAU bodies, we strive as well to enhance strong links between the WGAAC and ISAAC, SEAC, SIAC, and SCAAS. The WGAAC serves as a focal point for collaborative world-wide efforts in *Astronomy in Culture*.

2. Triennium Work (2018-2021)

During the 2018-2021 triennium the WGAAC organized five committees for members to further its initiatives:

- Committee 1 – development of a comprehensive eBook regarding a survey of *Astronomy in Culture*. This will be similar in concept to the IAU's *Big Ideas in Astronomy* and is to be posted/published on the IAU website and made readily available to the public. We anticipate this book will be ready for electronic publication by the end of 2021. The WGAAC plans for other books to follow.
- Committee 2 – development of initiatives for public outreach regarding *Astronomy in Culture*. We have begun this work and will add affiliation with Commission C2 to further the effort.
- Committee 3 – development of initiatives for educators and others regarding examples of cultural astronomy found in literature, poetry, music, films, etc. As part of our affiliation with Commission C1 we are developing a compilation of such cultural information regarding this aspect of astronomy and are working toward additional educational initiatives as well.
- Committee 4 – development of initiatives to gather knowledge regarding *Astronomy in Culture* in developing nations, especially where such has not yet been fully explored. Much has been learned about archaeoastronomy in many parts of the world, but there still are geographical gaps in the collective knowledge of the field. Commission C4 is a key affiliation here and we are in the process of compiling what is known.
- Committee 5 – development of initiatives for the advancement and promotion of strong cultural astronomy research, publication, and collaboration among scholars throughout the world. This also is meant to attract those in other fields (such as archaeology, anthropology, and Native American studies) who explore ancient cultures and

inspire them to include astronomy in their research and assessments. This committee has made good progress and continues its efforts.

Archaeoastronomy, a major part of cultural astronomy, very much relates to Commission C3 and C3 influences much of the above activity. The work of these committees is ongoing, and this will make important contributions to the growing field of *Astronomy in Culture*. The IAU through its WGAAC will continue to exert great influence on the further evolution of the field.

Significantly, we have now formed a 6th committee. In November 2020 the WGAAC was tasked with leading a joint collaborative initiative with the Royal Astronomical Society of the United Kingdom, and this was joined by the American Astronomical Society. The initiative addresses cultural sensitivities at world astronomical sites. Goals of the effort include developing a program to better educate astronomers as to Indigenous concerns, developing materials that will provide insightful information to the public, and developing information that can be used proactively when future observatory sites are considered. Work is well underway, and the team plans to offer workshops in 2021 and 2022 at major astronomical events of the IAU, the RAS, and the AAS. This will be an ongoing project and presentations are anticipated at other astronomy events as well. IAU members presently serving on the joint committee are: Steven Gullberg (Chair, USA), Megan Argo (UK), Rick Fienberg (USA), Duane Hamacher (Australia), Jarita Holbrook (South Africa), Alejandro Lopez (Argentina), Javier Mejuto (Honduras), Wayne Orchiston (Australia), Rosa Ros (Spain), Oana Sandu (Germany), and Gudrun Wolfschmidt (Germany). WGAAC Working Group Associate Steve Miller (UK) serves on the committee as well.

During this triennium several WG members worked to advance cultural astronomy education through degree programs and courses that they created at their universities.

3. WG Member Publications

The WGAAC encourages research and publication regarding *Astronomy in Culture*. WG members have prolifically published during the 2018-2021 triennium – a still growing list includes over 240 books and papers. Here are representative examples from 43 of our members:

- Belmonte J. A.** 2019, Gheorgiu, D.; Nash, G.; Bender, H.; **Pasztor, E.** Essay review on Land of the Shamans: archaeology, cosmology and landscapes *Journal for the History of Astronomy* 50, 482-83.
- Campion, N.** 2020, *The Archaeology of Cultural Astronomy: Material Culture, Astronomy and Power*, Oxford: British Archaeology Reports.
- Dimitrijević, M. S.** 2019, Milutin Milanković and the reform of Julian Calendar on Ecoumenical Congress in Constantinople in 1923, International Conference The Life and Work of Milutin Milanković: Past, Present, Future, 19-21 July 2019, Belgrade, Proceedings, editor Slavko Maksimović, Faculty of Architecture, 87-92.
- Frank, R. M.** 2018, Collective social memory as manifest in skyscape narratives. *Journal of Skyscape Archaeology* 4(1): 124-128.
- Gautschy, R.** 2020, The Karnak Clepsydra: Votive Gift or Utilitarian Object?, 171–183, in: K. Gabler, **R. Gautschy**, H. Jenni, C. Reymond & L. Bohnenkämper, “Text-Bild-Objekte im archäologischen Kontext. Festschrift für Susanne Bickel”, *Lingua Aegyptia – Studia Monographica*, Widmaier Verlag: Hamburg.
- González García A. C., & Belmonte, J. A.** 2019, Lunar Standstills or Lunastices, Reality or Myth?, *Journal of Skyscape Archaeology*, 5(2) 177-190.
- Goto, A.** 2018, House and burial orientations of the Hokkaido Ainu, indigenous hunter-gatherers of northern Japan. *Mediterranean Archaeology and Archaeometry*, 18(4), 173-180.
- Gullberg, S. R.** 2020, *Astronomy of the Inca Empire: Use and Significance of the Sun and the Night Sky*. Springer Nature.
- Gullberg, S. R., Hamacher, D., Martin Lopez, A., Mejuto, J., Munro, A., & Orchiston, W.** (2020). A cultural comparison of dark ‘constellations’ of the Milky Way. *Journal of Astronomical History and Heritage*, 23(2), 390-404.
- Henty, L.** 2020, Skyscape archaeology: the place of the sky in the academy. Chapter 1 in **Liz Henty** and Daniel Brown (eds), *Visualising Skyscapes: Material forms of cultural engagement with the heavens*. Oxford: Routledge.
- Herrmann, D. B.** 2019, *Atlas astronomischer Traumorte: Entdeckungsreisen auf den Spuren der Sternkunde*. Stuttgart, Germany: Franckh-Kosmos.
- Hockey, T.** 2020, Archaeoastronomy Sites of the USA: Likelihood of Preservation. *Bulletin of the American Astronomical*

- Society*, LII.
- Hoffmann, S. M.** and Vogt, N. 2020, Cataclysmic variables as possible counterparts of ancient Far Eastern guest stars, *MNRAS*, 494, 5775-5786
- Holbrook, J. C.** 2019, The Square Kilometre Array Art Exhibition, in: Daniel Brown, **Liz Henty** (Eds.), *Visualizing Skyscapes*, London, Routledge.
- Liritzis, I.**, Laskaris, N, Vafiadou A, Karapanagiotis I, Volonakis, P, Papageorgopoulou, C, Bratitsi, M (2020) Archaeometry: an overview. *SCIENTIFIC CULTURE*, 6(1), 49-98. doi: 10.5281/zenodo.3625220
- Krupp, E. C.** 2019, The Moon and Planets in Indigenous California. *Oxford Research Encyclopedia of Planetary Science*. Oxford University Press.
- Leaman, T. M. & Hamacher, D. W.** 2019, Baiami and the emu chase: an astronomical interpretation of a Wiradjuri Dreaming associated with the Burbung (Baiami-bu dhinawan yanhamanha: Gibbirgirraang winhanga-durin-ya Wiradjuri Yarrudhumarra-bu Burbung). *Journal of Astronomical History and Heritage*, 22(2), 225–237.
- López, A. M.** 2020, Cultural astronomy perspectives on ‘development’. In: Astronomy in Focus – XXX, Proceedings IAU Symposium No. XXX, 2018, M. T. Lago, ed., Focus Meeting 15: Astronomy for Development, IAU, XXX General Assembly, 580-581.
- Mejuto, J., & Rodas-Quito, E.** 2019, Etnoastronomía en Honduras: Retos y desafíos in Libro de resúmenes del I Congreso de Investigación en Ciencias Espaciales, pág. 29, UNAH, Tegucigalpa.
- Mudrik, A.** 2020, Luna e identidad entre migrantes europeos y sus descendientes en el sur de la región chaqueña argentina. *Avá*, 35.
- Mickaelian, A. M., & Farmanyan, S. V.** 2019, Armenian Archaeoastronomy and Astronomy in Culture, *ASP CS 520*, 3.
- Munro, A. M.,** 2019, *The Archeological Pertinence of Archaeoastronomy: Lessons-learned from Collaboration*, paper presented at the joint 2019 European Association of Archaeologists (EAA) and European Society for Astronomy in Culture (SEAC) conference in Bern, Switzerland.
- Munson, G. E.,** Ray A. Williamson, R. A., & **Bates, B. C.** editors 2020, *Before Borders: Revealing the Greater Southwest’s Ancestral Cultural Landscape. Occasional Papers on Cultural Astronomy No. 1*, SCAAS Multimedia Publications, Dolores, CO.
- Orchiston, W., & Vahia, M.** (eds.) 2021, *Exploring the History of Southeast Asian Astronomy: A Review of Current Projects and Future Prospects and Possibilities*. Cham (Switzerland), Springer International Publishers.
- Pankenier, D.** 2019, Parallel Planetary Astrologies in Medieval China and Inner Asia. *International Journal of Divination and Prognostication*, 1(2).
- Pasztor, E.** 2020, Visualisation of the sky in traditional cultures of Eurasia and its ancient representations. In: **Henty L.,** Brown D. (eds) *Visualising Skyscapes. Material Forms of Cultural Engagement with the Heavens*. Routledge, Oxon.
- Pérez-Fernández, E., Martínez García, B. Braña-Rey, F., & **Ulla-Miguel, A.** 2020, O ceo na pedra. Un proxecto de innovación educativa para o Ensino Secundario, no eido da astronomía cultural., III Xornadas de Educación Patrimonial de Galicia.
- Rappenglück, M. A.,** 2020, Capturing Heaven and Earth by Counting, Measuring and Constructing: The Prehistory of Mathematics, Metrology and Astronomy in the Paleolithic. In Maß und Mythos, Zahl und Zauber - Die Vermessung von Himmel und Erde. Tagung der Gesellschaft für Archäoastronomie in Dortmund 2018, edited by **Gudrun Wolfschmidt**, 88-126, Nuncius Hamburgensis - Beiträge zur Geschichte der Naturwissenschaften 48. Hamburg: tredition.
- Rodríguez Díaz, A., **Pérez Gutiérrez, M.,** & Duque Espino, D. M. 2019, “estrechando el círculo” de la fornacis de ptolomeo: el oppidum de hornachuelos (ribera del fresno, badajoz) / “narrowing the circle down” of ptolemy’s fornacis: the oppidum of hornachuelos (ribera del fresno, badajoz) conimbriga, lviii.
- Romain, W.** 2020, Subduing the Demons of Tibet: Geomantic Magic During the Yarlung Dynasty: A Landscape Archaeology Assessment. *Time and Mind: The Journal of Archaeology, Consciousness and Culture*.
- Saul, J. M.** 2020, Comment la mythologie permet de dater la préhistoire, *Bulletin trimestriel du Group Ile-de-France de Mythologie Française*, Lettre 114 (June) pp. 9-15.
- Savchuk, V. S., Kushlakova, N. M., **Vavilova, I. B.** & Nikolai Kibalchich, N. 2019, In the history of world rocket-space technics: discussion questions of domestic and world historiography. *Space Sci. & Technol*, 25(6), 70-83.
- Silva, F.** 2020, A probabilistic framework and significance test for the analysis of structural orientations in sky-scape archaeology *Journal of Archaeological Science*, 118, 105138.
- Simonia, I.** 2019, Ancient Astronomical Knowledge: The Unity of Diversity. *Astronomical Heritage of the Middle East*. ASP Conference Series, Vol. 520, proceedings of a conference held (13-17 November 2017) the Armenian National Academy of Sciences in Yerevan, Armenia. Edited by **Sona V. Farmanyan, Areg M. Mickaelian, J. McKim Malville,** and Mohammad Bagheri. San Francisco: Astronomical Society of the Pacific, p.59 – 70.
- Šprajc, I.,** 2019, Lunar orientations in the Maya architecture. In: Milan Kováč, Harri Kettunen, and Guido Krempel, eds., *Maya cosmology: Terrestrial and celestial landscapes, Acta Mesoamericana* 29, 27-44. Munich: A. Saurwein.

- Sterken, C., Hearnshaw, J., D. Valls-Gabaud, D.** 2019, *Under One Sky: the IAU Centenary Symposium*, IAU Symposium 349 Cambridge: Cambridge University Press.
- Wolfschmidt, G.** (ed.) 2020, *Maß und Mythos, Zahl und Zauber: Die Vermessung von Himmel und Erde. Measure and Myth, Number and Magic: Measuring Heaven and Earth.* Proceedings der Tagung der Gesellschaft für Archäoastronomie in Dortmund 2018. Hamburg: tredition (Nuncius Hamburgensis - Beiträge zur Geschichte der Naturwissenschaften; Band 48.
- Ziólkowski, M.** 2020, The Moon and Planets among the Inca and in the Andes. In *The Oxford Research Encyclopedia of Planetary Science*. Oxford University Press.
- Zotti, G. & Muzaffari, S. M.** 2020, New Light on the Main Instrument of the Samarqand Observatory. *Journal for the History of Astronomy*, 51(3), 255–271.

4. In Memorium

We will deeply miss our friend and colleague, William Liller (Chile), who recently passed in 2021.

5. Closing Remarks

The WGAAC and its members had a very productive triennium as work continued during the present pandemic. The joint initiative between the IAU, RAS, and AAS is exciting and the committee looks forward to seeing its efforts improve mutual understanding. The WG's other committees continue fascinating work as well. The WG's first eBook to be published later this year will be a banner achievement and a major contribution. The WG will actively explore all aspects of *Astronomy in Culture* and will promote educational public outreach initiatives. A primary goal is to help educators to learn aspects of cultural astronomy and then use this to inspire students at all levels to pursue endeavors in science. The field of *Astronomy in Culture* has reached a stage of increased momentum in its evolution and advancement. The IAU and its WGAAC will continue to play a central role in guiding the further development of and education for this field that is integral to the history of astronomy.

Steven Gullberg
*Chair of the C1-C3-C4 Working Group for
 Archaeoastronomy and Astronomy in Culture
 (WGAAC)*

March 2021



Astronomical UNESCO World Heritage Site of Risco Caído and the sacred mountains of Gran Canaria, Spain. On left, ray of sunlight penetrates temple chamber in Risco Caído to hit cup marks and triangular petroglyphs indicative of the day. On right, view of the Caldera de Tejeda, which has artificial caves and structures aligned with the rising and setting sun. Courtesy of the Portal to the Heritage of Astronomy, <https://www3.astronomicalheritage.net/>.

INTER-COMMISSION C1-C3-C4 WORKING GROUP FOR ETHNOASTRONOMY & INTANGIBLE ASTRONOMICAL HERITAGE

Chair Duane Hamacher

Members Beatriz Garcia, Alejandro Gangui, Steven Gullberg, Jarita Holbrook, Alejandro Martin-Lopez, Javier Mejuto, Wayne Orchiston, and Clive Ruggles

TRIENNIAL REPORT, 2018-2021

1. History

At the 2018 IAU meeting in Vienna, the IAU C1-C4 WG on Intangible Astronomical Heritage became the WG on Ethnoastronomy & Intangible Heritage. The aim of this WG is to provide an avenue for recording, preserving, and safeguarding culturally specific Knowledge Systems and traditions related to astronomy. This includes intangible heritage, such as language, oral tradition, song, dance, and social customs relating to astronomy.

2. Target Areas of Research Focus

The WG identified six (6) major areas regarding intangible heritage with respect to ethnoastronomy to be addressed: Language, Oral Tradition (stories and narratives), Music (including Song and Dance), Knowledge Systems, Cultural Practices (such as navigation and ceremony), and Artistic Representation (all forms of art and craft, both tangible and intangible). These form significant areas of focus within the WG and member expertise. During the previous triennium, we have engaged in a collaborative process of research and publication outputs that have led to 24 refereed publications, 1 book contract, and several non-refereed and popular articles.

3. Working Group Goals

Goals include UNESCO heritage recognition, preservation through government and regulatory bodies, and finding ways to preserve this, such as reducing light pollution, access to language and culture, education, and recoding (where appropriate and permissible) traditions such as story, song, and dance. Work was delayed by the COVID pandemic but is back on track.

3a. Publish a collaborative journal paper on Intangible Astronomical Heritage

This paper will outline the types, and importance of Intangible Heritage (IH), the requirements and process for submitting heritage applications, how to protect IAH, provide a few case studies, and discuss actions and plans for the future.

3b. Populate UNESCO portal with case studies and social media campaign

Identification of six case studies (one for each category) to populate the UNESCO web portal and develop a way for related stakeholders to upload their own content for inclusion. We will engage in a social media campaign to get our results and ideas out to the public. We will then explore the possibility of a documentary to be filmed on the subject.

3c. Host an international IAU-sponsored meeting and publish an edited volume.

This meeting will focus on implementing the key issues laid out in the journal paper, including a number of case studies. We will seek status as a funded IAU Symposium, with an emphasis on input from Indigenous researchers

and stakeholders. We will publish an edited volume similar to the one on "tangible heritage" published in 2010 (IAU symposium through Cambridge University Press). It will include in-depth case studies from a wide range of geographic and subject areas with strong representation from Indigenous researchers and communities.

4. Developments

IAU WG members are involved in current exhibitions that will pave the way for further development of the WG goals and pave the way for an IAU sponsored symposium. This includes the "One Sky, Many Worlds" traveling Indigenous Astronomy art and knowledge exhibition, to be launched in 2021 in Ottawa, Canada.

Jarita Holbrook has agreed to take over Chair of the WG from Duane Hamacher for the next Triennium.

5. Publications

Core research leading to WG outcomes has been published in a variety of academic journals and books and have been included in national curricula in member countries (such as Australia). These will be further developed for the case studies in the edited volume, as well as core content for the symposium.

The following publications represent a selection of those involving the development of ethnoastronomy and intangible heritage in its various forms.

Publications are organised by year published with WG Members in bold face.

2021

1. Bush, M. and **Hamacher, D.W.** (2021) *World Developments: Australasian and Oceanic Cultures*. In Clifford Cunningham (ed) "*A Cultural History of the Universe in the Age of Enlightenment*." Volume 4. London: Bloomsbury Publishing. In press.
2. **Hamacher, D.W.**, De Napoli, K. and Mott, B. (2021) Whitening the Sky: light pollution as a form of cultural genocide. *Journal of Dark Sky Studies*, Vol. 1, in press. (Preprint: arXiv:2001.11527)
3. Lee, A.S.; Maryboy, N.; Begay, D.; Buck, W.; Catricheo, Y.; **Hamacher, D.W.**; **Holbrook, J.**; Kimura, K.; Knockwood, C.; Painting, T.K.; Varguez, M. (2021) Best Practices and Protocols for Including Indigenous Astronomy in the Planetarium Setting. *Proceedings of the International Planetarium Society*, Vol. 25, pp. 69-77.
4. **Orchiston, W.** and Vahia, M. (eds.) (2021) *Exploring the History of Southeast Asian Astronomy: A Review of Current Projects and Future Prospects and Possibilities*. Cham (Switzerland), Springer International Publishers.

2020

1. Gamarra, M. R., **Gullberg, S. R.**, Estrazulas, M., Horvath, J., Zen, C. (2020). Complementary duality of the Inca's cosmovision: An astrophysics perspective. *Astronomische Nachrichten*, Vol. 340(9-10), pp. 817-827.
2. **Gullberg, S. R.** (2020). Cultural astronomy and educational opportunities. *Astronomische Nachrichten*, Vol. 340(9-10), pp. 810-816.

3. **Gullberg, S.R.; Hamacher, D.W.; Lopez, A.M.; Mejuto, J.; Munro, A.M.; and Orchiston, W.** (2020). A Cultural Comparison of Dark Constellations of the Milky Way. *Journal of Astronomical History and Heritage*, Vol. 23(2), pp. 390-404.
4. **Hamacher, D.W.** (2020) Native American Traditions of Meteor Crater, Arizona: Fact, Fiction, or Appropriation? *Journal of Astronomical History and Heritage*, Vol. 23(2), pp. 375-389.
5. **Hamacher, D.W.,** Leaman, T.M., Fuller, R.S., and Bosun, D. (2020) Solstice and solar position observations in Australian Aboriginal and Torres Strait Islander traditions. *Journal of Astronomical History and Heritage*, Vol. 23(1), pp. 89-99.
6. **López, A.M.** (2020) *Cultural astronomy perspectives on 'development'*. In *Astronomy in Focus – XXX*, Proceedings IAU Symposium No. XXX, 2018, M. T. Lago (eds), Focus Meeting 15: Astronomy for Development, IAU, XXX General Assembly, pp. 580-581.

2019

1. David, B. and **Hamacher, D.W.** (2019). *Environment and Landscape*. In *The Encyclopedia of Archaeological Sciences*, edited by S.L. Lopez Varela. John Wiley & Sons.
2. **Gullberg, S.** (2019). Cosmology of the Incas: Effects of light and shadow. *Astronomische Nachrichten*, Vol. 340(1-3), pp. 23-29.
3. Halkare, G.; Dahedar, P.; **Orchiston, W.** and Vahia, M.N. (2019) Astronomy of the Pardhi Tribe of Central India. *Journal of Astronomical History and Heritage*, Vol. 22(1), pp. 179-194.
4. **Hamacher, D.W.;** Barsa, J.; Day, R.; Passi, S.; and Tapim, A. (2019) Indigenous use of stellar scintillation for predicting weather and seasonal change. *Proceedings of the Royal Society of Victoria*, Vol. 131(1), pp. 24-33.
5. **Hamacher, D.W.** and Banks, K. (2019). *The Planets in Indigenous Australian Traditions*. In *Oxford Research Encyclopedia of Planetary Science*, edited by Peter Read. Oxford University Press.
6. **Holbrook, J. C.** (2019) *The Square Kilometre Array Art Exhibition*. In *Visualizing Skyscapes*, edited by Daniel Brown and Liz Henty, London: Routledge.
7. Leaman, T.M. and **Hamacher, D.W.** (2019) Baiami and the emu chase: an astronomical interpretation of a Wiradjuri Dreaming associated with the Burbung. *Journal of Astronomical History and Heritage*, Vol. 22(2), pp. 243-255.
8. **Mejuto, J.** and Rodas-Quito, E. (2019) Etnoastronomía en Honduras: Retos y desafíos in *Libro de resúmenes del I Congreso de Investigación en Ciencias Espaciales*, pág. 29, UNAH, Tegucigalpa.
9. Orchiston, W. and Drummond, J. (2019) The Tarawera volcanic eruption in New Zealand and Māori cometary astronomy. *Journal of Astronomical History and Heritage*, Vol. 22(3), 521–535.

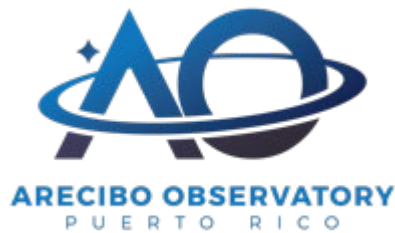
2018

1. Guedes, C.; **Hamacher, D.W.;** Barsa, J.; Day, E.; Day, R.; Passi, S. and Tapim, A. (2018) Death and Maier: meteors and death rites in the eastern Torres Strait. *Australian Journal of Indigenous Issues*, Vol. 21(3), pp. 39-59.

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Starry sky over Old Faithful Geyser in the World Heritage Site, Yellowstone National Park, Wyoming. Photo by Wally Pacholka. *The World at Night* (TWAN), <https://twanight.org/>.



Arecibo Salvage Survey Committee Update for History of Astronomy

Submitted by Luisa Fernanda Zambrano Marin on behalf of the
Arecibo Salvage Survey Committee

On December 1, 2020, the 900-ton instrument platform of the Arecibo radio telescope in Puerto Rico suffered a series of cascading catastrophic cable failures causing it to crash down into the telescope's 305-meter reflector dish. This followed a November 2020 safety evaluation which found that the main platform support cables may not be capable of supporting the load expected and decommissioning should commence.

By early January 2021, the University of Central Florida (UCF), operators of the Observatory for the National Science Foundation (NSF) and NSF established an Arecibo Observatory (AO) Salvage Survey Committee. With the site of this iconic scientific instrument now a dangerous debris field, this Committee was given a charge to work with the emergency salvage and clearing contractors to recommend the retrieval of items that have potential historical significance, or which might be leveraged for instrument research or informal education. The Committee then established screening procedures at the site to identify debris that might be of historic importance and/or scientific utility.

The AO Salvage Survey Committee consists of representatives from: the AO Science and Visitor's Center; AO staff, with scientists from astronomy, planetary and atmospheric sciences, as well as technical staff having knowledge of mechanical and electronic systems; the Smithsonian Institution, with expertise in museum curation and the history of astronomy; long-term AO users; and NSF, including the NSF historian.

Since January, the Salvage Survey Committee has identified hundreds of items with potential historical significance and has worked with the clearing contractors to locate these items. This included regular field visits with appropriate safety personnel to identify these objects, photographing (ground and drone) the site to locate them among the debris. Items identified include instruments as well as structural / engineering parts. Examples of structural components salvaged include: the rotary joint, sections of the zenith and azimuth tracks, one corner of the platform (*Figure 1*) and the cable car (*Figure 2*). Structural components such as the main and auxiliary cables and a number of cable and socket samples will be first examined for forensic purposes. Examples of instruments and devices from the Gregorian Dome include the S-band transmitter Klystrons (*Figure 3*) and the ALPHA receiver.



Figure 1. Platform structure hanging on the rim wall following collapse. The committee recommended salvaging samples of main components, such as platform corners, azimuth and zenith track portions, rotary joint and beams sections.

To date, the Committee is only identifying potential items of historic importance or scientific utility that were part of the structure at the time of collapse. In other words, the current efforts are largely triage. A separate procedure will be established to determine which objects will become a part of a curated or representative sample or collection in the future.

In due course, the Committee will report its recommendations to the AO Director and to the NSF. The AO Director will discuss the Committee's recommendations with NSF, and NSF will provide the AO management with its determination with respect to the recommendations provided in the final report.

It is an impossible task to rank the importance of instruments housed in this telescope; the pieces recommended for preservation carry a great significance in the history of Radio Astronomy, Planetary Radar, Space and Atmospheric Sciences and several generations of citizens impacted by its sheer presence.

The Committee's final report will be made available on the Observatory's and NSF's websites. Sign up on the Observatory's mailing list to receive updates on Seminars, Colloquiums, Science and Education activities.

Figure 2. The iconic cable car, which transported instruments, scientists, and visitors to the platform.



Figure 3. Planetary Radar S-band Klystron (2380 MHz, 12 cm, 500 kw). These instruments were among the key elements for Planetary Sciences research especially on Near-Earth Objects, Main Belt Asteroids, comets, and neighboring planets

Astronomy on Stamps before the Space Age

Ian Ridpath

Chairman, Astro Space Stamp Society (UK)

Astronomy and space have been popular subjects on postage stamps since the launch of Sputnik 1 in 1957, but before then they were few and far between. Some years ago I began to create a website with all the astro-themed stamps I could find that were issued prior to the watershed year of 1957. There are more of them than you might think, extending back to 1887 when Brazil produced the first-ever astro stamp, depicting the Southern Cross (*Figure 1*).



Figure 1. Brazil 1887

The first-ever postage stamp with an astronomical design was issued by Brazil in 1887. It contains a realistic depiction of the Southern Cross, including the fifth star, Epsilon Crucis, which is often missing from other, purely symbolic representations.



Figure 2. USSR 1955

A coloured engraving of the painting Astronomer Copernicus: Conversation with God by the Polish artist Jan Matejko features on this stamp issued by the Soviet Union in 1955. Matejko himself is pictured in the inset.

Many astro-themed stamps from those early years commemorate astronomers and observatories. Copernicus is the most-honoured astronomer, appearing on over a dozen stamps before 1957, mostly from Poland but also from Russia and China. The Russian one, issued in 1955, features the famous painting of Copernicus on a rooftop titled Astronomer Copernicus: Conversation with God by the Polish artist Jan Matejko (1838–93) (*Figure 2*).

Among the observatories on stamps is a classic view of Palomar Observatory issued by the US Postal Service in 1948 August, two months after the observatory's dedication ceremony (*Figure 3*). It was the

first astronomically themed stamp issued by the USA. Produced in vast numbers, it is still easily and cheaply available and should be in any astronomer's collection.

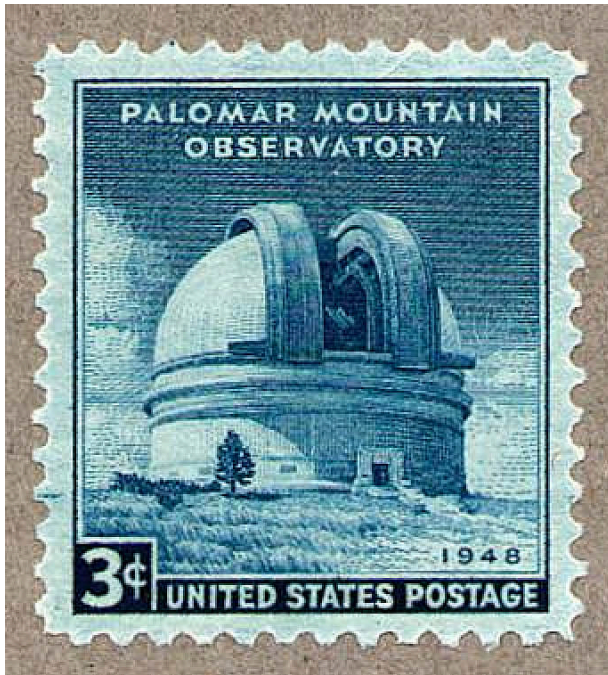


Figure 3. USA 1948

This 3-cent, light-blue stamp from 1948 showing the dome of the 200-inch reflector at Palomar Observatory was the first astronomically themed stamp issued by the United States.

An observatory of a very different type appears on a 1947 stamp from Jaipur, a former Princely state in northern India that is now part of Rajasthan. One of Jaipur city's greatest tourist attractions is the Jantar Mantar observatory, a set of stone instruments built by Maharaja Jai Singh II around 1730. The Jaipur observatory was restored in 1901 and declared a national monument in 1948. One of the smaller instruments is shown on this stamp from 1947 (*Figure 4*).

FIGURE 4. Jaipur 1947

One of the stone sundials at the Jantar Mantar observatory in Jaipur, India, built by Maharaja Jai Singh II around 1730, shown on a 1947 stamp from Jaipur. Jai Singh built four other observatories, at Delhi, Mathura, Ujjain and Varanasi, but the one at Jaipur was the greatest of all.



Of constellations illustrated on stamps, the Southern Cross and Ursa Major – or, more exactly, the seven stars that make up the Plough or Big Dipper – are predictably the most popular. The Plough's first philatelic appearance came in 1933 on a pair of stamps from Cyrenaica, a province of Libya in the days when that part of north Africa was under Italian control. The stamps commemorated a transatlantic flight led by Italy's air minister, General Italo Balbo, from Italy to Chicago and illustrate how the pointers in the Plough can be used to identify the north pole star (*Figure 5*). On a Japanese stamp from 1953 commemorating the 75th anniversary of Tokyo Observatory, the Plough and Polaris are joined by the W-shape of Cassiopeia in the sky above the open dome of the observatory's main telescope (*Figure 6*).



Figure 5. Cyrenaica 1933

The Big and Little Dippers are shown on this pair of stamps issued in 1933 by Cyrenaica, an area of north Africa that was at that time an Italian colony (now part of Libya). The stamp commemorates a transatlantic flight from Italy to Chicago in a formation of flying boats led by General Italo Balbo.



Figure 6. Japan 1953

The 75th anniversary of the founding of Tokyo Observatory was marked by the release of this Japanese stamp in 1953. Cassiopeia, Polaris, and the Plough form a backdrop to the open dome of the observatory's main telescope, a twin-tube refractor. The observatory moved in 1924 from Tokyo to Mitaka city, 20 km west, and is now the headquarters of the National Observatory of Japan.

About the author. Aside from collecting astronomical stamps, Ian Ridpath is editor of *The Antiquarian Astronomer*, published by the Society for the History of Astronomy, and is a member of the IAU Working Group on Star Names.

Without doubt, the greatest of all pre-1957 astro stamp issues is a set of six celebrating the opening of the Tonantzintla Observatory, Mexico, in 1942 (Figure 7). The set contains five black-and-white photographs of astronomical objects and a graph (the Hertzsprung–Russell diagram). What is not widely realized is that the images are not the work of Tonantzintla, which had not yet started observations, but actually come from the Harvard plate collection (Tonantzintla was established with the help of Harvard College Observatory and its director Harlow Shapley). These were the first stamps to feature real astronomical photographs, rather than engravings. Although they pale by comparison with the full-colour offerings of images from Hubble that have featured on stamps in recent years, they remain a landmark in philatelic as well as astronomical history.



Figure 7. Mexico 1942

This magnificent set of six stamps was released by Mexico in 1942 to mark the inauguration of the Mexican National Astrophysical Observatory at Tonantzintla. Since the observatory had not yet started work, the images actually came from the Harvard plate collection. The subjects and face values are: the Horsehead Nebula in Orion (2 cent); total solar eclipse (5 cent); the Whirlpool Galaxy, M51, in Canes Venatici (10 cent); the Sombrero Galaxy, M104, in Virgo (20 cent); the Ring Nebula, M57, in Lyra (40 cent); and the Hertzsprung-Russell diagram (1 peso). The three highest values were for air mail use.

Members of Commission C3 who would like to know more about these and all other pre-1957 astro stamps are invited to browse my website on <http://www.ianridpath.com/stamps/oldest.html>.

A New Website Devoted to the History of Radio Astronomy in France

James Lequeux

LERMA (Laboratoire d'Études du Rayonnement et de la Matière en Astrophysique et Atmosphères—Laboratory for the Study of Radiation and Matter in Astrophysics) is a research entity operated by CNRS and four higher educational institutions, including the Observatory of Paris (OP), the École normale supérieure (ENS), Université Pierre et Marie Curie (UPMC - Paris 6) and the Université de Cergy-Pontoise (UCP). A new website tells the history of LERMA with a focus on research in radio astronomy in France over the last 70 years, starting with the establishment of the Laboratory of Radioastronomy at the ENS in 1946.

The website—<http://aramis.obspm.fr/~demirm/>—is in French and includes many illustrations, several published for the first time.



East-West interferometer at Nançay at 169 MHz (1st version).

NEWS FROM MEMBERS

BAMBANG HIDAYAT

Indonesian Academy of Sciences

At the end of 2019 I was asked by Professor Othman of Malaysia to speak to an audience of teachers, who were attending a meeting in Johor Bahru, Malaysia. My speech was on “Astronomy as Culture.”

I also wrote the forward to a children’s book on astronomy and nature, *Cerita Anak: Aku dan Alam Semesta (Children’s Stories: I and the Universe)* written by De Laras. The text is in Bahasa (Indonesian).



NHA IL-SEONG

Department of Astronomy-Space Science, Yonsei University, Seoul

My current research project, with Nha Sarah, is the restoration of the old star-maps in three countries (China, Korea, and Japan). We hope to publish at the end of this year or early next year.

Recent publications include reminiscences, “IAU General Assembly Meetings from Patras (1982) to Rio de Janeiro (2009)” in *The Bulletin of the Korean Astronomical Society* (2019). I have edited several books, including *The History of World Calendars and Calendar-Making* (2017) with Wayne Orchiston and F. Richard Stephenson; and *Collections of Annotations of the Science Classic-1* (2019) and *Collections of Annotations of the Science Classic-2* (2020), both with Lee Kye-Soon. (Details of these publications and some chapters I wrote in the books are in the Publications section of this newsletter.)

COSTANTINO SIGISMONDI

International Center for Relativistic Astrophysics, Rome

I bought two books in a flea market in Rome and I decided to give them a new digital life. I worked with high school students from the Technical Institute Galileo Ferraris of Rome to digitize the two, which are hard to find in local libraries. One contained images of Mars drawn by Vincenzo Cerulli (1859-1927) in 1896-1897: “Dessins de Mars exécutés par M. V. Cerulli à l’observatoire de Ceramo,” *Bulletin de la Société Belge d’Astronomie* 3 (1898): 408. We translated this from French into Italian. The other was an essay on comets in history by Guido G. Artom (1868-1926), *Lo Scontro della Cometa* (1910). We transcribed this text and published the digital version in *Gerbertus* 14 (2021). You can see the Cerulli at http://www.icranet.org/index.php?option=com_content&task=view&id=1370 and the Artom at <http://www.icra.it/gerbertus/2021/Gerb-14-2021-totale.pdf>.





WILLIAM LILLER

1 April 1927 – 28 February 2021

Dr. William Liller, formerly of Belmont and Cambridge, MA, and recently of Reñaca, Vina del Mar, Chile, died peacefully in his sleep at 93 years old on February 28, 2021 after a brief illness.

Dr. Liller was born in Philadelphia, PA on April 1, 1927. After his mother passed away, he and his father moved to Atlanta, where his father was a partner in the advertising firm Liller, Neal, Battle.

Always fascinated by the night sky, Bill knew from a very young age that he wanted to be an astronomer. In 1944, after completing high school at Mercersburg Academy in Mercersburg, PA, he attended Harvard University, where he studied astronomy and played on the baseball team. In 1945, his education was interrupted for a year when he was drafted into the Navy and enrolled in the Radio Technician program. Bill received a bachelor's degree in astronomy from Harvard in 1949, and he continued his studies at the University of Michigan, where he received his PhD in 1953. He stayed on at Michigan as an associate professor in astronomy until 1960.

He returned to Harvard in 1960 when he was offered a full professorship and the astronomy departmental chairmanship. Happy to be back at his alma mater, he stayed at Harvard until 1981, and was well-liked by his students and colleagues. During this time, he received several awards for his work including a Guggenheim Fellowship in 1964 and the Robert Wheeler Chair of Applied Astronomy. In 1968, he also appeared as a guest astronomer on the Tonight Show with Johnny Carson, who was an amateur stargazer.

During his career, Dr. Liller was a member of several professional organizations. These included the American Astronomical Society (AAS), the International Astronomical Union (IAU), and the American Association of Variable Star Observers (AAVSO).

In 1968, Dr. Liller became the Master of Adams House at Harvard during the tumultuous times of the late 1960s. He was also instrumental in converting the Harvard house system into coeducation, as Adams House became the first coeducational dorm in 1970. Bill greatly enjoyed the chance to get to know the students outside of the classroom and was often involved in their extra-curricular activities including music, acting in house performances, and playing catcher for the intramural house baseball team. However, he realized that he needed to focus more time on his professional research and resigned as House Master in 1973.

On numerous occasions, Dr. Liller visited the Cerro Tololo Inter-American Observatory in northern Chile to carry out his astronomical research. In 1981, he decided it was time for a change and moved to Chile full-time, as he was offered a job doing research at the Instituto Isaac Newton. He became what he called a “born-again amateur astronomer,” observing from his backyard telescope and discovering the newest objects in the night sky, including two minor planets, a comet, and more than four dozen novae and variable stars. (In addition, the minor planet 3222 Liller was named in his honor.) Finally, he wrote several books and articles focusing on how backyard amateur astronomers could become more involved in the astronomical world.

In 1986, Dr. Liller was sent by NASA to Easter Island to observe Halley's Comet, where he discovered a new passion for archaeoastronomy and the culture and history of the island. He became a member of the Easter Island Foundation, providing resources and expertise in setting up a public library and a research and cultural center on the island. At the time of his death, Dr. Liller was a Director Emeritus of the Foundation.

From an early age, Bill was interested in music, especially classical, and earned almost enough credits to concentrate in music. He also enjoyed making his own instruments, and was most proud of his clavichord, which he brought with him to Chile. He also enjoyed following sports, especially professional tennis and the Boston Red Sox.

Excerpt from the IAU Membership Directory

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JOURNAL CONTENTS

The Antiquarian Astronomer

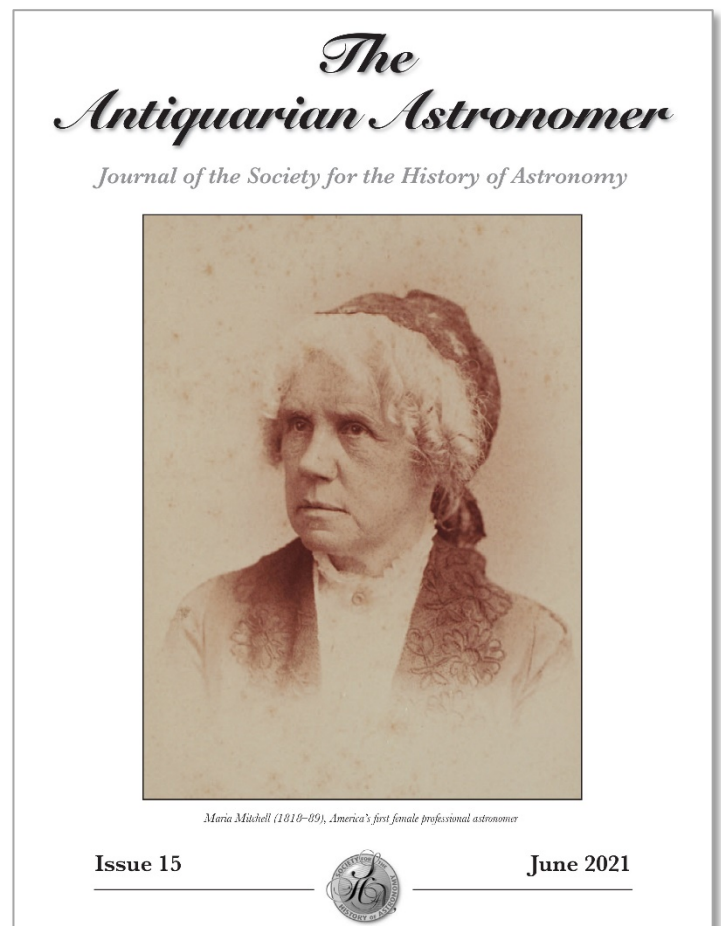
Journal of the Society for the History of Astronomy
Ian Ridpath, Editor

Issue 14, June 2020

- Georges Lemaître and the foundations of Big Bang cosmology
Simon A. Mitton pp. 2–19
- A Victorian amateur in Herefordshire: the life of Henry Cooper Key (1819–79)
Paul A. Haley pp. 20–50
- The story of the Lee Equatorial and Smythian telescopes
Robert Peeling pp. 51–65
- The colours of double stars: an investigation of spectral types and the personal equation
Peter J. T. Morris and William Sheehan pp. 66–76
- The Liverpool Observatory at Waterloo Dock Part 2: Greenwich on the Mersey
Richard E. Schmidt and Paul Dearden pp. 77–108

Issue 15, June 2021

- British radio astronomy's birthplace: Stanley Hey's radio observatory in Richmond Park
Timothy M. M. Baker pp. 2–14
- Popular practical astronomy in late Georgian and early Victorian Birmingham
David J. Bryden pp. 15–27
- Forgotten English astronomers and observatories:
A snapshot of late Georgian astronomy
Kevin L. Jobson pp. 28–39
- Maria Mitchell (1818–89): From Nantucket to Vassar
Paul A. Haley pp. 40–70



Journal of Astronomical History and Heritage

Wayne Orchiston, Co-Founder and Editor

Following is a list of review papers, research papers, and book reviews published in the *Journal of Astronomical History and Heritage (JAHH)* in the first half of 2021. With the March 2021 issue we began producing four issues of *JAHH* per year (instead of three, as previously), to accommodate the increasing number of papers that we receive and to help reduce the time delay between submission of a manuscript and its subsequent publication.

All back issues of the *JAHH*, from Volume 1 (1998) through to the present day are available via <https://www.jahh.org>. This web site also includes a 'Guide for Authors'. All *JAHH* papers also can be downloaded from the NASA / Smithsonian ADS site.

March 2021 Issue

Vol. 24 No. 1

Editorial	2
Papers	
Professor Govind Swarup's contribution to Indian science: the recollections of a non-radio astronomer <i>Arnab Rai Choudhuri</i>	3
William Dawes: practical astronomy on the 'First Fleet' from England to Australia <i>Richard de Grijs and Andrew P. Jacob</i>	7
Sydney's scientific beginnings: William Dawes' observatories in context <i>Richard de Grijs and Andrew P. Jacob</i>	41
An analysis of the golden numbers on the calendar disk on the astronomical clock in Lund <i>Lars Gislén</i>	77
The rise of ultraviolet astronomy in France <i>James Lequeux</i>	83
Comet tales from India: Donati's Comet of 1858 (C/1858 L1 Donati) <i>R.C. Kapoor</i>	98
Observations of the total solar eclipse of 18 August 1868 carried out by Jules Janssen at Guntoor, India <i>Françoise Launay</i>	114
Two proto-science-fiction novels written in French by eighteenth century women <i>Yaël Nazé</i>	125
On the alleged use of Keplerian telescopes in Naples in the 1610s <i>Paolo Del Santo</i>	137
The history of early low frequency radio astronomy in Australia. 10: Shain, Gardner, and Jovian observations made at Fleurs and Potts Hill field stations in Sydney during 1955–1956	141

Wayne Orchiston, Martin George, Harry Wendt and Richard Wielebinski

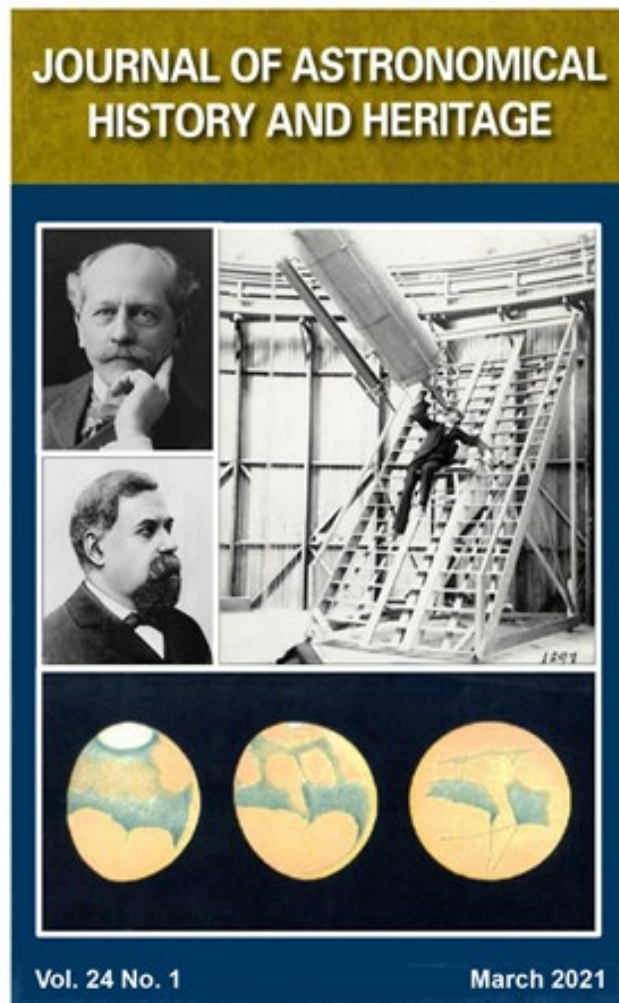
- Diameters (*bimbas*) of the Sun, Moon and Earth's shadow-cone in Indian astronomical texts, with special reference to the *Makarandasāriṇī* and the *Ganakānanda* 159
S.K. Uma, Padmaja Venugopal, K. Rupa and S. Balachandra Rao

From the Archives

- A complicated relationship: an introduction to the correspondence between Percival Lowell and Giovanni Virginio Schiaparelli 170
Jennifer Putnam and William Sheehan

Book Reviews

- On Trial for Reason: Science, Religion & Culture in the Galileo Affair*, by Maurice Finocchiaro 228
Clifford Cunningham
- On the Life of Galileo: Viviani's Historical Account and other Early Biographies*, edited by Stefano Gattei 228
Clifford Cunningham
- Where Have all the Heavens Gone?: Galileo's Letter to the Grand Duchess Christina*, edited by John P. McCarthy and Edmondo F. Lupieri 228
Clifford Cunningham
- What Stars Are Made Of: The Life of Cecilia Payne-Gaposchkin*, by Donovan Moore 230
David Whelan
- Portrait of a Binary*, by Sylvia L. Boyd 230
David Whelan
- Astronomy of the Inca Empire: Use and Significance of the Sun and the Night Sky*, by Steven R. Gullberg 233
Bruce Love
- Keeping Watch in Babylon: The Astronomical Diaries in Context*, edited by Johannes Haubold, John Steele and Kathryn Stevens 234
Clifford Cunningham
- Festschrift – Proceedings of the Christoph J. Scriba Memorial Meeting – History of Mathematics* (Nuncius Hamburgensis; Bd. 36), edited by Gudrun Wolfschmidt 236
Katharina Habermann
- Early Greek Philosophies of Nature*, by Andrew Gregory. 237
Clifford Cunningham
- The Shogun's Silver Telescope: God, Art, and Money in the English Quest for Japan, 1600–1625*, by Timon Screech. 239
Christopher M. Graney
- Ptolemy's Philosophy: Mathematics as a way of life, by Jacqueline Feke. 241
Clifford Cunningham



June 2021 Issue

Vol. 24 No. 2

Papers

Interferometry and monochromatic imaging at Marseille Observatory <i>Yvon Georgelin and James Lequeux</i>	247
Time signals for mariners in South Africa <i>Roger Kinns</i>	285
Time signals for mariners in the Atlantic Islands and West Africa <i>Roger Kinns</i>	315
Where was mean solar time first adopted?	337

Simone Bianchi

The Seven Sisters: a Pleiades cantata <i>Clifford J. Cunningham and Barbara Bacik Case</i>	345
Ragoonatha Charry and the observations of the total solar eclipse of 1868 from Vanpurthy (Wanparthy), India <i>T.V. Venkateswaran</i>	363
King Rama IV, Sir Harry Ord and the total solar eclipse of 18 August 1868: power, politics and astronomy <i>Wayne Orchiston and Darunee Lingling Orchiston</i>	389
European longitude prizes. 2: Astronomy, religion and engineering solutions in the Dutch Republic <i>Richard de Grijs</i>	405
Unified dating analysis of ancient star maps and catalogs in Asia <i>Tsuko Nakamura</i>	440
Australian eclipses: the Western Australian eclipse of 1974 and the East Coast eclipse of 1976 <i>Nick Lomb</i>	475
Show-casing seventeenth-century Jesuit astronomy in Asia: the lead-up to the first scientific observations of a solar eclipse carried out in Siam <i>Wayne Orchiston, Darunee Lingling Orchiston, Lars Gislén, Martin George, Boonrucksar Soonthornthum, Françoise Launay, Suzanne Débarbat and Matthieu Husson</i>	498
Karl Schwarzschild, Annie J. Cannon and Cornelis Easton: the honorary PhDs of Jacobus C. Kapteyn <i>Pieter C. van der Kruit</i>	521

Book Reviews

<i>Chinese Astrology and Astronomy: An Outside History</i> , by Jiang Xiaoyuan <i>David Pankenier</i>	544
<i>Heaven on Earth: How Copernicus, Brahe, Kepler and Galileo Discovered the Modern World</i> , by L.S. Fauber <i>Clifford Cunningham</i>	545
<i>Internationality in the Astronomical Research of the 18th to 20th Centuries</i> , edited by G. Wolfschmidt <i>Andreas Schrimpf</i>	546
<i>Leopolis Scientifica. Science in Lviv till the Middle of the XX Century</i> , edited by Oleh Petruk <i>Volodymyr Pelykh and Roman Plyatsko</i>	548
<i>The Light Ages: The Surprising Story of Medieval Science</i> , by Seb Falk <i>Marion Dolan</i>	549
<i>Mars</i> , by Stephen O'Meara <i>Clifford Cunningham</i>	552
<i>The Sky Atlas</i> , by Edward Brooke-Hitching <i>Clifford Cunningham</i>	554

<i>Star Maps, History, Artistry, and Cartography (Third Edition)</i> , by Nick Kanas <i>Clifford Cunningham</i>	554
<i>Celestial Atlas: A Journey in the Sky Through Maps</i> , by Elena Percivaldi <i>Clifford Cunningham</i>	554
<i>Storočia Astronómie v Prešove</i> , edited by Renáta Kolivošková <i>Martin Vaňko</i>	556
<i>The Mythology of the Night Sky: Greek, Roman and Other Celestial Lore</i> , by David Falkner <i>Clifford Cunningham</i>	558
<i>Astronomical Myths: Based on Flammarion's "History of the Heavens"</i> , by John F. Blake <i>Clifford Cunningham</i>	558
<i>The Birth of Modern Astronomy</i> , by Harm J. Habing <i>Robert W. Smith</i>	559

