BSHS THE · BRITISH SOCIETY · FOR THE · HISTORY OF · SCIENCE

NO. 113: JUNE 2017

ISSN: 1751-8261

Viewpoint

MAGAZINE OF THE BRITISH SOCIETY FOR THE HISTORY OF SCIENCE

Contents

Editorial

This issue is devoted to the history of those who have gone in pursuit of knowledge of the furthest reaches of the cosmos. We begin with an article by Amy Nelson on the non-human explorers sent into space (1-2). Missions to space are also the focus of articles by Nina Wormbs, who asks why Swedens aim for the stars (10), and Robert Poole, who takes us on a journey through space historiography (7).

Astronomy is the focus of articles by both Glen Cooper (3-5) and Pedro Ruiz-Castell (5-6), though each explores a very different context! Marek Kukula discusses the role of photography in astronomy, and there are details of how that work continues today (and an exhibition to attend! 8-9). Last, but by no means least, Jaco de Swart provides a fascinating insight into the history of the hunt for dark matter (11).

You'll also notice a link to a survey asking for your views on Viewpoint (6): please do spend 5 minutes to give us your thoughts on the magazine!

Contributions to the next issue should be sent to viewpoint@bshs.org.uk by 15th August.

Alice White, Editor

Canine Cosmonauts

Amy Nelson tells us about the dogs who led humans into space

They were a motley crew. Most of the small, mixed-breed dogs enlisted as experimental research subjects by scientists at the Institute of Aviation and Space Medicine in Moscow began their lives as strays. Pointy and flop-eared, spotted and solid-colored, with hints of terrier, spaniel, or spitz in their ancestry, they could not have understood the role they played in our most Promethean project – the quest to send humans into outer space and return them safely to earth. But their significance was apparent to the scientific community and the global public that followed each chapter of the unfolding race to conquer outer space.

Many people saw the dogs as experimental subjects playing a critical role in the production of knowledge about the environmental conditions of space travel. Others viewed them in ways that drew on the historic interactions of people and dogs, identifying them as scouts bravely blazing the trail to outer space, as victims sacrificed on the altar of geopolitics, or as faithful servants of humanity.

The most famous space dog was also the most controversial. When Laika became the first living creature to orbit the earth on 3 November, 1957, she instantly became a global celebrity. Her photograph appeared in

Cover image: A postcard of Belka and Strelka.
Above: Lisichka & Otvazhnaia.
Right: A pin commemorating Laika's flight.
Images courtesy of the author.

newspapers, amateur radio operators tracked the persistent bleeping of her satellite as it circled the globe, and millions of people hung on every update about her condition and the progress of her flight. When it became clear she would not survive -- the means to return a satellite safely to earth had not been developed yet – observers in the West indicted the Soviets for their callousness, while in the Eastern Blok, stamps, pins and monuments commemorated Laika's feat.

Other famous space dogs included Belka and Strelka who were the first living creatures to return safely from orbital flight in August 1960. Clad in their orange flight suits, they appeared at press conferences, visited schools and were featured on magazine covers. Their images adorned stamps and postcards. One of Strelka's puppies was given to the Kennedy family as a playmate for Caroline's dog, a Welsh Terrier named Charlie. The two canine cosmonauts did not fly again, but lived out their days in the kennel at the institute where they were trained. Contemporary visitors to Moscow can see their taxidermied remains at the Memorial Museum of Cosmonautics underneath the Monument to the Conquerors of Space. Comparable celebrity followed by quiet lives at the institute awaited Chernushka (Blackie)and Zvezdochka (Little Star), the dogs who tested the Vostok spacecraft that would make Yuri Gagarin the first man in space in April 1961.

For every famous space dog, there were dozens of others who lived and died beyond the public gaze. These dogs' stories are challenging to reconstruct – a veil of secrecy still limits access to key primary materials and confusion abounds where names are concerned. But a few dogs stand out for their ability to develop relationships with their handlers. Often, those relationships proved pivotal to a dog's ultimate fate.

Several years before Laika's historic orbital flight, for example, Tsygan and Dezik became the first animals to survive in space when they successfully weathered a vertical launch to an altitude of 110 kilometres and experienced four minutes of weightlessness before descending safely in their capsule to a landing on the steppe. A few days later, Dezik perished in the second test flight, prompting Anatoly Blagonravov, who headed the commission overseeing the biological flight program, to take the surviving dog home as a pet. Tsygan accompanied Blagonravov everywhere, became the leader of the neighbourhood dogs, and reportedly jumped on visiting dignitaries with impunity.

The fate of Lisichka is more poignant. Everyone who worked with this sweet-natured dog adored her. She cooperated with researchers and medical personnel, enduring long periods of confinement without complaint, willingly submitting to painful procedures, and adapting gracefully to wearing the elaborate sanitation suit. Even Sergei Korolev, the Chief Designer, had a tender spot in his heart for Lisichka, whose name means "little fox." During a difficult and contentious equipment test before her launch in the Summer of 1960, the famously gruff Korolev pulled the little ginger-colored dog from her ejection seat and held her close. As she nuzzled him he stroked her, murmuring, "I so want you to come back." A few days Lisichka and her fellow traveller, Chaika, perished when the booster rocket exploded during the launch of their spacecraft. Their failed flight remained secret for years and both dogs were written out of the published record.

Disaster defined the career of Zhul'ka (Little Bug) as well, but with less devastating consequences. After surviving two vertical launches, Zhulka underwent training as a satellite dog and was sent on what supposed to be an orbital flight in December 1960 with a dog named Shutka. Technical issues kept the craft from entering orbit, and then the auto-destruct mechanism malfunctioned. The capsule with the dogs crash-landed in deep snow near the Tungus meteor crater in Siberia. When the rescue team arrived two days later they found the dogs cold and hungry, but alive. Oleg Gazenko, the physician who oversaw the orbital flight program admired the pluck of the little dog with light fur and black button eyes. He took her home, where she lived for fourteen years. Although she too, was written out of the official histories, Gazenko regarded her as a heroine of spaceflight.

Where the space dogs are concerned, fame and affection sometimes worked in contrary ways. Laika, whose name means "Barker," was chosen for her one-way trip in part because the researchers were more fond of the other two finalists. One of them, Al'bina, had already flown in two vertical launches and had recently had puppies. The consensus was that she had served science enough, so the decision was made to sacrifice the less sympathetic (non-maternal) Laika. But seventy years after her historic flight, Laika lives on in global popular culture, while Al'bina has been forgotten. The significance of Laika's voyage and the circumstances of her death inform an enduring celebrity and complex memory articulated in music, literature, graphic novels and tribute websites. In the shadows of her fame, a few space dogs enjoyed moments of celebrity, and a few more secured bonds of affection with the human forces behind the biological flight program. But ironically, the very characteristics that endeared them to their humans also ensured that their legacies would be much more private than that of Laika.

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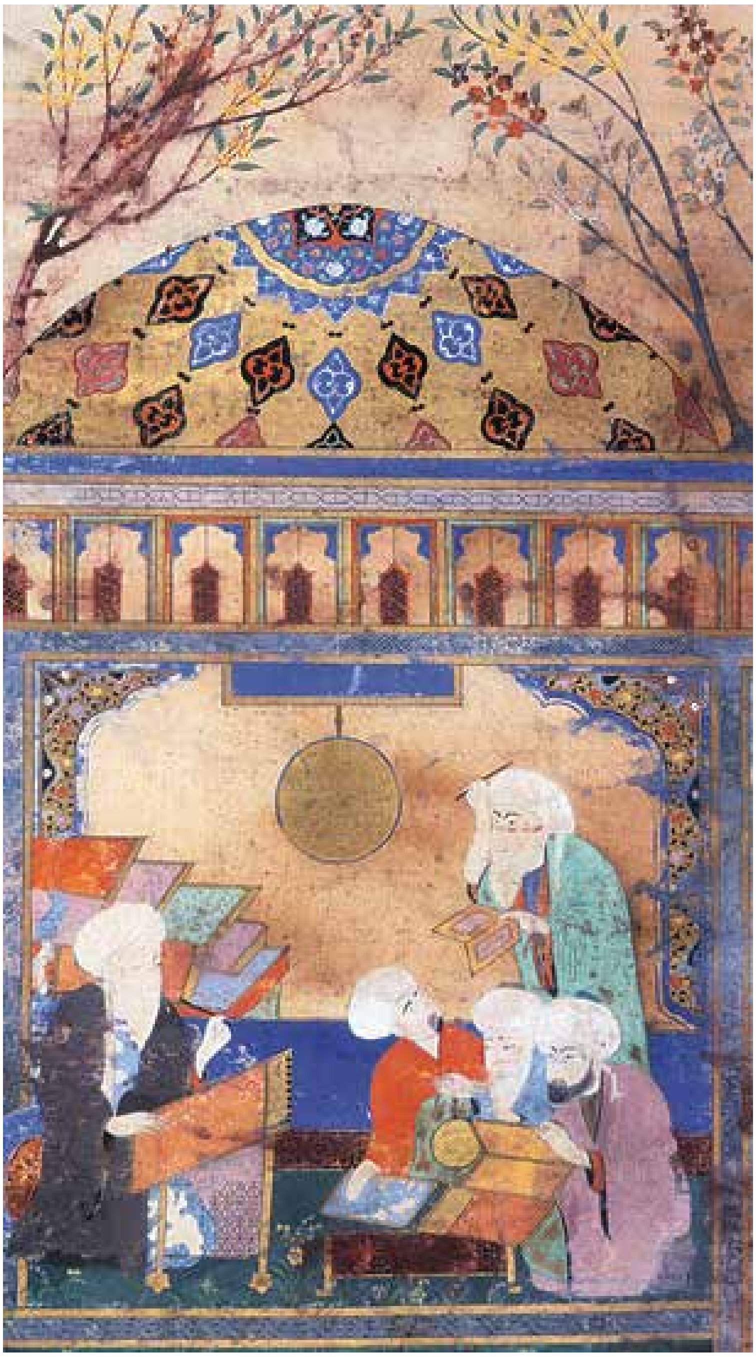
Islamic Astronomy from "Star Wars" to Star Tables

Glen M. Cooper explores the cosmos as seen by Islamic scholars through history.



Nasir al-Din al-Tusi at the observatory in Maragha, Persia. Image courtesy of the British Library.

Astronomy had a long and fruitful life in the Islamic world, where ancient Greek astronomy was transformed into a fully institutionalised endeavour employing a comprehensive and predictive theory that was consistent with physical principles as then understood.

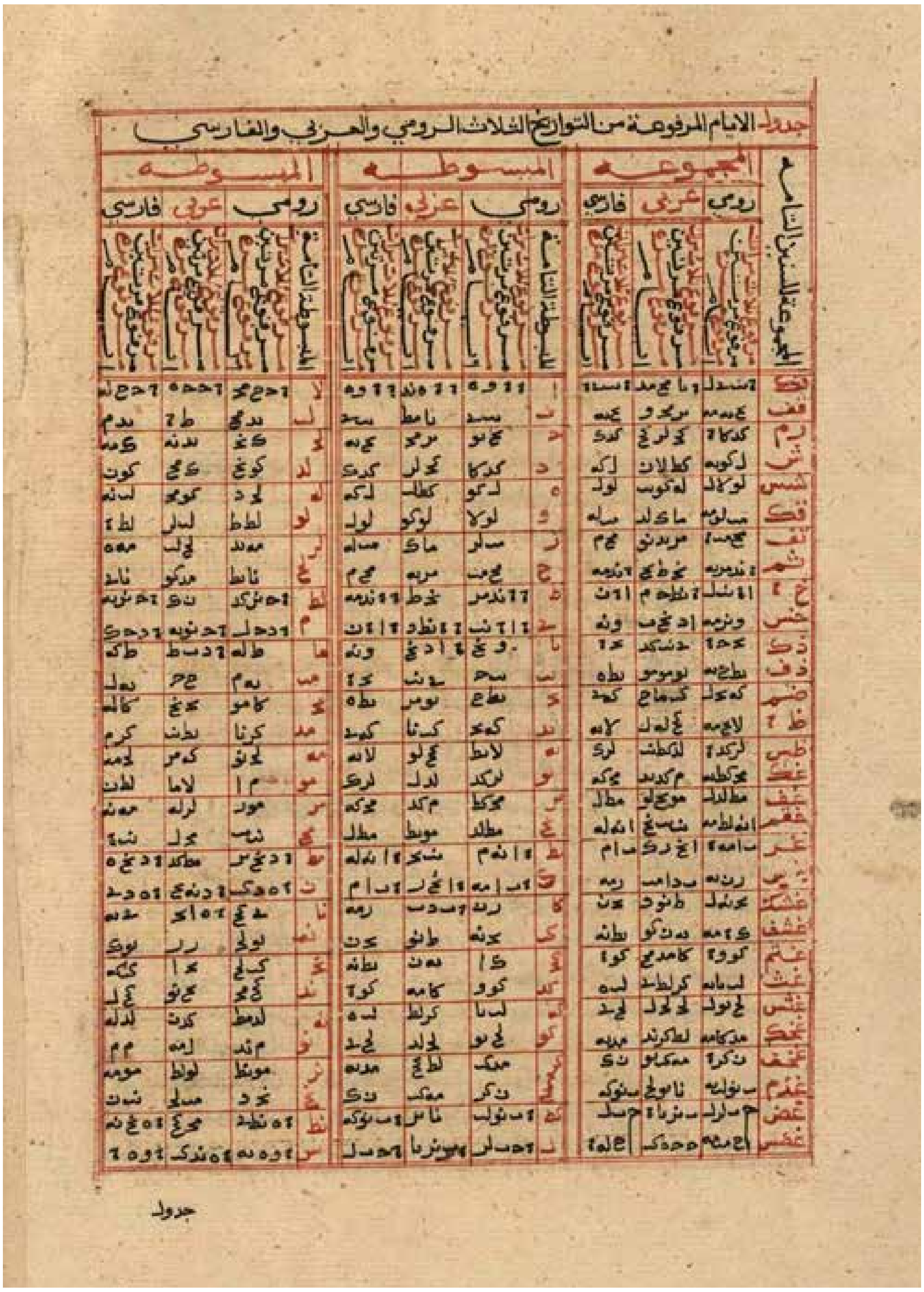
Astronomy in the ancient world was motivated by different concerns than what drives the science today. Its principal aim was to divine the future from planetary positions, which eventually could be calculated using past data and theoretical models. Astrologers have been associated with imperial courts since ancient Mesopotamian times. There, in a kind of ancient "star wars", they vied with each other for the most accurate predictions. Mesopotamian stargazers accumulated centuries of observational data, and invented mathematical methods for predicting astrologically significant planetary configurations.

While the Mesopotamian cultures provided incentive and data for astronomy, the Greeks were more concerned with integrating this knowledge into a cosmology, with geometrical models and a physics. The culmination of these efforts was the Almagest, the work of the 2nd Century mathematical astronomer, Ptolemy, who, using the Mesopotamian data, produced the most powerful system of predictive astronomy yet known, the Almagest. He also developed a comprehensive astrology, which, because of its mathematical precision, acquired the air of genuine science. The Almagest showed how to derive mathematical models of the planets from observational data. Ptolemy's methods were the foundation of Islamic astronomy.

Prior to Islam, the rulers of the Sasanian Persian Empire (224-651 CE) fostered a dynamic astrological tradition, which they employed for a variety of purposes. For example, the state religion, Zoroastrianism, espoused a chiliastic/millennialist view of history, and thus invited astrological activity. Astrological histories rationalised significant events and rulers in terms of a grand cosmological scheme written in the stars, which both justified the current dynasty and permitted knowledge of the political future. These interests in political and historical astrology were inherited by the Muslim Abbasid dynasty (750-1258 CE).

The most obvious difference between modern and Islamic astronomy is that the latter is primarily mathematical and predictive, and the former has other observational goals, such as describing the physics of other worlds. As noted earlier, the predictive character of astronomy derived from its use in astrological forecasting. The Ptolemaic models were to an extent instrumentalist, namely, useful for generating planetary positions rather than being strictly physically consistent. There were some thinkers, however, such as al-Tusi, who desired to present a unified physics and cosmology of the heavens. Through his efforts and those of his followers, several of Ptolemy's models that contained physically absurd elements were replaced with physically consistent ones. For example, in order to explain some planets' varying speeds, Ptolemy had postulated that one of the spheres responsible for moving these planets rotated uniformly around a pole that did not coincide with its own centre, which, although it gives good mathematical results, is physically impossible. Muslim astronomers invented new mathematical devices that produced the same effects without violating physical principles.

Observatories as institutions that housed a collective effort to gather positional data about the stars and planets were an Islamic invention. Programs of observation began under the 9th-century Abbasid rulers, but



Above left: Ulugh Beg observatory, courtesy of Alaexis via Wikimedia Commons.

Right: An Arabic translation of the astronomical tables of Ulugh Beg, courtesy of the Library of Congress.

culminated in the grand observatories of Maragha (13th C.) under the Ilkhanids, and Samarkand (15th C.) under the Timurids. The main goal of these observatories was to improve the planetary tables (zijes; sing. zij) used to calculate planetary positions. Unlike modern observatories, their Islamic antecedents were useful only until all the data had been gathered over a period of decades at most.

The main structural feature of the Islamic observatory was the meridian quadrant, which measured the planets' elevations as they crossed the meridian. (See above). In addition, there were more portable instruments, including armillary spheres, quadrants, and other devices for measuring celestial positions by hand. The way to improve upon data from earlier observatories was to build a larger meridian quadrant in order to obtain more precise observations, which in turn improved the accuracy of the zij tables. This basic design persisted for centuries, and even found its way into Tycho Brahe's 16th Century Uraniborg. (The main difference there was that, whereas the Ptolemaic tradition had astronomers taking observations at major conjunctions or at other significant times of the planetary cycles in order to extrapolate the rest using the model, Tycho observed the planets on the days between, and thus had a far more precise set of data).

The Abbasid Caliph al-Ma'mun (r.813-833) founded two observatories at Baghdad and Damascus, respectively, where some of the initial updates to the Almagest were accomplished. However, the most famous observatory was established at Maragha in northwestern Iran by the Mongol Ilkhanid ruler Hulegu (d.1265) in 1259, under the direction of Nasir al-Din al-Tusi (d.1374). The first observatory to be supported by a religious endowment (waqf), it not only produced an improved zij (Zij-i Ilkhani), but also began a major reform of Ptolemaic astronomy. This resulted in a new tradition of planetary theory that culminated in the models of Ibn al-Shatir (d.1375), elements of whose contributions Copernicus incorporated in his own revolutionary treatise, On the Revolutions (1543). The Samarkand observatory, established and supervised by the Timurid ruler and astronomer Ulugh Begh (d.1449), produced a new zij (Zij-i Sultani), and supported a flowering of the mathematical sciences.

The majority of those who used astronomical information did so in the form of tables, and so did not require advanced mathematics. Along with planetary models, Ptolemy had also shown how to use tables for the relatively easy calculation of planetary positions. Only basic arithmetic was needed, since the tables of various functions already had complex trigonometry built into them.

In the Islamic tradition, such tables were called "zijes", from a Persian word that means "thread", because their cross-hatched appearance, with numbers in the spaces, resembles a woven cloth (see illustration, above). Zijes were typically a collection of such tables along with instructions for their use, including tables for converting between calendars, for Islamic prayer times, and for determining planetary longitudes, based on the number of elapsed days and hours since a known position, or "epoch". Zijes were calculated using mathematical models of the planetary motions, which in turn were based on observational parameters that were determined at the observatories. So, advances in astronomy were expressed in new zijes, which were the result of more accurate parameters or better models, or both.

To simplify the process further for the everyday practitioner, yearly almanacks were produced, which used the zijes to determine all of the celestial data for the upcoming year on a daily basis, much like a modern ephemeris.

Islamic astronomy was interconnected with all of the other sciences, in a comprehensive cosmology inherited from Aristotle. Through their unrelenting critique of ancient astronomy and natural philosophy, Islamic astronomers laid the groundwork for the scientific advances of both the European Late Middle Ages and the Scientific Revolution. Copernicus, Brahe, Kepler and many others used methods developed in Islamic astronomy to critique and eventually replace the ancient cosmology.

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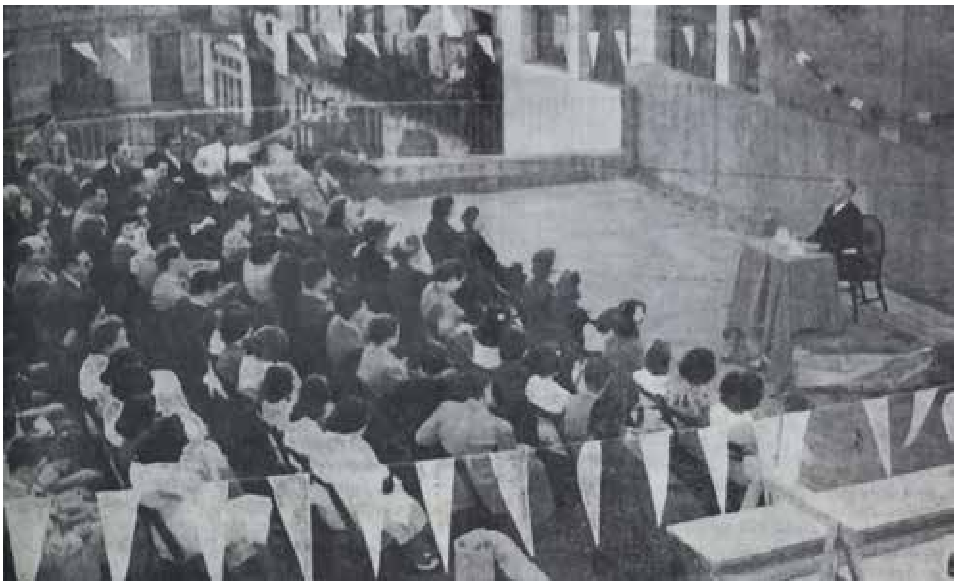
Cocktail parties under starlight

Pedro Ruiz-Castell highlights the role of amateur astronomy as a form of sociability under Franco's dictatorship.



The opening of Aster's new premises, 3 June 1949. Source: Aster, 1 (1949), p. 49.

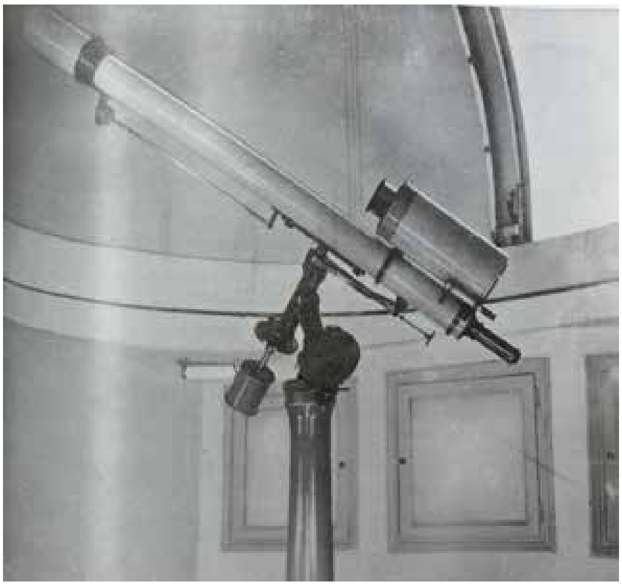
The Spanish Civil War (1936-1939) was a devastating conflict that marked the beginning of one of the longest European dictatorial regimes of the twentieth century. Franco's dictatorship signified a break with the past in many political, ideological, and social aspects, including cultural expressions and intellectual traditions. It also brought important changes from an institutional perspective and meant the purge and forced exile of many Spanish scientists and lecturers. Moreover, the years of hunger and misery that characterised post-war Spain were of intense social propaganda and mandatory recatholisation. This included the practice of science, which was submitted to the Catholic doctrine. The case of astronomy is particularly obvious, since the observation and study of the heavens was seen as a tool to offer evidence in favour of the existence of God and the Creation.

As a result, astronomy remained fairly popular in Spain during these years. The severe new regulations established by the dictatorial regime during the post-war years, however, had a strong impact in the normal life of the Astronomical Society of Spain and America (SADEYA). Furthermore, new young amateurs felt uneasy with how the main Spanish astronomical association was organised and run by academics and senior amateurs. Despite encouraging and promoting systematic amateur work –such as the methodical observation of variable stars–, SADEYA seemed to have problems accommodating the enthusiasm of young people. This situation led to the creation of new amateur astronomical associations in Spain during the central decades of the twentieth century.

The foundation of such new non-professional astronomical associations proves particularly relevant for historians of science, since the development of amateur science was much more difficult to oversee by the dictatorial regime –as it was less dependent on the precepts of official science. Moreover, such initiatives may be understood as attempts to develop new spaces for scientific sociability, in response to the new political and socio-economic conditions of the dictatorship. The search for valuable instructional and cultural resources that provided astronomy was combined, during these years, with the exploration of new and fresh spaces for socialisation sought by young people.

A good example is that of the Agrupación Astronómica Aster, founded in Barcelona in 1948 by a group of secondary school students. Aster eventually became responsible for a successful programme of observational astronomy that included the study of celestial objects such as the Moon, the Sun, planets, bolides, comets, nebulae, stars and star clusters. The association even achieved some international reputation in the late 1950s, after claims of being the first in Western Europe to record the signal of Sputnik 1 in 1957 –using amateur techniques (an antenna and a home-made radio device).

The creation of Aster, however, was not exempt from criticism, as few people found inappropriate having such an association run by young men. Claims were made that its founders were writing about things they knew little about and many people expected the new association to be soon transformed into a party and social club. Certainly, the successful popularisation of astronomy programme developed by Aster combined astronomical lectures and courses with visits to institutional and private observatories, outdoor talks, and excursions to touristic sites. There were also organised contests and exhibitions, in which pictures, books, journals, and instruments were displayed. Furthermore, Aster arranged the projection of films and documentaries, as well as musical sessions on the flat roof of the association premises –many of them using exclusive materials provided by foreign institutions such as the French and American consulates.



Inside view of Aster's observatory. Source: Cover page of Aster, 6 (1954), num. 65.

The most popular activities were the private parties held after some of the conferences, in which snacks and soft drinks were served, followed by a lively dance. Public parties, and especially dancing, had articulated the leisure of young people in Spain for decades. Nevertheless, the dictatorial regime paid special attention to the regulation and control of public parties, particularly under the influence of the Catholic Church, which developed a campaign against dancing, mostly on moral and class-conscious grounds. In this context, some individuals filed formal complaints with the authorities, denouncing that the association was run by minors and organised promiscuous activities. No doubt, private parties such as those organised by Aster reaffirmed an autonomous youth culture that flourished during the dictatorship in spaces not directly controlled or supervised by older adults.

The creation of new amateur astronomical societies and the organisation of such successful popularisation programmes, however, was not seen by the dictatorial regime as dangerous or threatening. In fact, it even seemed to fit well with some of the guiding principles defended by the regimen, such as the ideals of social harmony, cooperation, and union, as well as the glorification of youth – and many activities developed by Aster were reported and publicized by the press, radio, and Spanish newsreels (NO-DO). Undeniably, the observation and study of the skies could prove particularly useful for spreading the ideological values of the dictatorship. Many amateurs, however, saw in the practice of astronomy a way to share their concerns and hopes, as well as their perception of the world. Such an exchange of ideas constituted a bastion of freedom to enjoy with others, in which ways of thinking that differed from what they could experience in their respective environments were presented. Indeed, the development of amateur astronomy in autonomous groups outside the direct control of the regime played an important role in the gradual rebuilding of Spanish civil society.

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BSHS Notices

Views on *Viewpoint* Please!

It's been a while since we've asked, and we'd like to hear from you what you think about Viewpoint to ensure it's as good as it can be. For instance, would you like the magazine to be replaced with more online content from the BSHS, or do you like it just as it is?

Please complete our survey to let us know what you think:
www.surveymonkey.co.uk/r/6XVKM9F

BSHS Annual Conference

University of York, 6-9 July 2017

The BSHS turns 70 years old in 2017, and we'll be marking this anniversary at our Annual Conference!

The conference will begin with a plenary lecture by the President of the BSHS, Patricia Fara on the evening of July 6th, and continue over the next three days with parallel themed sessions and the opportunity to visit archives and historical attractions in York such as the National Railway Museum.

All enquiries relating to the local arrangements should be directed to: bshsyork2017@bshs.org.uk.

Celebrating 50 Volumes of BJHS

The British Journal for the History of Science (BJHS) is celebrating 50 volumes just as the BSHS has its 70th anniversary. To commemorate this great achievement, Editor Dr. Charlotte Sleigh has commissioned a virtual special issue for which each surviving former editor nominated one favourite paper from their period of tenure. As you can imagine, this takes us way back within the history–and historiography–of our field!

Read the editorial on this special issue in your next BJHS, either online or in hard copy, and view the special issue online: Cambridge University Press has made this special issue open access. You can find it at:
www.cambridge.org/core/journals/british-journal-for-the-history-of-science/celebrating-50-volumes

Why haven't we seen a history of the whole Earth, yet?

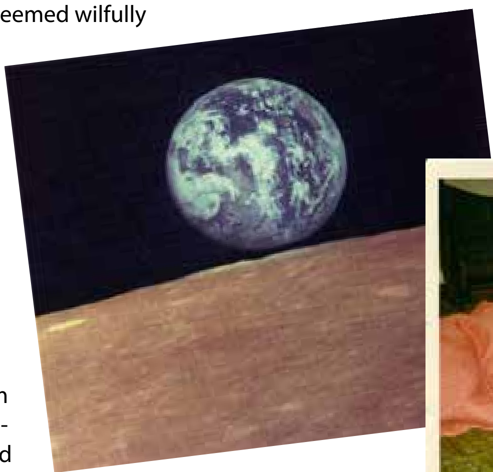
Robert Poole reflects on the historiography of space travel.

It might have begun like this: 'On Christmas Eve 1968, two Episcopalians and a Roman Catholic were in orbit around the Moon.' I was writing a book called *Earthrise: how man first saw the Earth* (Yale, 2008), about how the first pictures of the whole Earth came to be taken, and what their impact was at the time. I wanted to avoid the traditional, whiggish 'onwards and upwards' approach of space history. I was more interested in why the crew of Apollo 8 decided to read to the rest of homo sapiens from the book of Genesis: 'in the beginning God created the heaven and the Earth . . . and God saw that it was good.' But 'two Episcopalians and a Catholic' seemed wilfully obscure for a first sentence so I bottled out and put 'three astronauts'.

Pointless. Who else but astronauts would be in orbit around the Moon? What I should have put was 'three travellers'. That would have placed the experience of the astronauts firmly in the mainstream of historical experience - not part of an unfinished future, as space enthusiasts like to imagine, but part of the human past, as open to historical understanding as any other. While the rest of us were perforce looking out to space the astronauts had achieved the dream of philosophers since ancient times: they had looked back upon the whole Earth.

After the last astronauts left the Moon the journalist Norman Cousins said, 'The most significant thing about the Apollo programme was not that men set foot on the Moon, but that they set eye on the Earth.' There had been a lot of comments along these lines since, but how had it been at the time? Had Earthrise really taken the travellers by surprise, as often claimed? When the acid activist Stuart Brand asked in 1966 'Why haven't we seen a picture of the whole Earth yet?', did anyone in NASA take note? To investigate, I needed archives. Even the future has archives.

It turned out that space programs especially have archives. Since its inception, NASA has carefully documented its own activities (see www.nasa.gov), and in the year 2000 (which still sounds like the future to me), the ones I needed were housed at the Johnson Space Centre, formerly Mission Control Houston. I walked past ye olde Saturn V rocket, past the offices, past the astronaut training centre and the mockup space shuttle, to a row of huts at the back of the site with deer grazing between. All the manned spaceflight archives were lined up in cardboard files from the first Mercury to the last Apollo. I headed for Apollo 8, and worked my way through. After a few days I had the key answers, and most of the rest I picked up a couple of years later in Washington at the eclectic NASA History Office, the National Air and Space Museum (NASM), and the Library of Congress.



Images courtesy of Robert Poole.

At the time most space history was in the position of most history of science thirty years before: accounts by insiders of the development of their own field, embracing received assumptions and charting the path to further progress. I had enough familiarity with the history of time in the early modern period to feel I would be able to cut through the assumptions and see the bigger picture. I bashed out a draft and sent it to Roger Launius of NASM, who had rashly offered to look at something. He returned it, patiently annotated, pointing out with great tact that while I may have had some new ideas I had unwittingly reproduced as background much of the 'Huntsville school' version, attributing too much to the vision of Wernher von Braun (then being reassessed as a manipulative war criminal) and too little to Big Science and Cold War politics.

He was right of course. I had spent my formative years soaking up the space age. I have a snap of me aged twelve watching Apollo 11 in the middle of the night. Soon after that I read the New York Times book *We Reach the Moon* (I liked that 'we') and much else along similar lines, both fact and fiction. I would come home from school for lunch, watch the men walking on the Moon on black-and-white TV, and go back to school for the afternoon. I had a historian's training but I had filed all these experiences in a different place. It was going to be harder to think my way out of the space age than I had supposed. But I was by then a seasoned environmentalist, and that gave me a handle on the connection between space programmes (all of them, not just the high-profile manned expeditions) and ideas about the 'whole Earth'.

I hooked up with the Centre for the History of Science, Technology and Medicine at the University of Manchester, and gradually I learned to think less like a semi-evolved space nerd and more like a historian of science. I was invited to Simone Turchetti's wonderful 'Cold War, Blue Planet' conference and tried out a paper called 'What was whole about the whole Earth?', which in its published form was the hardest thing I'd ever written.

Manchester (specifically UMIST) was one of the institutions which received all of NASA's publications, and one day I found myself at the top of a stepladder in a backwater of the Joule Library, blowing the dust off maps of the Moon. Perhaps it was only then that I truly understood that the first space age was indeed History. When *Earthrise* came out (as a trade book rather than an academic monograph) the academic world didn't see it like that though. Not a single mainstream historical journal reviewed it (though *Nature* did), and its lonely bookshop classification was as 'astronomy'.

I've given many public talks since, and the questions still tend to be about the future. I've taken to calling the period 1957-72 'the first space age' to indicate that it's over, but people tend to ask when the second will be, and whether we'll meet intelligent aliens (no, but maybe some green mould). Progress has its twists and turns, its paradoxes, people seem to feel, but it's Progress all the same. A few more degrees of global warming may change that, but for now, the space rocket still stands for the future, like the Eiffel Tower for Paris. It's as deep a myth as the modern world has generated. But why is a space rocket the future while a submarine is just a submarine? Therein lies the key to much 20th-century culture.

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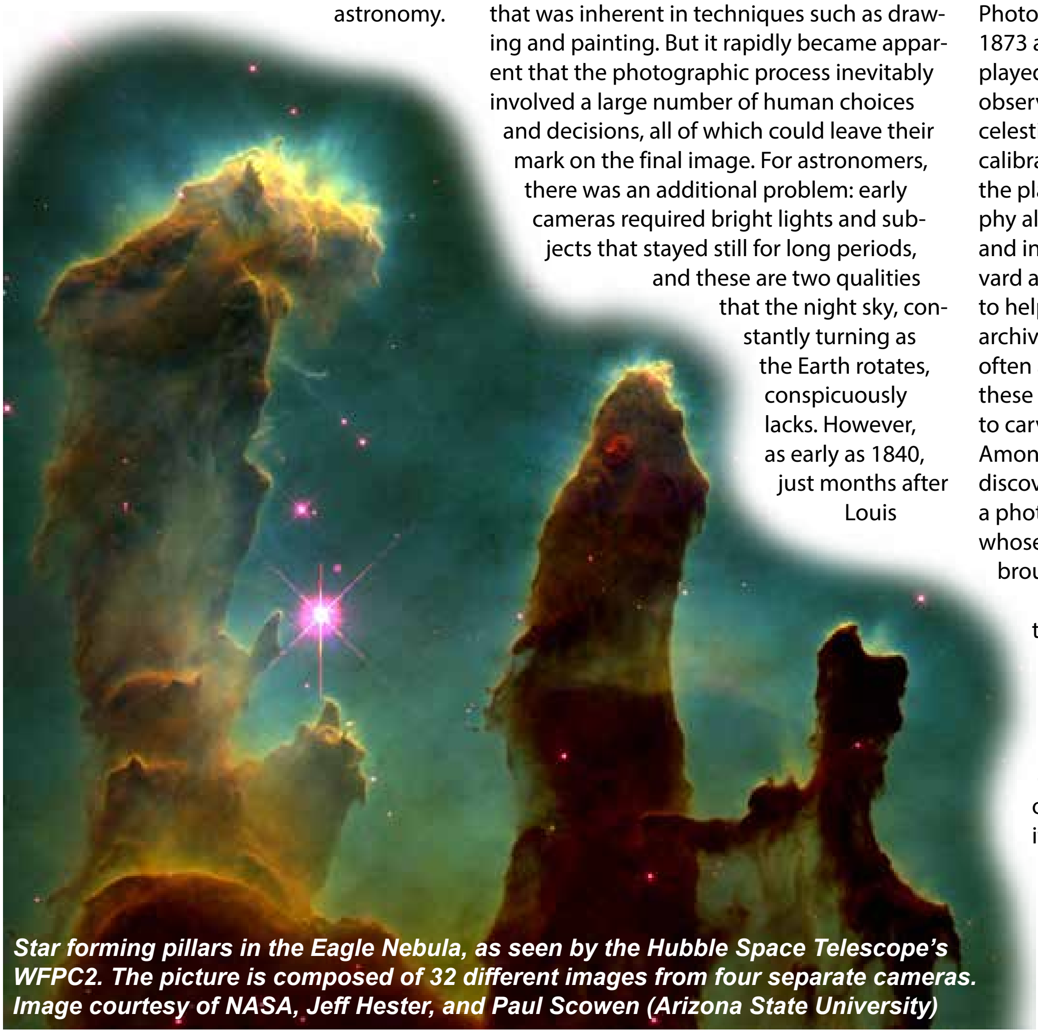
Visions of the Universe

Marek Kukula discusses how images of space have been created and crafted through time.

From the Hubble Space Telescope's technicolour cosmic vistas to the dusty Martian scenes beamed back by rovers on the surface of the Red Planet, our modern ideas about what space looks like have been transmitted and shaped by photography. As a visual science, dependent on looking, this is perhaps not entirely surprising. Even sixty years into the Space Age the expense and technical difficulty of sending humans beyond Earth orbit means that our view of the cosmos currently comes to us largely through cameras mounted on robotic spacecraft, or attached to powerful telescopes here on Earth.

But this intimate connection between the camera and outer space goes right back to the earliest days of photography itself. In the 19th century, scientists were quick to recognise the potential of this new technology as a means of capturing and recording light and many of the first photographic pioneers were also closely involved in astronomy. Among them was John Herschel, whose father, William, had discovered the planet Uranus in 1781, and who in turn became one of the most renowned astronomers of his time. John's experiments in photography led to the development of the cyanotype process, precursor to the modern blueprint, and also, in 1839, to what is perhaps the earliest glass plate photograph: an impression of his father's Great Forty-Foot telescope in the family garden in Slough. John's innovations had a linguistic legacy too: he is credited with coining the English word 'photography' (the French 'photographie' was apparently derived independently from the same Greek roots, meaning 'drawing with light') as well as the terms 'positive', 'negative' and 'snapshot'.

The marriage of photography and astronomy was not without its initial problems, however. Scientists hoped that photography could act as a purely mechanical form of reproduction, removing the subjective 'human factor' that was inherent in techniques such as drawing and painting. But it rapidly became apparent that the photographic process inevitably involved a large number of human choices and decisions, all of which could leave their mark on the final image. For astronomers, there was an additional problem: early cameras required bright lights and subjects that stayed still for long periods, and these are two qualities that the night sky, constantly turning as the Earth rotates, conspicuously lacks. However, as early as 1840, just months after Louis Daguerre's invention was announced to the public, John William Draper had captured the first successful daguerreotype photograph of the Moon, and astrophotography was born.



Star forming pillars in the Eagle Nebula, as seen by the Hubble Space Telescope's WFPC2. The picture is composed of 32 different images from four separate cameras. Image courtesy of NASA, Jeff Hester, and Paul Scowen (Arizona State University)

Throughout the second half of the 19th-century developments in technology gradually transformed photography into a powerful weapon in the astronomer's arsenal. A camera attached to the eyepiece of a telescope could record a view of the sky in the light-sensitive emulsion on a glass plate, enabling it to be studied and quantified at leisure. A long exposure could reveal objects that were too faint to be seen with the human eye and photographic emulsions were also sensitive to forms of radiation, such as ultraviolet, outside the range of human vision. Moreover, photographs of the same patch of sky taken at different times could reveal changes in stellar brightness or even the appearance of brand new objects.

At the Royal Observatory in Greenwich, a Photographic Department was founded in 1873 and the following year photography played an important role in the international observations of the transit of Venus, a rare celestial event that enabled astronomers to calibrate the distances between the Sun and the planets. The new field of astrophotography also brought with it an explosion of data and in the 1890s observatories such as Harvard and Greenwich began to employ women to help analyse their rapidly expanding archives of photographic plates. The work was often arduous and badly paid but many of these female pioneers seized the opportunity to carve out scientific careers for themselves. Among them were Williamina Fleming, who discovered the iconic Horsehead Nebula on a photographic plate, and Annie Maunder, whose prowess as a photographer of eclipses brought her international renown.

During the early 20th century photography played an important role in transforming the fields of astrophysics and cosmology. In 1919 physicist Arthur Eddington and Astronomer Royal Frank Dyson used photographs of a solar eclipse to test the predictions of Einstein's General Theory of Relativity, demonstrating that the mass of the Sun distorts the space and time around it. Soon afterwards, in 1923, Edwin Hubble's photographs of variable stars in the Andromeda Nebula proved it to be a separate galaxy from our own Milky Way, revealing the Universe to be millions of times larger than previously believed.

But by the 1970s astronomical research was pushing the limits of what traditional photographic films and emulsions could achieve. Astronomers seized on a newly developed electronic chip that could collect and record light: the Charge-coupled Device or CCD. Not only were CCDs more sensitive than photographic plates, they also produced images in a digital form suitable for quantification and analysis on a computer. Soon digital imaging technology had become standard on telescopes and spacecraft: in many ways, a modern instrument such as the Hubble is as much a camera as it is a telescope. The vivid beauty of these digital images also caught the attention of the media and helped to fuel a renewed public interest in the science of astronomy.

Meanwhile, astronomers' constant quest for larger, more detailed and more sensitive images was driving advances in camera technology itself, helping to pave the way for mass production and reductions in cost. By the early 21st century, digital cameras had become an affordable feature of everyday life and this, in turn, has led to a renaissance in amateur astrophotography. With a bit of practice, anyone with a modern camera can begin to take beautiful photographs of the night sky, and projects such as the Insight Astronomy Photographer of the Year competition now showcase the results to eager audiences around the world. Contemporary artists such as Wolfgang Tillmans, Katie Paterson and Thomas Ruff have also been enthralled by these photographic views of the heavens, bringing the debate about our place in the cosmos from the observatory into the gallery.

The field of astrophotography is now looking both ahead to the future and back towards its own past. The next generation of powerful telescopes and intrepid spacecraft is being designed with high-resolution digital cameras as integral components of the design but, at the same time, archives of photographic plates dating back to the 19th century are now being scanned and digitised. These historic photos contain a treasure trove of astronomical discoveries still waiting to be made, enabling scientists to probe the links between solar activity and the Earth's climate, map the orbits of planets and moons for future space missions and hunt for comets, asteroids and other, more exotic objects. We can only begin to guess at the celestial visions that astrophotography has yet to reveal, but it seems certain that the partnership between the telescope and the camera will continue to amaze and enthral us for years to come.

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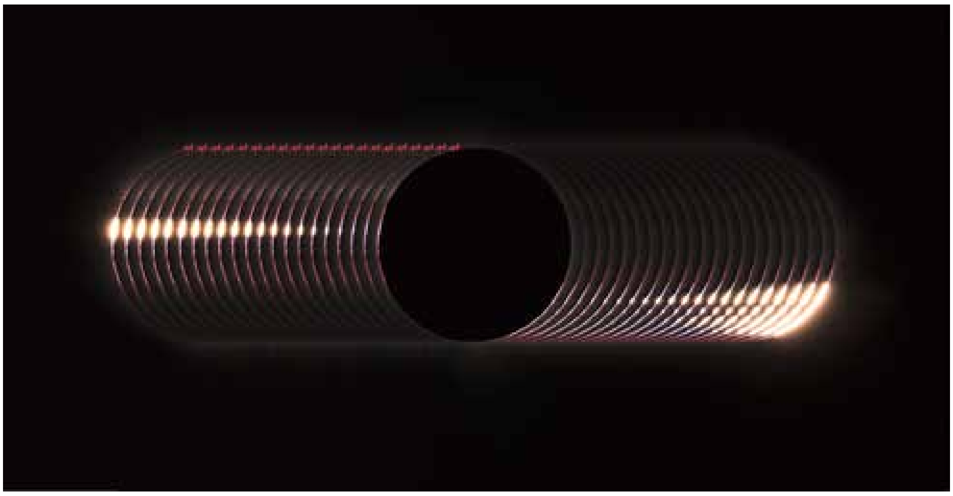


Insight Astronomy Photographer of the Year

Royal Observatory Greenwich
Exhibition: 16 September 2017 – 24 June 2018

The Royal Observatory's hugely popular Insight Astronomy Photographer of the Year returns in 2017 to celebrate the very best in astrophotography from around the world. The winning images are selected by an expert judging panel, which includes the Observatory's Public Astronomer, Dr Marek Kukula.

After the awards are announced in September 2017 the winning photographs will be displayed in a special exhibition at the Royal Observatory. The 2016 contest received a record number of entries, with over 4,500 outstanding entries submitted from 80 countries across the globe. More details and previous winning images can be found at www.rmg.co.uk/astrophoto

Above: 2016 Overall Winner, Baily's Beads © *Yu Jun*

Below: 2015 Overall Winner, Eclipse Totality over Sassendalen © *Luc Jamet*

From Sweden to Space

Nina Wormbs investigates the history of Sweden's space programme and its rationale.

Why on Earth did a small country like Sweden venture into space? The question is legitimate. Space activities are in general very costly and to raise that kind of money requires good arguments, and perhaps a large economy. Sweden is not only small but also on the periphery in many respects, and – adding to that - a neutral country. What were the prime reasons for Sweden to go into space and can we, after half a century, say anything about the outcomes of those efforts over time? These are two big question one can pose regarding this small country's endeavour, and I will discuss the first one and visit the second.

A first answer could actually be precisely because of the position of Sweden on Earth. In the mid-1960s, Esrange outside of Kiruna was established as a European Space Research Organisation (ESRO) site. At 67 degrees North, it combined a useful position on the globe, within the auroral zone, with a relatively good climate and high accessibility compared to the competitors. In relation to Andøya on the Norwegian coast, it was also easier to salvage payloads on the ground than in the sea. Esrange became an asset for European cooperation in space, but at the same time an asset for Swedish space activities. To use international cooperation as leverage for national activities is not an uncommon argument when trying to convince parliamentarians in matters of science spending. At least not for small countries.

Sweden was well placed, literally, to engage in space activities. However, just establishing Esrange, and a few years earlier Kiruna Geophysical Observatory which was inaugurated during IGY 1957, was not enough. During the late 1960s, efforts were made to also put a space organisation in place that could fund research and drive technology development. In 1972, the forerunner to the Swedish National Space Board was established along with the Swedish Space Corporation, SSC. The discussion on this took place at the same time as ESRO was reorganised and Europeans were starting to worry about a knowledge gap between them and the US. As John Krige has observed, space activities in a European context were part and parcel of industrial policy. This was true also for Sweden: the lion's part of the funding came from the ministry of enterprise and Swedish industry.

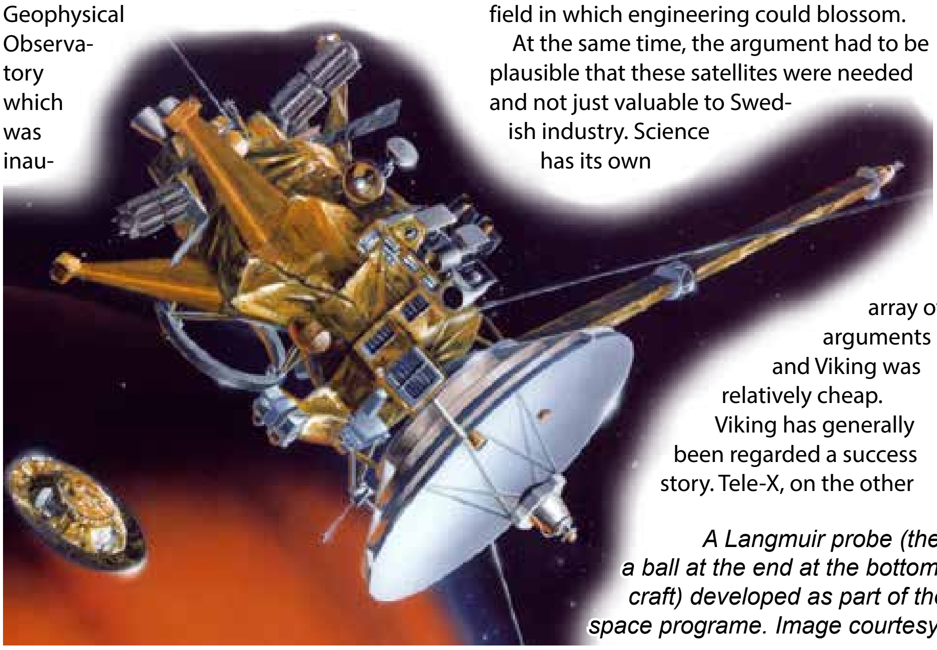
One should not, however, assume that this meant that people believed that basic technological development for space purposes would yield useful household artefacts. Instead, the industrial argument in this context claims that international contracts for national industry would stimulate know-how and increase competitiveness. This was an important factor in 1979 when funding for Swedish space activities increased substantially to allow for the procurement and production of one scientific satellite (Viking) and one telecom satellite (Tele-X). Swedish industry, it was argued, would profit from big projects like these. Important opinions in Sweden held that high-tech know-how might decrease as Sweden might not be able to put as much money into fighter airplane development as before: Space offered an alternative field in which engineering could blossom.

At the same time, the argument had to be plausible that these satellites were needed and not just valuable to Swedish industry. Science has its own array of arguments and Viking was relatively cheap. Viking has generally been regarded a success story. Tele-X, on the other hand, had a tougher time and ended up truly controversial even though she was technically and operationally successful. In fact, Tele-X was controversial long before 1979, acting as an early form of Nordic direct broadcasting satellite. The uses of communications satellites were contested and so were their organisational forms once in space. We still see the consequences of this in EU regulation of broadcasting on a European level.

A similar example was remote sensing, which was an early identified area where space technology could aid and/or replace existing systems. Sweden and Belgium joined France in the SPOT project, and the first satellite was launched in 1986. Arguments for this venture into space related to things like resource mapping and it became an object of foreign-aid activities. Capitalising on the images turned out to be rather difficult, however (although Chernobyl offered a very good example of the usefulness of SPOT imagery, which Johan Gärdebo has found in his ongoing dissertation work).

To evaluate decades of efforts is a daunting task. In the report from the last public inquiry on the topic, delivered to the minister of education in 2015, it was stated that Swedish space industry is internationally competitive. This was one of the original arguments made in favour of venturing into space. It was, however, also stated that greater collaboration was needed on the funding side and that increased international cooperation could enhance societal use. For this, more money was needed, the inquiry argued.

Studies of Swedish space activities have largely focused on the state and its authorities and company. In an ongoing oral-history project at KTH Royal Institute of Technology, we try to zoom in more on Swedish industry and its own arguments and reasons for space activities. In several interviews and witness seminars, we are asking central actors concrete questions on how and if the international contracts changed production, know-how and competitiveness. We want to know more about knowledge transfers from military to civil and from civil to military production, and which ideas and decisions were decisive. Hopefully, as a result of this oral history, we will be able to give a more nuanced answer to the question of why on Earth a small country like Sweden ventured into space.



A Langmuir probe (the stick with a ball at the end at the bottom left of the craft) developed as part of the Swedish space programe. Image courtesy of NASA.

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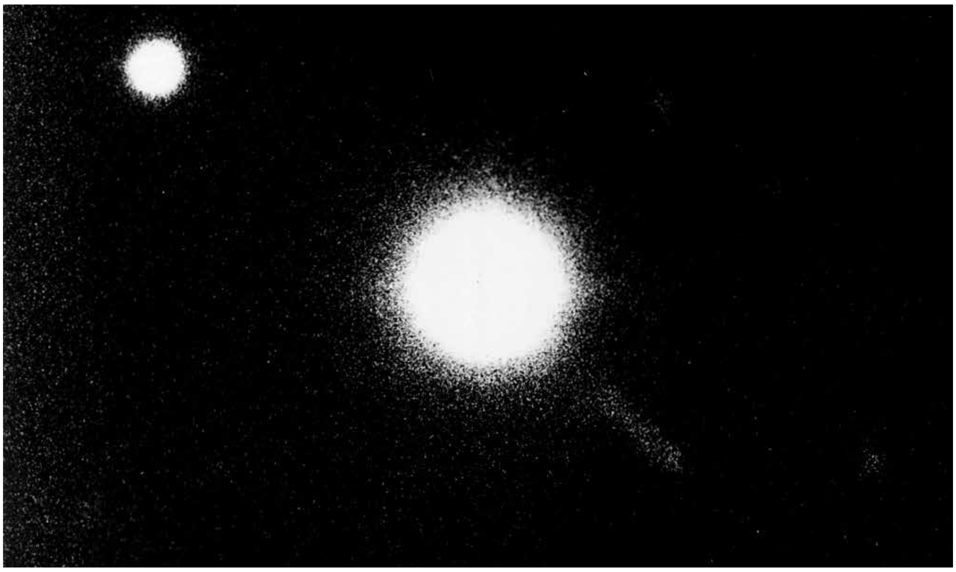
How we lost 85% of the universe

Jaco de Swart discusses the history of dark matter, and what it can tell us about science.



Quasar 3C 273, as observed ca. 1963 by Maarten Schmidt with the Hale Telescope. Image courtesy of Palomar Observatory and Caltech.

The current prevailing model of the cosmos is acclaimed for accounting for many of the Universe's observed features; its large-scale web-like structure, the microwave-background radiation, its Big Bang-induced expansion, the abundances of elements, and numerous other of its cosmic intricacies. However, this celebrated cosmological theory also has a familiar caveat: it tells us that 85% of all the matter in the universe is missing, and consists of a yet unknown type of mass.

Searching for this missing mass, better known as the elusive dark matter, is one of today's greatest efforts in the physical sciences. Telescopes are homing in on the centre of our Milky Way and particle accelerators collide protons to find traces of potential dark matter candidates. Some even theorise new conceptions of gravity to try and get rid of the concept of dark matter altogether. Whatever the solution to this observed excess of gravitational force, the stakes in solving the dark matter problem are very high. But how did we manage to lose track of such an enormous part of the cosmos in the first place?

This resembles a very Kuhnian question, in that it asks how an anomaly was formed. The case of the dark matter problem is a specifically interesting one: it shows the retrograde motion of how two readily available and independent results were recognised as a single anomaly, only after these results were transferred into a new context of research many years later.

In the early 1930s, and reinforced by newly completed sky surveys in the 1950s, galaxies in large clusters were found to be moving too rapidly to be explained by visible matter. Similarly, in a related but different subfield of astronomy, rotational velocities of galaxies observed in the 1960s and early 1970s conflicted with the known distribution of mass. Today these phenomena are acknowledged as evidence for dark matter, but at the time ambiguity dominated the discussion on how to properly account for them: the phenomena did not speak for themselves — as indeed they never do.

What tied these independent results together as evidence for missing mass was a shift in what mattered for astronomers and physicists. During the 1960s, the age of the Space Race, the field of astronomy changed rapidly. Radio astronomy had opened new windows to the Universe, and, in 1963, quasi-stellar radio sources, or 'quasars', were found to be the most energetic and distant sources in the cosmos. This promptly shaped new astrophysical research programmes, establishing a 'high-energy' astrophysics field in which astronomers and physicists joined forces to address these novel extragalactic phenomena.

At the same time, the institutional line between physics and astronomy was blurring. The unemployment rate in physics was four times higher than in astronomy, and in the early 70s, there were almost as many physics PhDs working in astronomy as there were astronomy doctorates. Not only its content, but also the manpower in astronomy was changing dramatically.

During these unprecedented developments in astronomy, the eyes of the new hybrid astrophysical researchers turned towards the larger cosmos. Not the least because of the observation of the cosmic microwave background in 1964, cosmology turned from a mathematical enterprise to a matter of observation. In cosmology's observational efforts of the early 1970s, the single most important observable was the Universe's mass density. 'Density is destiny', the textbook catchphrase goes: the mass budget of the Universe determines our cosmic fate and whether the Universe will expand forever, or gravity will make it collapse back again. Knowing the mass density of the Universe equalled to knowing the correct model of its evolution. With cosmology, mass had obtained a new weight.

In 1974, from astrophysics' new interdisciplinary research context, two collaborations found that the universe was 10 times more massive than was previously thought. They came to this result not because they directly observed more mass, but because these collaborations recognised the two earlier mentioned phenomena as evidence for the existence of a type of yet unseen mass. Independently, both in Estonia and the U.S., astronomers and physicists combined their expertise to explain two phenomena observed in different sub-disciplines with the introduction of a single anomaly: the existence of dark matter. At this point, one could say, we lost 85% of the Universe.

The history of dark matter matters in multiple ways. It shows the conditions that made this intriguing concept viable, but in parallel, it delves into the nature of scientific research. Where dark matter is still a closed book in the study of the universe, its history opens new dimensions to understand the practices of astrophysical sciences. As an unsolved problem, dark matter research serves as a fascinating ground to grope into the similarly dark intricacies of evidence, method, and argumentation in the science of the cosmos – concepts currently heatedly debated in the context of ideas like cosmic inflation and string theory. Perhaps in understanding how we lost part of the universe, we can find new ways to analyse these practices.

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Notices

New Journal of Science & Popular Culture

The *Journal of Science and Popular Culture* has recently been launched, and invites contributions from academics, scientists, communicators, industry professionals, and practitioners with an interest in the science and society interface.

www.intellectbooks.co.uk/journals/view-Journal,id=250

New SHOT Website

The Society for the History of Technology (SHOT) have updated their website, which has features such as *Technology's Stories*: an open-acess digital magazine featuring essays, blogs, book announcements from SHOT members. Take a look!

www.historyoftechnology.org/

Annual Science in Public Conference

University of Sheffield,10-12 July 2017

This conference takes place immediately after the BSHS Annual Conference (see p.7 for more details!). The theme is Science, Technology & Humanity. Science and technology are essential ingredients of our humanity. The emergence of fruitful and diverse scholarly perspectives on the history, practice, communication, governance and impacts of scientific knowledge reflects this fact. Yet rapid scientific and technological change has also unsettled the idea of what it means to be human; for example, through new frontiers in physical and cognitive enhancement, shift to knowledge economies, and potential threats to employment from mass automation. These changes take place in a context of broader challenges to expertise and evidence, dramatically illustrated by the EU referendum and the election of Donald Trump. Taking these matters seriously calls for a renewed focus on compassion, benevolence and civilization. This year at Science in Public, we ask: How do science and technology affect what it means to be human?

For more on this conference, see: scienceinpublic.org/science-in-public-2017/

BSHS Event Reports

The BSHS Postgraduate Conference goes to Europe!

5-7 April, European University Institute, Florence

For the first time in the Society's history, the annual postgraduate conference (PG) was held outside of the UK, at the European University Institute (EUI) in Florence. As the 2017 convenor, the EUI's History of Science Working Group in collaboration with the Centre Alexandre-Koyré invited postgraduates to present their research in the history of science, medicine, and technology from 5-7 April. For three days, early-career researchers from all over Europe, the Russian Federation, Canada, and the USA came together to present their work with fellow postgraduates, both in panels and during the evening wine reception overlooking the Tuscan hills. Moreover, we enjoyed an evening walk with gelato to the Piazzale Michelangelo (with a magnificent view over the city centre) offering additional time to chat, to meet new colleagues and to share the normal anxieties of PhD life in the very dynamic field of HSTM!

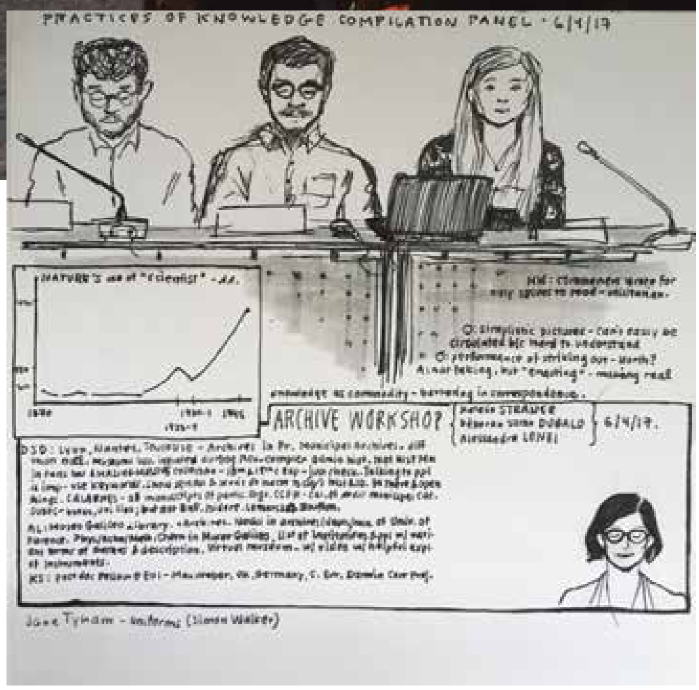
The topics ranged from biomedicine to amateur knowledge, colonial science to psychology, the visualisation of science to women in science, medical practices to oral histories, and many more. We enjoyed the Tuscan hospitality alongside great presentations that offered a broad and expansive discussion on the topics and methods in use in our discipline. The exciting programme was extensive and we can only mention a few personal highlights. A panel on botany explored the power dynamics of botanical knowledge, staging a dialogue between the commercial dimensions of the colonial botanical gardens of Calcutta and the

amateur knowledge and skills utilised in internal colonisation projects, surveying and cataloguing flora and fauna of the Scottish Highlands. The theme of scientific periodicals joined together cases considering discipline consolidation and authority building in the history of science, as well as fascinating notes on amateur entomology. Panels on the visualisation of science considered topics ranging from eighteenth-century representations of the anatomy of the female reproductive system to the role of early cinema in scientific research on brain waves in the early twentieth century. Another highlight was a fascinating research project on eighteenth century cases of 'vampirism' in the borderlands of the Hapsburg-Empire, reconsidering local knowledge and social and intellectual hierarchies within communities, juxtaposing amateur and official accounts of situated phenomena.

The conference staged three parallel workshops which we could attend, on archival research, publication strategies, and funding. These were followed by a visit at the Museo Galileo, a personal highlight for Alicia because of its eighteenth-century wax models of the dissections of the pregnant uterus; Catarina particularly enjoyed surveying the museum's seventeenth-century Coronelli globes. The conference closed with a keynote lecture by Professor Stéphane Van Damme entitled 'Between the Colonial Machine and the French Global: Revisiting an anti-globalist narrative of the French Empire of Science (1660-1780)'.

The History Department's base at Villa Salviati, its home since September 2016, also houses the archives of the European Union, which could not have had a stronger symbolic meaning in present political developments. Overshadowed by developments at the Central European University, in the Society's spirit, participants stressed the importance of scholarly solidarity, academic freedom and further collaboration on an international basis. We are already looking forward to the next PG!

Alicia Hughes
(University of Glasgow)
& Catarina Madruga
(University of Lisbon)



Screening Hidden Histories

This year BSHS ran screenings across the country to celebrate and highlight the history of science film *Hidden Figures*. I worked with Jessica van Horssen (Leeds Beckett University, former BSHS Communications Officer) to bring together interested people to view the film and discuss how the history of science, race, and gender are presented on screen. I helped to organise #HiddenFiguresParty events in the North East and gave talks and facilitated post-screening discussions in Newcastle, and in Leeds alongside Jessica – fulfilling a teenage dream of working at the glorious Hyde Park Picture House.

Mathematician Katherine Johnson in 1966, image courtesy of NASA; restored by Adam Cuerden.

Hidden Figures is a race and gender-line crossing film about three African-American women who worked at NASA – mathematician Katherine Johnson (Taraji P. Henson), programmer Dorothy Vaughan (Octavia Spencer) and engineer Mary Jackson (Janelle Monáe) – and it explores their roles in assuring the successful l963 launch of astronaut John Glenn (Glen Powell) into orbit. The film is an adaptation of Margot Shetterly's 2016 book *Hidden Figures: The Untold Story of the African American Women Who Helped Win the Space Race*, which was completed as screenwriter Allison Schroeder was writing the script (commissioned from the book proposal).

Hidden Figures manages to elevate itself above other historical scientist biopics that tend to focus on a great man, his genius, and his heroic journey (e.g. *The Imitation Game* where Alan Turing invents and builds the Enigma code breaking machine singlehandedly). Instead, we are given the story of a team of women beset by everyday racism and misogyny who are integral to the success of US space missions Project Mercury and Apollo 11. *Hidden Figures* has three central figures, although Katherine Johnson, her family and her story acts as a structure for the film and is representative of the experiences of the woman human computers' history that the film uncovers. The titular hidden figures are not simply Katherine, Dorothy, and Mary but all of the black women working in the segregated west section of Langley campus.

As indicated by the *Hidden Figures* opening sequence – where a confused police officer questions the women as they attempt to fix their car – the fact that women were working at NASA during the 1960s was not well known. As Katherine explains in response to a question about whether women can 'handle' such technical work: 'Yes, they let women do some things at NASA, and it's not because we wear skirts. It's because we wear glasses'. Few women scientists, and even fewer black women scientists, are seen on the silver screen; they are often defined by their male counterparts (fathers, brothers, lovers) and framed as sci-candy rather than fully realised scientists. I was so excited by the release of *Hidden Figures* precisely because it placed women scientists at its centre rather than on the fringes of another man's story.

In one post-screening session, my opening comment seemingly formed an apology. I apologised for the lack of diversity of those leading discussions. I recognised the issues with a white British woman talking about a film about the lives of African-American women. This reflected a more general lack of diversity within the HSTM community and in British academia – contact was made with groups including Black British Academics but appropriate speakers were not available for the majority of screenings. We were confronted with choosing between running the #HiddenFiguresParty with problematic hosts or not running the events at all. But it was important for there to be a forum to exchange views on a film that challenged ideas of what a scientist looks like.

Discussions also focussed on *Hidden Figures*' negative components such as the invented character Al Harrison, played by Kevin Costner who ably fills the great white man role. Harrison only judges people on their talents and heroically puts his nation's scientific ambitions ahead of national and institutionalised racism and sexism. During such a conversation in Leeds, a voice from on high (the cinema has a balcony) asked us to stop apologising and to stop being so negative. We were implored to consider how important this film was for a black audience, and specifically black woman viewers who have rarely seen themselves presented as professional scientists or even heroes in mainstream Hollywood movies. It allowed us to start more positive discussions of the film, returning to the enthusiasm underpinning these events and opening up the floor for more personal stories about the experiences of women in STEM.

What about the women? This is often a relevant question for historians of science – in our discussions of *Hidden Figures* at Newcastle, we asked: what about the men of colour? Margot Shetterly's own African-American father was a research scientist at NASA. But this is a Hollywood movie and it focuses solely on African-American women scientists at the expense of an accurately representing NASA's 1960s workforce. There are limits to what can be included in a 90-minute feature film that needs a clear message and an easy to explain story – black women scientists at NASA – so that it can get funding and eventually Oscar-corridor distribution. I hope that the success of *Hidden Figures* will inspire Hollywood to produce more films like it and offer a great range of role models for young viewers.

For those who wanted more detailed histories I suggested reading Shetterly's book, and in response to queries about British human computers happily recommended Marie Hicks' 2017 monograph *Programmed Inequalities: How Britain Discarded Women Technologists and Lost its Edge in Computing*. This book traces the history of women in computing in the UK and their increasing marginalisation as computing shifted from being considered low-skilled (woman's work) to being high paid skilled work (man's work).

So what did we achieve? By offering events to cinemas we were able to get some to add *Hidden Figures* to their programme, even if only for one showing! We spoke to people who were encouraged to attend the screening because of the opportunity for discussion. At these events we were able hear stories from women scientists from different races who wished that there had been films like *Hidden Figures* when they were growing up, young women who found the film inspiring, people who wanted to discuss screening history and science, and even helped to find an A-level science student find work experience in a lab. Thank you to everyone who organised, spoke at, or attended one of the BSHS Hidden Figures screenings.

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The *Viewpoint* Interview

Anna Maerker is Senior Lecturer in the History of Medicine at King's College London

Who or what first turned you towards the history of science?

As a high school student I enjoyed both science and history, so I was intrigued when I came across "history of science" among a long list of degree programmes. Christoph Meinel at the University of Regensburg very kindly had a long chat with me about the discipline which encouraged me to give it a go. (I still enrolled as a physics major thinking I needed a "sensible option" that might lead to a proper job though ...)

What's your best dinner-table history of science story?

Many stories from the history of anatomy are not really fit for the dinner table (unless I'm in the company of medics, or other historians of medicine ...). But I enjoy talking about the invisible participants in science and medicine - the woman who donated the foetus she lost to medical research, or how financial records of floorboard repairs and showcase locks can tell us what parts of a museum were most popular with visitors, for instance.

Which historical person would you most like to meet?

My main protagonists in the history of anatomical modelling tend to come across as rather intense and prickly, to put it mildly - I'd rather encounter them through my sources. But I would have loved to witness the work of the natural magicians, and to experience these moments of wonder as part of an early modern crowd.

What has been your best career moment?

I've been very lucky to study and work in inspiring departments, and with great colleagues. A key moment was doing the MPhil programme in Cambridge - a real buzz intellectually, and it was there I realised that being a historian of science might be an actual career option. Another formative experience was being given the opportunity to co-curate an exhibition at the Max Planck Institute; it gave me insights into the challenges and joys of exhibition work which I've drawn on ever since.

And worst?

A panicked hour desperately trying to get an electronics experiment to run, only to find that I'd forgotten to plug in the oscilloscope ... That definitely contributed to my realisation that I should become a historian rather than a physicist.

What are your favourite history of science books?

On Christoph Meinel's recommendation I read Shapin and Schaffer's *Leviathan and the Air-Pump* as an undergraduate student. It took me two weeks to get through, and it was the most mind-blowing (or perhaps "paradigm-shifting") experience I ever had in a library. I recently re-read Ludmilla Jordanova's *Sexual Visions*, which is as insightful and challenging as I remembered it from first encountering it at Cambridge many years ago.

If you did not work in the history of science, what other career might you choose?

Museum work: It's always been a real privilege (and great fun) to work with museum practitioners. Curators have an opportunity to develop new interpretations of science and medicine through material culture, and to communicate the work of our discipline to audiences beyond academia.

What would you do to strengthen the history of science as a discipline?

There is a lot of potential for historians of science to engage with a wide range of communities – with scientists and historians, with local communities, cultural institutions, artists, and policy makers. We shouldn't be shy about our ability to support the development of critical and creative perspectives on key issues from innovation to utility.

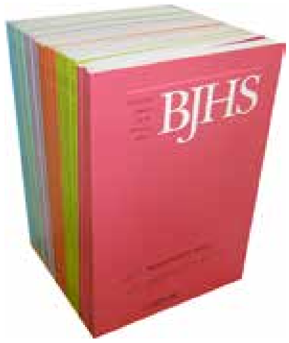
How do you see the future shape of the history of science?

It is rather worrying to see that, in the UK, HSTM programmes are under a lot of pressure at the moment, even those which are highly successful. More encouraging are the many new ways in which historians of STM now contribute to a diverse forms of collaborative projects and public histories, from popular non-fiction and novels to exhibitions and art projects.

The British Journal for the History of Science

Forthcoming papers include:

- Editorial, 'Past editors' favourite papers published during their time in office'
- Stefano Gattei, 'Galileo's legacy: a critical edition and translation of the manuscript of Vincenzo Viviani's Grati Animi Monumenta'
- Caitlín Róisín Doherty, '"Transporting thought": cultures of balloon flight in Britain, 1784–1785'
- Stephen Courtney, '"A very diadem of light": exhibitions in Victorian London, the Parliamentary light and the shaping of the Trinity House lighthouses'
- Ida H. Stamhuis and Annette Vogt, 'Discipline Building in Germany: Women and Genetics at the Berlin Institute for Heredity Research'
- Paul Josephson and Aleksandr Sorokin, 'Physics Moves to the Provinces: The Siberian Physics Community and Soviet Power, 1917-1940'
- Andrea Gambarotto, 'Lorenz Oken (1779-1851): Naturphilosophie and the Reform of Natural History'



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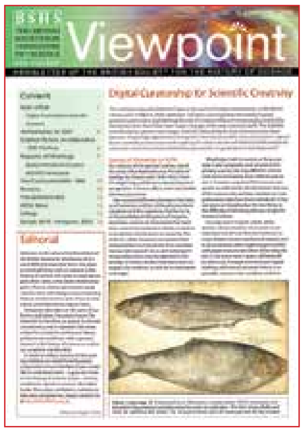
Viewpoint: the Magazine of the BSHS

Contributions

All contributions and correspondence should be sent to the Editor, Alice White, Wellcome Library, Gibbs Building, 215 Euston Road, London, NW1 2BE; viewpoint@bshs.org.uk. Electronic communication is preferred. *Viewpoint* is issued three times a year – in February, June and October. The next issue will be in October 2017 and the deadline for copy is 15 August 2017.



Circulation

Enquiries about circulation should be sent to the BSHS Executive Secretary, British Society for the History of Science, PO Box 73631, London, SW14 9BS. *Viewpoint* is free to BSHS members and is priced £12.00 a year (three issues) for UK non-members, £17.00 a year for overseas non-members.

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