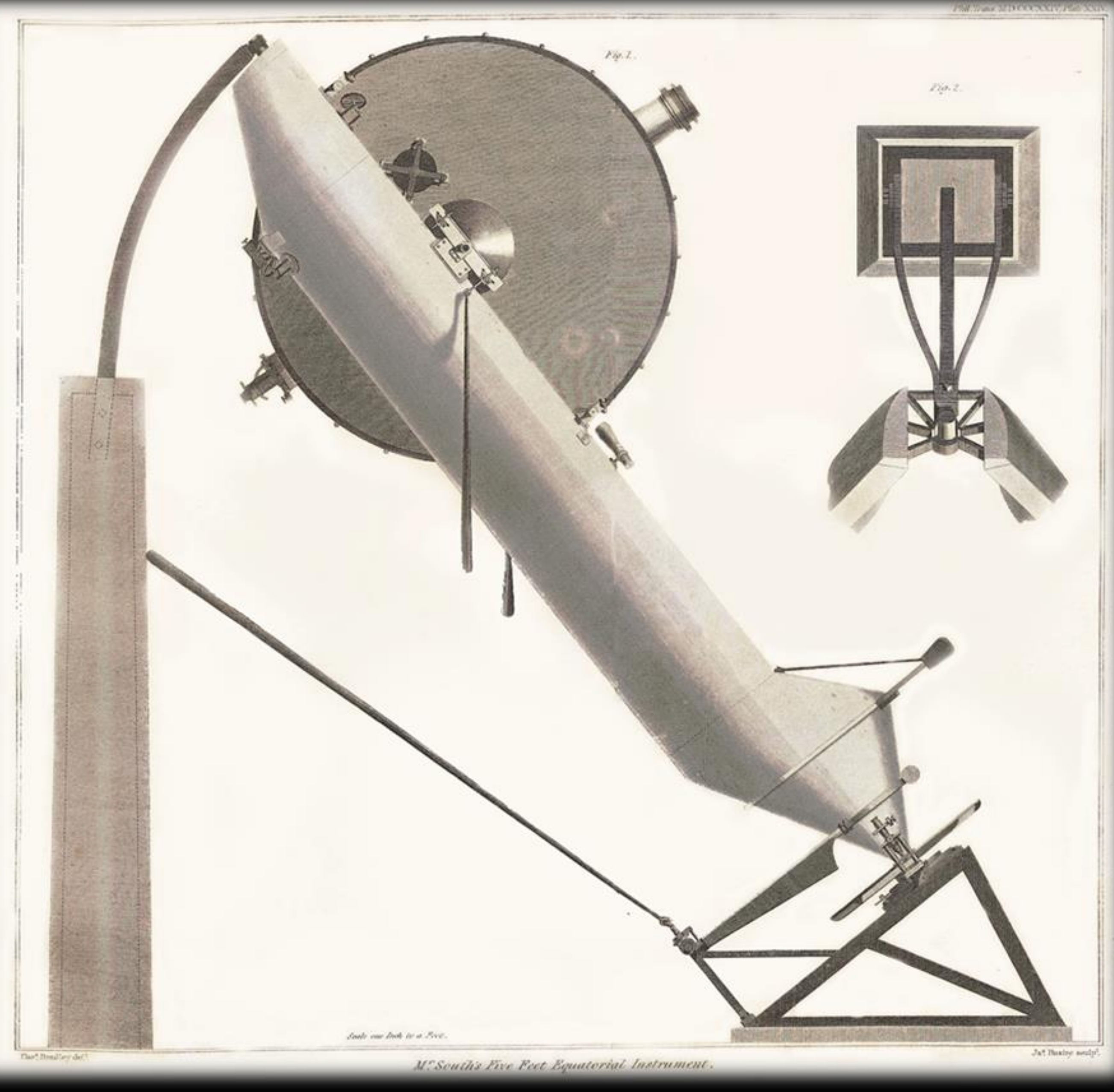
BULLETIN

ISSUE 33 SPRING 2020



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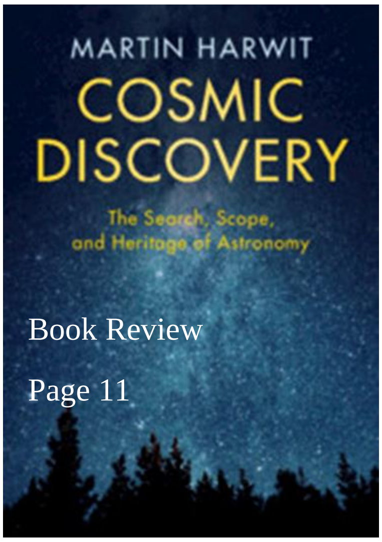
The Bulletin for the Society for the History of Astronomy

SEE THE BACK PAGE FOR THE FULL DETAILS OF THE SPRING CONFERANCE



Sidney Bertram Gaythorpe 1880-1964
With permission of Cumbria Archive Centre, Barrow
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Pulkovo Observatory - Russia

Editorial

When I offered to take on the role of co-editor of the SHA Bulletin last November, I wasn't quite sure what I was letting myself in for. Len Adam and Carolyn Kennett had set such a high benchmark that to take over from him, while he concentrated on his own astronomical observations and writing, was a task for which I had little experience. Editing submitted articles didn't seem problematical but after discussing the requirements with others at the subsequent Council meeting, particularly the recommendation for me to compile and assemble the layout using unfamiliar, professional-standard, publishing software and then get the next edition printed locally, it suddenly seemed a much more daunting job.

However, I set about recruiting a printing company local to me here in north Staffordshire. After meeting with one that I already knew in Leek and being assured they could to the job at a reasonable cost, I fell at the next hurdle; they couldn't handle the packaging and distribution; in itself no small task with a growing SHA membership in the UK and overseas. No matter, a trawl on the Web brought up several more printers on this side of the Potteries who could do the work. I phoned or went to see them; one in particular looked good and also agreed to show me the basics of page layout suitable for his requirements. The snag was the cost. By then, Len had advised how much his printer had charged SHA and unfortunately none of the printers I'd spoken with could match the price, all being out by two or three hundred pounds for even a 40-48 page Bulletin let alone the 68 page one like the last, Issue 32, Autumn 2019.

So, back to the drawing board and discussions on the phone and many e-mails with Carolyn. In her job she uses the services of a printer down in Cornwall so we agreed that I would concentrate on the editing and page layout of incoming articles in Microsoft Word, rather than using more sophisticated publishing software and she would do the final layout of the Bulletin, convert it to a pdf and submit it for printing and distribution via her local printer. From then on, all things ran smoothly.

And that's how Bulletin 33 Spring 2020, has come about. A final meeting at the SHA library, at the BMI on Monday 17 February to agree the end pages and cover design and we were good to go.

Bulletin 33 relies heavily on the established layout of previous issues but from the outset, although we had no intention of re-inventing the wheel, we felt that it needed rounding off a little smoother. For instance, we agreed to standardise the main headings and the body text on Times New Roman font, 26pt for the headings and 10pt for the main text. The long term effect, we hope, is to make the Bulletin leaner and cleaner; this issue is but a start. We hope you like the result but any comments, yeah or nay, would be most welcome. We have already spotted one or two small changes for next time.

For now, our thanks go to the SHA Council for their support but especially to Len Adam for his sage advice on publishing this magazine and for his sterling work in co-editing and publishing previous issues.

As always, we rely on you, the SHA Members to provide us with material, articles and pictures, reflecting your interest and research into the history of astronomy.

Bulletin Editors Kevin Kilburn and Carolyn Kennett, March 2020.

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SAVE THE DATE: 20th June 2020

SUMMER PICNIC AT LACOCK ABBEY

Once home of William Henry Fox Talbot

The SHA Autumn Conference 2019

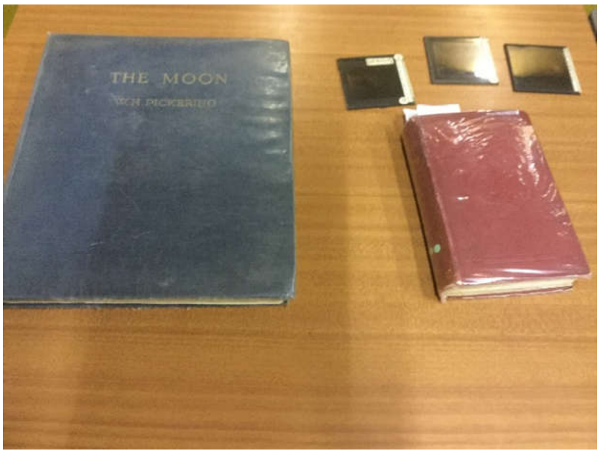
The Society for the History of Astronomy Moon-themed Autumn Conference and AGM was held on a wet and windy Saturday, 26th October 2019, at our usual venue, the Birmingham Midland Institute.

SHA chairman, Gerard Gilligan opened the meeting with a touching speech about Stuart Williams who had sadly passed away on 15th October. Stuart had been a cornerstone of the early society and with Allan Chapman had been influential in getting the society started. He will be greatly missed, especially by those who worked with him to establish the SHA in the year or so before the Founding meeting at Wadham College Oxford in June 2002.

At the AGM, all returning officers to Council were unanimously reinstated and Gerard gave his thanks for another successful year, particularly mentioning the Oxford Spring Conference which had been a highlight for many of the members in April 2019. Prizes were awarded as follows: The Peter Hingley award was presented to Carolyn Bedwell for all her hard work with the library and The Roger Jones award for survey contributions went to Bill Barton for his continued submissions to the survey. The next AGM will be held at the BMI Birmingham on 24th October 2020.

Mike Frost, the BAA Historical Section Director, told the audience that they have a new obituary section of BAA members available on the BAA website. See https://britastro.org/node/1616732 Many of our SHA members will find this an excellent resource.

The venue for the BAA 2020 Historical Section meeting will be confirmed soon but is likely to be at the BMI in Birmingham. The final news from Mike was that that Lee McDonald is stepping down as deputy director of the BAA Historical Section and SHA member, Bill Barton, is assuming the role.



During a short interlude, Eddie Carpenter showed the delegates several lunar themed items he had brought with him. Firstly there was 'The First Moon Atlas' by William Henry Pickering which can be viewed online https://archive.org/details/moonsummaryofexi00pickuoft. This book was published in 1902 and all the images included were taken in the late 1800's. The second book was 'The Moon' by Richard A. Proctor. Eddie's edition was very special as his was one of the first ten printed, which includes three real and not printed photographs of the Moon taken by Rutherford in 1856. Eddie finally brought some lantern slides of the Moon plus some glass plates of the Moon and some stereographic images and stereo glasses with which to view them. These interesting contributions can be seen in the image above.

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Our first speaker was Heather Sebire, an archaeologist and Senior Property Curator at the Stonehenge World Heritage Site, with a talk entitled 'Stonehenge, Archaeoastronomy and the Moon'.

Prehistory and astronomy at Stonehenge has played a huge part in the wider discipline of archaeoastronomy. William Stukeley was the first to acknowledge the alignment with the Sun between the circle and the Heel stone, at the Summer Solstice in 1724, and Norman Lockyer published his work on astronomy and the circle in 1909. Later work was undertaken in the mid 20th Century by Alexander Thom, Fred Hoyle (1977), Gerard Hawkins and most recently by Prof Clive Ruggles. The circle sits in a wide and complex landscape from which monumental remains date through a highly complex timeline extending back at least five millennia. The Curses and long barrows date from the early Neolithic, when the first farmers came to the UK, whereas the circle and avenue were built in a slightly later period. In the final stage several barrows were added by an even later population who brought metal working with them.

The circle is made up of an outer ring of Blue stones which were transported from Wales and an inner ring of capped, much larger sandstone Sarsens.

3D scanning has shown that every stone was worked to a high standard; a Temple to the people who used the site. Acoustic investigation has shown that the Blue stones 'ring' when struck. Regarding its famed solsticial alignment, it seems that the mid-winter sight line was the most important and we were shown several images of this in practice. The Heel stone may have had a partner which together would have initially framed the rising Sun. Nowadays, because of the changing obliquity of the ecliptic during the past four and a half thousand years the Sun appears to rise over the remaining right-hand Heel stone. Four station stones in the ring ditch predate the stone circle, forming a rectangle and creating sight lines for the lunar standstill positions; there are a number of cremated remains on one of the lunar standstill sightlines which may have been placed while a period of standstill was in action. All the astronomy sight lines, including the lunar ones, are now protected. The Stonehenge visitor centre has a new skyscape feature, which means you can view the sky at Stonehenge all year round:

See https://www.stonehengeskyscape.co.uk

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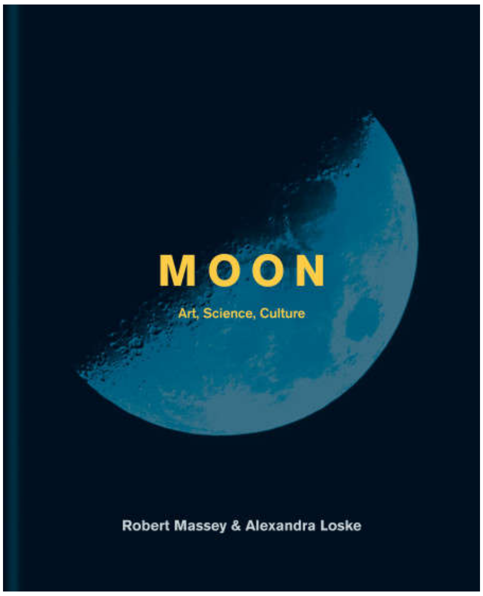
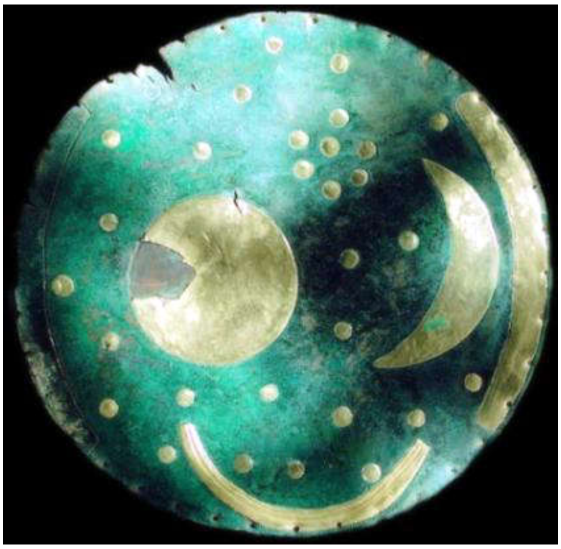
The next presentation of the morning session was given by Alexandra Loske and Robert Massey on the theme of their recent book 'Moon: Art, Science, Culture'.



We were treated to a wonderful visual history of the Moon and what it meant to artists and how this work overlapped with science. The Moon has been depicted from the earliest prehistory, with lunar phases being drawn on the walls of the Lascaux caves of the Dordogne, dated up to 20,000years ago.

The enigmatic Bronze Age Nebra sky disc was shown and described next. Discovered as recently as 1999, this wonderful object from the Halle Museum in Germany will be making a trip to the UK for the British Museum Bronze Age exhibition in 2021. It has a UK connection as all the tin and gold in the object came from Cornwall.



In the modern age, Jan Van Eyck's painting, *The Crucifixion,* c1440, shows one of the first real depictions of the lunar surface in a correct phase, a waning gibbous moon hovering over Calvary as Jesus is pierced with a lance. But it was Englishman, William Gilbert who produced the first real attempt to depict the moon accurately as seen with the naked eye in his drawing of 1603, just before the telescope came into use. The telescope transformed our relationship with the Moon with work by both Thomas Harriot and Galileo Galilei both drawing very early sketches of the Moon. By the 18th century the Lunar Society was formed, and people travelled to meetings under the Full Moon. Caspar David Friedrich regularly uses the Moon as a centre piece for his images in the 19th century. Steeped in symbolism he sets his paintings in a Sublime landscape with human figures often with their backs turned and off to one side, drawing the eye in to the Moon itself. By the late 19th Century photography started to transform our relationship with the Moon and new accounts of journeys into space were written by Jules Verne and H.G. Wells. They introduced the spacecraft as a believable object. It was only one year later after H.G. Wells book that there was the first moving image of the Moon by George Méliès. Another influential film 'Frau im Mond' (Women in the Moon) was one of the final silent films on the cinema. The film premiered on 15th October 1929 and features wonderful ideas such as multistage rockets and invented the countdown to liftoff. Finally, Robert and Alexandra spoke at length about the Apollo missions, talking about how science has come on to change the space program and how the visits to the Moon gave us a greater understanding of the formation of the Solar System.

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After the lunch break Prof Bill Leatherbarrow, Director of the BAA's Lunar Section, introduced us to 'Patrick Moore and our Volcanic Moon'.

Bill reminisced with fondness how Patrick would always say 'once a moon man - always a moon man' even at the most inappropriate moments. Patrick's first love was the Moon and he wrote over 100 books on the subject. He was one of the BBC's reporters covering the Apollo missions but he was principally known as the presenter, since April 1957, of the BBC Sky at Night monthly TV programme. His first and his last submissions to the British Astronomical Association were also about the Moon. The first was published in 1946 and was about craters on the Moon.

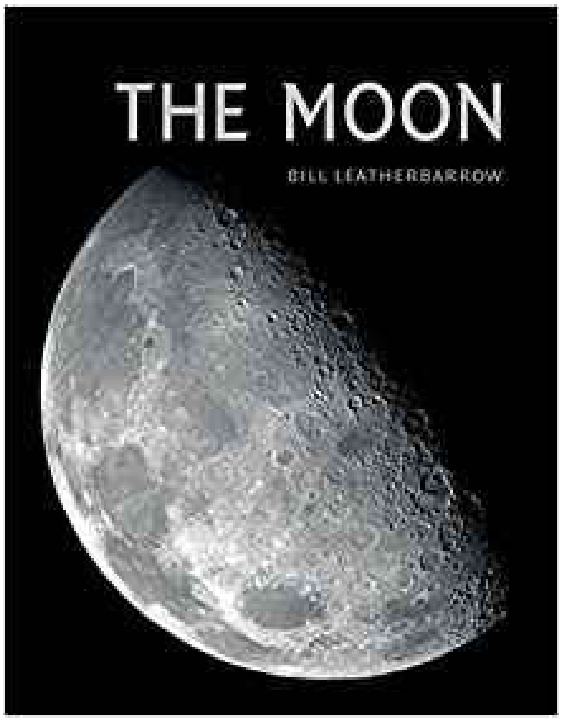
Nearly all his life, until mounting evidence to the contrary following the Apollo moon landings, he felt that the craters on the Moon were to do with volcanic activity, rather than bombardment from outer space. He clung to this theory for much of his life, even though Ralph Baldwin published with his now proven, meteor impact theory in 1949. Patrick was convinced he was correct and that through a telescope he could see evidence of volcanism. The first piece of his argument was that the craters were all round, as might be expected if volcanic. (This has been debunked; astronomical impacts are also explosive events involving a high amount of kinetic energy at the point of impact and leaving a round crater.)

Patrick claimed that moon-wide crater distribution showed chains of volcanos. He also said that many small peaks had craters on the top and these were likely to be volcanic vents. In his view, mountain tops were an improbable target for impacts and he felt that this was too obvious a target and should not happen. (This is actually due to lighting and the position of the Sun. These mountain top craters when imaged in more detail were found to be illusory). Finally, he claimed that you could not expect all the big impacts to come first and the smaller ones second. Patrick was a great friend with his BAA Lunar Section Director predecessor, H.P. Wilkins who was also a great advocate of the crater/volcano theory. He was probably heavily influenced by this man in this instance during his early work as a lunar observer.

Volcanism offered the exciting prospect that some events could still happen, whereas the impact crater theory implied something historical and perhaps of less interest to an active observer of the Moon. Patrick would be passionate about transient lunar phenomena (TLPs) all his life and in 1968 co-authored a NASA Technical Report, TR R-277, a Chronological Catalogue of Reported Lunar Events, listing transient events observed and recorded since the 16th Century.

It is now known that although the Moon has indeed witnessed volcanism but it would not have lasted for a long period in its history due to the rapid loss of internal heat because of its relatively small size and mass. The bright, heavily-cratered areas of the lunar highlands, pock-marked with more recent bright-rayed impact craters, are the original crust of the Moon dating from 4.4 billion years ago. The dark 'seas' come from a later period of heavy bombardment by very large impactors followed by a much later process of volcanism when magma flooded impact basins as recently as 2.5 billion years ago. There are a few volcanic craters, such as the

Hyginus formation with its associated rille of volcanic craterlets but these have no rims and are surrounded by dark volcanic ejecta. Bill's 2018 book 'The Moon', published by Reaktion Books in their new Kosmos series was reviewed in the Autumn 2018 Bulletin 30 and recommended.



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Next, Melanie Vandenbrouck and Louise Devoy spoke about the current Moon exhibition at the Royal Museum Greenwich.

The exhibition explores our historical relationship with the moon through Science, Humanities and the Arts. They looked at collections within the UK and the Smithsonian and from 700 objects they selected 180 to feature in the four-room exhibit. The whole exhibition was five years in the making. The exhibition opens with a tiny etching, 'I Want!, I Want!', by William Blake 1793 depicting a figure about to climb a ladder to the moon. This, they felt, mirrored our dreams and aspirations of our relationship with the moon which has been a constant companion, timekeeper and often spiritual object permeating all cultures during all periods throughout history.

The first exhibition area looks at how we have observed the moon, it houses everything from a Babylonian tablet describing a lunar eclipse to an astrolabe, dismantled to show its interior workings, which has a section capable of demonstrating the lunar phases. This astrolabe has one of the oldest geared systems in the world. The room also shows how we have connected to the moon through religions such as the Hindu god Chandra.

The second area of the exhibition looks at how our idea of the moon was transformed by the invention of the telescope. It includes a 20-inch telescope, so large that it had to be placed in the room and then the rest of the exhibition built around it. The collection includes how important developments in selenography were made following the introduction of photography and how lantern slide lectures brought this to the masses.

Area three is called 'Destination Moon' this looks at both fictional and actual travel to the moon. It explores how science and the arts have worked together such as in Fritz Lang's 1929 film 'Frau im Mond' (Woman in the Moon).. This room also shows how popular culture gets in on the act with clothes and designs which include lunar themes. The number of people who were involved with the space race and the launch of the Moon missions are commemorated with several images. The power of lunar imaging during the pre-Apollo days is recognized. The US program took over 32,000 pictures whereas the less well remembered Russian missions took very few. The final section, 'For all Mankind?' reflects on what's happened since the Atlas program was cancelled. Topics such as 'who owns the Moon?' are explored, it also looks at when we are going back and what science may be able to learn from a return to the Moon. The final object in the exhibition is the iconic photograph of Earthrise taken by the crew of Apollo 8 prior to returning from the first flyby loop around the moon, Christmas 1968, which acts as a mirror and reflects our dreams, passions and desires.

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The concluding talk was by the SHA President Allan Chapman entitled ‘The Moon, the Telescope and the Transformation of Astronomy after 1609’. Allan opened his talk with condolences over the sad loss of Stuart Williams and remembered his great contribution to the Society in its early years.

Allan began by showing an image of the moon drawn by Thomas Harriot, dated 1609 July 26th at 9pm in the evening. The image is very special as it not only is the first sketch of the moon through a telescope but, unusually, it has the specific time of the observation on it. The moon was just five days old and Harriot’s drawing totally overthrew all earlier ideas. Until then, the Moon had been regarded as a smooth celestial body demonstrating the perfection which the Catholic Church in Rome endowed on all God’s heavenly creations

By comparison with the previously accepted notion, Harriet sketched a jagged terminator, rough, not smooth, and much more akin to the mountains and plains on Earth. Had Harriot published his findings they would have preceded Galileo’s later telescopic observations by several months, and would have set a precedence for future observations. So why did he not publish? Allan explained there are several reasons: unlike Galileo, Harriot was a rich man; he was a mathematician and an astronomer. He had lands in Ireland, in the north of the UK and an annual income of £200 and with friends in high places. That was the problem. The political situation in England was volatile. Just four years before, his friend Lord Henry Percy had been imprisoned in the Tower in 1605 because of his tenuous association with perpetrators of the Gunpowder Plot, Another friend, the explorer Sir Walter Raleigh had also been imprisoned in the Tower. (Harriot had travelled to the New World in the 1585 expedition to Roanoke Island, funded by Raleigh.) Harriot was not looking for fame as he had also spent some time in the Tower so in 1609 it was perhaps safer for him to keep a low profile. He died in 1621, aged about 61.

His papers, including his drawing of the moon, were not discovered until 1784, in the Petworth House

archives, and showed that Galileo was not the first to draw the Moon as his drawing came on November 30th, 1609 some four months after Harriot’s. Galileo published quickly in 1610, he wanted money and fame, but in doing so he struggled to adjust to the higher society circles and rubbed a lot of important people up the wrong way, which got him into trouble.

(It wasn’t until 31st October 1992 that Pope John Paul II acknowledged that the Roman Catholic Church had erred in condemning Galileo 359 years before for asserting that the earth revolves around the sun.)

The use of the telescope at the beginning of the 17th Century was the first time that one of our five senses became enhanced. The telescope opened up other researchers to the observation and the description of the moon.

The Polish Astronomer, Johannes Hevelius, was also a rich man (from the brewery industry) and interested in astronomy. He drew the phases of the Moon in 1640, the craters in 1645 and this developed into the first lunar atlas.

The Rev. Dr John Wilkins from Wadham College Oxford thought that we might soon be able to fly to the Moon and, what's more, it may be inhabited.

The telescope was allowing people to see objects in the sky as worlds for the first time. Robert Hooke would work with Wilkins and they would build mini flying machines with spring motors, these are most likely the first flying machines ever constructed. They thought that they just needed to upscale the model and they could then travel to the Moon. By 1672, Wilkins knew it was impossible to travel to the Moon as Boyle had by then shown that 'space' would not be breathable by making and experimenting with a vacuum in his laboratory experiments at the Royal Society.

Robert Hooke also devised an idea about a telescope with a ½ mile focal length from which he felt one could observe the surface of the Moon as clearly as you could see sheep on Salisbury plain. By 1665 he starts to discuss the structure of lunar surface in his book 'Micrographia', also prompted by another new invention that enhanced the senses, the microscope

Allan rounded off his talk with the Great Moon Hoax , attributed to Richard Adams Locke in a series of six articles published in *The Sun*, a New York newspaper, beginning on August 25, 1835, about the supposed discovery of life and even civilization on the Moon, allegedly made by Sir John Herschel. This showed that people were still not looking at the Moon in any detail. This would come later with a great chart of the Moon by Dr John Lee and early photography. More about the Great Moon Hoax can be read in SHA Bulletin 32 written by Carolyn Bedwell.

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Speakers L-R: Heather Sebrine, Allan Chapman, Melanie Vandenbrouck and Louise Devoy, Alexandra Loske, Robert Massey and Bill Leatherbarrow.

We wish to thank all the attendees, more than 70 of them, and speakers who had to battle through less than ideal travel conditions and inclement weather to reach the conference.

Thanks also to James Dawson and his helpers for the always fascinating book stall.

Carolyn Kennett

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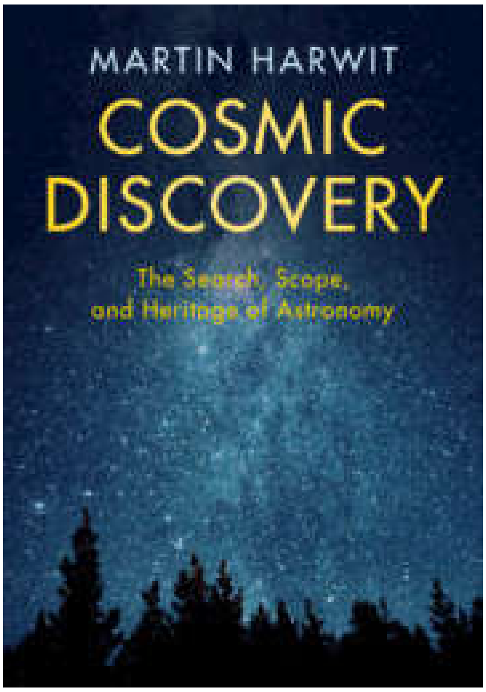
Book Review: Cosmic Discovery; The Search, Scope, and Heritage of Astronomy.

Martin Harwit, Cambridge University Press. March 2019. ISBN: 978-1-108-72204-9. Pp348. Abt £25 (Pb)

Reviewed by John Chuter



Martin Harwit is Emeritus Professor at Cornell University and served for many years as Director of the National Air and Space Museum in Washington DC. This book is a re-release after an original publication in 1981. Other than a short new preface this is essentially the same book. I had not realised this after deciding to do this review and wondered whether it still had relevance after such a long gap.

Michael Hoskin, a name known to many reading this, as a vice president of SHA, reviewed the book in 1983 for 'Science History Publications'. He regarded it as '.a highly original work.'. Whilst he took issue with the recruitment of certain aspects of astronomical history, he also acknowledged that 'none of this discredits the very important argumentation of the book, and the general remarks about the pace of astronomical discovery and the role in this of new instrumentation…'

Since 1983 we have had, as examples, The Hubble Telescope, The Compton Gamma Ray Observatory, The Keck Observatory, The Herschel Infrared Observatory and numbers of other large optical ground-based and space telescopes with the James Webb Telescope due, hopefully, in 2021. In each of these cases many astronomical questions have been answered, but perhaps more importantly, new questions have been posed.

In an interview for 'Physics Today' in 2014, Harwit was asked why he had written the book, 'I wanted to dispel two mystiques. The first was that advances in astrophysics came about as a result of theoretical insight; the second was that further advances would require the building of ever-larger optical telescopes. The only way I could show that neither was relevant was to document the [often] surprising discoveries brought about by small radio, infrared, x-ray, and gamma-ray telescopes. Neither theory nor large optical telescopes had delivered anything like these novel technologies. I think he has been shown to be right.

The book is more about how astronomical discoveries are made rather than what they are. He uses astronomical history to explore the philosophy behind this quest and, also the politics which then, as now, involves finances and the persuading of politicians, with usually more parochial interests, to part with the sums required.

There are five chapters. In essence, the first chapter, entitled 'The Search', could be read as a standalone essay, which is how it is described, with the final four chapters going into far more detail about the ideas presented. The four chapters are: Discoveries; Observation; Detection, Recognition, and Classification of Cosmic Phenomena; and The fringes of Legitimacy - The need for Enlightened Planning. There are two technical appendices on 'The Number of Undetected Species' and 'Information, Capacity and Information Rates', extensive chapter references, bibliographic notes and a glossary/index.

As a mathematician by training, I was fascinated by the analysis of the number of cosmological phenomena that have been discovered and those that are yet to be discovered. Notwithstanding Hoskins' comments, Harwit has described 43. These are listed in a table and include discrete items such as planets, asteroids, moons, various types of stars and nebulae etc. Harwit uses statistics and other techniques to show that this is probably only, at worst, a third, or, at best a half of the total number of cosmic phenomena yet to be discovered. Indeed, there is still plenty for future generations to discover and we need to make sure they can do so.
I pondered in the first paragraph whether the book still has relevance. I would say yes if you are interested in the 'why' and 'how', as well as the 'what' of astronomical or cosmic discoveries. Whether you wish to pay the price of this new book or seek a perhaps cheaper copy elsewhere, is a decision only you can make.

Here is a link to the review of the original edition by Michael Hoskins
http://articles.adsabs.harvard.edu/full/seri/JHA../0014//0000064.000.html

Edward Crossley, Bermerside Observatory and the Crossley Reflector.

Denis Buczynski

The history of the Crossley reflector at Lick Observatory is well known. This short document was compiled after a visit to Halifax in West Yorkshire in England, during which I visited Dean Clough Mills, which was once the world's largest carpet factory, owned and operated by the Crossley family.

While still a teenager, Edward Crossley followed his father and two uncles into the successful family business and when aged only 27, he inherited the textile mills of J.P. Crossley and Sons in Halifax, which by 1879 was the largest carpet manufacturer in the world, largely because of their pioneering development of steam powered looms and the fact that all their manufacturing processes, from raw materials through to finished carpets was on the same site, Dean Clough Mill. Carpets manufactured here were sold all over the world. Other interests and investments, including the Crossley Carpets Works Band, Dean Clough Library, and coal mines at Sharlston and Snydale in West Yorkshire and at Wragby in Lincolnshire. Crossley's even had cotton plantations in Louisiana.

Crossley's carpet manufactory was a major contributor to the life and economy of northern England between 1621 and the closure of the company in 1989. Carpet manufacture is still a major industry in the area.

Fig. 1. Dean Clough Mill as it is today, now a 22 acre community centre with, a hotel, leisure and arts facilities, shopping and restaurants situated on the edge of Halifax town cen

Edward Crossley was Mayor of Halifax 1874-76 and 1884-85. He curtailed his involvement in the family business when he became a Member of Parliament in 1885 but increasingly poor health forced him to give up this calling in 1892, and he died suddenly on 21 January 1905.

Fig 2. Edward Crossley

In the astronomical community, Edward Crossley is perhaps better known as a keen observer of double stars in the tradition of the 'Grand Amateur'. Between 1867 and 1872 his originally small observatory at his home, *Bermerside*, Skircoat Green, about 2km south of Halifax town centre, was equipped with a 9.33-inch Cooke achromatic refractor, a 3½" Cooke transit, eyepiece micrometers, and a Grubb clock. He employed Joseph Gledhill as his full-time observer, 1869-1905, to make observations of double stars, star occultations and the planets. With Gledhill and James Maurice Wilson, Crossley was author of *A Handbook of Double Stars* (London 1879).

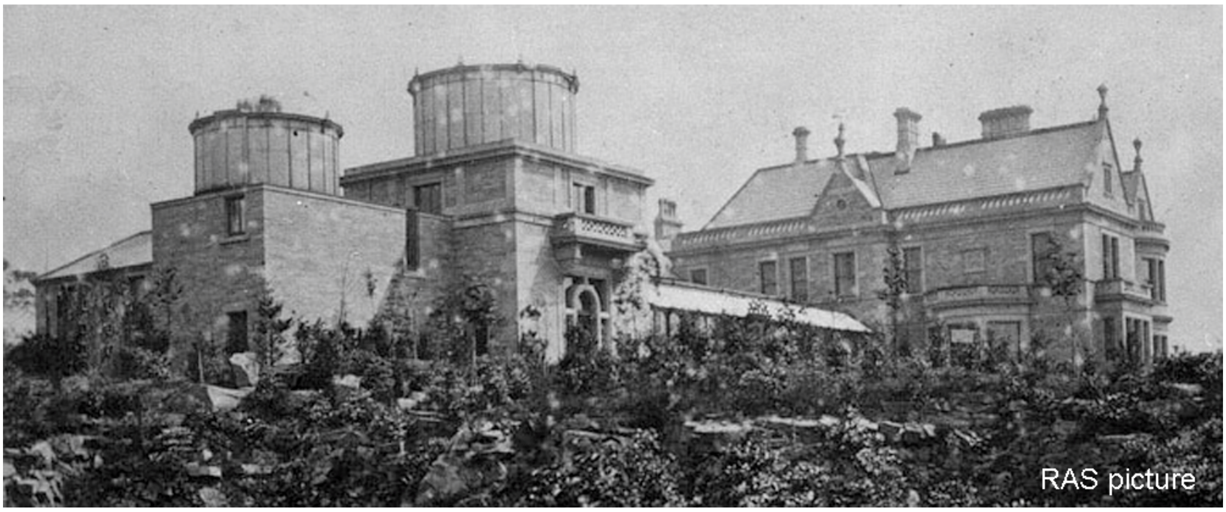


Fig 3. The observatory and Crossley's house, Bermerside

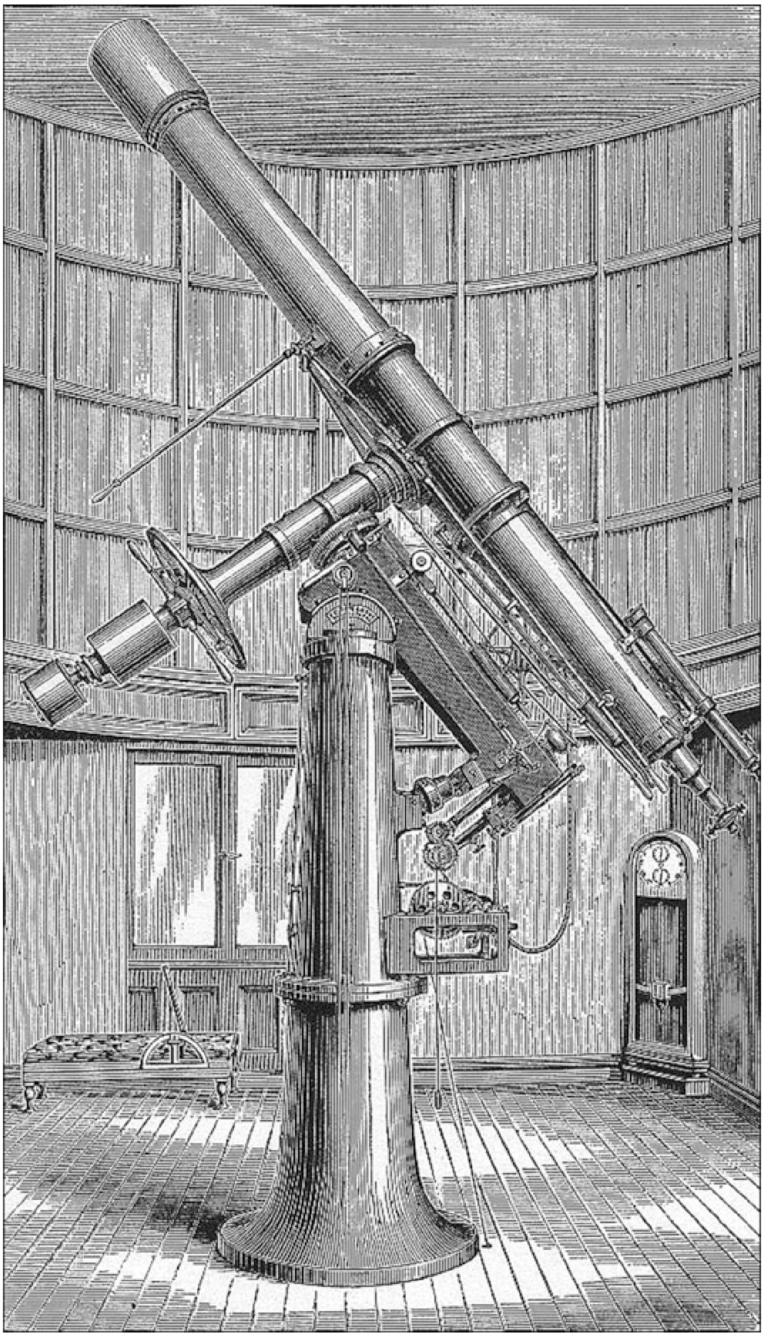
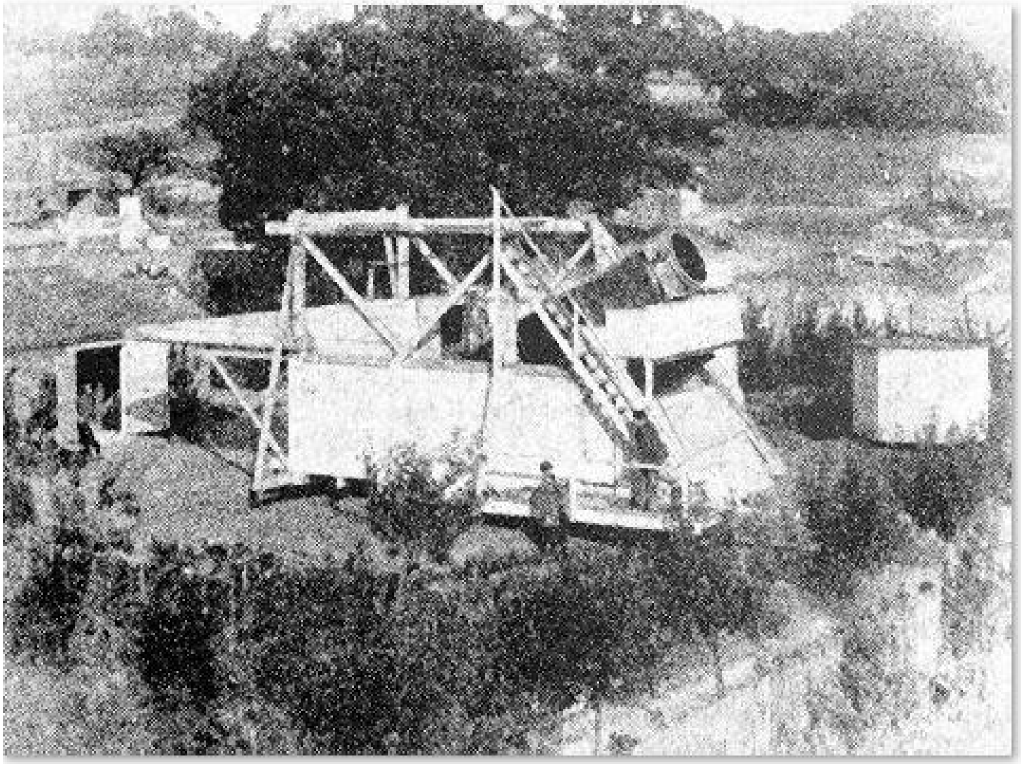


Fig 4. The 9.33-inch achromatic refractor c1887

In 1896 Crossley and Gledhill replaced the original lens with a new 9-inch Cooke photovisual objective. After Crossley died in 1905 this refractor was purchased by the Reverend Dr David Kennedy and installed in an observatory near Napier, New Zealand. In 1926 the Wellington City Corporation purchased the telescope and installed it in an observatory close to the centre of the national capital.

In 1885 he acquired the 36 inch reflector, originally constructed by Ainsley .A. Common, with the main silver-on-glass mirror by George Calver of Chelmsford, Essex. To minimise convective currents from the metal telescope mounting, the mirror was placed above the declination axis within a lightweight open framework supported on an equatorial mounting. The open tube was counterweighted beneath the declination axis. The polar axis was partially



floated in mercury to reduce friction. The telescope was originally erected at his observatory in Ealing. London.

Fig. 4. Common's 3-foot reflector in the garden of his home in Ealing. A.A Common is standing at the foot of the ladder. Circular tracks allowed the rotation of the entire structure.

Ainslie Common FRS was an English amateur astronomer best known for his pioneering work in astrophotography. He was born in Newcastle upon Tyne in 1841 becoming a plumbing and heating engineer, joining and eventually heading Mathew Hall & Co Ltd a business founded by his uncle.

After the big telescope's removal to Halifax and re-erection in a purpose-built domed observatory, for eight years Edward Crossley tried to use the 36-inch reflector for his observations of double stars but found the climate hopeless.

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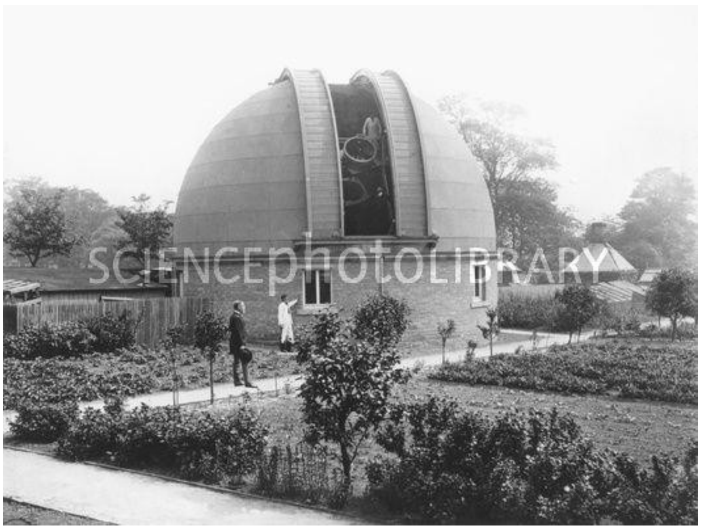


Fig. 5. The dome and the 36-inch telescope at Bermerside

In 1894 Edward Crossley gave the telescope to the Lick Observatory, then under construction on Mt Hamilton, near San Jose, Southern California. Lick was the first of the great mountaintop observatories to be developed in California. Some additional funds had to be raised to ship the telescope to California, which included various donators, and donated services of business. For example the heavy parts of the telescope were shipped, at no cost, by the Southern Pacific Company [Wiki]. For more information about the Crossley Reflector at Lick see https://www.jstor.org/stable/40668076?seq=1#metadata info tab contents

Later, the original skeleton tube (illustrated below) was replaced by a more substantial tube necessitating the relocation of the main mirror further back from the declination axis. Further modifications, including a new mirror, were subsequently made but what is still known as the Crossley reflector went on give much use for over a century, between 1895 and 2010, for the photography of asteroids and galaxies.

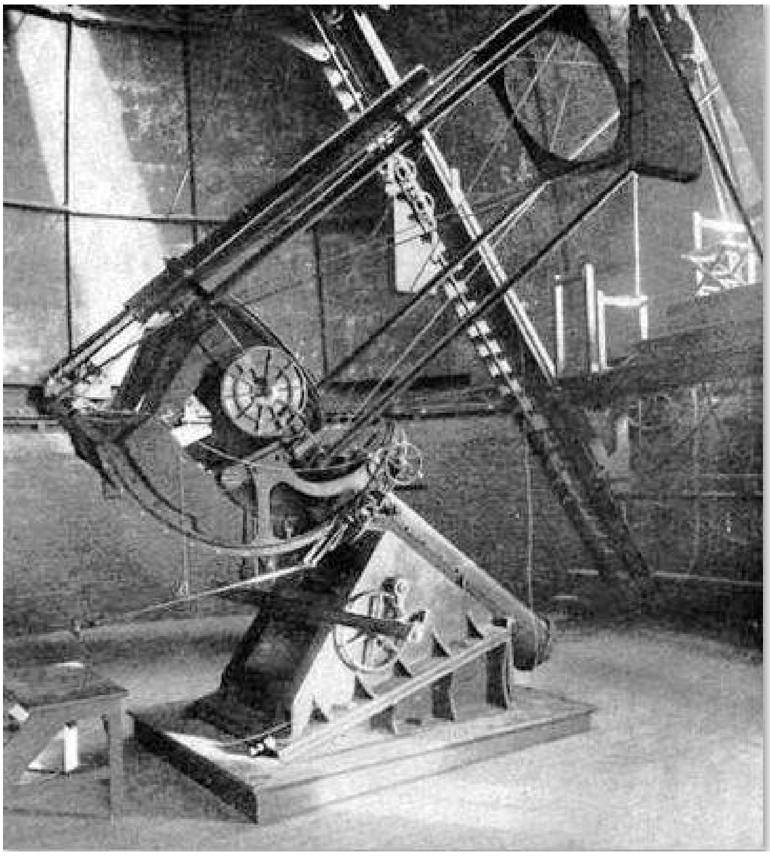


Fig. 6. The Crossley reflector in 1900 at Lick Observatory

In 2019 the house, which had previously incorporated Crossley's Bermerside Observatory, was offered for sale and described by the estate agent as follows:

A historic and unique Grade II listed Observatory which was professionally and sympathetically converted in 1997, to provide a most impressive and spacious four bedroomed residence which is situated in this highly desirable and much sought after residential location set in approximately 0.4 acres of landscaped gardens and woodland. The Observatory was built as part of the Bermerside Mansion by Edward Crossley in 1872 and after its conversion it has retained many original and period features which enhance the character of this delightful residence.

Denis Buczynski

Tarbatness Highland Scotland


4 bedroom character property for sale
The ObservatoryGreenroyd Close,Skircoat Green,Halifax,HX3
Offers in Region of
£495,000

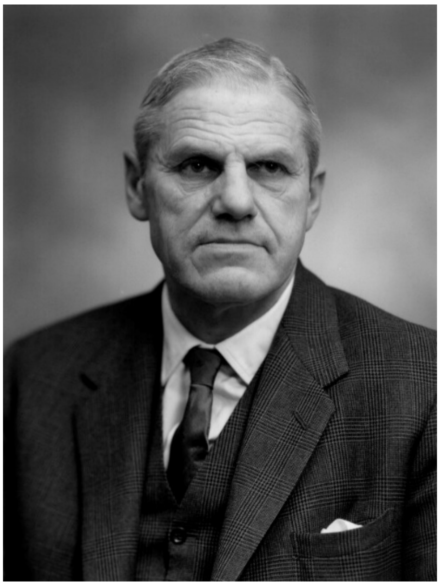
Bunk and Bilge – Harold Spencer Jones and Richard Woolley on Space Travel

Jonathan Spencer Jones

The question of the attribution of the comment "Space travel is bunk" to Sir Harold Spencer Jones shortly before the Sputnik 1 launch in October 1957 was aired in the Society's newsletter some years ago. (Ref 1,2,3)

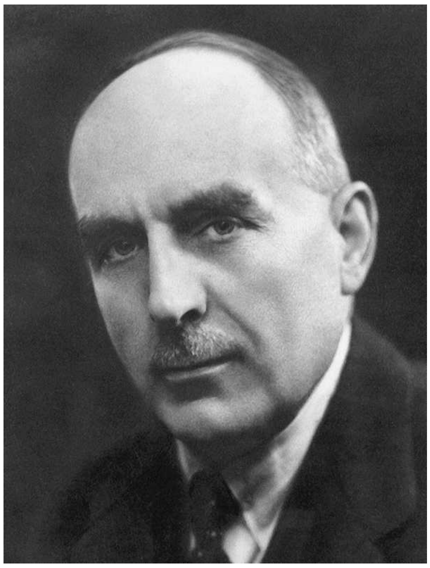
Since that time (2009) access to archival material has greatly increased with many newspapers and other publications becoming available online. A recent search of these, along with that of the files of cuttings and other papers still in the possession of the family, supports the view of the earlier commentators in providing no evidence for such a quote, nor indeed for its origin. This should enable the issue, in my view, to be categorically closed.

However, whether that can be done definitively is another matter. The comment has been widely quoted in books and elsewhere, often in a form derisive and sometimes by people who should know better, and not least by the popular go-to reference, Wikipedia. The source for the latter is a 1959 New Scientist reader's letter, which refers simply to "the Astronomer Royal's [utterance] *ex cathedra*" (Ref 4). Not only is this a secondary reference, without direct attribution to the quote, but at that time, Dr (later Sir) Richard Woolley had been the incumbent Astronomer Royal for almost four years.



Richard Woolley

To get a sense of Spencer Jones' views on space travel, let's look at what he did say on the subject as, contrary to Wikipedia's assessment, they indicate that such a comment would be both unlikely as well as out of character. The earliest reference I have located is a 1949 article following a tour of US observatories, imaginatively entitled presumably by the editor "Rockets are going to probe the stars." (Ref 5) There, Spencer Jones mentions the potential for using rockets for atmospheric research and referring to achievements at that time, comments that the possibility of sending a rocket to the moon "is not, however, as yet within the range of practical possibility".



Sir Harold Spencer Jones

The first substantive comment found is in a 1954 review of the book *Into Space* by British Interplanetary Society founder Philip Cleator (Ref 6).

"At that time [of the foundation of the Society, 1933] the idea of space travel seemed to almost everybody absurd and its protagonists enthusiastic but misguided eccentrics," Spencer Jones wrote. "But the members of interplanetary societies in this country, in America, and on the Continent, studied the problems seriously. They saw that the only possibility of space travel lay in the development of rockets."

As a result, “the idea of space travel has become commonplace. Every schoolboy is now familiar with it. There is nothing inherently impossible in shooting a rocket from the earth's surface into outer space. But the difficulties must not be underestimated; space travel is not just round the corner.”

And later in the review: “The author inclines to the view that this century will see the triumphant reaching of Mars and Venus by man: I am not myself at all optimistic about the prospects of even the moon being reached by that time.”

This, then, typifies Spencer Jones’ commentary on space travel, in retrospect appearing as perhaps unduly pessimistic in outlook, but reasoned. For example, in a popular article “Flight to the moon is a possibility but…” the following year, he referred to the “many complex problems” that would need to be solved for man to reach the moon. (Ref 7) Among them, the requirements for a rocket to escape the earth’s atmosphere, the need for a multi-stage rocket design and the building of a ‘first step’ space station a few thousand miles above the earth.

In another, he called for friendly cooperation between the US and Russia to avoid space station rivalry and possible space warfare. (Ref 8)

The editor of the Society’s Newsletter in a note to Griffin’s commentary alludes to Spencer Jones’ involvement in the organisation of the International Geophysical Year (IGY), which occupied him both before and after retirement at the end of 1955. Space-based observations were integral to the outcomes of the IGY and his various contributions indicate his awareness of both the US and Russian rocket development plans. (Ref 9) Indeed, the IGY had been under way for several months at the time of Sputnik 1 with the prospect of such an achievement growing ever more likely.

No publications with comments have been located from the weeks before the launch but writing a few days after, Spencer Jones described the event as a “major technical triumph” that could be regarded as “the first step towards the achievement of interplanetary travel”. (Ref 10) He remained less optimistic about manned space travel to the moon but over the following year, his views changed and in January 1959 he declared: “It seems to me that within ten years there is no reason why reaching the moon with a vehicle that is large enough to carry a man should not be possible.” (Ref 11) However, with his untimely death in 1960, he didn’t live to witness it, with the Apollo 11 moon venture in July 1969.

If Spencer Jones’ “space travel is bunk” is both unproven and unlikely, what about Woolley’s widely publicised “space travel is utter bilge” quoted on his arrival in UK to take up the post of Astronomer Royal in January 1956? Woolley apparently made no further comment at the time and perhaps once bitten, declined to comment on the Sputnik launch. (Ref 12) In his comprehensive memoir on Woolley, McCrea says simply that the comment “should be forgotten”. (Ref 13)

A 1995 letter to New Scientist offers the answer, with the writer John Rudge stating to having heard the original recording of Woolley saying: “All this talk about space travel is utter bilge, really”. (Ref 14) He attributes the published quote to an intentional misquote by newspaper editors as not in accord with the “flamboyant articles about space travel … with science fiction-style illustrations” of the day.

“One London paper printed his words truthfully but the lie had already gone around the world and nobody was interested in the truth still struggling to get its boots on,” wrote Rudge.

This commentary should now clarify both quotes but as a footnote, one article emerged in which “space travel is bunk” is first attributed to Sir James Jeans in the 1930s and Spencer Jones echoing it at the time. (Ref 15) No source is provided and no record has been found of either having said it in those years. One also may ask if it is likely to be the comment of an enthusiastic populariser of astronomer, as Jeans then was, reportedly taking his audiences on imaginary rocket trips to the moon and planets in his lectures? (Ref 16)

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11. The Birmingham Post, January 5, 1959, p 1
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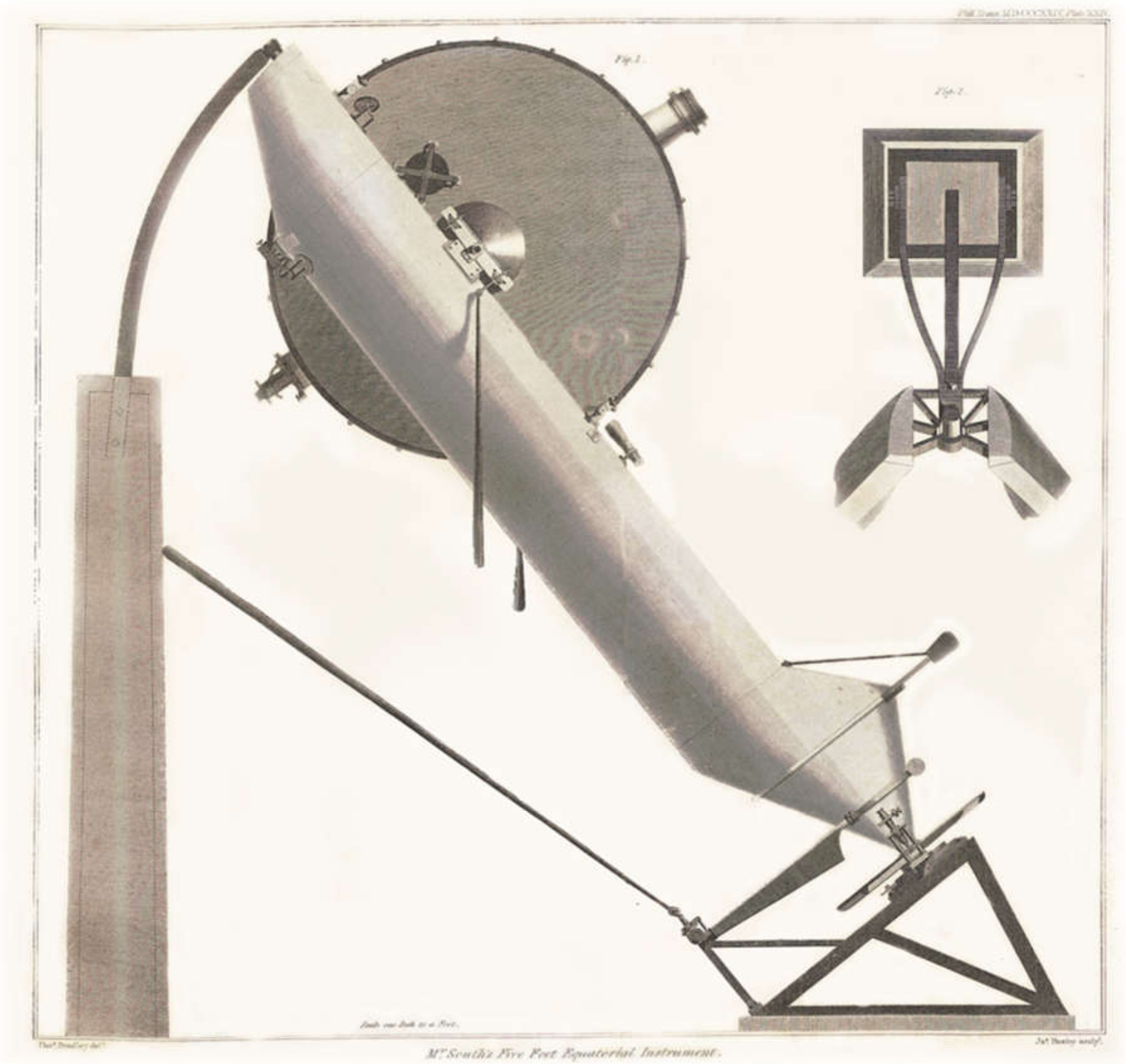
Sir James South's Five-foot Huddart Equatorial - Richard E. Schmidt

As difficult as it may be to imagine, Sir James South was at one time a cheerful young boy living in Southwark, London.   This was near the end of the eighteenth century, when the Souths lived not far from British engineer and hydrographer Joseph Huddart.

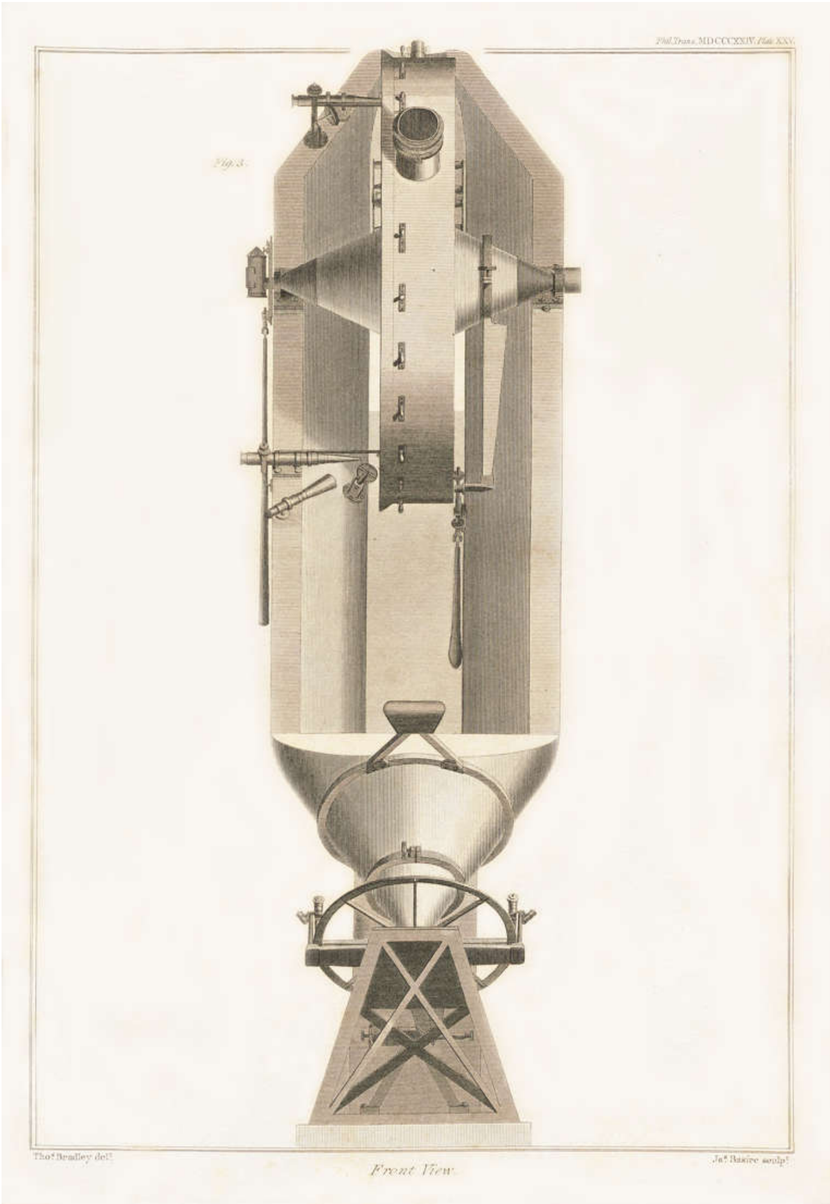
Joseph Huddart (1741-1816) (Wikipedia Commons)

Huddart's home featured an observatory that towered 50 feet above ground, housing a five-foot equatorial of his own design. Completed in 1797, the massive polar axis of tinned and painted iron work was 9¾ feet in length; it pivoted in the North on a 3-foot tall iron arc atop a 6-foot masonry pier.[1] The South pivot was supported by a cast iron frame about two feet in height. John and Edward Troughton made the brass work, with graduated circles, reading microscopes and levels. The objective of 3¾ inch aperture was by Peter and John Dollond. Huddart designed his equatorial as an extra-meridian transit circle. Its four-foot diameter declination circle had dual reading microscopes, plus a third for reading elevation of the polar axis. It was later improved by Troughton with an inlaid ring of platina (an alloy of platinum and other metals), divided to five arc minutes with micrometer screws reading seconds of arc, giving sub-second estimation. The hour circle at the base of the polar axis was two feet in diameter, divided to five minutes, with micrometer screws reading tenths of a second. The long handle of the right ascension slow motion is seen resting against the North pier in the figure below. The declination axis had adjustable pivots for level and collimation. Huddart could not set up North-South external marks, for to the North of his home higher buildings blocked his view, and to the South "a smoky town presented almost as great an obstruction".[2] Instead, he hollowed the declination axis, putting at each end adjustable cross-wires, object and eye glasses. Now East-West marks at right angles to the meridian could provide the requisite astronomical alignment.



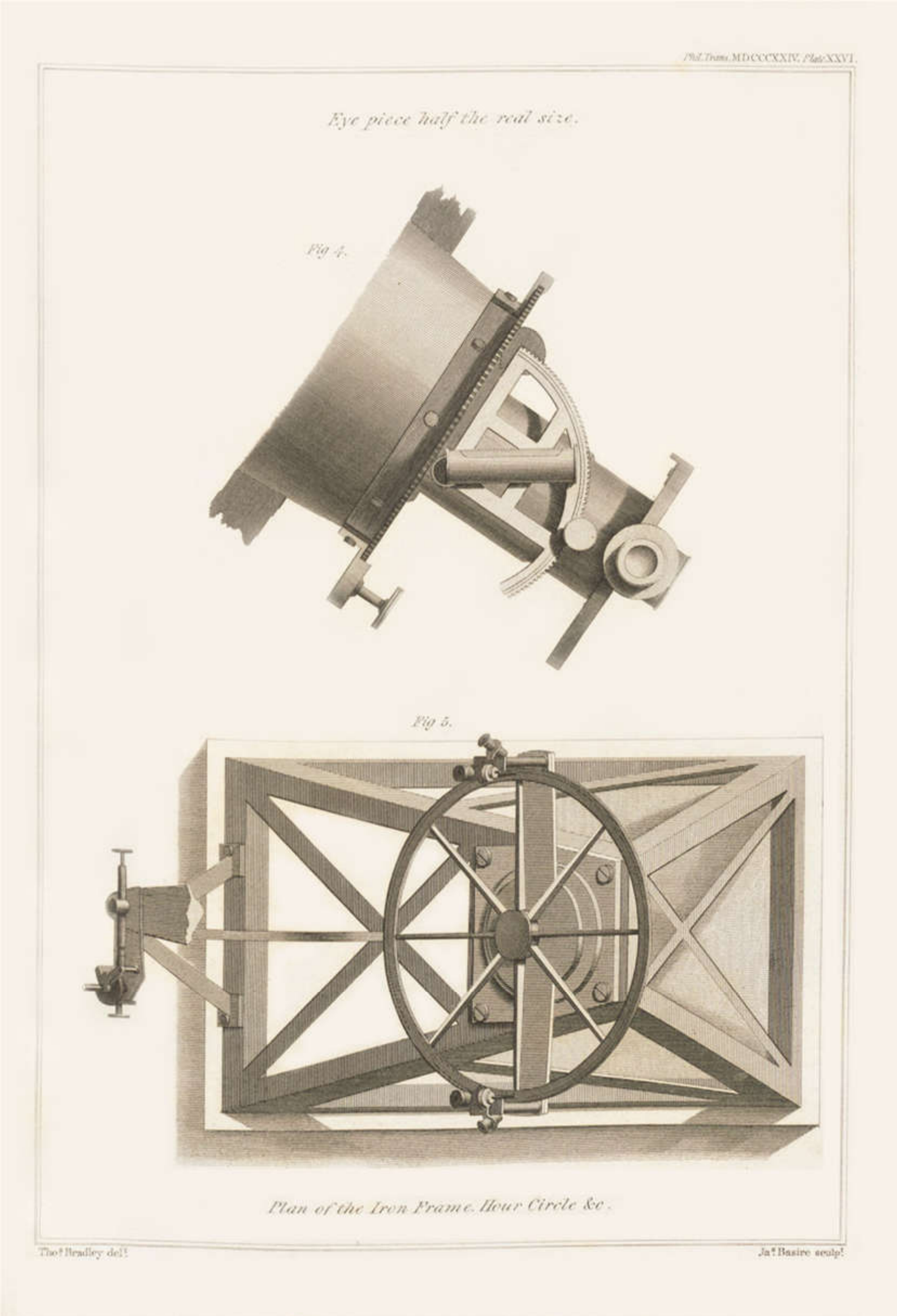
[1] Herschel, J. F. W., and South, J., 'Observations of the Apparent Distances and Positions of 380 Double and Triple Stars made in the Years 1821, 1822, and 1823', *Philosophical Transactions*, London, 1825.
[2] *Ibid*., p. 10

Huddart's five-foot equatorial, side view (*Phil. Trans.*)

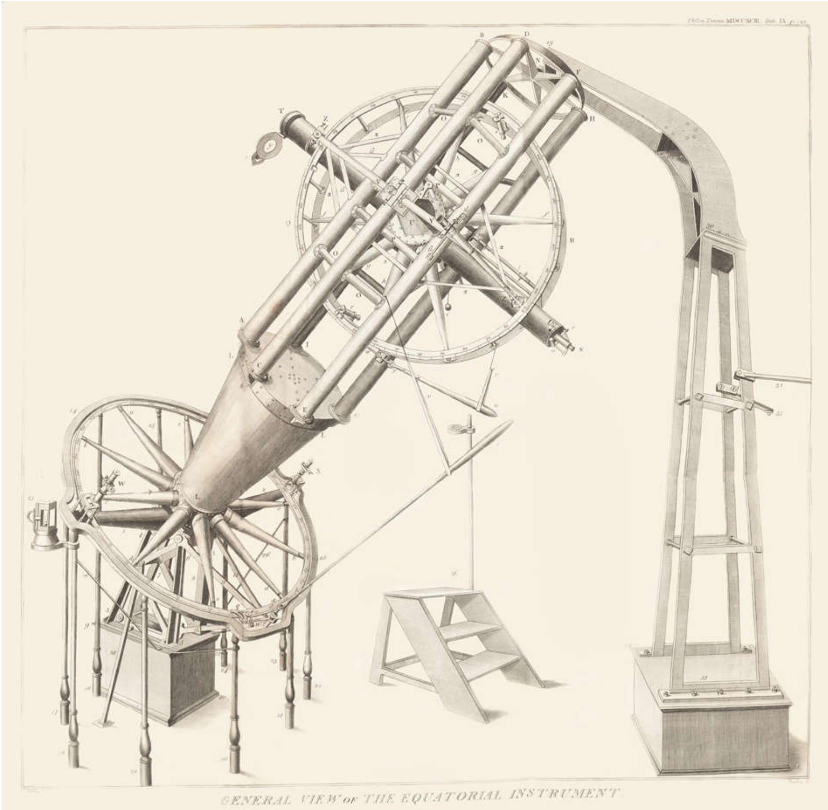


View from the South, Huddart equatorial (*Phil. Trans.*)

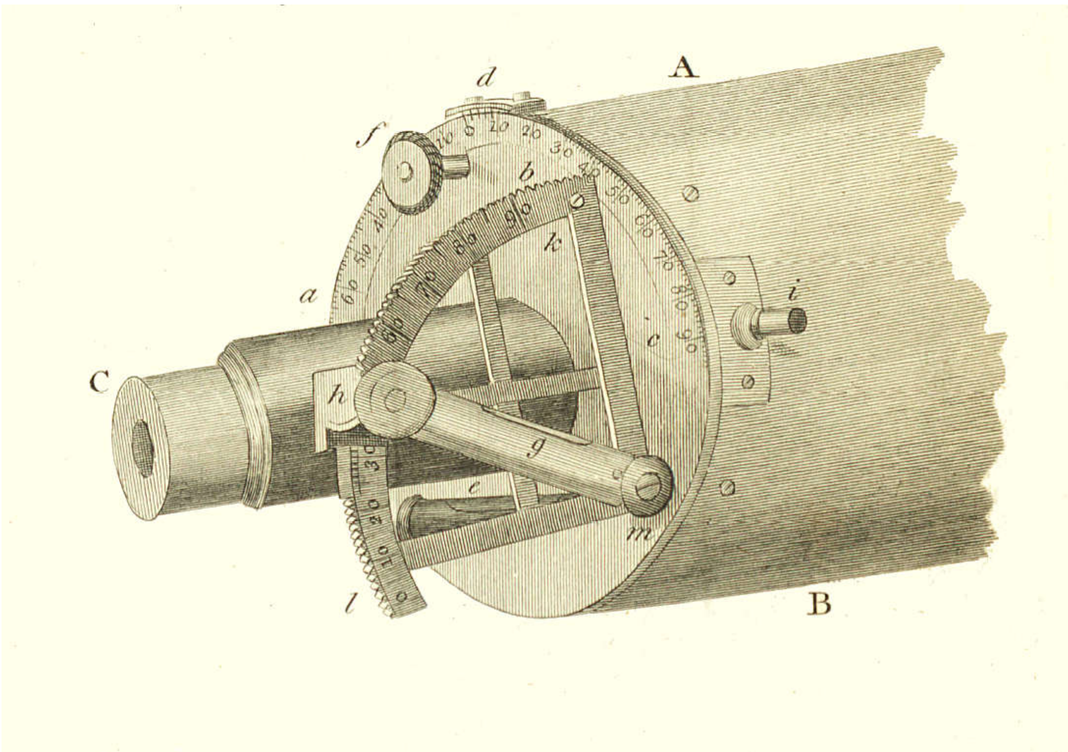
A further feature of the astrometric design of Huddart's equatorial is the specialized eye end of the telescope, where spirit levels, a quadrant, and graduated circle could be used to compensate for corrections to refraction and parallax when observing far from the meridian. The double parallel wire micrometer had position circle verniers reading to minutes of a degree. This arrangement was attributed to the design of the Ramsden equatorial made for Sir George Shuckburgh and described in the *Philosophical Transactions of the Royal Society*, 1793, from which its illustration is taken. The resemblance between Ramsden's and Huddart's equatorials can be seen in the figures of the mount and tailpieces.



Tailpiece and hour circle on Huddart's South pivot (*Phil. Trans.)*



Ramsden's Shuckburgh equatorial, 1793 (*Phil. Trans.)*



Ramsden's Shuckburgh equatorial tailpiece. (*Phil. Trans*.)

Huddart and his equatorial captivated the young James South's imagination, and is indeed said to have altered the course of his life. Soon South took up astronomy with a 6-inch Gregorian telescope. When

Huddart died in 1816, South had become an accomplished member of the College of Surgeons and married to a lady of considerable wealth. South was able to give up his surgical career, and he purchased Huddart's equatorial to begin the construction of a well-provisioned observatory on Blackman Street, the predecessor of his later fine observatory in Kensington.[3] The former observatory location "in the vicinity of one of the great thoroughfares of this immense metropolis, required the adoption of particular precautions against tremors." These included brick piers sunk seven and ten feet below ground. "So effectual are these precautions, that stars pass with perfect regularity…while the heaviest waggons are traversing the street within forty feet of the instrument".[4]

Insert picture: Sir James South, by Maull & Polyblank NPG P120(20), by permission National Portrait Gallery

In 1825 James South published with John F. W. Herschel 'Observations of the Apparent Distances and Positions of 380 Double and Triple Stars made in the Years 1821, 1822, and 1823', from observations made with South's Huddart equatorial and with his seven-foot Sisson-Tulley equatorial.[5] This was a joint effort to re-observe Sir William Herschel's double star catalogues of his observations from 1779-1784 and 1801-1804, earning for South and Herschel the 1826 gold medal of the Royal Astronomical Society.[6] Over three-quarters of their 578 observations were made with the Huddart five-foot equatorial. South was so pleased with the five-foot equatorial that he attempted in vain to have Troughton copy its design for the ill-fated mounting of his 11 ¾ inch Cachoix refractor. To quote Anita McConnell, "this elderly instrument, despite its bizarre appearance, gave him excellent service."[7]

On 1870 August 4, the Huddart equatorial was sold at South's Kensington estate auction for a mere £26.[8] Today both the Shuckburgh and Huddart equatorials are in the collection of the Science Museum, South Kensington.

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3 'James South', obituary, Proceedings of the Royal Society of London, Vol. XVI, (1868), p. xliv
4 Herschel, J. F. W., and South, J., *op. cit.*
5 *Ibid.*

6 'A list of persons to whom the medals or testamonials of the Society have been adjudged', *Monthly Notices of the Royal Astronomical Society*, Part II, Vol. XXXIX, (1872), p. 125
7 McConnell, Anita, 'Astronomers at War, the Viewpoint of Troughton and Simms', *Journal for the History of Astronomy*, Vol. 25, 1994, p. 219
8 'The Observatory of the Late Sir James South', *The Astronomical Register*, No. 93, September, 1870, p. 196

The Nebra sky disc: an alternative interpretation

Kevin Kilburn

The idea that our prehistoric ancestors were sky-watchers has long fascinated me ever since reading in Journals of the British Astronomical Association, published in the 1960s, of the meticulous work of Prof. Alexander Thom in plotting the alignments of standing stones in many of the UK's late Neolithic and early Bronze Age stone circles. His arguments and conclusions, that they were deliberately set up to monitor the risings and settings of astronomical bodies, particularly of the Sun, Moon and brighter planets, were persuasive to the astronomer, but highly contentious and largely unacceptable to the archaeological community, despite similar observations, particularly by the contemporary Egyptian dynasties at several sites along the Nile, and elsewhere at sites in the middle East having been readily accepted.

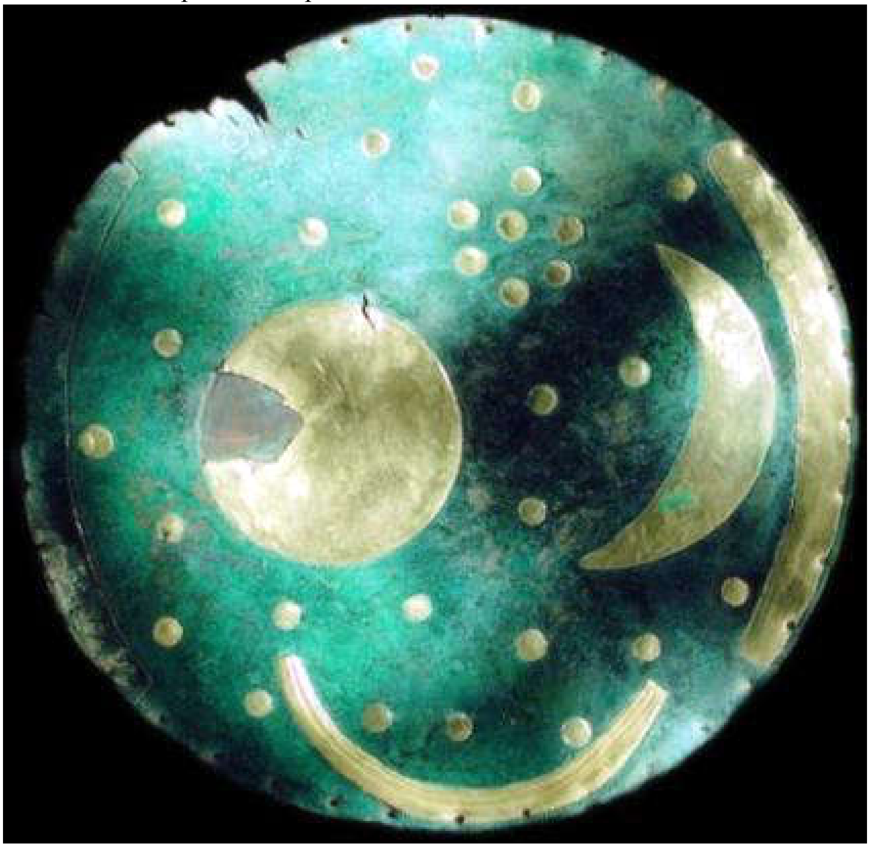
Twenty years ago I investigated a local phenomenon, the so-called Double Sunset visible from a thousand-year-old church, that of St Edward the Confessor, at Leek in the Staffordshire Moorlands. At the summer solstice, the Sun sets twice, firstly atop a hill, Bosely Cloud, ten kilometres to the northwest. Having disappeared from view, the Sun then briefly re-appears from behind the hill's northern escarpment to set once again behind the more distant horizon. This Double Sunset was first recorded by Oxford academic, Dr Robert Plot when he toured Staffordshire in the 1680s during the compilation of his *Natural History of Staffordshire* published in 1686. He also predicted that the phenomenon deserved close and ongoing monitoring as it would change over the years due to the slowly changing obliquity of the ecliptic, the Earth's axial tilt, that rocks to and fro (it's currently 23.4 degrees) with a cycle of 41,000years. Dr Plot was correct. By 1999, when I first attempted to observe the double sunset from St Edward's, it was no longer visible from the churchyard; it was last reliably seen in 1977. Changing obliquity of the ecliptic is to blame.

But there also exists in Leek a long-standing idea that St. Edwards was built on a prehistoric hill-top site. In the 1950's a local headmaster and historian, Harold Bode, great uncle of Prof. Mike Bode, who recently retired as professor of astrophysics at Liverpool's John Moore's University and another Leekensian, suggested that a stone circle once occupied the now Christianised site. Almost next door to the church is Foxlowe, a large Georgian house now used as public meeting place, music venue and centre for Leek's annual art festival. The name, Foxlowe, also suggests a prehistoric burial site. So here in the Staffordshire Moorlands, on the southwestern edge of the Peak District we have at least one historically documented astronomical alignment with perhaps a very ancient history; I have since found four other solsticial alignments as viewed from listed prehistoric monuments, all occurring at either the summer or winter solstice and all of them appearing to date from the period 3000-2000BCE. None of them have alignments, within a degree or so, nowadays, but allowing for the changing obliquity of the ecliptic, all (including Stonehenge) suggest deliberate and more accurate alignments at the time they were constructed. There is ample proof that astronomy was a cultural factor in the UK over 4000years ago.

So what about the Nebra sky disc? If I interpret what has already been published by archaeologists at Halle, not far from Leipzig, Germany, and about 20 miles from Mittelberg where it was dug up illegally by metal detectorists in 1999 before being handed in, the sky disc was buried around 1600 BCE judging by radiocarbon dating of material found on weapons buried along with it, but it has been suggested that the disc could be much older, possibly depicting something 100-200 years before it was buried.

It seems to depict the Sun and a crescent Moon set against a background of stars and with what appears to be a particularly tight cluster of seven stars, interpreted as being the Pleiades, midway between them. The bronze disc, containing dateable copper mined in Bischofshofen in Austria and tin from the river Carnon in Cornwall, is framed on its left and right edges by broad golden arcs, the so-called horizon arcs. The ornamental gold also came from Cornwall. What has been interpreted as a deeply-keeled 'boat' is set, like a smiley mouth, on the lower side of the disc.

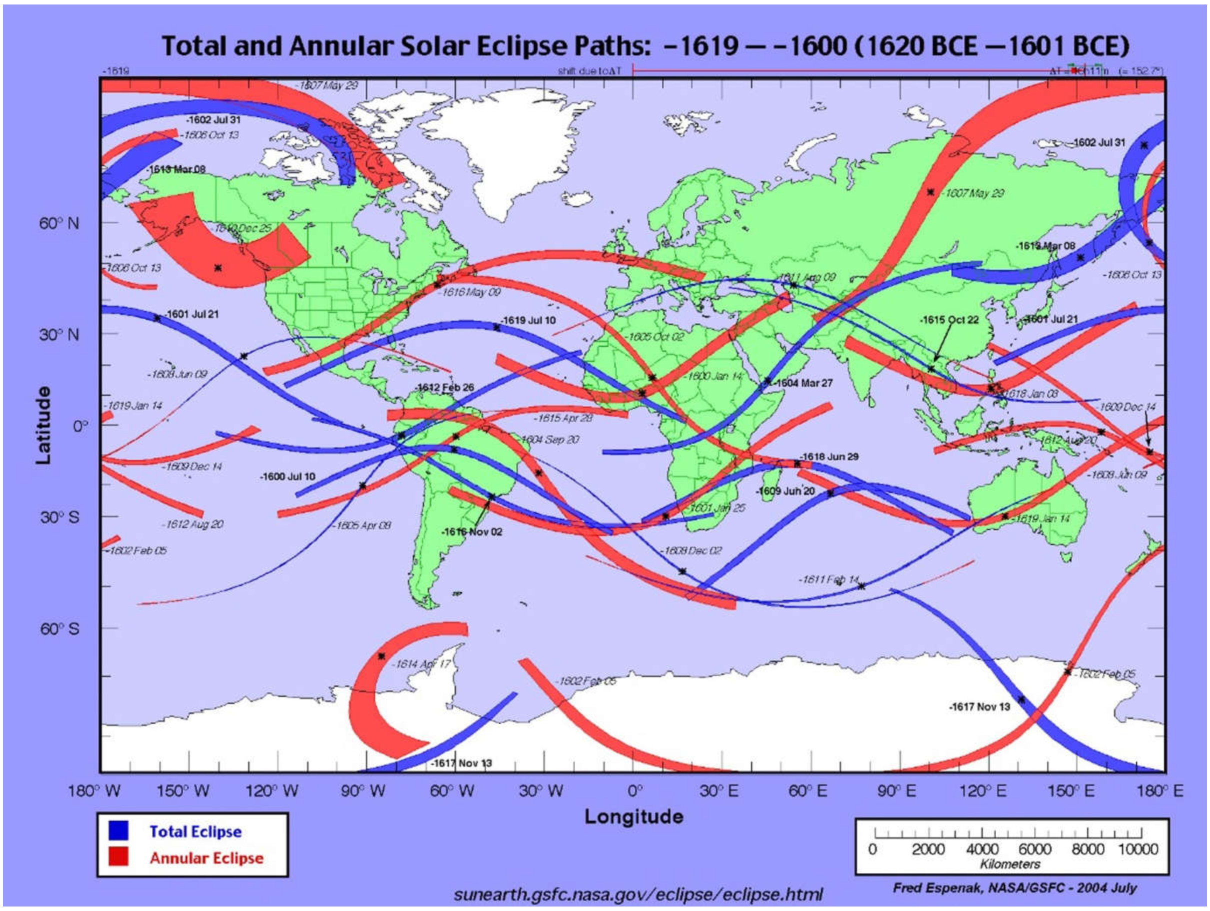
Saxony-Anhalt state archaeologist, Harald Meller, at Halle, who received the disc after it was handed in following a police sting that nabbed an illegal attempt to sell it on-line in 2002, has gone to great lengths to interpret the sky disc in the historical context of the archaeology of northern Europe but he says little about its astronomical interpretation. A more elaborate astronomical interpretation was put forward in 2012 by Howard Crowhurst in his little book, *The Nebra Sky Disc: Cycles in the Cosmos.* He links it to Egyptian and various other cultures but at least he does make an attempt to interpret its astronomy. A quick search on-line will find these and other references, to the sky disc. I leave it to you to decide who has the most fitting interpretation.



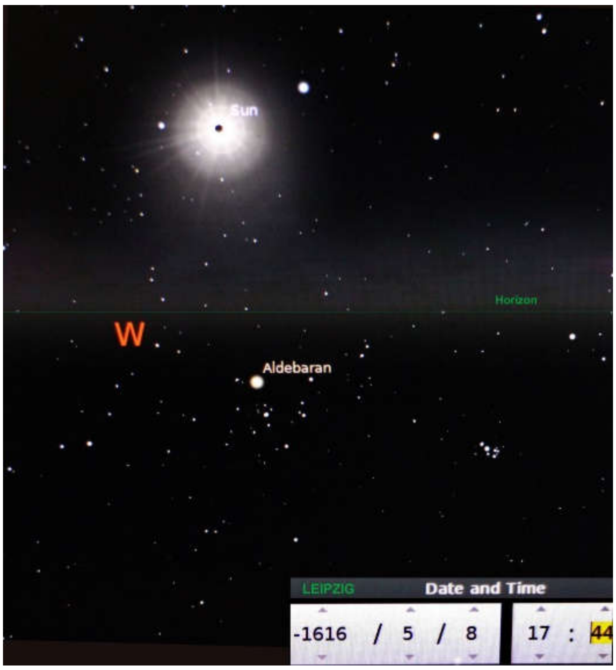
But this is my own interpretation: It struck me that the 'boat' looks very much like a deep solar eclipse. Crowhurst had other ideas but does suggest that the inclusion of the Pleiades indicated an astronomical event occurring at the time of the heliacal rising of the Pleiades in the early morning sky, probably sometime at the beginning of May.

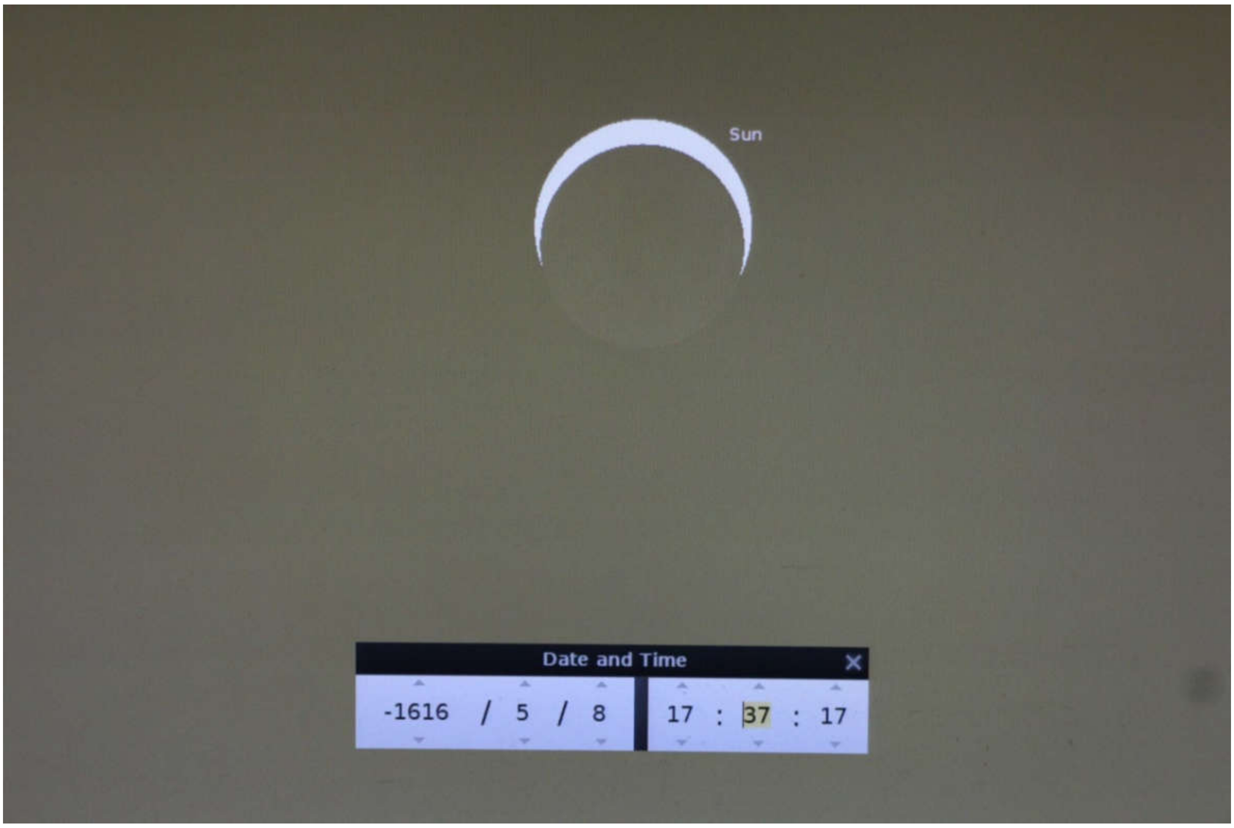
If an eclipse is indeed depicted, the NASA Eclipse Web Site includes a five millennium catalogue of solar eclipses between -1999BCE-3000CE (2000BC-3000CE) and it's easy to search for annular and total solar eclipses during the epoch -1999 to -1600BCE, straddling the date attributed to the Nebra disc. There were 976 solar eclipses during those four hundred years. Refining the search and looking for eclipses visible in May as seen from central Europe, specifically ones crossing Germany, only two stand out; that of 23 May 1886BCE (but tracking too far south), and especially that of 8-9 May 1616BCE. This annular eclipse track began at sunrise off the Pacific west coast of Mexico, crossed North America, where mid eclipse was visible in the New England states. It then swung eastwards across the Atlantic, passing over southern parts of the UK and thence across Germany during the afternoon of 8 May, ending at sunset a little further east.

The coincidence with the alleged deposition date of the Nebra disc is remarkable but let's examine this eclipse more closely using the planetarium freeware, Stellarium.



A quick ‘look’ at this annular eclipse, as viewed from Leipzig during the afternoon of -1616, shows that a very deep partial eclipse was visible. ‘Switching off’ the ‘atmosphere’ shows the eclipsed sun well above the western horizon on the border of Gemini and Auriga. Taurus and Pleiades have set but could not have been visible in the glare of the Sun at any time during that afternoon. We must therefore consider the presence of the Pleiades on the Nebra disc solely as a time/date marker indicating the approximate time of year, as suggested by Crowhurst.





So, in what appears to be a remarkable correlation of astronomical objects depicted on the sky disc with astronomically demonstrable events, the facts are these:

Nebra is about 40km west of Leipzig so relocating the Stellarium viewpoint to there, another coincidence unfolds; the 'boat'. Compared with the Nebra sky disc it's upside down in the sky, but not if one wanted to see it more clearly and safely, reflected in a still pool of water, rather than looking into the glare of the eclipsed Sun!

In early May 1616BCE the Pleiades were visible, rising just before the Sun; a heliacal rising. The date of the annular eclipse fits in and from Nebra a very deep partial eclipse, looking like a boat, would have been visible in the late afternoon sky. Of course I cannot prove that the people of Nebra did record a solar eclipse over three and a half millennia ago but if as the sky-watchers they undoubtedly were, then my interpretation of the Nebra sky disc offers a much simpler solution to those that have been proposed in the twenty years or so since it was unearthed (assuming of course that the disc is not a modern hoax, which has also been suggested). I'll leave it to the reader, perhaps evoking the Occam's razor principle in such philosophical matters, to ponder upon it.

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Image Kevin Kilburn Annular eclipse 31 May 2003 from Lossiemouth

Bright Star!—When did Keats write his famous sonnet? - William Sheehan

During the spring of 2004, when Venus was ravishingly bright in the Evening Sky as it swung away and then back toward the Sun for its much-anticipated transit, I was preparing for a series of lectures on the transit and wanted to begin, as is my tradition, with a poetic motto. I immediately thought of the sonnet by Keats:

Bright star! Would I were steadfast as thou art--
Not in lone splendour hung aloft the night
And watching, with eternal lids apart,
Like nature's patient, sleepless Eremite,
The moving waters at their priestlike task
Of pure ablution round earth's human shores,
Or gazing on the new soft fallen mask
Of snow upon the mountains and the moors –
No – yet still stedfast, still unchangeable….

I had always assumed that the Bright Star was Venus, which alone can hang "in lone splendour" aloft in the night sky, and is—as a planet--steadfast. However, as I looked further into the matter, I found that the literature is actually somewhat contradictory on the subject. The "Bright Star" sonnet seems to contain literary echoes to a letter Keats wrote in late June 1818 to his brother Tom from Bowness, Lake Windermere—sees in the following passage an anticipation of "Bright Star."

"There is no such thing as time and space, which by the way came forcibly upon me on seeing for the first hour the Lake and Mountains of Winander—I cannot describe them—they surpass my expectation…. There are many disfigurements to this Lake—not in the way of land or water. No; the two views we have had of it are of the most noble tenderness—they can never fade away—they make one forget the divisions of life; age, youth, poverty and riches; and refine one's sensual vision into a sort of north star which can never cease to be open lidded and stedfast over the wonders of the great Power."[1]

Obvious echoes here include "Open lidded" which seems to anticipate "eternal lids apart," and the common word "stedfast." Most editions of Keats, in the notes section, feel obliged, in addition, to refer to the well-known passage in *Julius Caesar* (Act 3, Scene 1): "I am constant as the northern star, Of whose true-fixed and resting quality There is no fellow in the firmament. The skies are painted with unnumbered sparks. They are all fire and every one doth shine. But there's but one in all doth hold his place. So in the world." The suggestion is that the "Bright Star" which is so steadfast is none other than the North Star. Indeed, it is fixation on the north star that leads Andrew Motion to dismiss verbal echoes to "Bright Star" in another Keats letter, written on July 25, 1819 to Fanny Brawne (with whom the sonnet has been connected by all except Gittings, who is led astray by tying it to the letter to Tom and dating it to 1818, which was before Keats's love affair with Fanny had begun). The letter ends with the line, "I will imagine you Venus to night and pray, pray, pray to your star like a Hethen. Your's ever, fair Star."[2] Motion writes, "There are two alternatives. The first links the poem to July 1819, when Keats tells Fanny Brawne that he 'will imagine you Venus …' This is suggestive but inconclusive: Keats is talking about the North Star, not Venus the evening star."[3] However, there are problems with the north star identification. At 2nd magnitude, the North Star can by no means be regarded as bright. (It is in fact the 50th brightest star in the sky.) To refer to it as a "Bright Star" is an error that would hardly have been made by Keats, whose astronomical knowledge was far from negligible. As is well known, as a student at Enfield he won, in

[2] John Keats to Fanny Brawne, 25 July 1819. In: *Letters of John Keats*, p. 272.
[3] Andrew Motion, *Keats: a biography*. Chicago: University of Chicago Press, 1997, p. 323.

1811, a copy of Bonnycastle's *Introduction to Astronomy*, and it is usually assumed that the phrase from Keats's 1816 sonnet "On First Reading Chapman's Homer"—"Then felt I like some watcher of the skies When a new planet swims into his ken"—refers to William Herschel's discovery of Uranus, as described in Bonnycastle's chapter "New Planets," though it is also possible that it refers to the New Planets (asteroids) being discovered during the first decade of the new century, as also described in Bonnycastle's book. It likely refers to both.) All things considered, it seems unlikely that "Bright Star" was meant to refer to Polaris, steadfast or no. Venus itself seems a better fit. We will explore this more fully presently.

The version of "Bright Star" quoted above is actually the second written; it was known in the nineteenth century as "The Last Sonnet" because Keats wrote this version of it on a blank page of his copy of Shakespeare's Poems in early autumn 1820, while he and Joseph Severn were on the boat to Italy. As for the original version, his friend and traveling companion Charles Brown said only that it was written in 1819. It reads:

Bright star! would I were stedfast as thou art!
Not in lone splendour hung amid the night;
Not watching, with eternal lids apart,
Like Nature's devout sleepless Eremite,
The morning waters at their priestlike task
Of pure ablution round earth's human shores;
Or, gazing on the new soft fallen mask
Of snow upon the mountains and the moors:-
No;--yet still stedfast, still unchangeable.
Cheek-pillow'd on my Love's white ripening breast,
To touch, for ever, its warm sink and swell,
Awake, for ever, in a sweet unrest;
To hear, to feel her tender-taken breath,
Half-passionless, and so swoon on to death.

The date of the poem's composition, though hardly of the first importance, is of sufficient interest to have attracted its share of theories. All things considered, we should like to know, and there are certain details that invite conjecture. Amy Lowell believed the poem was written in mid-April 1819, on the grounds that Keats was looking over letters he had sent Tom (who had died the previous December) during the Scottish tour with Brown, including the northern star one cited earlier.[4] She was not aware of the fact that this letter had been sent on to Keats's other brother, George, in October 1818. Robert Gittings, who did know this, was forced to suppose that Keats must have been looking through the letter before he sent it to George, and thus concluded that Keats wrote the sonnet in October 1818. He is forced both to ignore Brown's date of 1819 for the poem and also, by adopting a much earlier date, to argue that the sonnet refers not to Fanny Brawne but to Isabella Jones.[5] Bate, after considering Gittings's arguments in detail, finds them unpersuasive. Instead he concludes, from tone of the letter and biographical details of Keats's life, that the date of the sonnet must be anywhere between October and December 1819. This seems about right.[6]

There is another possible clue to the date: the striking reference to the "new soft fallen mask/Of snow upon the mountains and the moors." Keats's literary career overlapped with the period 1805 to 1820 which for many Europeans was the coldest of the "Little Ice Age," including the year 1816, which was remembered as the "Year without summer."[7] Sir Sidney Colvin, noting that a heavy snowfall took place during February 1819, suggests that this might have provided the inspiration for the "mask of snow," and adopts this date for the composition

[4] Amy Lowell, *John Keats*. Cambridge, Massachusetts: The Riverside Press, 1925, vol. II, pp. 202-206.
[5] Robert Gittings, *John Keats: the Living Year*. London: William Heinemann, 1954, pp. 25-26.
[6] Walter Jackson Bate, *John Keats*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1963, pp. 618-619.
[7] Brian Fagan, *The Little Ice Age: how climate made history, 1300-1850*. New York: Basic Books, 2000.

of “Bright Star.”[8] But February 1819 seems early, and there are many other possibilities suggested by the weather: thus May 1819 saw a period of severe frost, the summer of 1819 was, rather anomalously, claimed to be the longest, driest and warmest in living memory, but then the Little Ice Age returned in full force later that year. On October 22, heavy snow fell across South England, including the London area; there were two inches in London, and more in rural areas of Surrey. Also, snow fell widely and heavily towards the end of December, especially on the 28th, while during the first three weeks of January 1820 there was a particularly severe spell that produced deep snow across many southern and southeastern counties of England, including the Isle of Wight. The nontidal Thames froze as far downstream as Kew, and there were ice floes in the Thames estuary, with shipping disrupted. Thus anytime from October to December of 1819 (as Bate concluded on other grounds) seems to fit “the mask of snow” reference.

Suppose we can throw out the north star reference as a red herring, and instead concentrate on the identification with Venus—associated, at least by July 1819 with Fanny Brawne, and the most obvious object to identify as a Bright Star that is stedfast (since as a planet it does not twinkle)—what was Venus doing in the sky during the years 1818-19-20? During much of 1818 it was an Evening Star—reaching Greatest Elongation East of the Sun in mid-October. In mid-December, it was low in the west, forming a close grouping with Jupiter and Mercury on December 12. It then disappeared behind the Sun, and reemerged into the morning sky in January. It reached Greatest Elongation West of the Sun on March 7; was very close to Mars and Saturn at the beginning of May, and remained in the morning sky until September/October when it again passed behind the Sun. It emerged back into the evening sky as the year ended, and at the end of December was setting an hour and a half after the Sun.

If we were to date the poem entirely from the circumstances involving Venus, the latter part of 1818 would be the best fit. In October, when there was Little Ice Age snow upon the mountains and the moor, Venus was shining splendidly as an Evening Star, high aloft the night. Perhaps Keats—then working on Hyperion, and immersed in planetary imagery while looking after Tom in the last stages of his illness—retained an impression of the Bright Star of that highly wrought period that he carried over into the following year. Some date during the summer of 1819 would not fit with the mask of snow but it would fit the “morning waters” of the less well-known *** since by then Venus was showing in the Morning Sky. The very end of 1819, when Venus was again appearing in the Evening Sky, would also seem to work—and fits with Bate’s best date. It seems likely that the impressions of the previous year (back to the period when he was working on Hyperion and caring for Tom) were all at work as he produced the first version of the poem, probably late in 1819.

We know that Keats wrote the revised edition of the poem on a blank page of his copy of Shakespeare’s Poems in the autumn of 1820. By then, Venus, having reached Greatest Elongation East of the Sun again on about May 20, had once again passed behind the Sun and was reemerging into the morning sky.****

[8] Sir Sidney Colvin, *John Keats, His Life and Poetry, His Friends, Critics, and After-Fame* (London: Macmillan and Co., 3rd ed., 1920), p. 335.

Well-trodden Paths: Sidney Bertram Gaythorpe (1880–1964)

David Sellers

I was the first to plant free footsteps on a virgin soil,
I walked not where others trod.

Horace, *Epistles*, I.19.21-22

The name of Sidney Bertram Gaythorpe is familiar to most students of English astronomical history. His name is indelibly linked with the story of Horrocks, Crabtree and Gascoigne: that select group of north-country astronomers who blazed a trail for precision astronomy in the early seventeenth century. He spent much of his life researching for a biography of Jeremiah Horrocks – famous for his observation of the 1639 transit of Venus. Gaythorpe's two papers, analysing the potential observation location, appeared in the *Journal of the British Astronomical Association* in 1936 and 1954. They have been quoted by historians ever since. So too, have his papers on Horrocks' theory of the Moon, and the optics of Gascoigne's Galilean telescope and other early telescopes.

Sidney Bertram Gaythorpe 1880-1964
With permission of Cumbria Archive Centre, Barrow
Ref. BLC/100/EC/Gay 1

With the exception of a one-page obituary, written in 1964 by Colin Ronan

[1], nothing appears to have been published about Gaythorpe himself.

I became intrigued by Gaythorpe's life-long search for Horroxiana whilst I was writing a book about the transit of Venus and subsequently one about Gascoigne. Thereafter, I thought nothing more about him. Until, that is, I commenced researching for a biography of the Victorian astronomer and educationalist, Charles Thomas Whitmell, and found a host of letters written to Whitmell by Gaythorpe during the period 1902-19.[2] Gaythorpe emerges from these as an independent scholar of wide-ranging interests, versed in mathematics and astronomy, of course, but also avidly interested in history, topography, and the Greek and Latin classics.

Gaythorpe was born in Barrow-in-Furness and lived there with his parents, Harper and Ann, at 3 Prospect Road. Even after his marriage to Edith Postlethwaite in 1914, this large house continued to be his address.

After his death in 1964, much of his personal archive of letters and papers was acquired (via Colin Ronan) by the noted Horrocks expert, Professor Wilbur Applebaum. The letters are now owned by the University of Illinois Archives and an interesting catalogue can be consulted online.[3]

Some other Gaythorpe papers, however, are preserved in the Barrow Archive and Local Studies Centre.[4] In June 2016 I decided to make a trip—in pursuit of Sidney Gaythorpe, the man, his papers and his environs.

[1] Ronan, C., *Sidney Bertram Gaythorpe*, Journal of the BAA, v.75, pp.285-6
[2] When the correspondence started, Sidney was 22 years old, compared with Whitmell's 53 years.
[3] http://archives.library.illinois.edu/uasfa/1513050.pdf
[4] Barrow Archive and Local Studies Centre, 140 Duke Street, Barrow-in-Furness, Cumbria LA14 1XW

Once I was comfortably seated at a table in the Archive Centre, the friendly staff brought along a pile of material that I'd pre-ordered. Visible on top of the pile was already something that I had never seen published before: a photograph of Gaythorpe. Admittedly, this was a likeness of Gaythorpe as an elderly man, long after the days of his enthusiastic exchanges with Whitmell, but it was gratifying to know what the subject of my impending research actually looked like. I remembered one of his letters to Whitmell—a full eight years into their correspondence—diffidently saying 'Your remark…emboldens me to ask what I have often thought of asking but have hitherto lacked the courage, that is, if you could spare me a photograph of yourself'. Despite the frequent letters, the two had never met. In reciprocation he sent his own photo to Whitmell, explaining that it was taken when he was 27-28 years old, whereas now he was 'over 30 and well on the way to what Dante calls the summit of the arch'.[1]

Charles Thomas Whitmell. Image: Leeds Astronomical Society

Gaythorpe's father, Harper, owned an engraving business at 12 Harrison Street and it was here that Gaythorpe worked after leaving Barrow Grammar School. In addition to silver plate engraving, the business spent much of its time engraving ornamental certificates, scrolls, plaques and funeral memorials.

It was evident from the Whitmell letters that Gaythorpe was an avid reader of the *English Mechanic and the World of Science* (EM), a weekly newspaper published from 1865 to 1926. It had an impressive international readership. Apart from the articles and news reports, what its readers loved was the huge amount of space given over to their letters and queries, along with authoritative replies to these queries, sent in by more knowledgeable readers. It was as a result of this that he first got to know Whitmell.

From the late 1890s Whitmell had been a regular correspondent of the EM. His succinct analyses of various mathematical and astronomical conundrums were popular features of its columns. In July 1902 Whitmell had published in the EM a prediction that the body of Saturn would be seen illuminated through the Cassini Division of Saturn's rings on the 17th day of that month. It transpired that the phenomenon was indeed observed (though by few) and on 29 July Sidney Gaythorpe wrote his congratulations to Whitmell. This was the start of a seventeen year correspondence, primarily about positional astronomy.

Through these discussions, Gaythorpe also kept Whitmell abreast of his other researches, including self-effacing updates on his Horrocks quest. Acknowledging that his obsession was one that would not be shared by many, he

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[1] Letter to Whitmell (13 Jun 1910), *MS27, Charles Thomas Whitmell Archive*, University of Leeds Library, Special Collections (cited below as '*Whitmell Archive*')

said to Whitmell, whilst forwarding a draft paper on Horrocks' Lunar Theory, 'I fear though it will be "*caviar*" to all except a few like yourself'.[1] In July 1909, prompted by the overdue publication of a 1903 article on Horrocks that he had written for the local scientific society[2], he divulged that his *book* on Horrocks 'is slowly growing into shape'.[3] By the end of November 1909, however, he was lamenting the slow progress:

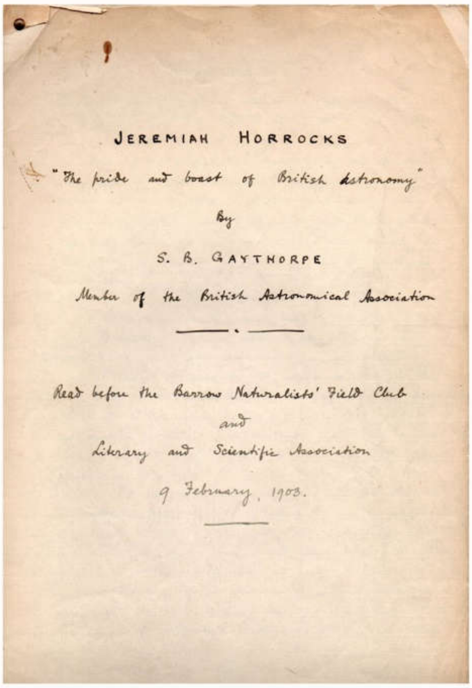
> 'I had hoped that by this time my book on Horrocks would have been well on the way towards completion; but I need hardly tell you what an amount of research is sometimes needed to settle almost a trivial matter, and that what can be stated in a few words may oftentimes have taken a very long time to work out.
>
> 'However, the work is not standing still, and during the next few months I'm hoping to devote more time to it [than] I've been able to do lately.'[4]

Little did he realise that the months would stretch into years, and the years would turn into decades.

In the Barrow archives the next item to attract my attention was a packet of diaries—a full set spanning the years 1917-1953. Strangely, there is no entry in them confirming Ronan's claim that Gaythorpe was a stretcher bearer during the First World War. At first, I'd speculated that such a 'non-combatant' role might have indicated that he was a conscientious objector. In fact, however, throughout 1917, the entirety of Gaythorpe's 'military activity' seems to have consisted simply of 'drilling' several nights per week in Barrow—a monotony only relieved occasionally by 'bayonet practice, etc'.[5]

We have to remember that when war broke out he was already 34 years old and, despite the appalling rate of loss of soldiers on the battlefields of Europe, it was some years before men of his age got the call-up. His diary for 1918 records that he was finally drafted into the services on 25 January, at the age of almost 38. This ties in with his letter four days earlier, 21 January, to Whitmell, in which he says

> 'You would no doubt be surprised at the news of my being called up. Though a skilled-man, I do not come within the schedule of protected occupations, and as the Tribunals are now withdrawing from men in the higher categories their certificates granted on occupational grounds, I have unfortunately fallen between two stools.
>
> 'The Ministry of Munitions have a complete record of my qualifications, both technical & educational, and as a result I am expecting to be posted to a Technical Corps. Considering my age & other factors I feel sure my abilities will be more fully utilised there than in any other branch of the service, but all the same you are not the first of my friends by any means who has expressed the opinion that my capacity would have been more amply & profitably occupied in war work at home.
>
> 'I wonder whether you would allow me, if occasion requires, to mention your name in regard to my mathematical knowledge, of which I have been advised to make a special feature.'[6]



Manuscript cover of a 1903 paper on Horrocks by Gaythorpe. Image by D. Sellers.

In the event, Gaythorpe proved singularly unfit for the military duties in the Royal Flying Corps, to which he had been assigned. According to his diaries, he spent most of his time confined to bed, on 'sick parade', or in a military hospital due to hay fever and a

[1] Letter to Whitmell (28 Jan 1907), *Whitmell Archive*
[2] S.B.Gaythorpe, *Jeremiah Horrocks: 'The Pride and Boast of British Astronomy'*, Annual Reports, Proceedings, &c., of the Barrow Naturalists' Field Club, v.XVII (1909), pp.1-5-107
[3] Letter to Whitmell (23 Jul 1909), *Whitmell Archive*
[4] Letter to Whitmell (22 Nov 1909), *Whitmell Archive*
[5] It is not clear under what auspices he was involved in military drills. Diaries for the years before 1917 are missing.
[6] *Whitmell Archive*

long succession of respiratory problems. He was finally discharged from the service on 30 April 1920.

His diaries for the period immediately following his discharge show what efforts had to be made by those pursuing original historical research at the time. He made many visits to Oxford, Cambridge and London in order to trawl through manuscripts. Each manuscript had to be transcribed—in general, photography, such as I was using on his papers, was not an option for him. Nevertheless, I felt a kinship with this dogged investigator as he ploughed through many manuscripts that I too, it transpired, nearly one hundred years later, had also leafed through—hoping to uncover exactly the same nuggets that he had probably anticipated: His archive at Barrow includes transcriptions of exactly the same sections of Henry Power's correspondence (now in the British Library) that I had recorded when researching Gascoigne. Power was known to have discussed the life of William Gascoigne with the Towneleys. Maybe Gaythorpe, like me, had been hoping to unearth some biographical gems.

Many times he would have to rely on the diligence of others to supply information that a modern researcher could easily find on the Internet. The Illinois catalogue of the Gaythorpe letters reveal just how much time had to be spent sending queries by post or making personal visits in that pre-*'online'* age. His letter to the City Librarian in Leeds about whether the famous *Ducatus Leodiensis* of Ralph Thoresby made reference to Horrocks or Gascoigne elicited a negative reply, even though we, in a matter of seconds via *Google Books*, can readily see that the *Ducatus* actually contains a family tree for Gascoigne! He spent a lot of time at the Royal Greenwich Observatory transcribing and translating a manuscript of Horrocks's famous *Venus in Sole Visa*: Now, images of the manuscript can easily be ordered directly from the National Archives.

Over the coming years, occasional papers indicated that his work on Horrocks and his associates was continuing and deepening; His diaries reveal that no stone was left unturned, no small clue relating to the life of Horrocks was left un-investigated.

Fastidiously, he entered into his diary any snippets of information that might be of help, including some that were maybe nothing more than gossip: "On 14th Oct. 1909 an old resident of Toxteth Park, a Mr. Clark of Ampthill, or Ashbourne Rd (? Fulton Clark, of 3 Ashbourne Rd) told R.G., who saw him in the tram, that he (Clark) had one of Lassell's clocks made by the brother-in-law of Horrocks and that he believed H. was buried in Lassell's grave in the Ancient Chapel of T.P. Mr. Clark who claimed to be a relation of Horrocks, was aged 75 in 1906." (6 Sep 1926)

Other diary entries mention the endeavours of other Horrocks enthusiasts, whose work has been subsequently overlooked or lost. For instance, on 24 Aug 1927 he recorded meeting Prof. H.H. Turner[1], who "told me of a letter that had been sent to the Mayor of Southport by Rev. Canon J. Solloway, Abbey Vicarage, Selby, who had written a life of H. The MS. had been submitted to Macmillan's & reported favourably upon by their reader (Prof. R.A. Gregory, HHT thought). Canon S. said in the letter which H.H.T. read to me that he (Canon S.) had been in the house in wh. H. he believed had made his transit obs."

Carr House, near Much Hoole, Lancashire. (Image by David Sellers).

From the Latin manuscript of *Venus in Sole Visa* (Venus seen on the Sun) he read first-hand Horrocks's description of the transit observation on that winter afternoon in December 1639. He saw the young astronomer's account of 'retiring to a suitable room' to observe the striking silhouette of Venus, 'a new spot of unusual size and perfectly circular shape, now already fully entered upon the left limb of the Sun'.

[1] Herbert Hall Turner, Savilian Professor of Astronomy at Oxford University

There had been a tradition that this referred to a particular room on the first floor of Carr House, to the south of the village of Much Hoole.

There is no record, however, in Horrocks's own writings that this was the case. Gaythorpe decided to investigate whether the observation would even have been feasible from this room. What would the azimuth and altitude of Venus have been, compared with the orientation of the mullioned windows of the room? Would there have been space within the room to project the image of the Sun, given the type and size of telescope that Horrocks probably used. He enlisted the help of the Ordnance Survey in determining the position and orientation of Carr House, and made a series of personal visits to measure up the rooms.

In due course a report of his investigations appeared in the Journal of the British Astronomical Association (JBAA). This was in two parts. Part one, *Horrocks's Observations of the Transit of Venus 1639 November 24 (O.S.)*, published in December 1936, was a thorough analysis of the local circumstances of the transit and Horrocks's timings.

Before part two could appear, WWII intervened and a dramatic event occurred, which not only caused delay to the paper, but also sealed the fate of Gaythorpe's long delayed book on Horrocks. On 4 May 1941, during the 'Barrow Blitz', his house, in Prospect Road, was utterly destroyed in a Luftwaffe bombing raid, and along with it, many of his books and papers. In a letter to his friend and fellow Horrocks enthusiast, Dr Stephen Liberty (a cleric from Bedlington, Oxford), Gaythorpe wrote 'it was as if the house was never there'.

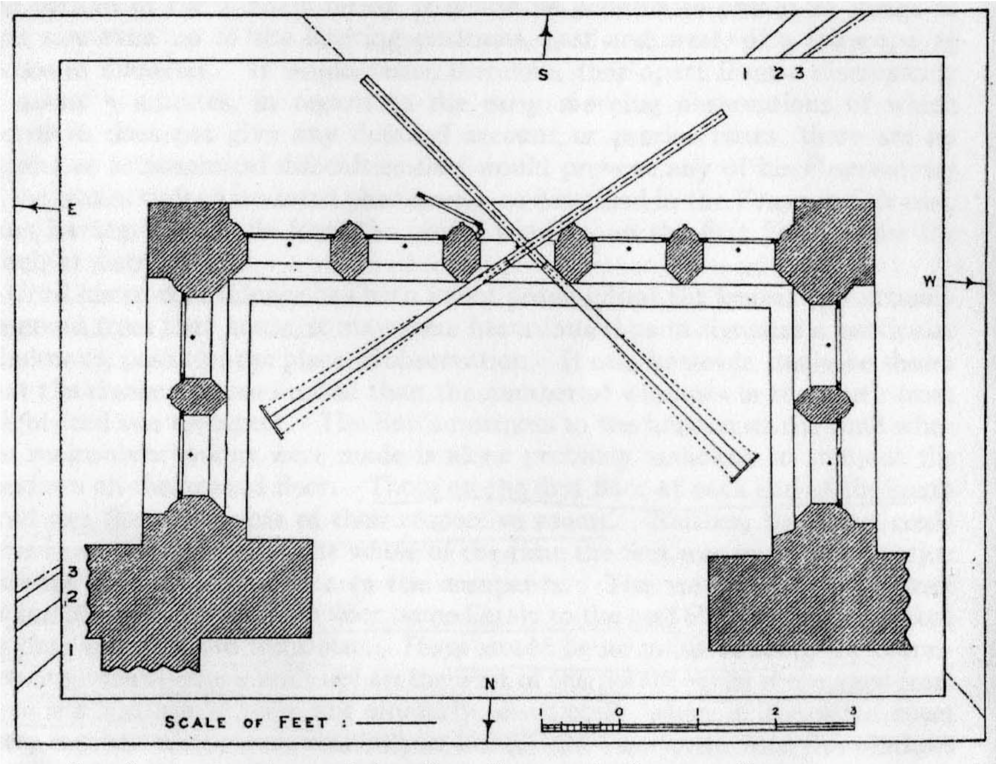
Liberty recognised that Gaythorpe's 'magnum opus' was in jeopardy. What was more, so many falsehoods and inaccuracies published about Horrocks stood in need of correction. He wrote to Gaythorpe,

> I wish that all these inaccuracies & misrepresentations about Horrox could be stopped by the publication of an edition from your hand, & with your introduction of the '*Venus in Sole visa*'. I am sure that is the 'desideratum' most necessary—& it would be a pity if the value of all your researches were lost to the world for want of publication even in a concise form.[1]

The second part of the paper about the Carr House issue was finally published in the JBAA of July 1954 with the subtitle '*On the probable site from which the observations were made'*. It examined whether any of the rooms at Carr House could have been used for the observation of the transit. Gaythorpe's conclusion was that 'If on the basis of tradition, Carr House is accepted as the site, it seems very probable that the centre window on the first floor, above the porch is the one from which the observations were made'. It is worth noting that Gaythorpe himself questioned that 'tradition' and he also doubted that the setting sun could have been viewed from that room without using the side-lights, as well as the south-facing main window.[2]

This paper really marked the end of Gaythorpe's travails on the life and work of Jeremiah Horrocks. The projected book, upon which he had laboured for more than half a century, never materialised After the destruction of his house and parts of his considerable library, he was forced to move to a much smaller home—a bungalow at 3 Litchmead Grove. According to his obituarist, Colin Ronan, 'this dislocation delayed his work and later, ill-health forced him to abandon the [book] project and so to satisfy himself by publishing a series of articles, although unhappily these were never completed'. Gaythorpe died in November 1964 at the age of 84.

[1] Letter from Stephen Liberty to Gaythorpe (21 Dec 1942). Barrow Archives Z/2896/1
[2] For a recent discussion of this matter, see *New observations from Carr House*, Kevin Kilburn and Clive Elphick, Astronomy & Geophysics, v.53 (2012), 3.20-21

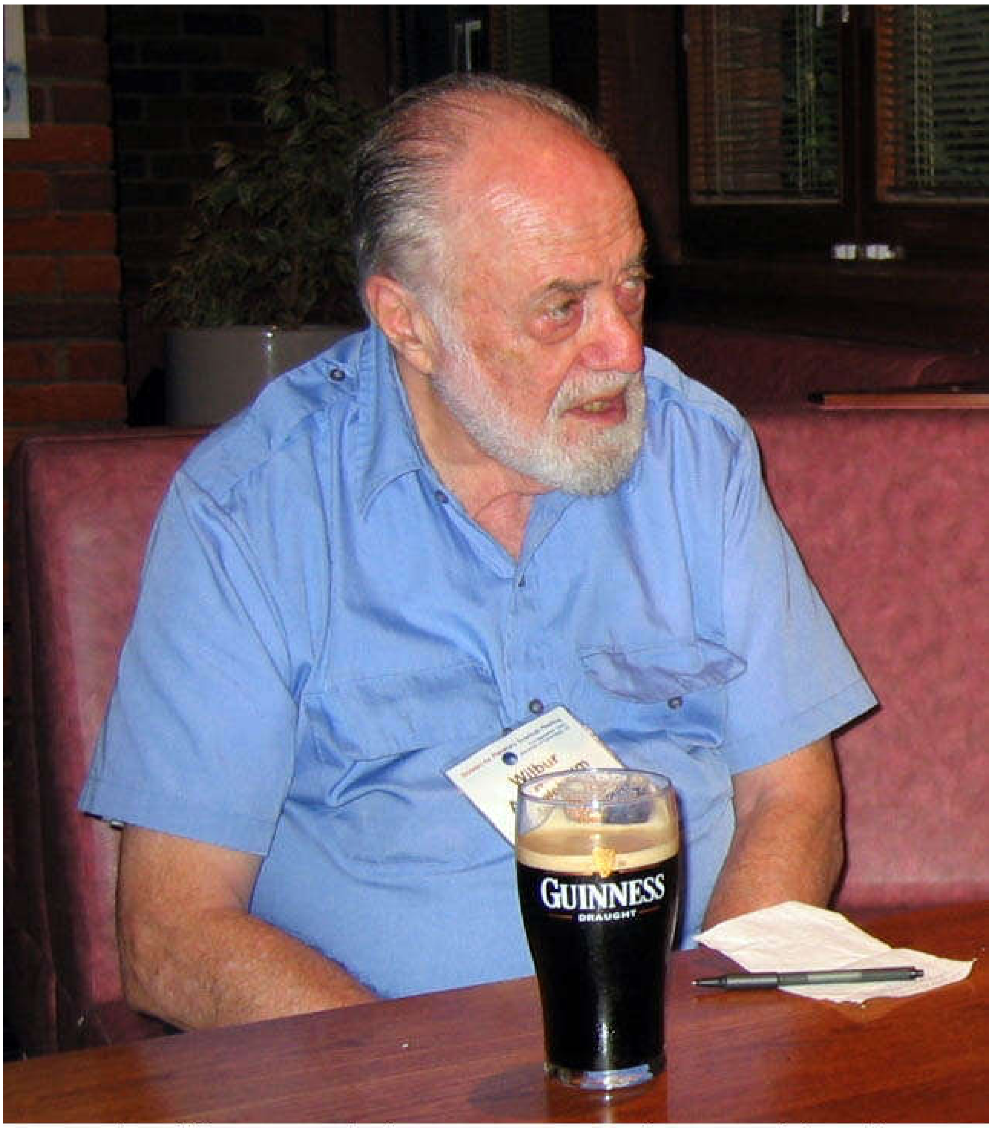


Gaythorpe's plan of the first floor window at Carr House

Gaythorpe's last home at Litchmead Grove, Barrow-in-Furness. Image by David Sellers

In a cruel repetition of circumstances, it transpires that the American historian of astronomy, Professor Wilbur Applebaum, who received much of the surviving Gaythorpe archive, and was himself, working for decades on an authoritative scholarly biography, *Jeremiah Horrocks and the New Astronomy*, died in late 2019 in his early nineties, without the book reaching publication. Applebaum had already published a revised translation of *Venus* *in Sole Visa*, with a fresh Introduction in 2012.[1] At the time of his death he was professor emeritus at Illinois Institute of Technology, where he taught the history of science for twenty-five years. His research interests and publications centred on seventeenth-century astronomy and the Scientific Revolution. He created and edited *The Encyclopaedia of the Scientific Revolution from Copernicus to Newton* (2000), and wrote *The Scientific Revolution and the Foundations of Modern Science* (2005).

Fortunately, it appears that Wilbur Applebaum's biography of Horrocks was very close to completion and arrangements are being made to bring it to publication—hopefully, later this year. Watch this space!



Prof Wilbur Applebaum. Image by David Sellers

[1] Applebaum, Wilbur, *Venus Seen on the Sun: The First Observation of a Transit of Venus by Jeremiah Horrocks* (Brill, Leiden, 2012). Before this publication, the only translation available was in Rev. Arundell Blount Whatton's *Memoir of the Life and Labors of the Rev. Jeremiah Horrox* (1859)

Astro-research 7

Paul A. Haley

Sharing good practice is defined within the third principal aim of the Society – with special emphasis on '*research by amateurs.*' A-R 6 (*Bulletin* 32, pp. 37-45) explored research strands for observational astronomy. This paper considers 5 more case-studies, exploring the general theme of specialist accessories and instruments, including: measurement / comet-seekers / the 'Dorpat-7' / inside Pulkovo observatory / and making a discovery. See SHA *Bulletins* 27-32 for the first 6 parts of this series.

Beginning a research strand 5: measurement

The writer's interest in the history of astronomy was sparked by the papers of John Larard (Webb Society) and Joseph Ashbrook (Sky & Telescope) celebrating tales of past double-star observers. Time spent observing multiple stars led to the construction of a brass filar micrometer on a Myford lathe (1989), and the speedy discovery of some of the engineering difficulties. A decade later the challenge of cutting an objective lens was considered but not attempted. Micrometers were important accessory instruments whilst the heliometer was a unique form of telescope with a divided objective. Both measured the angular displacements of stars and planets and required a skilful observer to ensure results were both accurate and precise. Their manufacture demanded engineering and optical proficiency of the highest standard – making any research of their history an opportunity to learn about some of the best instrument-makers in the world. Examples are illustrated in Figs 1 & 2 although their intricate working is difficult to infer without detailed technical drawings; these reveal the importance of finely-pitched screw threads, anti-backlash mechanisms and practical solutions of how an achromatic lens could be cleanly cut into two halves. Micrometer research links with the history of double star observers – consider the designs available to Herschel, South, Dawes, Tebbutt, Schiaparelli or Burnham for example. Heliometer instruments link with the history of parallax measurement and were used by a smaller group of specialists - Bessel, Winnecke, Gill and Elkin for example.

The illustrations invite further research; perhaps exploring the cost of such instruments or considering how errors were minimised. Both random and systematic errors undermined results and careful observers invested much time in their reduction. Including estimates of the uncertainty of measurements was not common practice with some observers naively claiming results of more than three significant figures could be routinely made. Determination of the orbital elements of a visual binary proved an exacting science with only the best results used in practice.

Further reading: the ingenuity of micrometer development across the 17^{th}-19^{th} centuries has been explored by Randall Chapman Brooks [1991JHA…22…127B]; for double star observers and catalogues a useful paper is by Joseph S Tenn [2013JAHH … 16(1) … 81T]; heliometer development has been discussed by Edward H Geyer [1985Ap&SS.110..183G]; and the historical search for stellar parallax by J D Fernie [1975JRASC..69..222F].

Fig 1: Micrometer designs: Top Row – Smeaton (1770), Nairne & Blunt (1780), Troughton (1795); 2nd Row – Dollond, Amici, Dollond; Middle Row – Fraunhofer (1820), Schroeder, Cooke; 4th Row – Repsold (1860), Clark, Grubb (1885); and Bottom Row – Burnham, Warner & Swasey (1896), Watson (1915).

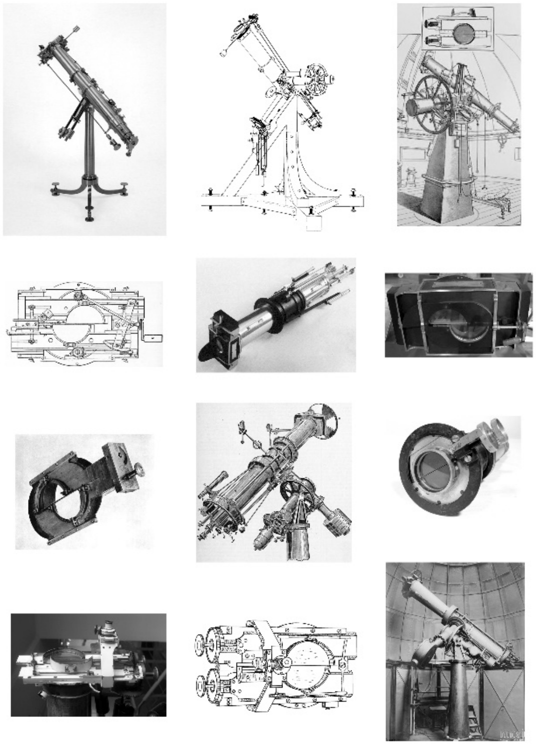


Fig 2: Heliometer designs: Top Row – Fraunhofer (1815), Konigsberg, Radcliffe; 2nd Row – 4-inch Repsold for Dun Echt; 3rd Row middle – Yale; and Bottom Row – Fraunhofer x2 (1820), 7-inch Repsold at Cape.

Beginning a research strand 6: comet-seekers

The writer has been fortunate to have owned or built over a dozen telescopes over 5 decades but only recently the opportunity to purchase a new instrument. Switching from an 8-inch maksutov-cassegrain of 120-inch focus (f/15) to a 5.2-inch apochromat of 36-inch focus (f/7) led to purchase of a wide field 35mm Panoptic eyepiece, producing a field of 3.5° at 26x magnification. The Pleiades (~ 2°) or Orion's belt (~ 2.7°) are easily viewed with over half the Hyades (~ 6°) also visible in this 'comet-seeking' configuration. Interest in how short-focus instruments evolved began and a starting date of 1780 was chosen. Despite early success at Slough British astronomers proved slow to adopt these new designs.

Caroline Lucretia Herschel (1750-1848) used a 4.2-inch Newtonian comet-sweeper (1783) of 27-inch focus (f/7) on an alt-azimuth stand which gave a field of 2.2° at 20x magnification. Three years later she discovered her 1st comet (1786 Aug) with 7 further comets found over the next decade. Her brother also made her a 9.2-inch (1791) of 63-inch focus (f/7), giving a 1.8° field at 25x power. Both telescopes facilitated vertical sweeps of the sky from a fixed observing position, with the larger instrument also measuring positions.

Short-focus refractors were rare at this time. William Kitchiner (1775-1827) at 43 Warren Street, Camden was testing most instruments available. His *Practical Observations of Telescopes* (1818), pp. 155-6 refers to 'a large night-glass' with a prism eyepiece moving from horizon to zenith using a single double convex lens of 3-inch aperture and power of 12-15x. Another early advocate was Jean-Louis Pons (1761-1831) at Marseille using a home-made 3-inch comet-seeker of 20-inch focus (f/7) with a 4.5° field.

Joseph Utzschneider (1760-1840) developed the Benediktbeuren glass factory with Joseph Fraunhofer (1787-1826) enabling production of high-quality flint glass and achromatic objectives up to 9-inch aperture by 1816. They marketed a 3-inch achromatic comet-seeker of 25-inch focus (f/8), providing a 6° field at 10x and a 15x power; these were priced at 486 florin (£40 ~£3.2k today) with a tripod and 392 florin (£33 ~£2.6k today) without. Observatories at Berlin (Encke), Mannheim (Nicolai), Jena (Schrön), Warsaw (Arminski), Bonn (Argelander) and Mecklenburg (Kleffel) were amongst the first to use the new design. The wide field and limiting magnitude of 12 facilitated comet and asteroid searches together with identification of variable stars. [The Bonn instrument was later modified by Henkel for Argelander's *Durchmusterung,* with the addition of large circles, verniers and a solid column mount for the south dome of the observatory.]

Georg Merz (1793-1867) succeeded Fraunhofer and marketed (1836) a 3.8-inch comet-seeker of 32-inch focus (f/8) giving a 5° field at 12x with 3 further powers of 18, 27 and 40x. These cost 700 florin (£58 ~£4.6k today) and proved popular: Pulkovo (Struve), Leiden (Kaiser), Neuschatel (Ragnior), Bonn (Argelander), Charkoff (Struve), Munich (Ertel), Washington (Gilliss), Vienna (Starke), Boston (Bowditch), London (Simms), London (Lettsom), New Hanover (Young). An Ertel instrument was mounted equatorially for Markree (Cooper) in 1842 leading to discovery of minor planet Metis (9) by Graham 6 years later. Nathaniel Bowditch (1773-1838) donated his comet-seeker to Harvard observatory where it was used first by George Phillips Bond (1825-65) and later by Charles Wesley Tuttle (1829-81) and his brother Horace Parnell (1837-1923) – see 'The Tuttles of HCO: 1850-62' by R. E. Schmidt, in *The Antiquarian Astronomer*, 6 (2012), pp. 74-103. The instrument had a 2.1° field on the Merz equatorial but was modified (1857) into a broken-back altazimuth using a large prism, giving a 4.5° field.

Comparing instruments used by successful comet hunters can also be useful:

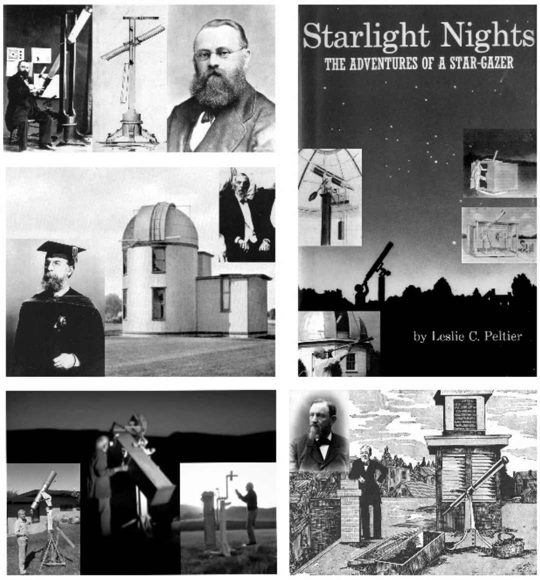


Fig 3: Comet observers and their instruments.

Lewis Swift (1820-1913) found 13 comets (1862-99) mainly using a 4.5-inch Fitz equatorial of 45-inch focus (f/10). Initially at Marathon he moved to Rochester, New York (1872) where optician Ernst Gundlach (1834-1908) designed a 9-element eyepiece giving a 3° field at 34x power. Combined with a replacement Clark lens (1877) Swift's discoveries quickly increased.

Ernst Wilhelm Leberecht Tempel (1821-89) found 19 comets (1859-74) using a 4.2-inch Steinheil refractor of 64-inch focus (f/15) equipped with 24x and 40x powers, giving a 2° field. He also found the Merope reflection nebula in the Pleiades (1859) and 5 minor planets (1861-68). Tempel observed from Venice, Marseille, Milan and Florence.

William Robert Brooks (1844-1921) emigrated to the USA (1857) from Maidstone, Kent. He found 27 comets (1881-1911) using 3 short-focus telescopes: a 5-inch Newtonian of 35-inch focus (f/7) and a 9.2-inch Newtonian, both home-made; and a 10-inch Clark refractor at the William Smith observatory, Geneva, New York.

Leslie Copus Peltier (1900-80) found 12 comets (1925-54) using a 6-inch refractor of 48-inch focus (f/8) giving a 2° field. This was used in 2 observatories built at Delphos, Ohio, the first with a 9-foot dome and the second building mounted on a circular track; he also used a 12-inch Clark refractor of 187-inch focus (f/16) after 1960. Peltier's book *Starlight Nights* (1963) is an inspiring tale.

William (Bill) Ashley Bradfield (1927-2014) found 14 comets from south Australia using: a 6-inch Dallmeyer portrait lens (c. 1870) of 33-inch focus (f/6) with a war-surplus Erfle lens giving 26x power; and a 10-inch Newtonian of 56-inch focus (f/6) on home-made alt-azimuth mounts.

Beginning a research strand 7: the 'Dorpat-7'

The Fraunhofer refractor commissioned by Friedrich Georg Wilhelm Struve (1793-1864) at Dorpat observatory [B29] defined a new standard for equatorial telescopes. One visitor to see the new German design (1832) was James South (1785-1867) who was setting up his Campden Hill observatory [C16] at Kensington with its 30-foot dome. Over the next three decades six copies of the Dorpat instrument were produced and these can be seen in the table below.

Each of the 'Dorpat-7' group had an interesting history – not least the Berlin instrument used to discover Neptune – and interested readers are encouraged to investigate further.

Beginning a research strand 8: inside Pulkovo observatory

Having considered accessories and specialist telescopes the intriguing question of what the inside of a 19th century observatory actually looked like is next explored. The 'astronomical capital of the world' was chosen as it inspired so many visiting astronomers, such as: Schumacher, Piazzi Smyth, Airy, Gill and Maria Mitchell.

No	Observatory	Country	Astronomer	Date	Size	Notes
1	Dorpat [B29]	Russia	W Struve Mädler	1825-39 1840-	9.5-inch 170-inch f/18	[1824] clock-driven equatorial / cupola dome double stars / Jupiter
2	Berlin [B11]	Germany	Encke Galle d'Arrest	1835-	9.5-inch 170-inch f/18	[1829] made for Vienna tripod / 24-foot dome Saturn / Neptune (1846)
3	Kazan [E33]	Russia east coast	Simonoff Lyapunov Kovalsky	1837-42 1848-55 1855-	9-inch 13.5-foot f/18	[1837] 14000 guilders cupola dome / fire (1842) Orion nebula / p. motion
4	Kiev [E34]	Russia	Fedorov	1841-55 1855-92	9-inch	[1841] 15000 guilders
5	Washington USNO [E44]	USA	Gilliss Maury		9.6-inch 183-inch f/19	[1844] $6000 23-foot dome / conical wooden tube / stone column
6	Collegio Romano [C38]	Italy	Secchi		9-inch 170-inch f/19	[1854] 10500 guilders 23-foot cupola dome
7	Palermo [B22]	Italy	Ragóna Tacchini	 1863-	9-inch 13.5-foot f/18	[1858] 15000 guilders Solar

Pulkovo observatory [D18] and the work of Friedrich Georg Wilhelm Struve (1793-1864) holds a magical fascination for the writer. An early interest in double stars involved time observing Σ pairs and saving hard for a copy of *Resolute and undertaking characters: the lives of Wilhelm and Otto Struve* (1988) by Alan H Batten (1933-). Many years later research for David Gill (1843-1912) linked to Struve's work on meridian arcs and a meeting with geodesist Jim Smith. Recent work on 19th century observatories has enabled further investigation of this inspiring centrepiece of Russian imperial astronomy and geodesy. An image bank was developed to further understand the layout of the observatory complex and its many instruments.

Google Books is one source for Struve's, *Description de l'observatoire astronomique central de Poulkova* (1845). Written in the French language it repays careful scrutiny but further research reveals the delightful set of images within the accompanying volume, *Description de l'observatoire de Poulkova – planches* (1845).

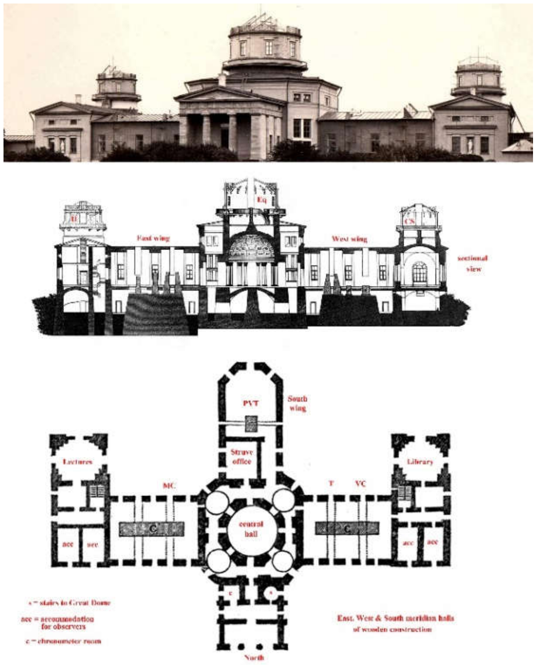


Fig 4: Pulkovo observatory [D18] showing locations of instruments.

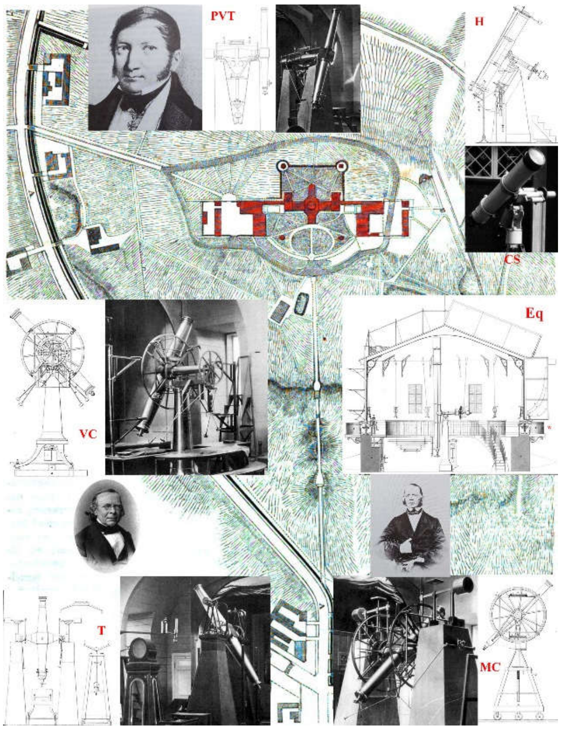


Fig 5: Pulkovo instruments: [PVT = prime vertical transit / H = heliometer / CS = comet seeker / VC = vertical circle / Eq = equatorial / T = transit / MC = meridian circle]

Online searches in German and Russian are also worthwhile but be prepared to find relatively few images. Perhaps one of the best 'planches' shows the 15-inch Merz refractor and internal layout.

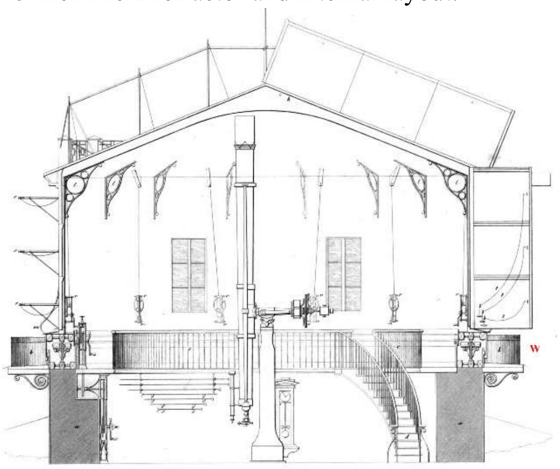


Fig 6: Inside the 32-foot dome at Pulkovo – the 15-inch Merz & Mahler equatorial of 270-inch focus (f/18).

This is interesting to compare with illustrations of its sister instrument at Harvard College Observatory. George Phillips Bond (1825-65) was the first astronomer to use both instruments; with his bicentenary approaching a verifiable photograph of him is long overdue! Such is the way of research that no sooner had Bond's life been reviewed then the writer was inevitably drawn to learn more about America's most famous female astronomer.

Beginning a research strand 9: making a discovery.

A period of two months and a £100 budget was allocated to research the life of Maria Mitchell (1818-89) with ~ 15 hours per week time available (summer 2019). Outcomes required were: a literature review, an image bank for montages, transcription of some archive materials, and to find something new about her work. The last point might appear unlikely given that Maria Mitchell (MM) is a famous figure whose life has been examined in minute detail, especially in America. But nothing ventured, nothing gained … and one attraction of the history of astronomy is that new discoveries can be made by anyone with commitment and determination. Believing something new will be discovered can be an incentive to begin work. The opportunity to further research female astronomers is a further factor for the writer.

Readers of this series will not be surprised to learn that the first two weeks were used to begin a chronological timeline for MM covering her whole life. Books consulted included: *Sweeper in the Sky: The Life of Maria Mitchell, First Women Astronomer in America*, by Helen Wright (1949) online; *Maria Mitchell and the Sexing of Science*, by Renée Bergland (2008); *Maria Mitchell: The Soul of an Astronomer*, by Beatrice Gormley (1995); and *Maria Mitchell: A Life in Journals and Letters*, by Henry Albers (2001). Online obituaries and articles were examined and the Maria Mitchell Association web-pages checked. In contrast to her well-documented early days in Nantucket her time at Vassar College (1865-87) appeared to offer opportunities for new insights.

As the image bank grew steadily a focus on the instruments used at different times and locations became increasingly important. The repetition of online authors became very apparent, especially where inaccuracies were blindly copied. Montages for the gold medals MM received and her time on Nantucket were designed.

Fig 7: Gold medals awarded to Maria Mitchell.

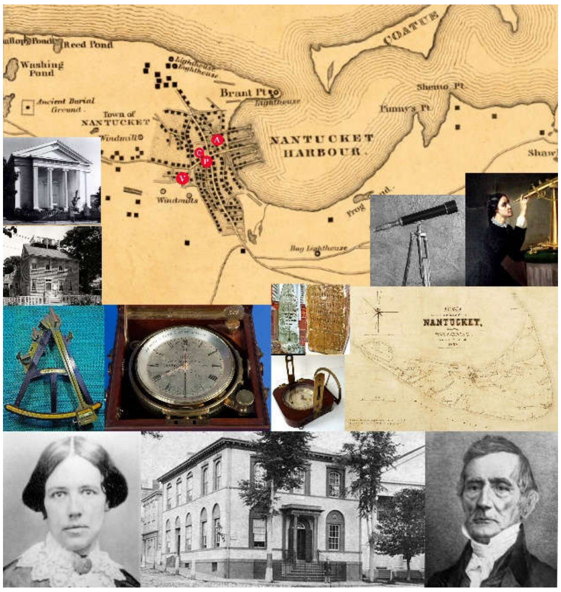


Fig 8: Nantucket island was mapped (1838) by William Mitchell and his daughter Maria who became a skilful user of chronometer, sextant and telescope. [V = Vestal Street / C = Coffin school / P = Pacific Bank / A = Atheneum library]

MM was appointed Professor of Astronomy and director of the observatory at Vassar College, Poughkeepsie, New York, where a 12.3-inch Fitz equatorial of 200-inch focus (f/16) had been installed. Although of impressive size the instrument quality provided several challenges; both the achromatism of the objective and the limitations of the drive would need attention, undermining its potential to continue her work on measuring close binary stars. Fortunately, MM had her own small telescopes to begin sunspot observations (1868), which preceded her Iowa solar eclipse expedition (1869) with many of her 'hexagon group' of students.

The unexpected finding of 200 glass plates in their original envelopes (1997) provided proof that her students photographed the Sun regularly; in a lecture (1873) MM mentioned that exposures of 6-seconds were involved. Vassar College celebrated these observations in their *Seeing the Sun* exhibition, but the accompanying booklet included the unlikely suggestion that the images had been taken using the large equatorial. Further scrutiny revealed that sunspot images were always taken around mid-day by a pair of students. Perhaps at first glance this information appears tenable, but for the writer it rang several alarm bells. In the words of Arthur Conan Doyle, writing of his most famous character, 'Come, Watson, come – the game is afoot!'

Fig 9:Six of Maria Mitchell's astronomy class of '68 were called the 'hexagon' group. They included (sitting, middle) Mary Watson Whitney (1847-1921) who became the second director.

Fig 10: Vassar College observatory (top left) was where astronomers Maria Mitchell and her father William Mitchell lived. The women's college was founded by Matthew Vassar who was born near Norwich, England.

The possibility of a new discovery [how were the Vassar College sunspot images actually taken?] was found after 3 weeks research. To solve the conundrum would require some careful detective work, but hopefully a description of how MM worked would exist somewhere. Over the next month the Vassar College archives were investigated online, with the kind support of archivist Dean Rogers who also provided a pdf list of student pairs imaging the Sun. A spreadsheet was compiled and details of students taught by MM in each college year tabulated; each student was then further researched online. However, none of this work revealed how the images were taken in practice.

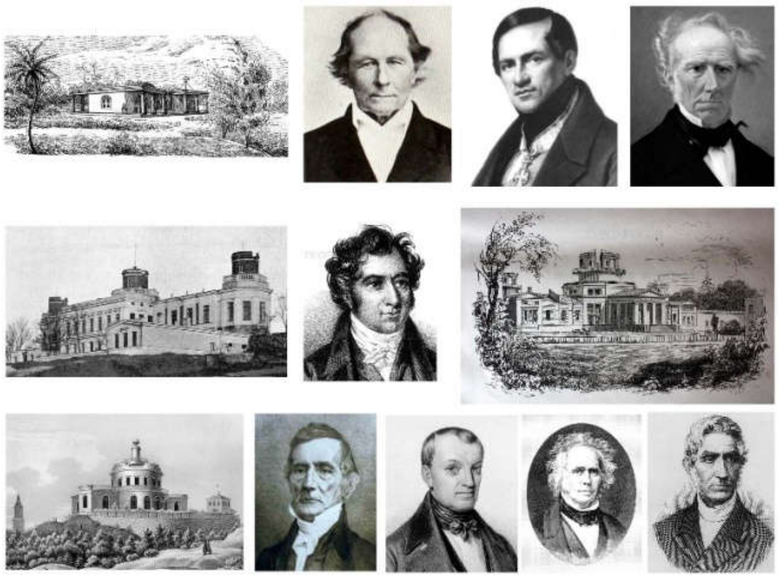
During the Iowa solar eclipse Joseph Winlock (1826-75), the director of Harvard College observatory, used a long-focus photoheliograph and weight-driven heliostat to image the Sun. He was assisted by instrument-maker Alvan Clark (1804-87) and their equipment would have been familiar to MM. Time was now spent exploring the possibility that a similar approach might have been used at Vassar, possibly utilising the observatory roof; the orientation of the observatory at Vassar College was found and since the roof-top was accessible by students for meteor watches the idea seemed plausible. A working hypothesis was emailed to Debra Meloy Elmegreen (current Professor of Astronomy on the Maria Mitchell Chair at Vassar College). Despite her limited time available (she is currently president-elect of the International Astronomical Union) her speedy response and encouragement proved a welcome boost, although the mystery remained.

Arrival of the detailed MM biography by Henry Albers (1925-2009), who had spent several years in retirement researching her and was a former director at Vassar College observatory (1958-89), surprisingly revealed no further information. A decision was made to purchase photocopies of the observatory annual reports for transcription; only two weeks remained to solve the mystery. Each report consisted of a small number of handwritten pages and it was apparent that little or no use of their contents had been made by earlier biographers – so this primary material has great value. Unfortunately, key sections of pages for the early 1870s were illegible so again an impasse was reached.

The next option was to download and examine the digital library images of Vassar College. With just days left for the project an 1874 image under careful scrutiny finally revealed the evidence of how the sunspot images were taken by students. The reason for the mid-day timing of the photographs became apparent and also for the lengthy (6s) exposures. A final explanation was emailed to Debra Elmegreen and favourably approved – the solution, a new revelation, fully explained the mystery. The writer informed Ian Ridpath of the outcome and the research findings will appear in a forthcoming issue of the *Antiquarian Astronomer*; this paper will mark the writer's fiftieth contribution to SHA publications

Astro-conundrum 6 ... Observatories 1830-39

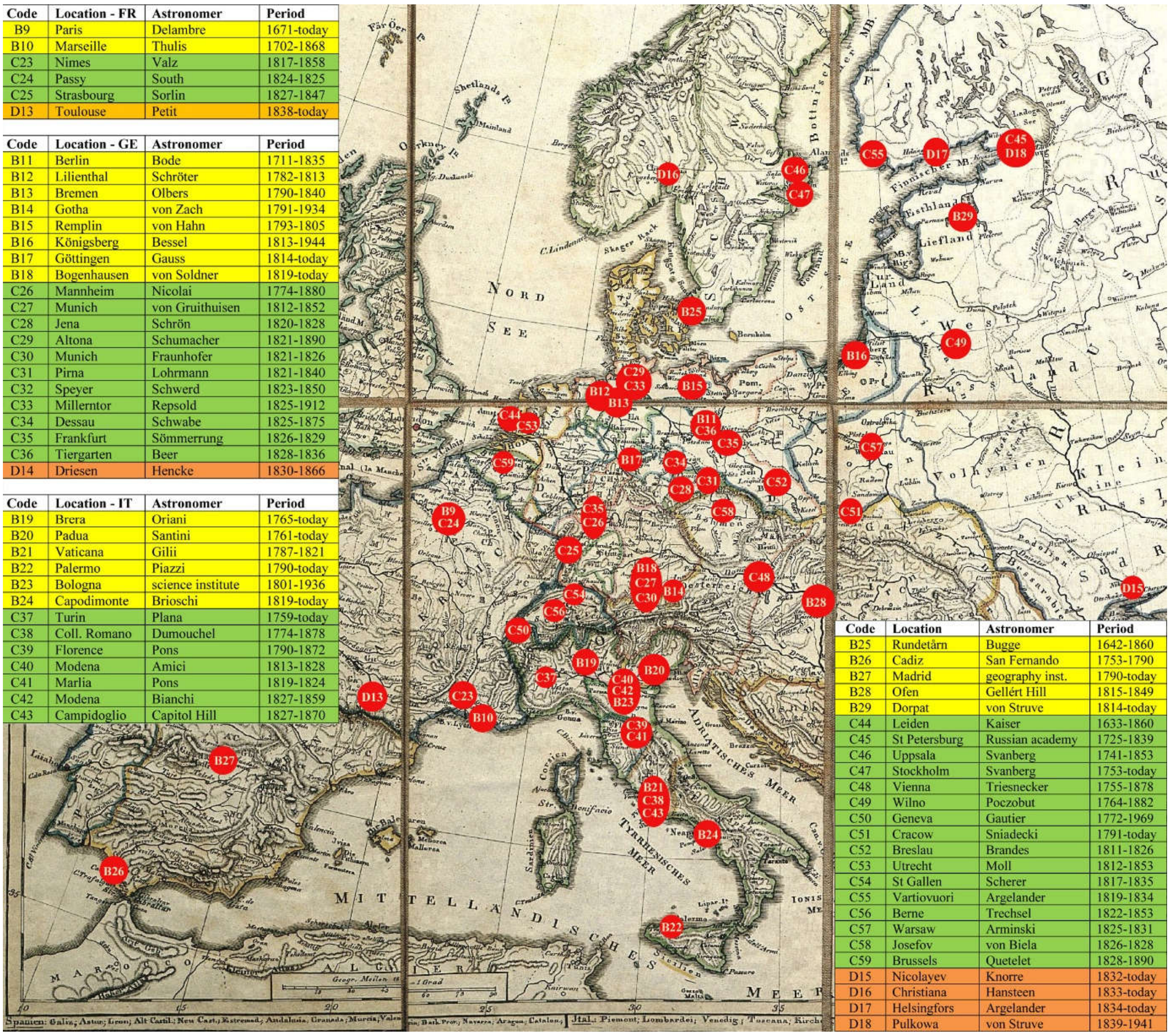
Born between 1786 and 1799 here are 8 pioneering astronomers and 4 observatories. What are their names and where were the observatories? Who was twice imprisoned as an enemy spy? Which observatory might have been consumed by fire in 1827? Who coined the word 'photography'? Which person set up 2 of these observatories? Which Cambridge astronomer spent 3 months in 1829 visiting a dozen observatories in Belgium, Germany, Switzerland, northern Italy and France? Having saved £140 (~ £9800 today) he returned home with just 2s 6d left (~ £8 today) but his luggage included a double-image micrometer from which Modena astronomer? Who was also a: statistician / calligrapher / politician / railway investor / lecturer / banker / microscopist / horologist?



19th Century Observatories: 1830-39

Paul Haley

The 5th paper of a series exploring the growth and development of astronomical observatories with a focus on instruments used and observing programmes. An astro-conundrum provides an additional visual challenge. Observatories with a prefix ‘A’ to ‘C’ have previously been introduced, in *Bulletins* 29 (pp. 8-10), 30 (pp. 42-7) and 31 (pp. 19-28) respectively; British and Irish examples for 1830-39, with a prefix ‘D’ were covered in *Bulletin* 32 (pp. 46-51). In this issue examples from across the world for 1830-39 are covered. Observatories marked with a * are revisited in future papers. The distribution of worldwide observatories and observing locations for 1800-39 are also illustrated.



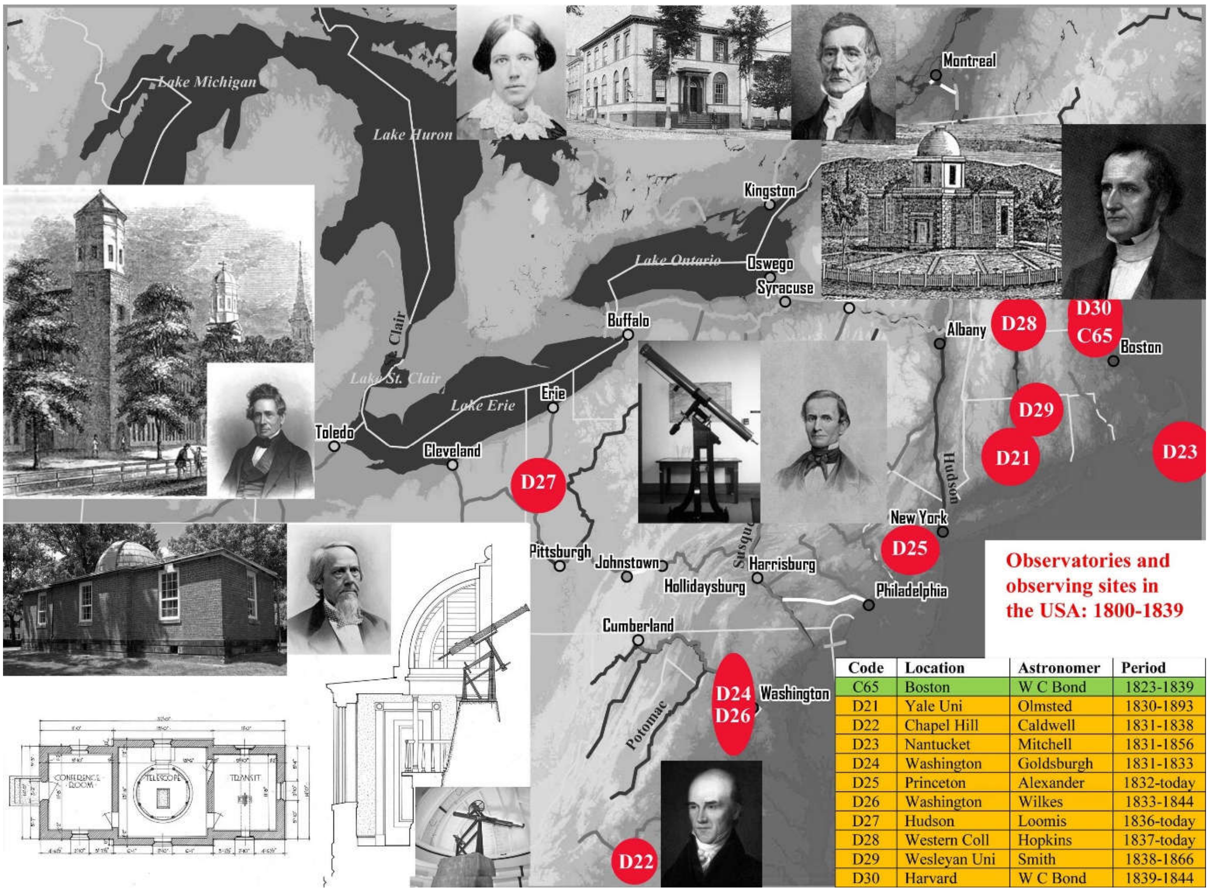
Code	Location - FR	Astronomer	Period
B9	Paris	Delambre	1671-today
B10	Marseille	Thulis	1702-1868
C23	Nimes	Valz	1817-1858
C24	Passy	South	1824-1825
C25	Strasbourg	Sorlin	1827-1847
D13	Toulouse	Petit	1838-today

Code	Location - GE	Astronomer	Period
B11	Berlin	Bode	1711-1835
B12	Lilienthal	Schröter	1782-1813
B13	Bremen	Olbers	1790-1840
B14	Gotha	von Zach	1791-1934
B15	Remplin	von Hahn	1793-1805
B16	Königsberg	Bessel	1813-1944
B17	Göttingen	Gauss	1814-today
B18	Bogenhausen	von Soldner	1819-today
C26	Mannheim	Nicolai	1774-1880
C27	Munich	von Gruithuisen	1812-1852
C28	Jena	Schrön	1820-1828
C29	Altona	Schumacher	1821-1890
C30	Munich	Fraunhofer	1821-1826
C31	Pirna	Lohrmann	1821-1840
C32	Speyer	Schwerd	1823-1850
C33	Millerntor	Repsold	1825-1912
C34	Dessau	Schwabe	1825-1875
C35	Frankfurt	Sömmerrung	1826-1829
C36	Tiergarten	Beer	1828-1836
D14	Driesen	Hencke	1830-1866

Code	Location - IT	Astronomer	Period
B19	Brera	Oriani	1765-today
B20	Padua	Santini	1761-today
B21	Vaticana	Gilii	1787-1821
B22	Palermo	Piazzi	1790-today
B23	Bologna	science institute	1801-1936
B24	Capodimonte	Brioschi	1819-today
C37	Turin	Plana	1759-today
C38	Coll. Romano	Dumouchel	1774-1878
C39	Florence	Pons	1790-1872
C40	Modena	Amici	1813-1828
C41	Marlia	Pons	1819-1824
C42	Modena	Bianchi	1827-1859
C43	Campidoglio	Capitol Hill	1827-1870

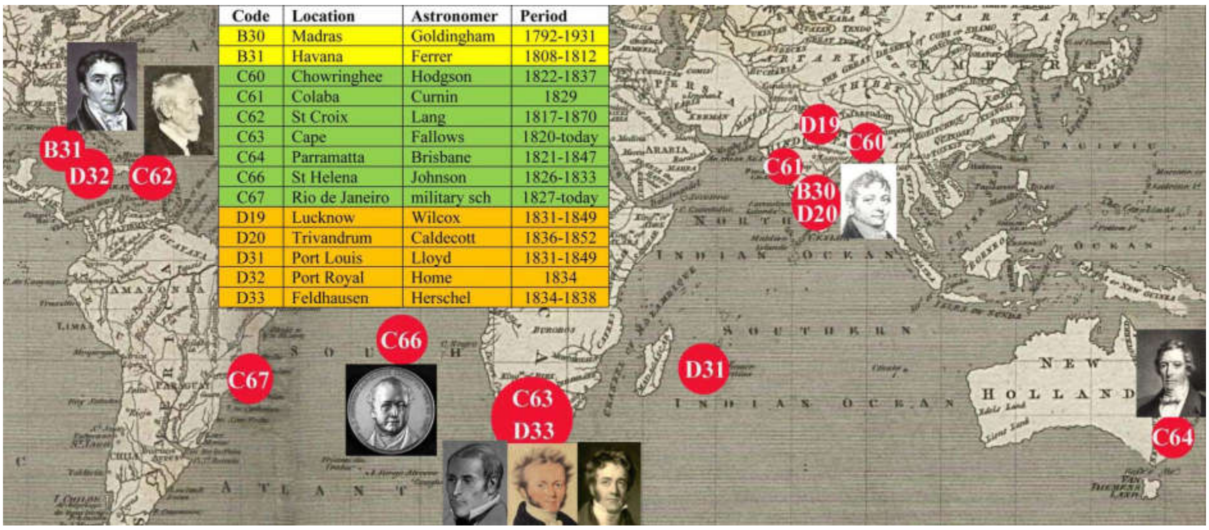
Code	Location	Astronomer	Period
B25	Rundetårn	Bugge	1642-1860
B26	Cadiz	San Fernando	1753-1790
B27	Madrid	geography inst.	1790-today
B28	Ofen	Gellért Hill	1815-1849
B29	Dorpat	von Struve	1814-today
C44	Leiden	Kaiser	1633-1860
C45	St Petersburg	Russian academy	1725-1839
C46	Uppsala	Svanberg	1741-1853
C47	Stockholm	Svanberg	1753-today
C48	Vienna	Triesnecker	1755-1878
C49	Wilno	Poczobut	1764-1882
C50	Geneva	Gautier	1772-1969
C51	Cracow	Sniadecki	1791-today
C52	Breslau	Brandes	1811-1826
C53	Utrecht	Moll	1812-1853
C54	St Gallen	Scherer	1817-1835
C55	Vartiovuori	Argelander	1819-1834
C56	Berne	Trechsel	1822-1853
C57	Warsaw	Arminski	1825-1831
C58	Josefov	von Biela	1826-1828
C59	Brussels	Quetelet	1828-1890
D15	Nicolayev	Knorre	1832-today
D16	Christiana	Hansteen	1833-today
D17	Helsingfors	Argelander	1834-today
D18	Pulkowa	von Struve	1839-1941

Fig A: Early European astronomy sites



Code	Location	Astronomer	Period
C65	Boston	W C Bond	1823-1839
D21	Yale Uni	Olmsted	1830-1893
D22	Chapel Hill	Caldwell	1831-1838
D23	Nantucket	Mitchell	1831-1856
D24	Washington	Goldsburgh	1831-1833
D25	Princeton	Alexander	1832-today
D26	Washington	Wilkes	1833-1844
D27	Hudson	Loomis	1836-today
D28	Western Coll	Hopkins	1837-today
D29	Wesleyan Uni	Smith	1838-1866
D30	Harvard	W C Bond	1839-1844

Fig B: Early American astronomy sites. Clockwise from top: Maria Mitchell & W. Mitchell at the Nat. Pacific Bank, Nantucket; A. Hopkins at Williams Coll.; A. W. Smith with 6-inch Lerebours at Wesleyan Uni.; J. Caldwell at Uni. of North Carolina; E. Loomis with 4-inch T&S at Western Reserve Coll.; and D. Olmsted at Yale Uni. in New Haven.



Code	Location	Astronomer	Period
B30	Madras	Goldingham	1792-1931
B31	Havana	Ferrer	1808-1812
C60	Chowringhee	Hodgson	1822-1837
C61	Colaba	Curnin	1829
C62	St Croix	Lang	1817-1870
C63	Cape	Fallows	1820-today
C64	Parramatta	Brisbane	1821-1847
C66	St Helena	Johnson	1826-1833
C67	Rio de Janeiro	military sch	1827-today
D19	Lucknow	Wilcox	1831-1849
D20	Trivandrum	Caldecott	1836-1852
D31	Port Louis	Lloyd	1831-1849
D32	Port Royal	Home	1834
D33	Feldhausen	Herschel	1834-1838

Fig C: Early equatorial & southern astronomy sites.

FRANCE

B9 - Paris Observatory * [1671-today] Dominique François Jean Arago (1786-1853) succeeded Bouvard as director in 1830. Arago continued his physical investigations into electromagnetism and polarised light, finding evidence of this in Halley's comet tail (1835), but his political responsibilities within the Second Republic soon increased. Instruments: a 6.3-inch Cauchoix-Gambey transit (1834) of 94-inch focus (f/15); and the Lerebours 9.6-inch (1823) & 12.6-inch (1829) achromatics on alt-az mounts on the terrace.

B10 – Marseille Observatory * [1702-1868] Benjamin Valz (1787-1867) succeeded Gambart in 1836 and continued the work on minor planets and comets.

D13 – Toulouse Observatory * [1838-] Frédéric Petit (1810-65) was the first director but spent 12 years relocating the observatory away from the city centre to the Butte de Jolimont.

GERMANY

B11 – Berlin Observatory * [1835-1913] Johann Franz Encke (1791-1865) moved from the old tower to a new 2-storey observatory. Instruments: a 9.5-inch (1829) Fraunhofer equatorial of 170-inch focus (f/18) beneath a 24-foot iron dome, used by Encke and assistant Johann Gottfried Galle (1812-1910) to discover both a second gap and the third ring C of Saturn (1837); a 4-inch Pistor meridian circle (1838) of 60-inch focus (f/15); a 2.8-inch Fraunhofer-Utzschneider heliometer of 42-inch focus (f/15); and a 3-inch Utzschneider comet-finder of 26-inch focus (f/9). Galle became the main observer with 3 comet discoveries by 1840. Encke planned the Academy star maps (1830-59), expanded the *Astronomisches Jahrbuch*, and published results in the *Astronomische Beobachtungen*.

B14 - Gotha Observatory, Seeberg * [1791-1934] Peter Andreas Hansen (1795-1874) was director. The exposed site on Seeberg hill required costly maintenance so a decision (1839) was taken to relocate to the city. Hansen studied the mutual perturbations of Jupiter and Saturn and lunar theory.

B16 - Kőnigsberg Observatory * [1813-1944] Friedrich Wilhelm Bessel (1784-1846) produced an exact reference system for star positions. His *Tabulae Regiomontanae* (1830) defined coordinates for Maskelyne's 36 fundamental stars in relation to the equator and ecliptic using daytime observations with the 4.2-inch Reichenbach meridian circle. He completed a geodetical survey of East Prussia with results demonstrating the Earth was an oblate spheroid. Bessel developed the *Akademische Sternkarten* star atlas and published a theory of comets. The £750 investment (~£60k today) in the 6.5-inch f/16 Fraunhofer heliometer (1829) was repaid when the parallax of 61 Cygni was measured (1838).

B17 - Gőttingen Observatory * [1814-today] Carl Friedrich Gauss (1777-1855) was director. He added geomagnetic instruments and worked with Wilhelm Weber (1804-91) to connect these to the University physics laboratory (1833) using a telegraph operating at 6 words per minute over a distance of 2 miles.

B18 - Bogenhausen Observatory, Munich * [1819-1927] Johann von Lamont (1805-79) succeeded Soldner as director. He installed a 11.2-inch Merz equatorial (£1830 in 1835, ~£147k today) of 196-focus (f/18) and observed two dozen stellar spectra using a small prism eyepiece. Lamont later focused on geomagnetic work.

C29 – Altona Observatory, Hamburg * [1821-90] Heinrich Christian Schumacher (1780-1850) continued as director. He had launched the journal *Astronomische Nachrichten* in 1821 and produced 30 volumes over 3 decades. In 1827 Adolph Cornelius Petersen (1804-54) was appointed and observed at Altona for 24 years, also playing an active role in geodetic surveys.

C33 - Millerntor Observatory, Hamburg * [1825-1912] Charles Rümker (1788-1862) succeeded Repsold as director from 1833-57. He produced star catalogues beginning in 1832 with the southern stars he had observed at Parramatta.

C36 – Tiergarten Observatory, Berlin [1828-1836] Wilhelm Wolff Beer (1797-1850) and Johann Heinrich Mädler (1794-1874) used the 3.7-inch f/15 Fraunhofer equatorial to observe the Mars opposition of 1830 and the Moon. The *Mappa Selenographica* (1834-6) was published in 4 volumes and *Der Mond* (1837) included descriptions and measurements of 148 craters and 830 mountains. Mädler moved to Berlin Observatory in 1836 as observer before succeeding Struve at Dorpat in 1840.

D14 – Driesen Observatory * [1830-66] Karl Ludwig Hencke (1793-1866) worked as a postal clerk by day and planet-hunter at night from a roof-top observing platform. He used a Fraunhofer achromatic of 2.5-inch aperture and 30-inch focus (f/12) which retailed for 68 florin (~ £450 today) and enabled stars to the 10th magnitude to be mapped. Hencke believed that since 4 minor planets had been found by 1807 there must be more to be discovered – his diligent star charting would be rewarded 15 years later.

ITALY

B19 - Brera Observatory, Milan * [1765-today] Geodesist Francesco Carlini (1783-1862) was director from 1832-62. Instruments: a 4-inch Starke meridian circle (1832) of 60-inch focus (f/15) was mounted in the highest tower (1837); and a 12-inch Amici reflector (1839). Carlini worked with Plana to investigate plumb-line deviations produced by alpine mountains.

B20 – Padua Observatory * [1761-today] Giovanni Santini (1787-1877) installed a 4.6-inch Starke meridian circle (1837) to re-observe stars from Bessel’s zones. Working for a decade with assistant Virgilio Trettenero (1822-63) the results would be published in 5 catalogues.

B22 – Palermo Observatory * [1790-today] Niccolò Cacciatore (1770-1841) was director but he focused more on meteorological observations.

B24 - Capodimonte Observatory, Naples * [1819-today] Ernesto Capocci (1798-1864) succeeded Brioschi in 1833 and continued his work on comet orbits. Antonio Nobile (1794-1863) and Leopoldo Del Re (1805-72) were also observers.

C37 – Turin Observatory * [1759-today] Giovanni Antonio Amedeo Plana (1781-1864) was director. He published 3 volumes on lunar theory (1832) and completed geodetical surveys.

C38 - Collegio Romano Observatory * [1774-1878] Francesco de Vico (1805-48) succeeded Dumouchel as director of the Vatican observatory in 1838. He observed eclipses, satellites and comets with the 6.2-inch Cauchoix refractor.

C39 – La Specola, Florence * [1790-1872] Giovanni Battista Amici (1786-1863) succeeded Pons as director in 1831. He observed comets, double stars, Saturn and aurorae with his own instruments. Amici constructed reflecting circles for navigators and optics for achromatic microscopes; He began planning a large refractor of 10.5-inch aperture.

C42 – Modena Observatory * [1827-59] Giuseppe Bianchi (1791-1866) continued as director during this decade.

REST OF EUROPE

B25 – Rundetårn Observatory, Denmark * [1642-1860 & 1928-today] Christian Friis Rottbøll Olufsen (1802-55) began as observer at Copenhagen (1829) and then director (1832). Instrument: a 3.5-inch Fraunhofer achromatic (1830) of 54-inch focus (f/15). Olufsen worked with Bessel on lunar parallax but his city location and 19-foot dome limited instrument capacity and a new observatory at Østervold would open in 1861.

B29 - Dorpat Observatory, Russia * [1814-today] Friedrich Georg Wilhelm von Struve (1793-1864) was director working on geodesy and double stars. His measures of 2714 pairs (1824-37) appeared in *Stellarum duplicium et multiplicium mensurae micrometricae* (1837) together with results for the parallax of Vega. At the end of the decade he moved to Pulkovo with his 3 assistants: Georg Fuss (1806-54), Georg Thomas Sabler (1810-64) and his son Otto Wilhelm Struve (1819-1905).

C44 – Leiden University Observatory, Netherlands * [1633-1860] Frederick Kaiser (1808-72) began as observer (1826) and succeeded Pieter Johannes Uylenbroek (1772-1844) as director (1837). Instruments: a 1.9-inch Ertel portable transit (1838); a 3.1-inch Plőssl dialyte; a 3.9-inch Fraunhofer comet-seeker of 35-inch focus (f/9). Kaiser decided to replace the poor quality 22-inch Rienks-Roelofs reflector (1828) with a 6-inch Merz equatorial.

C55 - Vartiovuori Observatory, Åbo, Russia [1819-1834] Friedrich Wilhelm August Argelander (1799-1875) published his *Catalogus aboensis* (1835) based on Åbo measures of 560 stars showing proper motion and investigated how the solar system moved in space. Instruments were transferred to Helsingfors and Åbo became a maritime school (1836).

C59 – Brussels Observatory, Belgium * [1828-] Lambert Adolphe Jacques Quetelet (1796-1874) was director. Instruments (by 1836): a 6.3-inch Cauchoix-Gambey meridian transit of 95-inch focus (f/15); a 3.7-inch T&S mural circle; a 3.7-inch T&S equatorial of 64-inch focus (f/17); and a 7-inch Rienks reflector of 44-inch focus (f/6). Quetelet focused on geomagnetism, meteorology, meteor showers and statistics.

D15 - Nicolayev Observatory, Russia * [1832-today] Karl Frederich Knorre (1801-83) became naval astronomer at Nicolayev (1821) and then director (1832) for 5 decades. Instruments: a 4-inch Ertel meridian circle (1824), used to complete a section of the Berlin Academy sky chart.

D16 – Christiana Observatory, Norway * [1833-today] Christopher Hansteen (1784-1873) first directed the university geodetic & astronomical observatory (1815-28). Instruments: a 1.4-inch Sisson transit of 17-inch focus (f/12); a 1.8-inch Reichenbach achromatic (1822) of 20-inch focus (f/11); a 5-inch Bidstrup Gregorian (1790) of 40-inch focus (f/8), from Bugge at Copenhagen; and a 2.6-inch Fraunhofer achromatic of 38-inch focus (f/15). Hansteen became director of the new observatory at Christiana which was based on the Altona design. New instruments: a 4.4-inch Ertel meridian circle (1828) of 62-inch focus (f/14) in the East wing (1834); and a 4.4-inch Utzschneider achromatic (1828) mounted alt-azimuthly by Repsold (1833).

D17 – Helsingfors Observatory, Russia * [1834-today] Argelander spent a decade at Åbo before transferring to a new observatory on Ulrikasborg, Helsingfors (Helsinki, Finland today). Instruments in the 3 cylindrical domes: a 4-inch Reichenbach meridian circle (1827), a 24-inch Liebherr repeating circle (1824) and a 5.5-inch Fraunhofer transit of 96-inch focus (f/17), all from Åbo; and a 6.9-inch Merz equatorial (£540 in 1835, ~£43k today) of 115-inch focus (f/17) and time ball in the central dome. Argelander then moved to Bonn (1837) to plan another new observatory. He was succeeded by Lundahl (1783-1846) and then geodesist Frederik Woldstedt (1813-61).

D18 – Pulkovo Observatory, St Petersburg, Russia * [1839-1941 / - today] Struve was the first director with a remit to coordinate and centralise Russian imperial astronomy and geodesy – including the work of the regional observatories of Dorpat, Helsingfors, Kazan, Kharkov, Kiev, Moscow, Nicolayev and Wilno. The patronage of Nicholas Pavlovich (1796-1855) ensured its location, on his estate 12 miles S of St Petersburg, became the astronomical capital of the world; an estimated 600000 silver roubles was invested in the instruments and library (~ £40000, or £3 million today). Instruments: a 15-inch Merz & Mahler equatorial of 270-inch focus (f/18) in the central 32-foot dome (40000 guilder, ~ £267k today); for meridian work, a 6-inch Ertel vertical circle of 78-inch focus (f/13) and a 6-inch Ertel transit of 104-inch focus (f/17) in the west wing, a 6.2-inch Repsold prime vertical transit of 94-inch focus (f/15) in the south wing and a 6-inch Repsold meridian circle of 86-inch focus (f/14) in the east wing; a 7.4-inch Merz & Mahler heliometer of 123-inch focus (f/17) in the 20-foot east dome and a 3.8-inch Merz comet seeker of 30-inch focus (f/8) in the 20-foot west dome.

INDIA

B30 - Madras Observatory * [1792-1931] Thomas Glanville Taylor (1804-48) succeeded Goldingham in 1830. Instruments: a 3.7-inch Dollond transit (1829) of 60-inch focus (f/16); a 3.7-inch Dollond mural circle (1829) of 48-inch diameter; and a 3-inch Dollond equatorial of 60-inch focus (f/20). Taylor began work on the Madras catalogue and actively supported GTS work in India, initially assisting George Everest (1790-1866) at Calcutta. Goday Venkata Juggarow (1817-56) was trained by Taylor (1834-8) before establishing his own observatory at Vizagapatum in 1840.

D19 – Lucknow Observatory * [1831-49] Founded by Nasiruddin Haider (1803-37), surveyor James Dowling Herbert (1791-1833) planned the observatory but was succeeded in 1835 by Richard Wilcox (1802-48) who installed the T&S instruments: a 72-inch mural circle (1839); a 6-inch transit of 96-inch focus (f/16); and a 5-inch equatorial of 108-inch focus (f/21). Wilcox intended to compliment the work at Madras with assistants Kalee Charan and Ganga Pershad but results were never published.

D20 – Trivandrum Observatory * [1836-52] Founded by Svati Tirunai (1813-47), astronomer John Caldecott (1800-49) installed: a 3.7-inch Dollond transit; a 4-inch Dollond mural circle (1836) of 5-foot diameter; a Jones mural circle; a portable T&S alt-az; with a 5-inch Dollond equatorial of 90-inch focus and a 4.3-inch equatorial of 60-inch focus added 6 years later. However little astronomical work was undertaken.

USA

D21 – Yale Observatory, New Haven, Connecticut * [1830-93] Denison Olmsted (1791-1859) and Elias Loomis (1811-89) observed Halley's comet (1835) with a 5-inch Dollond triplet (1830) of 120-inch focus (f/24), using an alt-az mount on casters from the Atheneum chapel tower. Olmsted investigated meteors after the 1833 Leonid display. Students Ebenezer Porter Mason (1819-40) and Hamilton Lanphere Smith (1818-1903) began using Holcomb reflectors and made a 12-inch Herschelian of 168-inch focus (f/14). Mason observed nebulae in Sagittarius (1839) using brightness contour mapping for the Omega and Trifid nebulae.

D22 – Chapel Hill Observatory, University of North Carolina [1831-38] Joseph Caldwell (1773-1835) was the first president of UNC and initially used a roof-top platform at home for observing. He funded a 20-foot square wooden building for instruments purchased during a trip to Europe (1824): a Simms meridian transit and alt-az; and a Dollond achromatic. Observers included Caldwell, Mitchell and James Phillips until a fire destroyed the building (1838).

D23 – Nantucket Observatory, Massachusetts * [1831-56] William Mitchell (1791-69) observed the solar eclipse of 1831 Feb from his Vestral Street home assisted by 12-year old daughter Maria (1818-89). They observed Halley's comet (1835) and Maria made sextant and transit observations for rating chronometers for whaling ship captains. In 1836 her father was observing for the US Coastal Survey and started working at the Pacific National Bank in Main Street where the family soon moved. Maria started her 2-decade career as librarian at the Nantucket Atheneum. They again set up a roof-top observing platform for their 2.7-inch Dollond achromatic of 42-inch focus (f/16) but were soon loaned additional instruments.

D24 – Depot of Charts & Instruments Observatory, Washington [1831-33] Naval officer Louis Malesherbes Goldsborough (1805-77) used a 2-inch Patten transit of 30-inch focus (f/15) for rating chronometers. It was mounted on a brick pier within a circular building near the White House.

D25 – College of New Jersey / Princeton * [1832-today] Stephen Alexander (1806-83) and physicist Joseph Henry (1797-1879) used a 3.5-inch Fraunhofer achromatic of 48-inch focus (f/14) and a 2.8-inch Dollond achromatic of 42-inch focus (f/15) to observe eclipses and occultations. They determined their longitude difference from Philadelphia using meteor observation in 1835.

D26 – Capitol Hill Observatory, Washington * [1833-44] Charles Wilkes (1798-1877) succeeded Goldsborough and relocated the observatory, increasing its size to 14x13-feet. Instruments: a 3.7-inch Troughton transit (1815) of 63-inch focus (f/17), loaned by the Coast Survey for solar transits; and a 3.2-inch achromatic of 42-inch focus (f/13). James Melville Gilliss (1811-65) became assistant (1836) and director (1838).

D27 – Hudson Observatory, Western Reserve College, Ohio * [1836-today] Loomis transferred from Yale to WRC and visited Europe (1836) for instruments: a 4-inch T&S equatorial of 66-inch focus (f/16) and a 2.7-inch Simms transit of 30-inch focus (f/11) with an 18-inch circle, both installed (1838) in a 37x16-foot brick building with a 9-foot tin dome.

D28 – Hopkins Observatory, Williams College, Massachusetts * [1837-today] Albert Hopkins (1807-72) built a 48x20-foot hexagonal stone observatory with a 13-foot dome on a wooden turret. Instruments: a 8-inch Herschelian reflector of 10-foot focus (f/15) and a 3.5-inch T&S transit of 50-inch focus (f/14).

D29 – Wesleyan University, Middletown, Connecticut * [1838-66] Augustus William Smith (1802-66) used a 6-inch Lerebours achromatic of 84-inch focus (f/14) in a 9-foot wooden octagonal observatory behind his home in Cross Street. This Methodist university also had a 1-ton orrery (1836) with a 45-foot solar system and 36-foot zodiac for students to use as a planetarium.

D30 – Dana House Observatory, Cambridge, Massachusetts * [1839-44] William Cranch Bond (1789-1859) became observer for Harvard College. Instruments from Dorchester: a 9-inch Short Gregorian of 60-inch focus (f/7), mounted in a cupola added to his 2-storey home; a 2.7-inch T&S transit of 46-inch focus (f/17); two 3-inch achromatics; and geomagnetic instruments. Within 2 years funding plans for a major new refractor at Harvard would be underway.

OTHER

C63 - Royal Observatory, Cape of Good Hope, South Africa * [1820-today] Fearon Fallows (1789-1831) oversaw the observatory build with its two 14-foot copper domes (£3000) installed (1829) but then died from scarlet fever. The 2nd director Thomas Henderson (1798-1844) observed with assistant William Meadows, making nearly 10,000 measures with a 4.9-inch Dollond transit of 120-inch focus (f/24) and a 4-inch Jones mural circle of 72-inch focus (f/18). Henderson introduced a new time service (1833) with night firing of a pistol from the observatory roof. The 3rd director Thomas Maclear (1794-1879) arrived in 1834, just before the Herschel family whose base at Feldhausen was 4 miles away. Maclear's assistant Thomas Bowler (1812-69) was soon replaced (1835) by 16-year old Charles Piazzi Smyth (1819-1900), with a second assistant William Mann (1817-73) also appointed (1839). Maclear investigated the problematic mural circle, installed the 12-inch Herschel reflector beneath one dome, and began re-measuring La Caille's arc of meridian (1837-47).

C64 - Parramatta Observatory, New South Wales, Australia * [1821-47] James Dunlop (1793-1848) returned to Parramatta (1831-6) from Makerstoun but poor health limited his work. Inaccuracies found in the Parramatta star catalogue of 7385 star-positions (1835) revealed errors in the transit telescope. By 1847 the observatory had succumbed to white ants but the instruments were rescued by hydrographer Phillip Parker King (1791-1856) and later used at Sydney. Parramatta was eventually demolished in 1879.

D31 – Port Louis, Mauritius * [1831-49] John Augustus Lloyd (1800-54) became Surveyor-General at Mauritius (1831) and developed the Beaufort Tower into an observatory. Instruments: a 3-inch Cary transit of 46-inch focus (f/15); a 3-inch T&S transit of 46-inch focus (f/15); and a Ramsden alt-az circle mounted beneath a rotary roof.

D32 – Fort Charles, Port Royal, Jamaica [1834] Naval captain James Everard Home (1793-1853) observed the 1834 November solar eclipse using a 4-inch achromatic of 60-inch focus (f/15); Byron Drury (1815-88) also timed the eclipse aboard HMS Racehorse at Port Royal using a similar telescope. Home later used a 3.5-inch Tulley to observe the 1842 July eclipse from Woosung, China; adding a 3rd solar eclipse from Kororaroka, New Zealand in 1845 October.

D33 – Feldhausen, Claremont, South Africa [1834-8] John Herschel set up his 18-inch reflector of 240-inch focus (f/13) in 1834 February; also his 5-inch Tulley equatorial of 84-inch focus (f/17) in a dome 4 months later. To overcome rapid tarnishing Herschel rotated 3 specula with each one needing re-polishing after a dozen nights use. By 1835 October he had reviewed the whole of the southern heavens, assisted by mechanic John Stone, observing 1200 doubles and 1700 nebulae & clusters. The Magellanic Clouds received special attention together with Halley's comet and a sudden brightening of η Argus at the end of 1837. Gauge analysis suggested the 20-foot reflector could potentially show 5.5 million stars across both hemispheres, with the faintest of the 14th magnitude.

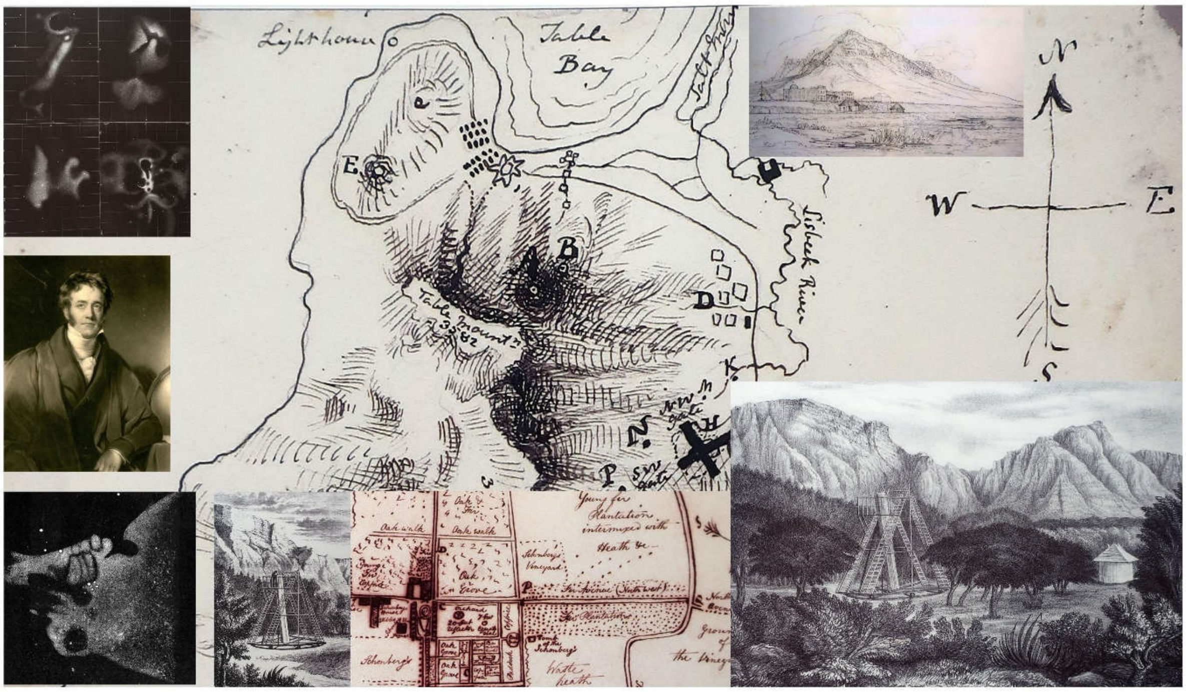


Fig D: John Herschel at Feldhausen, Cape of Good Hope, South Africa

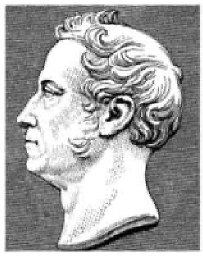
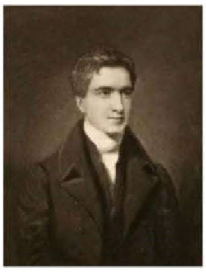
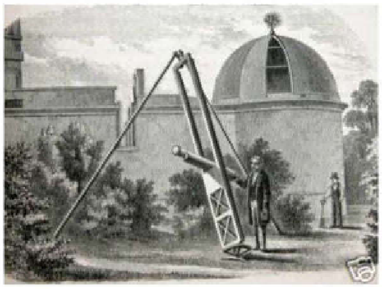
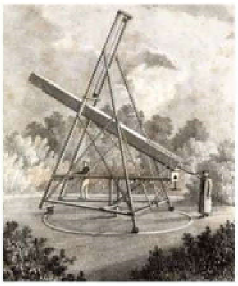
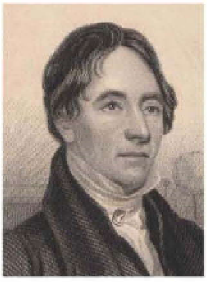
*In SHA *Bulletin* 34 the decade 1840-1849 will be reviewed. Please email feedback on this series to Paul Haley: pahastro@aol.com

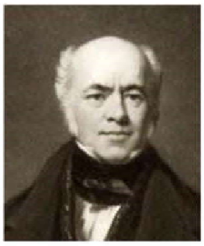
Astro-conundrum 5 ... Observatories 1830-39

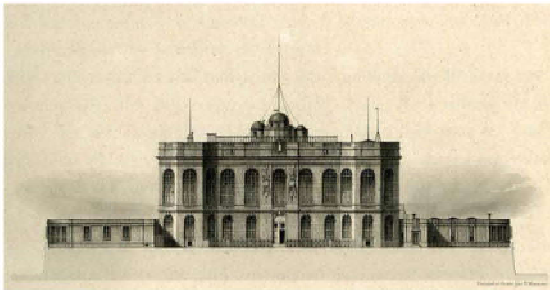
Born between 1774 and 1813 here are 10 pioneering astronomers and 4 observatory sites. What are their names? Who set up each observatory and where were they located? What size are the 2 telescopes used in the open air? Which observatory significantly altered its appearance over the next 2 decades? Who investigated the possibility of a planet beyond Uranus? Which 5 astronomers produced important catalogues? Whose interest in astronomy developed after visiting Palermo observatory? Which person observed both solar eclipses and pendula? Who made the most southerly observation of Halley's comet? Who tested aerial reflecting telescopes? Who was also a: politician / blacksmith / meteorologist / barrister / naval officer / photographer / engineer / mathematician / numismatist / teacher?







ANSWERS for AC-5 – by Paul Haley [E: pahastro@aol.com]

1) Nasmyth, Mary Rosse, Mary Somerville, Smyth, Robinson, Dick, Lee, Herschel / Baily and Cooper were the 10 pioneers. Observatory sites at: South Villa, Regent's Park [Bishop], Bedford [Smyth], Markree, Sligo [Cooper] and Paris, in 1837 [Louis XIV, Cassini]. 2) Telescopes: Smyth's 3.7-inch f/32 refractor (1830) & Cooper's 13.2-inch f/23 refractor (1832).
3) Paris observatory gained two large domes in the 1850s. 4) Mary Somerville investigated the perturbations of Uranus.
5) Catalogues were produced by: Smyth / Robinson / Herschel / Baily / and Cooper. 6) Smyth visited Piazzi (1817).
6) Baily. 7) Herschel in South Africa. 8) Dick made aerial telescopes. 9) Cooper (politician & meteorologist), Mary Rosse (blacksmith & photographer), Lee (barrister), Smyth (naval officer), Nasmyth (engineer), Mary Somerville (mathematician), Lee & Smyth (numismatists) and Dick (teacher).

Top Row:
James Hall Nasmyth (1808-90) [C3], Mary Field Rosse (1813-85) [D12], South Villa observatory [D9],
Mary Fairfax Greig Somerville (1780-1872), William Henry Smyth (1788-1865) [C18]

Middle Row:
Thomas Romney Robinson (1792-1882) [A11], Bedford observatory [C18], Markree observatory [D3]
Thomas Dick (1774-1857) [C19], John Lee (1783-1866) [D1]

Bottom Row:
John Frederick William Herschel (1792-1871) [D33], Francis Baily (1774-1844) [C7], Edward Joshua Cooper (1798-1863) [D3]
Paris observatory (1837) [B9]

Society for the History of Astronomy

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SHA Spring Conference 2020

10:00 am – 5:00 pm Saturday 25th April 2020

Cancelled

Institute of Astronomy, Cambridge University, Madingley Road, Cambridge, CB3 OHA

Cancelled

Conference Guest Speakers

Lee Macdonald *–Proposals to move Greenwich Observatory, 1836-1945.*

Steve Barrett – *200@70. The Design and Construction of the 200" Hale Telescope on Palomar Mountain.*

Christopher Taylor – *The Astronomers and the birth of Atomic Physics.*

Philipp Nothaft –*Walcher of Malvern and the Twelfth-Century Renaissance of Medieval Astronomy.*

Mike Leggett- *The Rise and Fall of Edward Iszatt Essam.*

Tours of the IoA telescopes will occur during the lunch break

Conference fees: £10.00 for members, £15.00 for non-members (includes tea/coffee)
An on-site buffet lunch will be available for £10; this must be pre-booked
There is ample free onsite parking. The venue is a long way from Cambridge railway station. Recommend either taxi or bus from there. There are no cafes or restaurants open near the site.

Cancelled

For more details and to register please contact: Mike White
meetings@shastro.org.uk
www.shastro.org.uk