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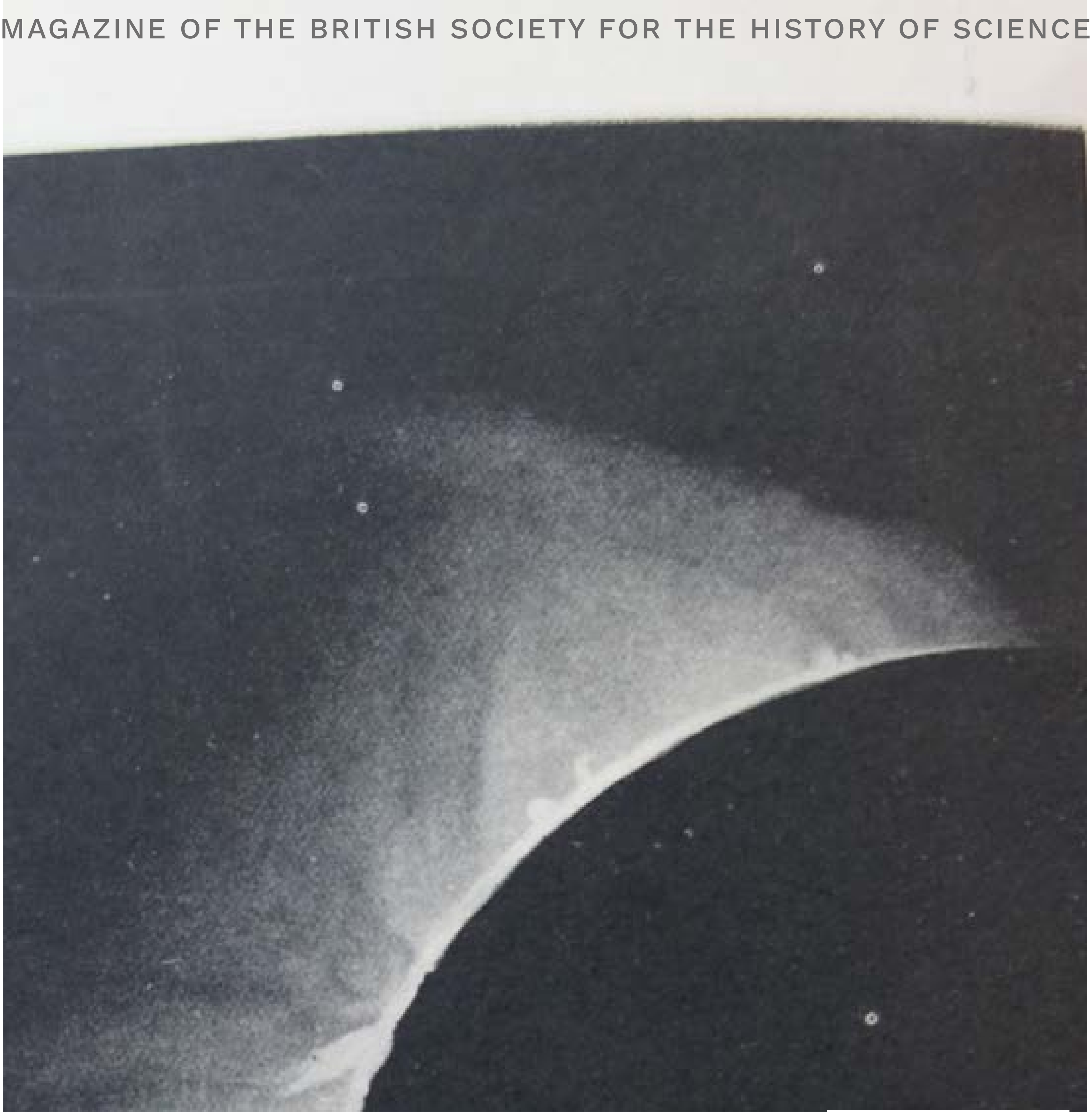
VIEWPOINT

MAGAZINE OF THE BRITISH SOCIETY FOR THE HISTORY OF SCIENCE



Illusive Subjects.

Explore the crossover between photography and astrophysics: the difficulties of evidencing the very small, the very large, and the humans involved.

BSHS

ISSN: 1751-8261

News • Photography and Astronomy• Advertising with Albert • Capturing the Neutrino • Book Excerpt • Interview •

Contents

Editorial

Excitingly, this is my first editorial as the new editor for *Viewpoint*, and I am so pleased to bring you this fascinating issue.

Another first is the contribution from a school student, as Kevin Wang explores the past, present, and future of the neutrino. *Viewpoint* partnered with Kevin's school, and will soon provide an issue connected to his high school curricula.

Connecting to this research, Madelyn Hernández provides a fascinating report on the funding she has received from the BSHS that has enabled her to explore the historical role that women have had in bringing photography to astronomy, and Robert Fleck shares his analysis of the different uses that advertisers have made of Einstein's image over the decades.

Speaking to these multiple appropriations, our book excerpt is *Uncivilised: Ten Lies That Made the West* by Subhadra Das, and I provided an interview as introduction to you all.

Let us know your thoughts on this via @BSHSViewpoint or by email. Future contributions should be emailed by Friday 3 May 2024 to viewpoint@bshs.org.uk.

Joe Holloway, Editor

BSHS Small Grants.

The BSHS is pleased to confirm the following successful applications for the September 2023 iteration of the call for Small Grants:

Sarah Lowry (Royal College of Physicians) 'Covid-19 Oral Histories - Recording the Experiences of Healthcare Workers During the Pandemic.'
Amount: £500

Erika Jones (Royal Museums Greenwich) 'Beyond the Ocean's Depths: Revisiting the Challenger Expedition (1872-1876) Interdisciplinary Conference.'
Amount: £500

Charles Withers (University of Edinburgh) 'Working with Charles Lyell.'
Amount: £500

Lavinia Gambini (University of Cambridge) 'Global Recipes in Early Modern Worlds: Ingredients, Actors, Exotica.'
Amount: £500

Tom Abram (Archives of IT) 'AIT Forum on Histories of the Internet'.
Amount: £500.

Selected unsuccessful applicants have been invited to apply for upcoming future rounds.

The February 2024 call has been issued, and the BSHS is looking to award grants of up to £500 each to conferences and workshops to be held in person, funds to be spent by 4th March 2025. Awards may be used for any reasonable purpose to support running a conference, which might include catering, venue, or accessibility costs. Please note, however, that the society is committed to lowering its climate impact and therefore will not fund air travel.

Details of materials required and the application form can be accessed via https://www.bshs.org.uk/grants

Postgraduate Conference

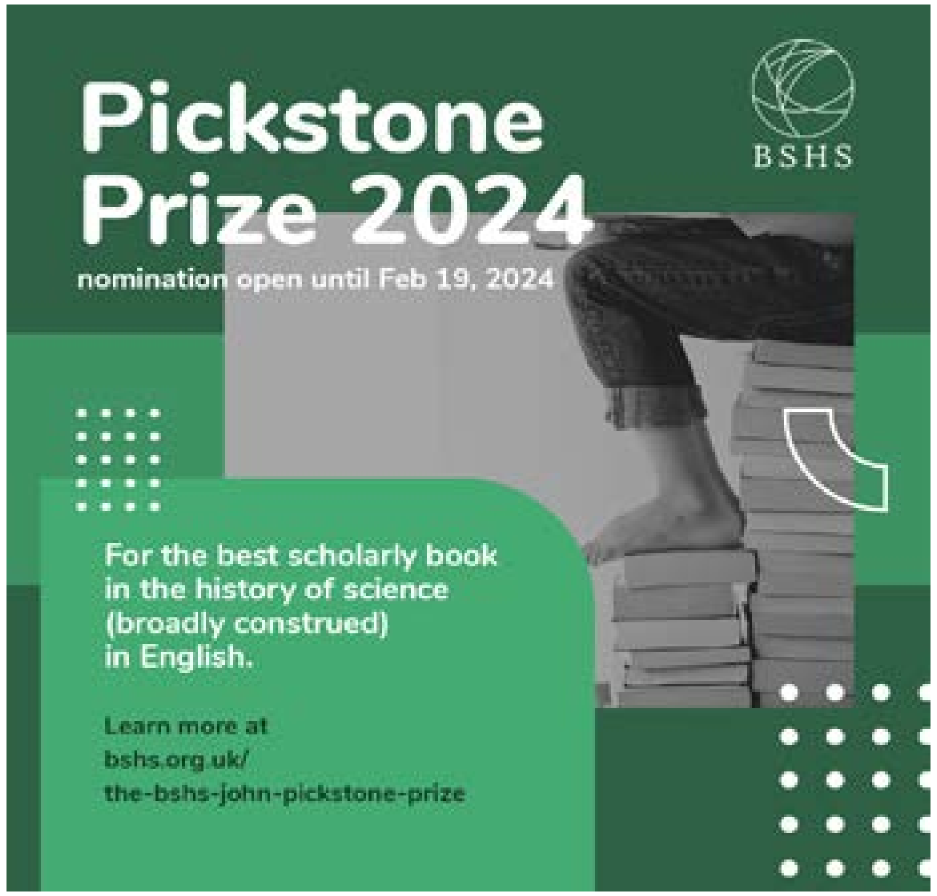
In addition to the annual BSHS conference (see adverts on pages 4 and 7 of this volume for the CfA) the annual BSHS postgraduate conference will run from the 19th-20th April 2024.

This year's postgraduate conference will be hosted by the University of Warwick, under the theme of the Global History of Science, Technology and Medicine.

The call for papers has now closed, and successful applicants can expect to hear back from the panel during the week beginning the 19th February.

All attendees are invited to apply for the Butler-Eyles BSHS travel grant at https://www.bshs.org.uk/grants/butler-eyles-travel-grants

Further information can be found at the dedicated BSHS postgraduate conference website: https://pg-conference.bshs.org.uk/



'Stonehenge of the North' Acquired by English Heritage.

The Thornborough Henges are three large Neolithic circular 'henges' that are over 4500 years old, located in North Yorkshire. Each of them are more than 200m across and have been sites of ceremonial importance for at least 2000 years.

English Heritage has now completed its acquisition of these henges, and whilst they are currently closed to public so that repairs can be made following recent storm damage, the organisation hopes to make the site available for everyone to enjoy shortly.

For more information on the history of this site please visit: https://www.english-heritage.org.uk/visit/places/thornborough-henges/

Plymouth Secures Funding for 'Underwater National Park'

The first National Maritime Park has been successful in its bid for £11.6m funding from National Lottery Heritage Fund. Through this the Plymouth Sound National Marine Park will provide a heritage site containing over 600 shipwrecks that houses internationally significant wildlife, with the majority of this being underwater.

For more information please visit https://plymouthsoundnationalmarinepark.com/

Cover Image: *One of eleven photographs of the Orion Nebula (M42). Andrew Ainslie Common, 1883. Attribution: CC 1.0 Universal. Source: Science Museum Group Collection.*

Above: *One of eleven photographs of the Orion Nebula (M42). Andrew Ainslie Common, 1883. Attribution: CC 1.0 Universal. Source: Science Museum Group Collection.*

Science in Prose: The Introduction of Photography to Astronomy

Madelyn Hernández reports on her research funded by the BSHS into the historical role that women had in combining the photographic arts with the science of astronomy.

From its early stages, photography has been closely linked with astronomy. This history often focuses on figures like John Draper, John Herschel, William Cranch Bond, John Adams Whipple, and Warren de la Rue. My research uncovers a less-explored facet of this history: the role of British women in shaping the narrative of the introduction of photography and astrophotography. This exploration centers on the books On the Connexion of the Physical Sciences (1834) by Mary Somerville, A Popular History of Astronomy during the Nineteenth Century (1885) by Agnes M. Clerke, and The Heavens and their Story (1908) by Annie and her husband, Walter Maunder, primarily authored by Annie. Their books, landmarks of their time, were widely read within the scientific community and amongst various sectors of the general public, playing a crucial role in integrating photography with astronomical research. Supported by the BSHS grant, the Agnodike Travel Research Fellowship, and the Royal Society Lisa Jardine Grant, my research journey led me to the Royal Society Library, the British Library, the Royal Astronomical Society Library, the University of Reading Archive, and the Bodleian Library. There, I found critical archival sources to reconstruct how Somerville, Clerke and Maunder navigated their time, working with publishers, printers, photographers and illustrators, to introduce the new practice of photography in astronomy in their era.

On the Connexion

On the Connexion of the Physical Sciences is a masterful blend of poetry and science. Mary Somerville's writing is clear and well-organised, yet it soars to poetic heights when depicting certain phenomena. This literary technique skillfully transitions from the specific to the general and from the mundane to the magnificent. Published in ten editions from 1834 to 1877, the book captivated readers with its engaging narrative style and remained a relevant scientific resource in the physical sciences of their time. Somerville's work delved into the interconnectedness of the physical sciences, highlighting their mutual dependencies. She eloquently explained, for example, how properties like air density and temperature impacted sound and music theory.

Above *The Royal Society, 6-9 Carlton House Terrace, London. Photo by author.*

In the nascent stages of photography in 1844, Somerville reached out to John Herschel, a friend and collaborator, seeking insights into the Daguerreotype process and the study of "photographic rays" – the effect of light on chemicals, a method potentially useful for analysing the sun and its composition. Herschel's response and the sending of subsequent articles inspired Somerville to conduct her own experiments, on the action of light on vegetable juices, findings that were later communicated to the Royal Society.

By the 7th edition in 1846,

Somerville had expanded On the Connexion to include details on the photographic process, covering methods, chemicals, applications, and the potential for studying the sun through the chemical action of light. However, by the 9th edition in 1858, she expressed scepticism about photography's limitations in representation and its efficacy in solar studies.

It was only in the tenth edition, revised posthumously by Arabella B. Buckley, that significant updates were made. Buckley introduced new content on spectrum analysis, another method utilising light to study the sun, alongside advancements in photographic processes. This final edition cemented the book's status as a comprehensive, state-of-the-art resource in the field of physical sciences.

History of Astronomy

A Popular History of Astronomy during the Nineteenth Century was a seminal work that masterfully chronicled a century's worth of astronomical discoveries. Its methodological precision and engaging writing style established it as a classic in the field. Popular History focused on the 'new astronomy' driven by advancements in spectroscopy and photography.

Popular History was a dynamic, evolving work. Published in 1885, with 15 years remaining in the century, Clerke planned for subsequent editions, culminating in its final version in 1901. Her meticulous approach, covering everything from content and structure to the strategic use of images, showed her dedication to creating a work that was well-received at the time but would also stand as a lasting contribution to the history of astronomy.

Clerke strategically chose to include the photograph of the Great Orion Nebula by Andrew A. Common as the frontispiece in the second edition of her book. Common's photograph, presented in 1883 at the Royal Astronomical Society, was a significant milestone, offering a level of detail and accuracy previously unattainable in astrophotography. That's when photography "assumed the office of historiographer of the nebulae," Clerke wrote, "since this one impression embodies a mass of facts hardly to be compassed by months of labour with the pencil."

Common's Orion Nebula served as a distinctive symbol of her historical narrative, and its inclusion as the frontispiece in Popular History crowned the astrophotographical achievements presented. The narrative of Popular History, enriched with updates and new images in subsequent editions, established a canonical history of astronomy, astrophysics, and astrophotography that was very significant for their contemporaries.

Centre: Photograph of the Sun's Corona during an eclipse. Original by Annie Maunder, reproduction by author.

Heavens and their Story

The Heavens and their Story uniquely blend scientific discourse, narrative style, and visual representation, and was primarily aimed at a young audience. Annie and Walter Maunder were instrumental in pioneering solar photography and significantly contributed to the study of the sun's corona and sunspots. Authored at the dawn of the 20th century, when photography had become an indispensable tool in astronomy, the book offered first-hand narratives about the work of astronomers, making it particularly engaging for its readers.

A. Maunder employed various narrative techniques to immerse her young audience in the universe's wonders, combining poetic and narrative styles. She aimed to inspire a fascination with astronomy, hoping to attract more youth to the field. A. Maunder emphasised that one need not be wealthy or have a grand observatory to engage in astronomical pursuits.

Illustrations in the book played a crucial role. They were not just complementary but were integral to the narrative. A. Maunder used images to enhance explanations and represent concepts, moving beyond mere decoration to become argumentative and explanatory. The book detailed various methods for observing the sun and other celestial objects, advocating for photography as a tool for detailed and accurate representation.

A. Maunder's narrative style in the book was authoritative, especially when referencing her own photographs, providing a direct connection between her narrative and the astronomical work. This approach challenged conventional perceptions of women's roles in science and allowed Maunder to have her voice heard in a field where her husband was the main advocate of their mutual research.

The Road Ahead

These women were more than authors; they were visionaries instrumental in shaping the field of astronomy. Their books, spanning different audiences and times, demonstrate how women in science have been instrumental at every stage of the evolution of photography in astronomy. These are just a short view of my research findings, which also delve into the material aspects of these books and more – evaluating the evolution of visual and textual languages in astronomy, including texts, drawings, and photographs that depict astronomical objects or practices.

Madelyn Hernández
PhD Candidate in Historical and Social Studies on Science, Medicine, and Scientific Communication University of Valencia.

Advertising with Albert: Einstein Billboard Art Across Space and Time

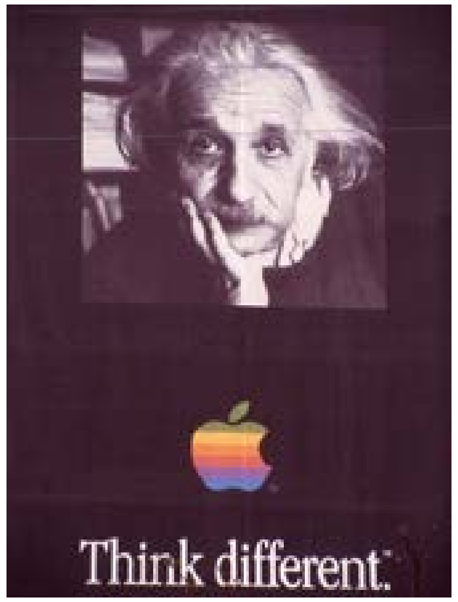
Robert Fleck shares photographs he took at different places and times of advertising billboards featuring the famed physicist Albert Einstein, illustrating the universal attention-getting potential of the most recognizable icon in science, proving that genius sells.

Everyone is familiar with billboards, if not enamored by them. These large advertising platforms are purposely designed to attract attention and to create a quick, memorable impression.

Equally familiar is the name and face of Albert Einstein (1879–1955), arguably the most famous and recognizable scientist in history, even if not everyone is familiar with the details of his science that revolutionized physics in the early twentieth century. With his fright-white, wild and wispy cosmic halo of hair, his face became a symbol and he an instantly identifiable pop icon. It is no surprise that he has appeared all over the world on a multitude of advertising bulletin boards, toys, T-shirts, coins, banknotes, mugs, murals, magazine covers and more. Einstein's immediately recognizable visage certainly attracts attention.

Copenhagen Apple

In this larger-than-life Apple advertisement, Einstein looked down on



Copenhagen's Rådhuspladsen (Town Hall Square), one of several in a "Think different" Apple ad campaign that also featured iconic historical figures including Gandhi, Picasso, Edison, and John Lennon.

Einstein advertisements such as this one – and there is a universe full of them – "implied that buyers were smart to buy the product, or likely to become smart if they did. Conversely, the simplicity and ease of use of a product was endorsed by the assurance that you did not need to be an Einstein to use it" (John Barrow, "Einstein as icon," Nature 433, (2005), 218-219).

Paris Perrier

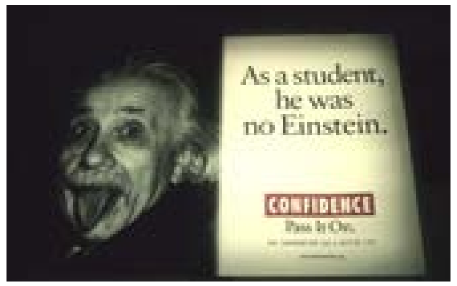
A Paris Perrier thirst-quenching billboard featuring a T-shirt with Einstein's most iconic and widely circulated photo (see below for another example) that was taken by photographer Arthur Sasse on Einstein's 72 birthday outside the Institute for Advanced Study in Princeton, New Jersey. In 1933, after fleeing

Above: Albert Einstein signature redrawn to SVG format. 2008. Image in public domain. Source: Wikimedia Commons. All other images photographed by author. **Centre**: Apple advert (1998, Copenhagen). **Bottom right:** Perrier advert (2003, Paris).

Nazi Germany, Einstein became its first permanent faculty member. In a gesture of annoyance, the usually reserved humble genius, demonstrating his unconventional free spirit, stuck out his tongue at the pursuing paparazzi who were hoping to take a birthday photo and perhaps hear one of the world-famous professor's characteristically witty quips about current global affairs.

Ein Stein in London

No Perrier? How about a beer? Here's the "genius" of beer, Carling in a can. This clever advertisement proclaimed it – or perhaps the imbiber – to be "SMARTER THAN EIN STEIN. Your best bet yet" and was prominently displayed in the London Underground's Archway station.



Foundation for a Better Life

"You will never amount to anything!" one of young Einstein's teachers said at Munich's Luitpold Gymnasium in despair at his daydreaming. Although he was a good student – particularly in science and math – he disliked authoritarian teachers, servile students, and rote learning. As a result, he became the patron saint of distracted students everywhere.

Einstein's disdain for things formal and authoritative (including education and attire) is well known: when questioned later in life about his rumpled and informal attire, he reportedly replied that "It would be a sad situation if the wrapper were better than the meat wrapped inside it.". Einstein's "success came from questioning conventional wisdom, challenging authority, and marveling at mysteries that struck others as mundane. This led him to embrace a morality and politics based on respect for free minds, free spirits, and free individuals" (Isaacson, p. 7). "To punish me for my contempt of authority," a famed Einstein would ironically later lament, "Fate has made me an authority myself" (Alice Calaprice, ed., The Ultimate Quotable Einstein, p. 12).

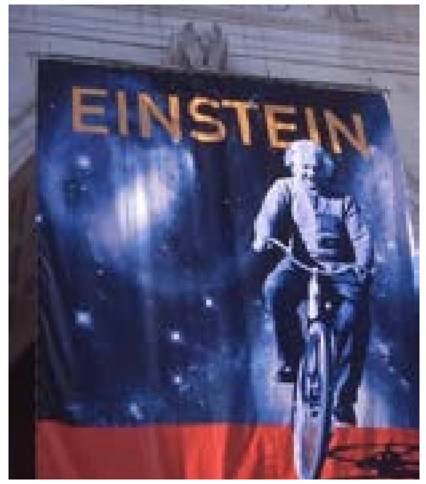
Life is Like Riding a Bicycle

Here we see Einstein riding a bicycle advertising a 2003 exhibition at the American Museum of Natural History in New York City as part of the "2005: The World Year of Physics" centennial celebration of Einstein's annus mirabilis ("miracle year"), a year when, as Einstein put it, "a storm broke loose in my mind" unleashing a burst of creative activity not seen in science since Isaac Newton's anni mirabiles during the plague years of 1665 – 1666. In that year, 26-year-young Einstein, unknown to the physics community and working alone in his "unfortunately scarce spare time," sent five important papers to Europe's leading physics journal, Annalen der Physik, on three revolutionary topics, each one eventually recognized as the work of genius. The first paper proposed the light-quantum ("photon") particle nature of light to explain the photoelectric effect – the conversion of light energy into electrical energy as occurs in solar cells – and earned its author the 1921 Nobel Prize in Physics. There were two papers on special relativity, the first presenting the relativistic kinematics of space-time, and the second demonstrating the equivalence of mass and energy, which he later wrote as E = mc2, arguably the most famous equation in science. The other two papers applied statistical molecular-kinetic theory to demonstrate the reality of atoms and molecules, a reality categorically denied by many in the world of physics who at that time regarded atomic theory as no more than a useful theoretical construct.

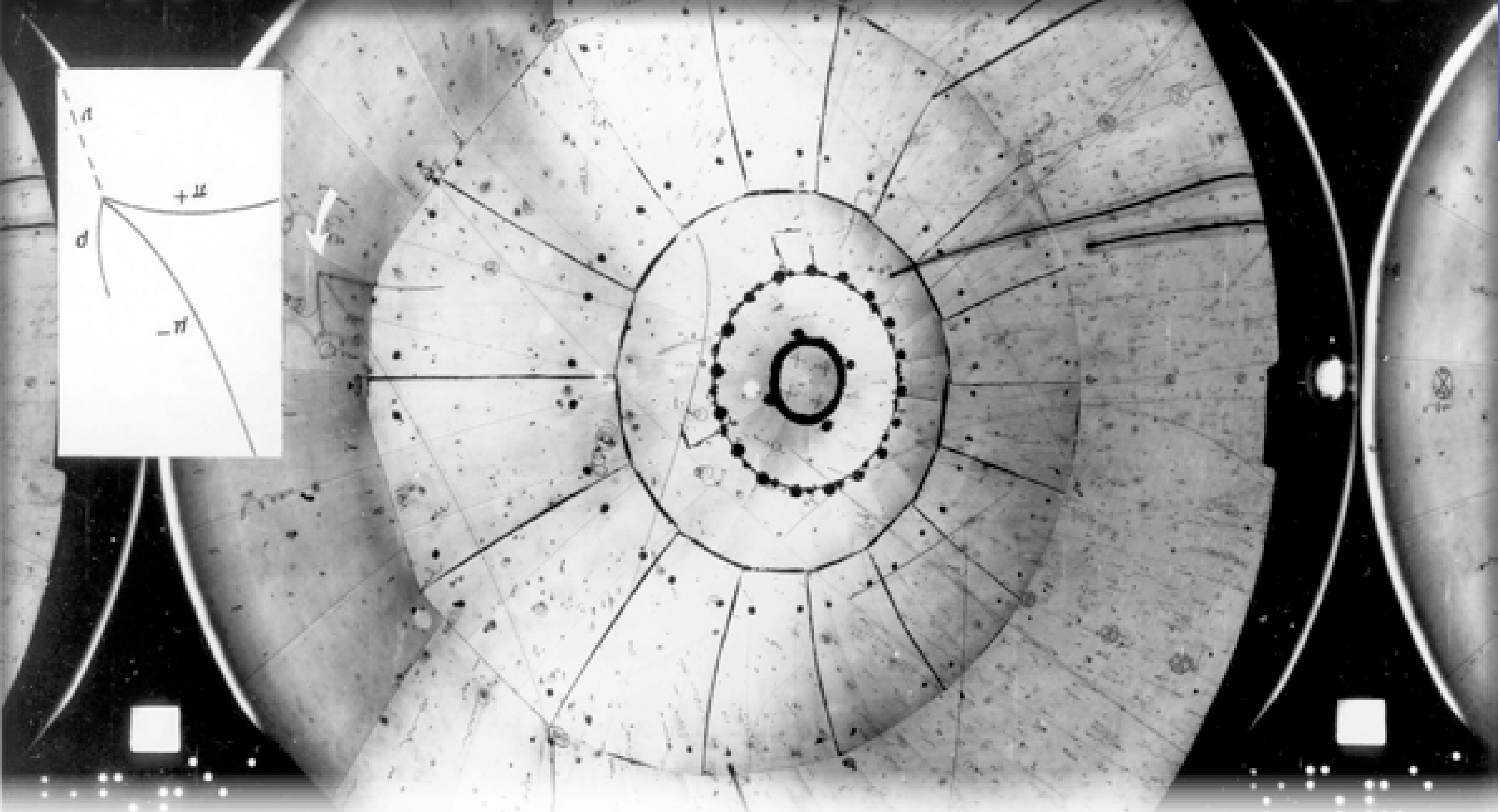
"Life is like riding a bicycle. To keep your balance you must keep moving," Einstein wrote to his younger son, Eduard, who was eventually diagnosed with schizophrenia and confined to an asylum near Zurich. Albert himself never learned to drive a car – "too complicated for him," according to his cousin and second wife, Elsa – and this photo was taken in 1933 at the home of a trustee for the California Institute of Technology where Einstein was completing a 2-month visiting professorship. Like a bike-riding child, Einstein retained his awe and curiosity of the natural world throughout his life. "Studying, and striving for truth and beauty in general, is a sphere in which we are allowed to be children throughout life" (Calaprice, p. 100).

Like his scientific legacy, the licensing of Einstein's name and image for advertising endures, proving that genius still sells. Einstein certainly would have been surprised by all of this. "I have no special talents," Einstein confessed three years before his death. "I am only passionately curious" (Calaprice, p. 20).

Robert Fleck
Emeritus Professor
Physics and Astronomy
Embry-Riddle Aeronautical Univerisity, Florida.



Top Left: Carling Tube Advert (1992, London). **Centre Left:** Foundation for a Better Life Advert (2006, JFK Airport, New York City). **Bottom Right:** American Museum of Natural History Advert (2003, New York City).



Capturing the Neutrino: The Ghostly Particle

Kevin Wang explores the careers of some important figures in the history of neutrino studies, and looks at where research is directed, and what theoretical and practical advancements this might lead to.

As a high school student, I used to think that the universe was made of atoms, however, this is not entirely incorrect. If we were to account for all the matter in the universe, the material that is composed of atoms – called ordinary matter – is actually only a very small proportion. Only about 4% of the universe is an element on the periodic table. Despite this small percentage, there is still far more matter than antimatter in the universe. According to the Big Bang theory, equal amounts of matter and antimatter were created, but somehow a slight imbalance allowed matter to dominate. A phenomenon known as neutrino oscillation suggests that these two forms may change from one to the other and thus neutrinos may be the key to solving this mystery. Investigating this provided insights into the matter-antimatter asymmetry.

Wolfgang Pauli

Wolfgang Pauli (1900–1958) was a physicist who made great contributions to the field of quantum mechanics, including his proposing of the neutrino. In 1930, Pauli was confused by a seemingly impossible experimental result. When measuring radioactive decay, experimenters tracked the energy and the mass of the decaying particle, but the results did not initially make sense. This was because of what we now know as beta decay, where instead of emitting electrons, some atoms disintegrate instead. It is evident that with this form of decay, some energy from the decaying atoms disappeared, in contradiction to the first law of thermodynamics, under which energy cannot be created or destroyed but only transferred. So, Pauli proposed a new idea to account for this, where a new type of small, chargeless particle is also emitted alongside an electron. Shortly after this, James Chadwick demonstrated the existence of such a particle but with mass identical to the proton, which he termed the neutron. Chadwick named his particle the "neutron," but as Pauli had already given his proposed particle that name, this led to confusion. Physicist Enrico Fermi suggested renaming Pauli's particle as the "neutrino," which translates to "little neutral one" in English, to avoid this ambiguity. The moniker stuck, and it is still used today. There was, however, a sceptical reaction to Pauli's theory of the neutrino. Contemporaries found it difficult to understand the existence of an undetectable particle. Eventually, long after Pauli's departure, Clyde Cowan and Frederick Reines finally achieved experimental confirmation of the neutrino in 1956. They were able to verify the existence of these elusive particles by detecting neutrinos generated in a nuclear reactor.

Reines and Cowan

Physicist Clyde Cowan graduated from the University of Alabama with a bachelor's degree in 1940 and from Princeton University with a doctorate in physics in 1949, where he met Frederick Reines. Stevens Institute of Technology awarded Reines his undergraduate degree in 1939, and New York University awarded him his doctorate in physics in 1944. Cowan and Reines aimed to directly detect and observe neutrinos by designing an experiment that could make visible the weak interactions associated with these elusive particles. They made use of neutrinos' weak interactions with matter, the very thing which makes them challenging to find. They concentrated on the phenomenon referred to as "inverse beta decay" where an electron antineutrino (a very small neutrino that is electronically neutral) is fired at a proton, producing a neutron and a positron. Whilst unlikely to occur, this collision would produce recognizable gamma rays. By devising an experiment that could pick up the weak interactions linked to these elusive particles, at their experimental set-up at the Savannah River nuclear reactor in South Carolina, USA, Cowan and Reines found the first evidence of neutrinos on June 14, 1956. They observed correlated flashes of light from the scintillator tank filled with cadmium chloride – a substance known to give off a gamma ray after capturing a neutron. The existence of neutrinos and their function in weak interactions like this were directly confirmed for the first time by this important experiment.

Above: The first neutrino-induced reaction in pure hydrogen produced in the bubble chamber at the AEC Argonne. United States Department of Energy. 2014. Image in public domain. Source: Wikimedia Commons.

Above Left: *Wolfgang Pauli. Bettina Katzenstein. Attribution CC 3.0. Source Wolfgang Pauli Centre.* **Above Right** *The Discovery of Neutrinos. 2010. Attribution CC 2.0. Source: Savannah Rivier Site*

McDonald and Kajita

Even after Cowan and Reines demonstrated the existence of the neutrino to the world, many people still believed it to have zero mass. Fortunately, Arthur McDonald and Takaaki Kajita of Japan showed that neutrinos may oscillate between different types, permeating almost everything in the universe and that they did in fact have mass. The two scientists were awarded the 2015 Nobel Prize in Physics for their discovery.

Precise measurements of solar neutrinos and the study of neutrinos from cosmic sources were made possible by Kajita and McDonald's inventive detection techniques, which included the Super-Kamiokande experiment by Kajita and the Sudbury Neutrino Observatory (SNO) experiment by McDonald. A vast subterranean water tank was utilised in Kajita's Super-Kamiokande experiment in Japan to detect Cherenkov radiation, which is created by neutrino interactions. Heavy water was employed in the SNO experiment by McDonald in Canada to identify various neutrino kinds. These detection methods have since been further developed and utilised in subsequent neutrino experiments worldwide.

Future Uses

People have suggested using neutrino beams to communicate across the earth by sending the beam straight through the earth instead of having to bounce electromagnetic waves off satellites or around fiber-optic cables. Since neutrinos hardly interact with anything, using neutrinos could give us a few milliseconds' advantage in communication.

Neutrino voltaic technology also has the potential to completely change how we produce electricity, with neutrinos as the source of the electric current Due to their extremely small size and the difficulty in detecting them, neutrinos have the unusual ability to flow through almost any object without coming into contact with it. This means that they are unhindered in their ability to pass through the crust of the Earth, as well as through buildings and other things. The way that neutrino voltaics operates is by sandwiching a semi-conducting layer between two metal layers. A tiny electrical charge is produced in the semiconducting material whenever a neutrino travels through the gadget. One of the biggest advantages of neutrino voltaics is that it can work 24/7, regardless of weather conditions or time of day. This means that it could provide a constant source of clean, renewable energy that is not subject to the same fluctuations and intermittency as solar and wind power. Another advantage is that neutrino voltaics have a much smaller physical footprint than traditional solar panels, as the use of this technology does not require large arrays of panels to capture sunlight. It also has the potential to be much more efficient than traditional solar panels, as it can capture energy from neutrinos that would otherwise pass through the Earth without being utilised, generating clean, sustainable energy and reducing our dependence on fossil fuels.

People started to show interest in the neutrino concept after Pauli brought it forth. Even though the question of the imbalance between matter and anti-matter is still unresolved, since Pauli's concept of the neutrino, investments are being made to make it directly beneficial to all people. Imagine a future without the problem of electrical supply. The future is being scattered by this phantom particle, and once we catch it, everything will change.

Kevin Wang
Harrow International School, Beijing.

Above: Fischer-Saller Scale of Hair Colour. 2022. Attribution CC 4.0 International Source Wikimedia Commons.

Special excerpt. *Uncivilised: Ten Lies That Made the West***.**

Subhadra Das provides a preview of their latest monograph and introduces us to the racist colonial underpinnings of the Royal Society, Sir Francis Galton, and the Fischer hair colour gauge.

Chapter One NULLIUS IN VERBA

Tucked away in the storerooms of University College London's state-of-the-art teaching museum is a metal box. It's flat like a cigarette case, only much longer – just over a foot long – and it doesn't contain any cigarettes. If you flip open the two clasps along one long edge, you will see laid out before you thirty samples of synthetic human hair, all of different colours and textures. Most of them mimic straight hair, running the gamut of blonde and brunette. The palest flaxen shades are in the middle, changing by degrees to darker shades of brown on either side. The last three samples on the right show different shades of red hair. Black hair is represented by the last four samples on the left.

Like most of the others in the box, the innermost of these shows straight hair. The three outermost demonstrate black hair with varying degrees of curl. Altogether, the thing gives an impression of an antique hairdresser's sample kit. It's mildly creepy in the way of so many historical curiosities, but otherwise seems fairly innocuous. Take a look at the faint engraving on the top left- hand side of the lid however, and you will find a clue that there is something more sinister going on here.

In old-fashioned cursive writing the object itself tells us what it is: 'Haarfarbentafel', which, roughly translated from German means 'hair colour gauge'. The inscription also spells out a name: Prof Dr Eugen Fischer. A German anthropologist,in 1927 Fischer was appointed Director of the Kaiser Wilhelm Institute of Anthropology, Human Heredity and Eugenics. His anthropological research informed his beliefs that miscegenation – so-called race mixing – should be discouraged in the interests of maintaining Aryan racial purity. Fischer's scientific research would go on to inform the Nuremberg Laws, the antisemitic and racist legal codes that underpinned the Nazi state during the 1930s and into the Second World War. These laws would go on to target and legitimise the persecution and murder of disabled people and racialised groups of people, including Jewish, Black and Roma people, in acts so terrible we had to come up with new terms to describe them: genocide and crimes against humanity.

Fischer's hair colour gauge was the first object I got to know when I was one of the newly appointed curators of the UCL Science Collections in 2012. You may think, as I certainly used to, that all museum curators know everything there is to know about their collections, but the reality is that we all have to start from somewhere, and for me, this was it. My job was to make the historical science collections at the university available for teaching, research and public engagement. One of the first tasks on my to-do list was to help a couple of my academic colleagues who were teaching on the Museum Studies course. They wanted to assign a research project to their students that involved taking a deep dive into the archives in relation to museum objects about which relatively little was known. The metal box of hair samples fitted the bill and the students went on to meet the brief and more. Thanks to their research, we now had lots of new, and frankly horrifying, information about the object, like who made it, when and how they used it and to what purpose.

We could say with some certainty that the device was designed by a eugenicist scientist to study the children of local women and European soldiers in the colony of German South West Africa (now Namibia). He did this against the backdrop of the Herero and Namaqua genocide (1904–8) – now acknowledged as the first genocide of the twentieth century. Fischer's research was seen as proof that 'racial characteristics' – like hair and eye colour – were passed from parents to their children. In other words, it was seen to prove that 'race' had a basis in biology. Similar devices were made and used in racial studies in other parts of the world later in the twentieth century, including Nazi Germany, just a few decades later.

As a former UCL student who was now a member of staff, and knowing its reputation as being at the cutting edge of scientific research, I had always been under the impression that we were the good guys. All of this research, however, threw up a new question, one that would go on to both frame and haunt my career as the curator of a historical science collection at one of London's, if not the world's, leading universities. If the hair gauge was, in fact, an object designed by a race scientist who went on to become a Nazi, what on earth was it doing here? The answer lies in the history of science. More particularly, it lies in what science means to us in our civilised society. To find the answer, as with most things, we have to go all the way back to the beginning.

Above *Portrait of Francis Bacon, Viscount of St Alban, by John Vanderbank. Image in public domain, sourced via Wikimedia Commons.*

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If Western civilisation were a city, science would be its citadel. Built on higher ground, at the heart of the settlement, science is the bastion of a rational, civilised society, a solid fortress that is supposed to be built on observation, reason and truth for the benefit of all concerned.

Civilised people, as we have come to know them, are not prey to myths and superstition. They do not succumb to fear, irrationality or the other base emotions of 'savages'. They do not have unquestioning faith in what they cannot see for themselves, be it God or monsters. Instead, civilised people are able to look at the world objectively, without prejudice or bias and, through the application of reason, lay their hands upon the truth. To be scientific, then, is to be as civilised as it gets. The methods of science require scientists to be as rational as they possibly can – to pause and look at the bigger picture. They need to step out of the hubbub and the messiness of their everyday lives and look at what is really going on. It's this separation of scientists from the very things they are studying which is held to be the greatest strength of the scientific method. Science, we are led to believe, does not trouble itself with philosophy, reputation, power or any other such social and cultural fripperies: it deals with reality.

One of the most celebrated figures in the history of science is Francis Bacon, a seventeenth-century English lawyer, politically disgraced Lord Chancellor (he took bribes and got caught) and the man generally credited with drawing up one of the earliest iterations of the scientific method as we think of it today. The Baconian method of science relied on the physical examination and detailed observation of the natural world to gather data as the direct path to the truth. This was as opposed to the existing theology or moral philosophy of his day, which bothered itself with trying to work out what was right and wrong. Instead, Bacon placed his sole focus on what could demonstrably be proved. For Bacon and other early scientists like him, the scientific method was a tool that allowed them to be more practical – and in some ways more democratic. Rather than defer to the word of God in the Bible, for example, or the word of Aristotle from classical sources, anyone could – and should – go forth and find things out for themselves.

This is the scientific method in its earliest form as we recognise it. Bacon and his peers also had the benefit of developing a whole new slew of scientific instruments for measuring the world around them – the telescope, the microscope, the barometer, clocks and watches, sextants and surveying equipment – all of which are still used today. According to Bacon, these instruments, along with careful observation and experiment, would lead reliably and directly to the truth. When, after years of lobbying by Bacon, Charles II granted a charter to the Royal Society, this freedom of thought and focus on hard facts to the exclusion of everything else was integral to its mission. So integral, in fact, that the Royal Society's motto remains engraved above a door in its London headquarters to this very day: Nullius in verba – take no one's word for it. Do not rely on testimony when you can depend on facts. It was this faith in the experimental philosophy that laid the foundations for modern Western science.

In the centuries that followed, Bacon was held up as a beacon for Enlightenment thought in the seventeenth and eighteenth centuries. European Enlightenment thinkers rejected the existing religious and classical philosophies in favour of what they believed to be a more effective and useful approach to understanding and living in the world. As the name Enlightenment suggests, thinkers during this period were keen to expose the old ways of doing things to the bright light of reason. It was an idea that crossed art and academia, that saw Voltaire skewer the French nobility in satire, Jean-Jacques Rousseau advocate for educational reform and Denis Diderot attempt to compile the entirety of human knowledge into his Encyclopédie.

For Enlightenment thinkers, no subject was beyond the bounds of human understanding, and to pursue that understanding was key to what it meant to be alive, to be human and to contribute to the work of the world. In the now immortal words of René Descartes: 'I think, therefore I am.' Finally, after centuries of stumbling around in the darkness of religion, myth and superstition, humankind had taken a firm hold of the torch of reason, which would now light the way on our collective journey to the truth. The pure light of reason, though, managed to cast some long, troubling shadows. Our collective journey turned out not to be so unambiguously unified. European scientific endeavours would go on to show, or so it seemed, that some people were more capable of rational thinking than others.

*

I used to think I was no good at science because when I was at school, I found chemistry and physics so unspeakably boring. In truth, it's because I wasn't very good at maths.

When it came to computing the implications of a hypothesis, say, or really, just computing anything, I found myself yearning to go back to reading, for example, the graphic novel about the Holocaust I had started the night before. Why speculate about things you can't even see, I figured, when there is so much documented about the history of the world that you can? As such, the social sciences were healthily represented on my schedule. I was first in the queue to sign up for the anthropology and psychology options in high school and I studied archaeology at university. Rather than try to make the world – and the people in it – add up like a chemical equation, it made better sense to me to try to understand them as they were, instead.

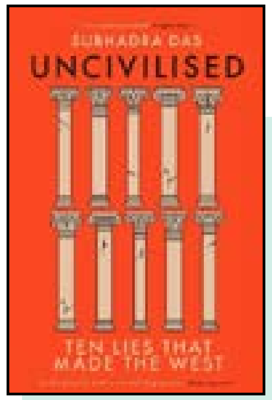
Being a science curator turned out to be a good news–bad news scenario for me. The good news was that the job was all about the history and philosophy of science rather than the science itself. So, I could use my research and archiving skills to tell the wider story of the history of science at UCL, where I was now settling into my museum career. The bad news was the actual content of that history. This was especially true of the Galton Collection.

Named for Sir Francis Galton, on the face of it, this was yet another historical science collection, like any of the others I had been assigned to work with. Just as with electrical engineering, physiology, medical physics, chemistry and the like, the Galton Collection was made up of historical objects related to the study of genetics at the university. In reality, it was much – very much – more than that. And, after only a few weeks in the job, everything I thought I knew about science had been blown spectacularly out of the water.

After ten years of working and teaching with the collection, I can safely say that Francis Galton is the most important and influential Victorian scientist most people have never heard of. Before I started working for UCL Museums, I had never heard of him, and I wasn't alone. Over the years, it's become clear that many undergraduates, summer school students, members of the public, even many of the faculty don't know about him either. Despite being a key figure in the history of a whole bunch of sciences – meteorology, crime science, statistics, sociology and genetics – Galton's name only rarely appears in school history textbooks or in science documentaries. This is probably because Galton was a race scientist. He spent much of his life studying human behaviour and heredity and, in 1883, he coined the term 'eugenics' – the study and practice of selectively breeding human beings – and, by doing so, established a whole new field of science.

Galton was a racist and a colonialist, and those ideas informed his approach to his science. It took a good five years of being a science curator for me to feel brave enough to even say that. First off, as attempts to separate the scientist from their science go, it fails outright. For another thing, we aren't very good at talking about race. We're not good at looking at its impact, considering how it works or resolving the legacy of the damage it left in its wake. We're also not good at understanding where the idea of 'race' comes from, and particularly how science and the magic of rational thinking was used to establish 'race' as an idea in the first place.

Subhadra Das
Independent Scholar.



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To see more of Subhadra Das's research, visit https://www.subhadradas.com/.

Viewpoint Interviews...

Joe Holloway, Associate Fellow University of Exeter, and Editor of *Viewpoint.*

What brought you to work for *Viewpoint?*

As an academic grounded in interdisciplinarity I have always been drawn to organisations such as the *British Society for the History of Science.* I have a strong background in academic publishing, and outputs such as *Viewpoint* play a vital part in the dissemination of knowledge and public engagement that deserves to be championed. *Viewpoint* crucially helps to circulate groundbreaking original research by early career researchers as well as insights from those adjacent to the academic establishment in an accessible way for a wider audience, and so this editorship was an opportunity to get early access to important developments before they reach more mainstream publications.

How does your work fit within the history of science?

I am primarily a critical disability studies researcher and so my relationship with the history of science is chiefly through the cultural history of representations of impairment, the history of medicine, and the development of prosthetic technologies. My research focuses on recent history (going back to the eighteenth-century) and I interrogate popular, medical/academic, and legal depictions of impairment in connection with evolving societal discourses around selfhood. Beyond the disciplines already mentioned, I also draw on psychoanalysis and phenomenology, as alternating lenses to view these understandings of impairment, and to unpick the (often unconscious) ableism at the heart of them.

What are you working on just now?

Beyond my role at *Viewpoint* and my teaching at Exeter I've been working on a manuscript proposal that explores portrayals of conjoined twins in various media over the last 50 years, contextualising this with the evolution of the social model of disability. In this, I argue that as this idea made the topic of disabled agency more visible, non-disabled media reacted against this, chiefly through the portrayals of conjoined twins in opposition to each other, as a resistant counter-model that functioned to disempower disabled people. I have also just finished a chapter for Palgrave Macmillan on representations of conjoined twins in video games, and another for a collection with the University of Mississippi Press on portrayals of conjoinment in children's literature. I also have a couple of journal articles in progress, but as they are still under review I won't talk about them here!

What is your best dinner-table history of science story?

The joys of this kind of work is a constant stream of amusing historical anecdotes! One that springs to mind instantly is that in the seventeenth century two medical professionals had a rivalry before the French King. To settle their differences, they drew lots, and took it in turns to poison each other, each relying on the power of their own 'universal anecdotes'. The second one to be poisoned died almost instantly, leaving the other as the undisputed medical authority.

What historical person would you most like to meet?

I would love the opportunity to chat with Franz Anton Mesmer, the German physician who famously developed the technique of 'mesmerism' – the precursor to hypnotism and one of the originators into the study of the unconscious mind. At the height of his fame Mesmer gave some astonishing performances, theatrically inducing and then 'healing' the symptoms of various psychosomatic disorders for hundreds of people at a time. I would be thrilled to witness one of these performances and to chat with him later about how he feels his power of 'animal magnetism' biologically works.

What has been your best career moment?

Quite obviously it has been my being picked for this present role! Beyond this, however, my best career moments are naturally in the seminar room, and there is something quite magical about helping students to conquer difficult texts or concepts. Undergraduates particularly bring such a fresh approach to ideas that can otherwise feel somewhat stilted and stagnant in academic course, and everytime I conduct a seminar I always end up learning something important myself.

And Worst?

I've worked for a number of academic journals in the past, and I remember one occasion – I won't say which journal – where the proofs had already been authorised and sent to the press, but then one author withdrew their consent to publish at the last minute, as they had double-submitted elsewhere, and their preferred choice had accepted it right at the most frustrating moment for us! We had to scramble rapidly to find something to fill the gap!

Joe can be followed via @EngTwiterature.

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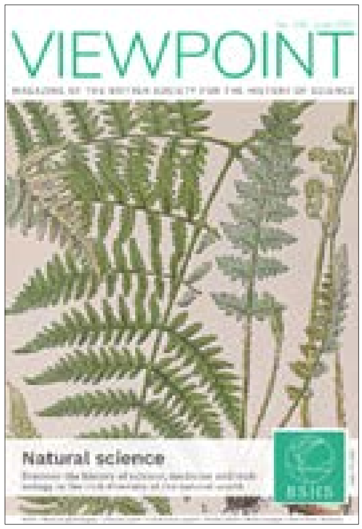

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