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Viewpoint

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Thales of Miletus and Aristotle, who believed that Thales was the first to aim at understanding the original causes of the world. As depicted in the Nuremberg Chronicles, c. 1483. Images in the public domain, courtesy of Wikimedia Commons.

Editorial

For the first issue of *Viewpoint* of 2017, we are going back: way back! This issue features articles all about ancient science. We begin with an article by Liba Taub on the various ways that such scientific knowledge was expressed, from poetry to letters and technical texts (1-3). This is followed by Helen King discussing myths and truths about Hippocrates, and how these continue to shape how medicine is practised today (4-5).

The ancients' fascination with bodily fluids are the subject of articles on milk, by Laurence Totelin (6-7) and reproduction, by Sophia Connell (9-10). We count on Serafina Cuomo to supply our history of ancient mathematics (8-9), and Mark Bradley provides insight into ancient understandings of perception (10-11).

Our interview this issue is with Sophie Waring, curator at the Science Museum. We also have notices of upcoming conferences, and reports on a BSHS funded conference and grant.

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

Alice White, Editor

Science Writing BCE: Ancient Texts

Liba Taub introduces us to the many forms of science writing used in ancient times.

What we call 'science' has often been described as a Greek invention, even though some historians would now argue against this, pointing instead to Mesopotamia as the birthplace of scientific and mathematical practices. Nevertheless, a number of distinguished ancient Greek and Roman thinkers held the view that certain types of explanation originated in ancient Greece. Aristotle (384-322 BCE) credited Thales of Miletus (*fl.* 586 BCE) with having been the first to aim at understanding the original causes of the world; in Book 1 (A) of the *Metaphysics*, Aristotle offered a history of explaining the origin, causes and composition of the world, naming particular specific individuals and their ideas. This approach to recounting the history of scientific thinking—providing an intellectual history concentrating on great individuals and the concepts associated with them—has had a long and fruitful history.

Whilst writing my book *Ancient Meteorology* (2003), I became interested in the ways in which ancient Greek and Roman authors writing on meteorological topics chose to communicate. My study of Greco-Roman works dealing with meteorological phenomena alerted me to the diversity of genres and types of texts used by ancient authors to communicate their ideas and methods for explaining and predicting weather phenomena, texts which include poetry, astrometeorological calendars (known as *parapēgmata*), natural philosophical prose works, letters, question-

and-answer texts and commentaries, as well as others. A wide range of styles of writing was deployed; this characteristic of ancient writing on meteorology intrigued me. As I was trained—like many other historians of ancient science—in the tradition of the history of ideas, this diversity took me by surprise, and ignited my curiosity regarding the choices made by ancient authors writing on what we moderns regard as 'science'.

Most of our evidence relating to ancient Greek and Roman science is found in written texts. In the past, a primary focus on intellectual history and the history of ideas has seemingly taken for granted that all 'content' can be extracted without considering the medium of communication. I argue that a consideration of the formal features of ancient Greek and Roman writings on scientific topics reveals layers of meaning that cannot be uncovered by concentrating solely on the ideas conveyed. Our understanding of those ideas, as well as of the cultures in which they were produced, communicated, studied and preserved, is enhanced by a deeper engagement with the 'medium' which conveys the message (cf. McLuhan 1964).

In my current work, I focus on the significance of formats—or genres—used by ancient technical authors to convey their ideas and methods. I have been motivated by a wish to take seriously the choices available to those authors, and also by the conviction that important historical information—not least about the context in which the text was composed—is conveyed by the use of a particular genre. My intention has been to explore the variety of formats used by authors of ancient Greek and Roman works on scientific subjects, whilst considering the intellectual and wider cultural contexts in which these works were produced.

Today, we take for granted the numerous formats deemed suitable for communicating scientific work, including specialist journal articles and introductory teaching texts as well as pieces in the 'popular' press. Modern readers—as I was myself—are often surprised that a variety of formats was used for Greek and Roman scientific and mathematical texts. Furthermore, today's readers of ancient scientific, mathematical and technical works do not always come into contact with the form of the original text. Readers working from translations may miss the meanings conveyed through formal features, such as metre. A case in point is Lucretius' *De rerum natura*, a work probably read by some only for 'scientific' content (excerpting the technical bits while ignoring the original poetic form) and by others only as poetry, bypassing the natural-philosophical detail. Readers of the Penguin prose translation of Lucretius' *On the nature of the universe* by R. E. Latham (1994) can be excused if they do not realise

Lucretius, De rerum natura*, as copied by Girolamo di Matteo de Tauris for Sixtus IV, Italy, 1483. Courtesy of the Library of Congress.*

that the author was a poet who believed (as he twice notes, 1.921-50 and 4.1-25) that his verse offered an especially appealing version of Epicurean philosophy—in the 'honeyed-cup' of Latin poetry. That Lucretius chose to convey natural-philosophical ideas using epic hexameter is thus lost; the cultural meanings and nuances conveyed by that metre disappear, and our understanding of the ideas contained in the poem truncated. Perhaps an understanding of this significant limitation of the prose translation explains the publication by Penguin in 2007 of a verse translation by A. E. Stallings, *The Nature of Things*. And how many of us would have guessed that the *Greek Anthology* of poetry contains mathematical problems?

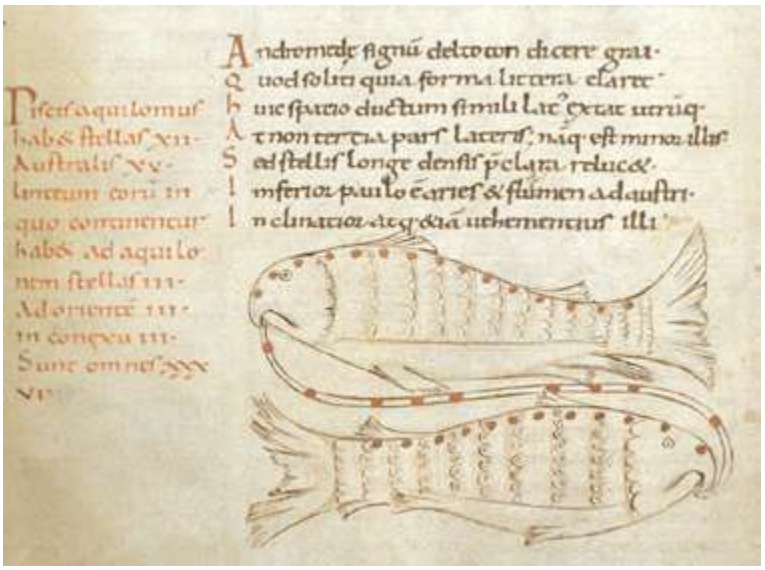
In my book *Science Writing in Greco-Roman Antiquity* (now in press with CUP), I adopt a text-based approach to thinking about ancient work on scientific and mathematical topics. In drawing attention to the choice of medium used to convey the message, I hope to spark further consideration of the interac-

tion between the two, including the effect of literary conventions associated with particular genres on the presentation of material, as well as its reception by readers. Indeed, genre is one of the important bridges connecting authors and readers, for both bring to texts expectations and shared tacit knowledge regarding specific genres of communication.

Several questions spring to mind: were particular formats or genres used within particular fields of scientific inquiry and, if so, why? These are intriguing questions, to which the answers are not as straightforward as might be imagined. For example, the fundamentals of Epicurean cosmology and physics were communicated in antiquity through several distinct genres, including letters, poetry and biography. This suggests that, for those promoting Epicurean ideas, there was no one favoured medium. Similarly, whilst the formal features of Greek mathematics are distinguishable and were historically extremely influential, mathematics was communicated not only via formal proofs, à la Euclid. This suggests that it is not only the relationship between form and content that is important, but also the relationship, for example, between form and function. For what purpose were the ideas being communicated in a specific work? How did the aim of a work relate to the form in which it was composed and presented? Did the purpose(s) for which a text was composed influence the format? It may seem surprising—even counter-intuitive to modern sensibilities—that in a number of cases it was a poetic presentation of ideas originally communicated in prose that survived and thrived. As an example, Aratus' poem, the *Phaenomena*, was repeatedly translated from Greek into Latin in antiquity, an indication of its interest and appeal, overshadowing Eudoxus' prose *Phaenomena*, upon which it was based; Eudoxus' text did not itself survive. Did different genres reach different audiences? Convey different messages? Tend to be valued in different ways? These are questions that are difficult to answer in general terms.

It is imperative to recognise that very different sorts of texts may be concerned with scientific subjects. Indeed, the formal diversity of Greco-Roman texts dealing with scientific and mathematical subjects argues for a nuanced understanding of the place of scientific thinking in broader culture, reminding us that it is not always easy to identify 'science', nor is it a simple task to label particular texts as 'scientific'. The aims of the author of a text and its intended function are often best understood by investigating the specific historical context in which the work was produced. For this reason, I adopted a 'case studies' approach, to try to limit some of the difficulties of generalisation.

Necessarily, I concentrate on a relatively small number of genres or types of text concerned with the physical world and mathematics: poetry, letters, encyclopaedia, commentary and biography. Yet, even while focusing on a limited number of forms, we see the persistence of some (including the popularity of poetry) as well as the creation and flourishing of 'new' genres, such as the encyclopaedia. Particular genres offer information about intellectual communities within the Greco-Roman world. For example, letters often give specific evidence of the relationships between the author and intended readers, including patrons, followers and members of correspondence networks; the letter was a format favoured by some members of the Greek mathematical community.



Pisces from BL Harley 2506, f. 36v, Aratus of Soli, *translated by Marcus Tullius Cicero. Courtesy of the British Library.*

An important sub-theme throughout my work is the interplay and fluid relationships between oral and written presentations, attested in poetry (including the mathematical epigrams that may have been recited at symposia), as well as letters (which often begin conversationally) and even commentaries (sometimes reflecting a group discussion). Yet, in spite of the recurring marks of oral culture pervasive in Greco-Roman scientific writings, my focus has been on the consideration of these writings as texts. I am primarily interested in what might be termed 'authorial choices', working with the recognition that—to some extent—ancient authors writing about scientific and mathematical topics had a range of formats to choose from. (I deliberately chose not to try to engage with issues relating to readership, while recognising that the authorial choice of genre would have elicited various responses from potential readers. Indeed, we have strong clues that certain genres would have had special appeal to readers, and that this would have been important to authors: Lucretius' view that the 'honeyed-cup' of poetry would attract more readers than prose has already been mentioned.)

Of course, Greco-Roman scientific writings were read not only in antiquity, but in subsequent periods, across various cultures, in their original languages and also in translation. Many of these texts had a very long 'afterlife' beyond their original readership, serving as exemplars of what scientific, mathematical and technical texts could—even should—look like, well in to the modern period. The genres used by Greek and Roman authors to communicate scientific material persisted, even when, at times, the original ideas conveyed were actively rejected.

One of my ambitions is to encourage more reading today of ancient scientific and technical texts, and more work to be done on texts as texts, particularly those that have not been much studied. We should study examples of ancient scientific, mathematical and technical writing because of the complexity they offer, reminding ourselves that the historical and cultural contexts of scientific, mathematical and technical discourse provide many layers and levels of meaning. Through the study of these writings as texts, we can see traces of the writers and communities of readers of scientific work, as they communicated ideas and practices embedded in wider culture.

Significantly, the genres examined were used to convey scientific ideas; however, these same genres were not used only for 'scientific' subjects, but for others as well. This underlines a recurrent theme here: 'science' is part of broader culture, which cannot be simply bracketed off from other cultural expressions.

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Hippocrates and Medical Ethics, Then & Now

Helen King argues that our modern (mis)understanding of the work of Hippocrates has implications for how medicine is practised today.

Hippocrates, polychrome majolica, cloister of Old Cemetery, Padula charterhouse (Certosa di San Lorenzo), Padula, Campania, Italy. Courtesy of Velvet, Wikimedia Commons.

If you're on social media, you can't avoid Hippocrates. Leaving aside the frequent, and unfortunate, exclamation that 'they're all a lot of Hippocrates', a day rarely goes by without someone tweeting something Hippocrates is supposed to have said, or a website using his name to sell a diet, a remedy or a food. Many claims about Hippocrates are made in order then to allege that recent studies have confirmed Hippocrates' theories or remedies. 'Quotes sites' collect what are claimed to be the words of Hippocrates. Sometimes the same 'quote' appears in different forms on the same site; for example quotesfab.com has 'Life is short, the art long', 'The life so short, the craft so long' and 'The art is long, life is short' without any acknowledgement that these are all attempts at Aphorisms 1. This is a treatise which has, over time, been taken as the condensed wisdom accumulated over Hippocrates' lifetime, and was used in medieval medical education, but there is no evidence to support its historical status.

Many sayings attributed to Hippocrates are not even from the 'Hippocratic' corpus. Whatever the internet tells you, Hippocrates didn't say 'Let food be thy medicine and medicine be thy food'. The use of 'thy' rather than 'your' in many recurrences of this injunction also gives an archaic flavour that is supposed to emphasise Hippocrates' authority. As for 'First do no harm' (sometimes presented as Hippocrates saying 'primum non nocere', which glosses over the difference between ancient Greek and Latin!), that has finally been recognised as 'a literary creation' (Cardenas 2013: 262) which ignores the point that food was not considered a medicine at all; in the Hippocratic texts, food was transformed into the body, while medicines had the power to change the body. It seems to be formed from merging phrases from the Oath – the doctor will 'keep the ill from what is to their harm or injustice' – with Epidemics 1.11 – the doctor has two goals, 'to do good or to do no harm'. Neither says 'First', and modern commentators have found 'first do no harm' very challenging because many modern tests carry a risk of harm, while modern treatments carry the risk of side effects which can't be predicted in advance, or – like chemotherapy or radiotherapy – cause harm

Portrait of Hippocrates, as depicted in Daniel Le Clerc, The history of physick, or, an account of the rise and progress of the art, and the several discoveries therein from age to age.
Image courtesy of the Wellcome Library.

in order to heal.

Some of the quotes shared on social media are, indeed, from the Hippocratic corpus, although that doesn't mean they originate with the historical Hippocrates; none of the many works in the Hippocratic corpus comes with any attribution, not even the so-called 'Hippocratic Oath'. It's on this text that claims for the ethics of Hippocrates being valid for all time are often based, although such claims often rely on skewed translations of the text. Outrage that someone is 'breaking the Hippocratic oath' abounds online and, despite Vivian Nutton's analyses of the history of the oath, the myth that all doctors now and in the past have taken it is often repeated. As to its ethical content, contrary to popular belief, the Oath doesn't forbid abortion; in one interpretation, it only forbids abortion using pessaries, while in another interpretation the relevant clause aims at preventing doctors handing over abortive pessaries which could then be misused by those acquiring them. It may be closer to the modern message from your pharmacy, 'This medicine has been prescribed for you only. Do not pass it on to others.' Nor does the Oath specifically forbid assisted suicide: the issue raised is again one of controlling the potentially lethal drugs used by ancient doctors.

Another use of the name of Hippocrates which has ethical dimensions today concerns finance. There is nothing in the Hippocratic corpus about charging fees for the doctor's services. In the Hippocratic tradition, one famous legend involves him refusing to treat Persians, because they are the enemies of the Greeks. This shadowy side of Hippocrates' ethics, the restriction of his services to his own people, has been conveniently ignored in the modern decision, for example, to name an Italian aid mission to Libya 'Ippocrate' to underscore its health and humanitarian purposes'.

The Persian king tries to persuade Hippocrates to change his mind by offering all the gold he could desire, but the great Greek doctor is represented as entirely immune to this offer: 'words of wisdom have greater power with me than gold' (Temkin 1991: 64). Despite this prudent founder figure, alternative medicine has had no difficulty attaching itself to the image of Hippocrates to make money, most notably the Hippocrates Health Institute in Florida, which promotes detox and a vegan diet (never something recommended in the Hippocratic corpus!) to cure cancer. When orthodox medicine uses Hippocrates to raise money, it is always presented as being for the greater good. Brigham and Women's Hospital in Boston, MA, runs 'The Hippocrates Society', to which physicians and scientists at this and its sister hospital can subscribe, from $167 per month. Members' names are listed on the Donor Wall and their donations 'make it possible to care for patients, discover new treatments, use the most advanced equipment, and educate the next generation of compassionate, highly-skilled medical professionals'. At the Aultman Hospital in Canton, OH, the Aultman Foundation (motto: Improving the Health of Our Community – One Gift at a Time) runs the Hippocrates Honor Society, which takes donations to honour any of their physicians and gives awards for lifetime achievement to 'outstanding physicians who go above and beyond'. These are 'physicians who exemplify the qualities of excellence, compassion, integrity and leadership'. Over the history of Western medicine, Hippocrates has certainly been a model of the first three of these qualities; alongside the familiar bald and bearded images, another representation showed him with furrowed brow and with his head covered, perhaps to symbolise that he travelled widely, or perhaps to protect his head, the seat of reason (Temkin 1991: 56).

As historians, what are we to make of all this? There still seems to be a folk-image of Hippocrates' moral and ethical qualities behind invocations of his name. The complexities of the ancient texts are of course ignored, but so are aspects of the ancient representation of Hippocrates which don't fit with what we now think we need from a founder of medicine. As Hippocrates goes on being remade in the image of whatever modern medicine thinks it needs, it seems a pity that anyone wastes time on, for example, trying to shoehorn invasive and potentially harmful tests and treatments into aphoristic statements which prove not even to be genuine: and, even if they were the words of the historical Hippocrates, why do they need to bind us now?

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Milk: the symbolism & ambivalence of a substance

Laurence Totelin explores how ancient Greek and Roman scholars viewed milk and its associated biological processes.

Think of the word 'milk'. What first comes to your mind? Many of you will think of the cow's milk that is stored in your fridge. Others, because of dietary choices or requirements, will consider another animal milk (goat or ewe) or vegetable milk (soy, almond, or rice). Far fewer – I am certain – will think first of human breastmilk, unless they currently have a relatively-new baby at home, in which case thoughts of breastmilk might become all-encompassing (as I know from experience). Some of you with babies might also think of formula milk, a preparation whose main constituent is the lactose found in cow's milk. In most cases, the milk that first comes to your mind will have been shop-bought and will be pasteurised, packaged, and often branded.

It goes without saying that our Western experience, where 'bottled or tetra-packed cow's milk' has become almost synonymous with 'milk' is an oddity from an anthropological and historical point of view. A large proportion of the world's population is lactose intolerant, and thus unable to digest cow's milk, which is particularly rich in that sugar (as I am); the age of complete weaning from the breast worldwide is closer to four years of age than it is to six months; and cows are expensive animals to maintain. However, while many of us are aware of this, it remains difficult to conceive of a situation where cow's milk is mostly drunk fresh, transformed into cheese, or simply not a staple of the diet; and one in which breastmilk means the difference between the life and death of an infant. I would argue that milk, this seemingly simple substance, provides a very good point of entry into the study of societies, their values and modes of life. It can reveal significant differences between societies that appear close to our own, such as that of the ancient Greeks and Romans.

When the Greeks and Romans speak of 'milk', without qualification, they usually refer to ewe's or goat's milk. They usually specify when they are talking about cow's milk or breastmilk. Further, when listing breastmilk as an ingredient in pharmacological recipes, they sometimes state that the milk must be that of a woman who has borne a male child, which was most potent. The Greeks and Romans considered breastmilk to be the most nourishing of all milks. Thus, Pliny the Elder (first century CE) writes that:

> *Human milk is the most useful [of all milks]… Any human milk nourishes the most, followed by goat's milk, hence perhaps the story that Jupiter was fed in that way [that is, by a goat].*
>
> *Natural History* 28.123

Pliny is here referring to the myth whereby Zeus/Jupiter was fed by a goat (sometimes called Amalthea), because his mother Rhea could not take care of him (see Figure 1). Today, so many Western children are – at least partly – surrogate-fed by an animal, usually a cow or a goat, that we rarely pause to think about the meaning of ancient stories in which a hero or god is fed by an animal. By feeding on a goat, Jupiter took on some goaty characteristics: most prominently, he became 'horny', incapable of remaining faithful to his long-suffering wife Hera/Juno. Similarly, the twins Romulus (who went on to found the city of Rome) and Remus, by feeding on the she-wolf took on some of her courage and violence: Romulus ultimately killed his brother Remus. When the 1st-century CE physician Soranus listed the attribute of the ideal wet-nurse, he insisted that she be 'self-controlled, sympathetic and not ill-tempered, a Greek, and tidy' (*Gynaecology* 2.12), lest she imparted bad characteristics to the nursling. However, there is more to myths in which children are fed by animals: these are legends of survival. A human baby in antiquity was unlikely to survive if a wet-nurse was not found. Only exceptional infants could survive on a diet

Figure 1: The Goat Amalthea with the Infant Jupiter and a Faun, Gian Lorenzo Bernini, 1615, Museo e Galleria Borghese, Rome. Credit: Peter80, Wikimedia Commons.

of animal milk. While there are example of ancient milk-bottles, I would argue that they were only used by older babies (see Figure 2).

The Greeks and Romans puzzled over milk-drinking peoples, such as the Scythians or the mythological Cyclopes, who drank raw milk. They preferred consuming their milk in the form of cheese – anthropologically a cooked, 'more civilised', aliment. In cases of illness, however, Greek and Roman physicians often recommended the use of milk. In some occasions, it served as a restorative after a long treatment; its most common usage, however, was as a purge: drinking relatively large amounts of milk, and more particularly of whey, sometimes in conjunction with hellebore, helped purge patients of their bad humours. As modern readers, we can surmise that the Greeks and Romans were less tolerant to lactose than we are, which explains why they found milk such an excellent purgative. The ancients, for their part, wondered whether milk was purgative in itself, or whether the purge resulted from drinking large amounts of it.

Animal milk, then, could be a dangerous substance for the ancients. They also described cases of milk poisoning, caused by drinking too much curdled milk, a milk that contains rennet. This poisoning manifested itself in choking. Choking is not one of the common symptoms of modern milk poisoning: modern and ancient categories differ from each other.

Even breastmilk, which had curdled in the breast and become too 'cheesy', could provoke choking. Soranus describes this dangerous condition:

> *Breastmilk that is thick and cheese-like is hard to digest, and in the same way as food that has not been fully chewed, it blocks the passages and, occupying the main openings in the body, it is a danger to life.*
>
> *Gynaecology 2.22*

Now, the ancients believed that the first milk (our colostrum) was particularly cheesy, and therefore dangerous. Soranus recommends avoiding breastfeeding for the first few days, lest the infant consumes milk that could lead to choking.

Why this fear of colostrum (a fear that is common to many societies)? To understand it, we must think of the origin of breastmilk. To the ancients, milk was concocted menstrual blood. They had observed that during pregnancy and lactation women do not – usually – menstruate. They deducted that both the foetus and milk must be transformed menstrual blood. Menstrual blood and milk should not flow at the same time (it is likely that women in antiquity experienced a late return of menstruation); if they did, blood risked tainting milk. However, immediately after birth, a woman bleeds (lochial bleeding) while producing milk. In that liminal period, in antiquity, women were deemed particularly prone to pollution, and likely to pose a danger to their offspring.

Milk in antiquity was then a rather ambivalent substance: one through which a mother, biological or surrogate, could pass on characteristics – good or bad – to her nurslings; one that was essential to the survival of babies (animal or humans), but could equally kill; one that could lead to healing but also potentially poisoning. It is worth mentioning that milk was one of the substances regularly offered to the spirits of the dead through libations (pouring a liquid to the earth). Unlike our cheap, easily available, and neatly packed (cow's) milk, it was a substance that, in all its manifestations, was consumed with care.

Figure 2: Roman container in the shape of a swan, date difficult to determine, Science Museum, London. This container may have served as a milk bottle to feed an infant. Credits: Wellcome Images.

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BSHS Notices

BSHS Annual Conference

University of York, 6-9 July 2017

The BSHS turns 70 years old in 2017, and we invite you to join us in 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. There will be a lecture and reception in the Tempest Anderson Hall, close to the location of the first ever meeting of the British Association for the Advancement of Science in 1831, and there will be a conference dinner in the Royal York Hotel in the centre of the city.

For more details about the conference, keep an eye on the @BSHSNews Twitter account and visit the conference website:

bshsconference.org.uk/

The Annual Science in Public Conference will take place immediately after the BSHS Annual Conference - for more on Science in Public, see p.10.

BSHS Postgraduate Conference 2017

European University Institute Florence (EUI) and the Centre Alexandre-Koyré Paris (CAK), Florence, 5-7 April 2017

This year, the BSHS Postgraduate Conference is heading to Europe! The EUI and CAK will host postgraduate members of the BSHS at their annual conference this April.

For more information on this conference, and on how to put yourself forward to host a future postgraduate conference, visit:

www.bshs.org.uk/conferences/post-graduate-conference

Pebbles & tyrants: calculating in ancient Greece & Rome

Serafina Cuomo explains what we know about mathematics and counting in ancient times, based on abaci.

The Salamis abacus, Epigraphical Museum of Athens EM 11515. The numbers are in acrophonic numerical notation, which was in use approximately between the 5th and the late 3rd century BCE. Two of the number strings read 1,000 500 100 50 10 5 1 drachma 1 obol ½ obol ¼ obol 1/8 obol. Drachma and obol were units of currency, and there were signs in the notation specific to them. The longer string has: 1 talent (corresponding to 6,000 drachmas) 5,000 1,000 and so on.

A story was circulating at the time of the Roman Empire about Solon, the legendary sage and poet who was alleged to have given new laws to Athens in the sixth century BCE. Solon

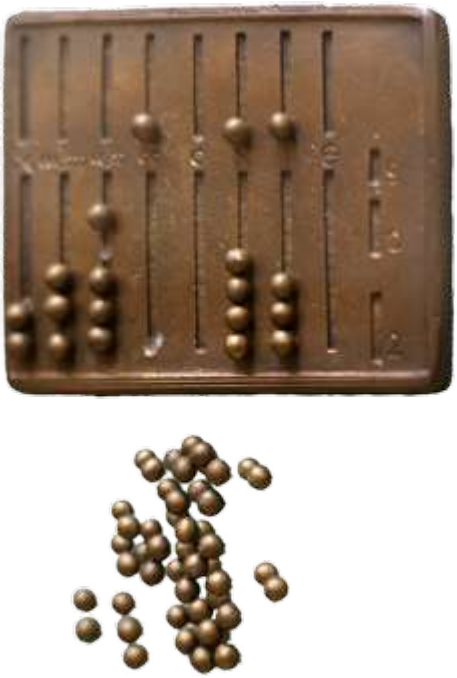
> *used to say that those who had influence with tyrants were like the pebbles employed in calculations; for, as each of the pebbles represented now a large and now a small number, so the tyrants would treat each one of those about them at one time as great and famous, at another as of no account.*
> *Diogenes Laertius,* Lives of the Philosophers. Solon *I.59 (Loeb tr.)*

Solon's pebbles would have been shifted around on a counting board, which looked probably like the slab of marble found on the island of Salamis, near Athens, in the 19th century (see Figure 1, left).

With its two sets of engraved parallel lines, and three strings of numerals facing in different directions, the Salamis abacus is a particularly complex example of a type of counting board of which around thirty more survive. Not all have both numbers and lines; some have been broken, repurposed, scribbled over, and, while dating these objects within more than one century can be difficult, all have been found in the Greek-speaking part of the ancient Mediterranean. They are all sizeable, flat or with a table-like surface, and made out of stone or marble. They could all be used to carry out calculations using flat, small objects as counters.

A second type of calculating device was also used in the ancient Mediterranean: the so-called Roman abacus (Figure 2, right). The size of a hand and made of bronze, only around six exemplars survive, and none from the Eastern side of the Empire. The counters of Roman abaci moved along fixed grooves, which were inscribed with Roman numerals, up to a million in the example above.

No instruction book for either a Greek or a Roman abacus has survived, but there are passages such as our opening Solon story which refer to their use, and the similarity in shape and design with medieval, early modern and modern abaci (used in schools in Japan to this day) has facilitated reconstructions of how one could add, subtract, multiply and divide on ancient abaci. Many possibilities exist, as the internet will testify. My personal favourite is Alain Schärlig, who has tried his ideas out on the (virtual equivalents) of various types of extant Greek counting boards (see Alain Schärlig, *Compter avec des cailloux: le calcul élementaire sur l'abaque chez les anciens Grecs*, Lausanne: Presses polytechniques et universitaires romandes 2001.).



A so-called Roman abacus, image contributed by an anonymous photographer.

One chief rule applied to both Greek and Roman abaci: you lay out your counters in a column; when you have five counters in one column, you substitute them with one counter in the next higher-value column. Thus, addition consists in laying out units in the first column, tens in the tens column, hundreds in the hundreds column, and so on for all the numbers being added – and then shift and substitute until all the counters have been laid out and re-grouped, and the emerging sum total can simply be read off the abacus. Subtractions are slightly more complicated because when necessary, one counter in a higher-value column may have to be transformed into five or ten counters in a lower-value column. The real crunch comes with multiplications and divisions. More than one method may have been in use, from simple, empirical ones such as repeated addition and repeated subtraction, to more complex ones involving times tables or doubling-and-halving.

Reconstructing calculation procedures is not the only area where some questions

remain open. It seems puzzling that, while there is archaeological evidence of Greek-style counting boards being used in Roman times in the Western part of the Mediterranean, no Roman-type abaci seem to have gone east. The circumstances surrounding the development of the different technology of Roman-type abaci are also obscure. It does not help that we lack an archaeological context for most of the surviving Roman abaci, while several Greek abaci were found in the proximity of market-places or temples. Indeed, the shape of the Greek-style counting board lends itself to calculations being witnessed, and perhaps performed, by more than one person at the same time. In other words, an abacus like the Salamis slab seems designed for public, inter-visible calculations. Rather than the lone accountant in his *cubiculum*, it suggests an open, interpersonal calculating practice, which is hinted at by, for instance, Theophrastus, who, in his 4th-century BCE collection of Athenian characters, describes the absent-minded man as

> *the sort who, when he has made a calculation with an abacus and determined the totals, asks the person sitting by him, 'What's the answer?'*

Calculating in ancient Greece and Rome was, in short, both similar and intriguingly alien to what we do today. The abacus may appear unnecessarily complicated, but it is in fact cognitively extremely efficient. The substitution rule taps directly into a nigh-universal human cognitive feature known as subitization, i.e. the ability to perceive the numerosity of a group of objects without counting them. Subitization on average stops operating when the objects are more than five or six. Thus, calculations on the abacus were, to a significant extent, performed with the hands and the eyes as much as with the mind – they were the very opposite of mental arithmetic. In Reviel Netz's words:

> *We imagine numbers as an entity seen on the page; the Greeks imagined them as an entity grasped between the thumb and the finger.*

Abaci were also the opposite of prescriptive – the very fact that many different reconstructions are possible, and that some operations could plausibly be carried out differently on the same type of abacus, points to a diverse population of users, with different levels of expertise. Speed of calculation may have been no more important than the need, in some situations, to calculate or at least verify results alongside, and together, with other people.

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Reproduction According to Aristotle

Sophia Connell discusses where the ancients thought babies came from.

The earliest artefacts depicting the female form attest to past awe of female reproductive capacities (see Figure 1). For the early Greek science, finding a phenomena to be wondrous, however, was a sign of ignorance. So, for example, the author of the Hippocratic Treatise *On the Sacred Disease* (c. 4th century BCE) declares epilepsy to be 'no more sacred than other diseases, but has a natural cause, and its supposed divine origin is due to humans lack of knowledge'. The ancient Greeks believed that one ought to discover the reasons and causes based in nature rather than resort to a supernatural source.

Some have thought that the emergence of natural explanations for sexual reproduction, where males are given the most significant role, led to the end of the dominance of female deities and the subsequent respect accorded to actual women. Swiss scholar Jacob Bacofen (*Das Mutterrecht*, 1861) first proposed this thesis which was then revived by certain feminists (for example Elizabeth Davis' *The First Sex*, 1971). One thinker who has over the years served as a prime example of such misogyny is Aristotle. For Aristotle (382-322 BCE), women are colder and less capable than men, counting in a sense as deformed or defective. Their contribution to reproduction is not like the hot and potent male semen, but is the lesser menstrual fluid, passive to the former's action. On reflection, it seems most likely that sexism already existing in ancient Greek culture created certain biases in Aristotle's theory and others like it, rather than the theories generating sexism.

As a keen zoologist, some say the first, Aristotle's explanations were much broader in scope than his medical contemporaries, who tended to focus on therapy for infertility. Aristotle was also dissatisfied with other budding natural scientists, such as Empedocles (490-430 BCE) and Democritus (460-370 BCE). Aristotle argued that their explanations were too 'materialist' and could not account for patterns and regularities in nature. For Aristotle, four causes or explanations are required; (1) the final cause (what it is for) (2) the formal cause (what it is) (3) the efficient; and (4) the material causes (the forces and potentials within materials). Aristotle's five book treatise, *On the Generation of Animals*, presents the causes of reproduction. The (1) final cause is that being perishable an animal's form would go out of existence if they did not reproduce it from one generation to the next. The (2) formal cause is that the parent animal has a form which is potentially present in the matter out of which the animal is made.

The famous Venus of Willendorf (made around 25,000 years ago), based at the Natural History Museum, Vienna, Image courtesy of Jorge Royan.

Another puzzle that Aristotle is keen to untangle using the four causes is that of sex difference. Although he recognised some instances of asexual reproduction, in most cases, males and females contribute separately to the generation of a new animal. The male is the (2) formal and (3) efficient cause:

Illustration of the female generative organs from the famous 1543 De humani corporis fabrica *of Andreas Vesalius. Image courtesy of the Wellcome Library.*

it ensures that a new animal comes to be the same in form by initiating the processes of development. The female contributes the (4) materials. In line with many ancient speculations of the mother's role in reproduction, Aristotle regards it as primarily nurturing and providing nutrition. But nutrition is not simple or passive. The ancient Greeks believed that an animal digests food by heating and changing it (via the actions of its soul) so that the food becomes a living functioning part of the body. The female contribution to reproduction is therefore a highly specialised material, actively changed by the female's soul. Although the form of the infant comes from the male animal, it is also present potentially in the female animal's contribution to generation. Furthermore, Aristotle posited that both male semen and female menstrual fluid are derived from blood – both being more "worked up" portions of it, which the soul has refined. Blood, he argues, contains all the potentials that a given animal needs to create and maintain all the parts of its body and so can initiate the development of (male contribution) and also *become* the new living being (female contribution).

Unlike Aristotle, most other theorists supposed that males and females contribute semen of the same sort, released during sex, which mix together. They also had different views on the origins of semen. For the Hippocratic doctors, it comes from all the fluid parts of the body, the four humours (Hippocratic works, *Airs, Waters, Places, On the Natural of the Child, Diseases 4*). Others held that semen comes from parts such as hands, faces and toes (notably Democritus as detailed in Aristotle's *Generation of Animals* Books 2 and 4). Plato (428-348) and the medical writer, Diocles of Carystus (375-295), semen comes from the brain and passes down through the spinal chord to the genitals.

Though they might have had different ideas on how reproduction happened, what Aristotle and his opponents did not disagree about was the inferiority of the female. In answer to the question of a (1) final cause of sex differentiation, Aristotle says that it is better for the superior (male) to be separated from the inferior (female) (*On the Generation of Animals* II 1). For the author of the Hippocratic *On the Nature of the Child*, female semen is weaker and colder and the female body spongy and inadequate. Plato thought of the female state as a punishment via reincarnation for a badly lived male life and imagined that the uterus could drive a women mad with its desire for offspring, rising up in the body and literally suffocating her (many Hippocratic doctors also believed in this phenomena of the 'wandering womb').

Aristotle's blood-based theory of semen was taken up by Galen, and remained prominent in the Medieval period as the brain-based theory dwindled. Galen also followed the Hippocratics in assigning a colder semen to the female. And Aristotle's vision of the female is still clear in the sketches of Andreas Vesalius – her body an inverted and incomplete male one, where lack of *pneuma* (hot air) has failed to push out the parts into penis and testes (see Figure 2). Certainly the female form was no longer a starting point. However, the process of its dis-valuation had begun far back in the mists of time, and early theories of reproduction reflected and reinforced sexist attitudes that already existed in ancient society, rather than having created them.

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Further Reading

- Jacob J. Bacofen (1861) *Das Mutterrecht : Eine Untersuchung über die Gynaikokratie der altern Welt nach ihrer religiösen und rechtlichen Natur* (Stuttgart: Karis and Hoffmann).
- Elizabeth Gould Davis (1971) *The First Sex* (New York: Penguin).
- Rebecca Flemming (2000) *Medicine and the Making of Roman Women* (Oxford University Press).
- Lesley Ann Dean-Jones (1994) *Women's Bodies in Classical Greek Science* (Oxford University Press) .
- Sophia M. Connell (2016) *Aristotle on Female Animals* (Cambridge University Press).

Notices

HAPP Visiting Fellowships at St Cross College, Oxford

The Centre for the History and Philosophy of Physics (HAPP) at St Cross College, University of Oxford is able to offer one Visiting Fellowship each term for scholars coming to Oxford to carry out research on a topic in the history and philosophy of physics. The Visiting Fellowship competition is a rolling programme with the following deadlines prior to each term for this academic year:

- 5pm on Friday 24th March 2017
- 5pm on Friday 19th May 2017

Details on how to apply can be found at the webpage below:
www.stx.ox.ac.uk/happ/scholarships-visiting-fellowships-and-prizes

Annual Science in Public Conference

University of Sheffield,10-12 July 2017

This conference will take place immediately after the BSHS Annual Conference (see p.7 for more details!). The theme this year 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/

Were the Greeks colour-blind? William Gladstone & ancient Greek colour vision

Mark Bradley investigates the history of ideas about people perceived colour in different eras.

We begin our story with William Gladstone, one of the superstars of British politics in the Victorian era, four times British Prime Minister and Chancellor of the Exchequer. When he wasn't busy being Prime Minister, he spent much of his time studying Homer's epic poems the *Iliad* and the *Odyssey*. He wrote a great deal about these poems, but he is perhaps most remembered for arguing that Homer's colour system was founded exclusively upon light and darkness, and that the organ of vision 'was but partially developed among Greeks'.

Gladstone had worked through Homer's poems, which were considered the foundations of western literature, in painstaking detail: brilliant though they were in so many ways – human emotions, characterization, imagery, plot, tragedy and so on – they fell down in one important matter: they appeared to use a tiny fraction of the colour terms that we use in English, and where terms were used they were deployed in extremely strange ways. Anticipating the observation that this was because Homer was blind, Gladstone correctly begins his discussion by debunking this myth, which was almost certainly a fiction developed by later generations. There was something not quite up to scratch with Homer's eyes, but it was an ailment he shared with the rest of Greek civilization. In making this claim, Gladstone kick-started a debate about colour, biology and culture that is still raging 150 years later.

What Gladstone claimed to have observed in Homer is this:

- The same word is used to denote essentially different colours – so the word for 'violet' is used to describe the sea, and sheep. 'Chloros' – 'green' in Greek – is used to describe foliage, fresh twigs and honey.
- Objects are described using fundamentally different colours. So iron, for example, is described sometimes as 'violet', sometimes as 'grey'.
- There is sparse and deficient use of colour where it would normally be expected. Homer's sky is starry, broad or great – but it's never blue!
- There is a vast predominance of black and white over any other colour. The word for 'black' is used about 170 times in his poems, 'white' about 100 times, 'red' 13 times, yellow just 10 times, violet 6 times and so on.
- Homer's colour vocabulary is tiny compared to ours – e.g. there is a striking lack of any word that appears to mean 'blue'.

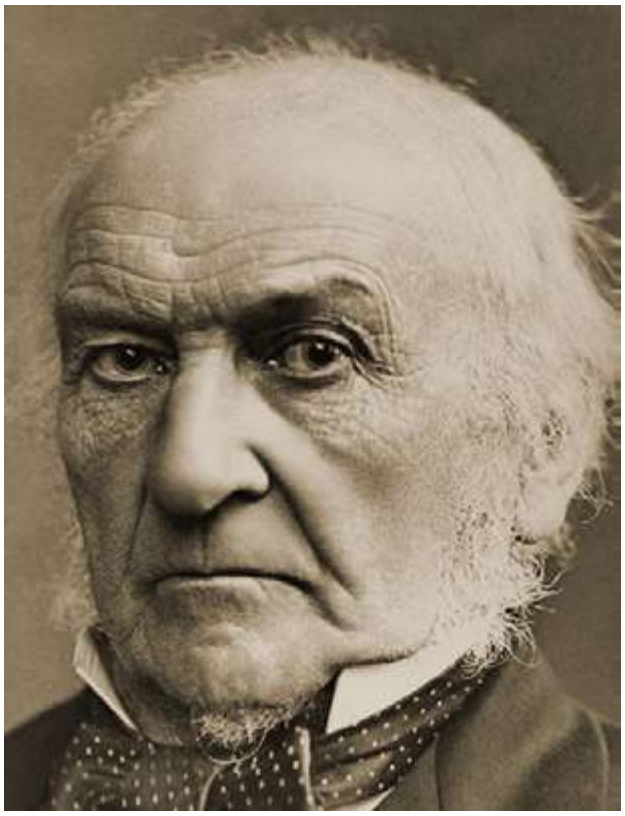
One Homeric use of colour that scholars have wrangled over for 150 years is the poet's description of the 'wine-dark sea' (*oinops pontos*). What colour would the sea have to be to be *oinops*, we might well ask? Sunset-red, perhaps? Violet? purple? dark? Deep blue? According to Gladstone, this is just another example of Homer's inability to capture colour experiences accurately.

In the 19th century, this idea that ancient colour vision was light years behind colour vision in the modern west chimed well with some of Darwin's ideas about human evolution and the development of civilization. Darwin's *Origin of Species* was published just a year after Gladstone's work, and would make a splash that prompted Gladstone to revisit his views about colour some twenty years later. Gladstone also nudged his new theories in the direction of 'colour blindness', a phenomenon that was just beginning to attract attention in the mid-19th century.

Gladstone himself argued for the 'progressive education of the human organ' – the eye – and suggested that cultures start out by distinguishing white and black, and then gradually add red, yellow, green and blue slowly in that order. By and large, Gladstone and some of his contemporaries convinced the world that the ancients were actually not very civilized at all. In fact, Gladstone ends his study by claiming that modern infants have a more sophisticated colour sense than Homer:

> *'A child of three years in our nurseries knows, that is to say sees, more of colour than the man [Homer] who built upon his own foundations an edifice so lofty and so firm that it still towers unapproachably above the handiwork not only of common, but even of many uncommon men.'*

Gladstone's claims caused a storm in scientific circles that lasted over a hundred years, and continues to underpin the way scientists and biologists think about colour today. Perhaps the most significant of the studies that were influenced by Gladstone's approach to colour was *Basic Color Terms: their Universality and Evolution*, published by two American sociologists, Brent Berlin and Paul



William E. Gladstone, portrait by the London Stereoscopic Society. Image in the public domain,courtesy of Wikimedia Commons.

Above: A 'wine-dark sea' (oinops pontos)? Perception of the water's colour has likely changed over time. Image courtesy of KPFC.
Below: A comparative diagram of colour categories (after U. Eco, (1985) 'How culture conditions the colours we see', in M. Blonsky (ed.), On signs. Oxford: 157-75.)

Kay in 1969. Berlin and Kay proposed that you can measure how evolved any culture is, current or historical, by counting the number of basic colour terms it possesses. They argued that all cultures, however basic, have terms for black/dark or white/bright, and if a culture has three colour terms then the third is red, and so on. They proposed seven levels in which cultures could be classified, with Stage I having only black and white and Stage VII having eight or more basic color terms (English, they claimed, has 11 terms). Berlin and Kay claimed that as languages evolve they acquire new basic colour terms in a strict chronological sequence, and if a basic colour term is evident in a language, then the colours of all earlier states should also be present. At the time, this theory was enormously influential, but more recent scrutiny has challenged both Berlin and Kay's definition of basic colour terms and the means by which they gathered the data. Gladstone, for example, would have been appalled by their conflation of Greek terms and English basic colours.

Studies of ancient colour vision across the last hundred years have been dominated by efforts to demonstrate that the ancients in fact employed a highly sophisticated colour system. This system operated, the typical argument goes, along rather different parameters from our own: rather than hue, the ancients were sensitive primarily to such things as luminosity, saturation and texture, or even less obvious variables such as smell, agitation and liquidity. And colour is about much more than just lightwaves hitting the retina. It is well-known that even today different cultures can discriminate and describe colours differently, and there are many examples of languages that employ unusual patterns of colour usage: Russian has two distinct terms for our colour blue, for example, and the Japanese category *ao* cuts across our blue and green. Various African, South American and Asian communities employ what are to us very strange systems of colour usage: the Hanunóo in the Philippines employ two distinct registers of colour terminology that incorporate qualities of moisture, texture and shine (see the table below, outlining Umberto Eco's estimate of colour classification in English, Latin and Hanunóo); and the nomadic Dinka of the Southern Sudan appear to perceive their world through the colours and patterns they use to differentiate the hides of their cattle.

A bit like the Dinka, the Greeks and Romans concentrated on the colours that mattered to them: blond hair was an exotic oddity, so this colour was a useful category for identifying the outlandish; Roman imperial politics put high stock in the use of purple patches and shades to denote authority, and employed a linguistic armoury of over a dozen terms for purple by the late Empire. In other words, it could be argued that cultures distinguish the colours that matter to them. For the ancients, colours normally denoted *things* rather than part of the spectrum: light, blood, ocean, sky, verdure, hair, dyed clothing, and so on – and categories were much more about the raw material than what it happened to look like.

So to return to the classic colour problem: Instead of trying to determine what shade of bluish-red Homer's wine-dark sea was, as many have done in the past, we need to shift the emphasis towards thinking about the experience of the object: Homer's sea was deep, intense, dangerous, captivating like wine: it is wine-dark when Achilles is intoxicated with grief and revenge over the death of his beloved Patroclus; it is wine-dark when Odysseus is shipwrecked in waters that are as deep, intense and treacherous as wine.

Colour, then, is in the mind. Once we accept this, we can go back to Mr Gladstone and tell him he got it wrong: we can start to see the world through Homer's eyes.

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mμ	Average English	Latin	Hanunóo level 1	Hanunóo level 2
800-650	Red	*Fulvus*	Marara (dry)	
640-590	Orange	*Flavus*		
580-550	Yellow		Malatuy (fresh)	
540-490	Green			
480-460	Blue	*Glaucus*	Mabi,ru (rotten)	
450-440	Indigo			
430-390	Violet	*Caerullus (sic)*		

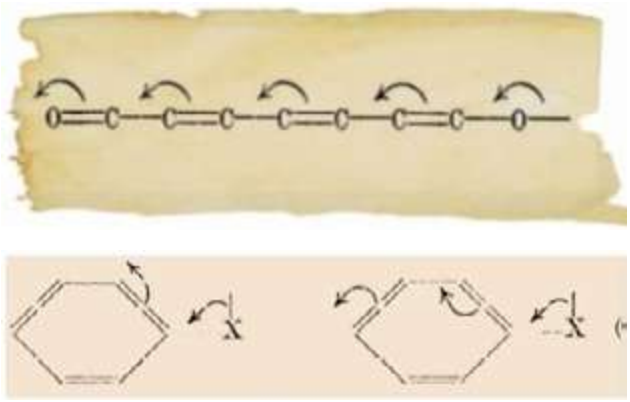
Malagti (light) / Mabi,ru (dark) / Marara (reddish) & Mabi,ru / Malagti (weak) & Malatuy

Further Reading

For a detailed study of Greco-Roman colour, see Mark's book *Colour and Meaning in Ancient Rome* (2009, Cambridge University Press).

Conference & Grant Reports

Grant Report: Curly Arrows & Crushed Dreams



Robinson and Ingold's curly arrows, illustrating their ideas about electron movements in chemical reactions.

My grant contributed to the crushing of my dreams of a first this year, as it confirmed that "The Development of the Electronic Theory of Organic Chemistry" was indeed what I had suspected: exactly what I wanted to write. A Part II Chemistry thesis written in 1972 by an Oxford undergraduate, Jennifer Seddon, this work did pretty much what the title says, focussing on the work of Robert Robinson and Christopher Ingold in the 1920s.

Principally, Robinson and Ingold introduced curly arrows as representative of electron movements in the interpretation of chemical reactions, which intrigued me (and was the last bit of science I actually enjoyed before academic pressures squeezed the last drop of pleasure from my science degree!). In fairness, it's actually a quite amazing piece of work and almost certainly better than I'd have managed (if you're reading this, if one's kicking about I'd love a signed copy!). The thesis argues that the differences in Robinson and Ingold's work stemmed from their contrasting attitudes to "theory", which Robinson considered a means to an ends whereas Ingold valued it for its own sake. The only fault my untrained eye could find was a repeated reference to Ingold as a physicist; Ingold was a physicist in the same way I am a mathematician (really quite good at it at school, though not taking the subject forward into further study).

I used my grant to cover the cost of a research trip to the Royal Society Library, who held materials central to my research that could not be posted (and that I could not afford to have copied). I slept through the train journey, as in order to make the most of my trip I had been forced from my slumbers at some ungodly hour in order to arrive at the Library before it opened at 10am. I spent seven hours almost transcribing the material verbatim for later use.

The library was wonderful; sufficiently small that I could not slack off, yet sufficiently relaxed that every so often a conversation would gently break the silence: would recommend to a friend.

Ultimately, my fears realised, I shifted the timeframe of my work. Rather than looking at the work of Robinson and Ingold, I examined the work of Gilbert Lewis and Robinson, which had the happy side-effect of removing any discussion of quantum mechanics; although this was easily my strongest area in second year theoretical chemistry, I still have no technical understanding of the topic. Admittedly, it was also minimal in Seddon's work, though not too significantly to its detriment. Seddon's dissertation was highly significant to my literature review and offered a thorough (and helpfully referenced) outline of Robinson's work. I conducted further research at the RS's Robinson archive, which also contains Arthur Lapworth's letter in which the first association is made between theories of reactivity and Lewis's electronic theory of bonding (ROR/4/40 for those interested). This served my purposes in highlighting how close Robinson's predecessor had been to his theory, while lacking the ontological association between arrows and electrons that would later arise, and which is retained to the present.

All in all, a rather enjoyable day in the library; didn't get that damn first though.

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Conference: The Body & Pseudoscience in the long 19th Century

18 June 2016, Newcastle University

The conference was launched by Dr. James Mussell, Leeds University, who gave the keynote presentation on 'Print Presence in the Electrical Age: Oliver Lodge and the Pseudoscience of Media and Mediation'. This focused on the way Lodge negotiated the pseudoscientific spaces of late 19th and early 20th century culture, looking at the complementary relationship between body and spirit, form and content. Although Lodge believed in the uniting potential of spirit, this rested on the properties of matter as exemplified in his publication, *Raymond* (1916), which was his way of keeping his dead son alive. This stimulating presentation set the scene for a day that considered the different ways that the scientific and pseudoscientific were negotiated through the body.

The interdisciplinary nature of the conference was evident by the mix of papers from English Literature, Art History, History of Science, Philosophy and the Wellcome Library. The first panel of the day, 'Scientific Credibility and the Human Body', included papers on the pseudoscientific treatment of

'milk leg', Victorian fad diets, and the literary representation of ways in which phrenology and physiognomy were used to distinguish between the deserving and undeserving poor. These papers addressed issues of how the body was read in the nineteenth century and the different ways in which scientific 'truths' emerged. The panel, 'Affective Responses to the Visual', considered the intellectual exchanges of the worlds of art and fiction with science, highlighting the problem of ascribing meaning to visual changes in the body as well as the dynamic of the visual and the verbal in the pursuit of sympathy. '(In)Corporeality and Nineteenth-Century Forces' was a panel comprising papers on the representation of mesmerism in periodicals and in fiction and William James's experiments with anaesthesia. These papers emphasised the slippery nature of what was deemed 'scientific' or 'pseudo-scientific' and how the latter contributed to knowledge about the human mind and body. The final panel, 'Medical (Pseudo)Science: Mind and Body' explored the hinterlands of chemistry and medical science in Edith Nesbit's short stories and the 'science' of phrenology as a tool for self-improvement, raising questions about the role of the mind and body in the construction of scientific knowledge.

The plenary session was led by Dr. Edmund Richardson, Durham University, with a case study of the famous nineteenth-century medium, Daniel Dunglas Home. This generated lively discussion on the distinction between the scientific and the pseudoscientific, and why so many eminent scientists were prepared to risk their reputations in the search for knowledge and truth. That nineteenth-century pseudoscience remains a fruitful area of research suggests that it can still contribute to discourses on knowledge of the self through reading the body.

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A Tribute to Professor Alison Winter

Professor Alison Winter (1965-2016) passed away on 22 June at the age of 50, leaving a husband, Adrian Johns, and four children.

Winter's career was characterized by immense verve and vitality, in work as in life. All those around her knew in her a scholar of exceptional quality: widely-read, omnivorous in her academic interests, yet with a passionate commitment to expending time, effort and affection upon students, colleagues, family and friends, indeed upon every one of the many projects she took up. Her postgraduate career began at the University of Cambridge, where some of her earliest research concerned the German mathematician Caroline Herschel, who discovered numerous comets. For her doctoral research, Winter took up what initially seemed an unpromising topic: Mesmerism or animal magnetism, a medical doctrine which began with the work of Franz Anton Mesmer in 1770s Vienna, becoming a focus of medical dissent in different parts of Europe during ensuing decades before being relegated to the new category of 'pseudoscience', trivialised and largely forgotten. Winter argued instead for the huge importance of animal magnetism, both as a central focus of opposition to the medical and political establishment, and as a perceived threat to public order in revolutionary decades, which could only be neutralized by the production of alternative sciences of the relationship between body and mind. This was the subject of her first book, *Mesmerized: Powers of Mind in Victorian Britain*, published in 1998. After taking up a post at the University of Chicago, her alma mater, Winter's second monograph, *Memory: Fragments of a Modern History*, followed in 2012, and was awarded the university's Gordon J. Laing Prize in 2014. Equally innovative and idiosyncratic, it asks critical questions about the scientific study and personal experience of memory in the twentieth century, exploring the intersections between the emerging culture of memorialization as an historical subtheme, the narration of memory in judicial, scientific and personal settings, and the relationship between memory and factuality. It showed, in other words, the indispensability of history to understanding the development of modern sciences of the self.

Every project Winter took up, from a forgotten medical fashion to her hands-on renovation of an immense nineteenth-century house in Chicago, was pursued with enthusiasm, persistence, energy and an amazing amount of sheer hard work. In all senses, she was a person of great accomplishment. If all history is autobiography, she might be compared to the comets on which she worked for a time, for she illuminated her field too briefly. Yet she leaves a lasting mark upon the discipline, her colleagues, family and friends.

Emma Spary

The *Viewpoint* Interview

Sophie Waring is Curator of Chemistry at The Science Museum, London

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

Blind luck and the UCAS clearing service! I was fortunate enough to drop an A-level grade and after the panic faded, as I had done both science and humanities A-levels the UCL History Faculty suggested that I might prefer life in the Science and Technology Studies Department next door. I am extremely grateful to Jane Gregory who interviewed me, took a chance, and let me onto the course. I have never looked back and always thought of that as the most momentous stroke of luck in the course of my life: I found a life-long passion for HPS and met my husband.

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

I don't have many just yet, but I try not to talk about my research and work all the time anyway! After enough glasses of wine I will tell people about the time I ripped a dress Andy Warhol made for Edie Sedgwick when I was working as a gallery assistant at Sotheby's. I also damaged a minor work by Monet, one of his Water Lilies series, when it hadn't been packed and labelled properly. I was only 20 and thought I was going to be sacked on the spot! Thankfully, I wasn't.

What has been your best career moment?

There are several. The moment Simon Schaffer phoned to tell me I could join the Longitude Project as a PhD student is certainly up there – I had to sit down and breathe for a few minutes on a crowded high-street in Cardiff, a woman stopped to ask me if I was alright!

And worst?

The general state of having to battle for jobs and funding, watching friends leave academia just because they can't deal with the stress, short-term contracts or lack of funding. Additionally, the feeling when you have to leave an idea, object, or piece of writing behind when you run out of time on a project or at an institution.

Which historical person would you most like to meet?

Without a doubt, Thomas Young, he was the central character of my PhD and I often find myself wondering what he would think about various aspects of modern life. I would also want to go back to see his Ri lectures, they can't really have been as dull as the reviews suggest!

What are your favourite history of science books?

Several key texts come to mind that I admired during my PhD, Robert Fox's *The Savant and the State* stands out as being an incredible and inspirational work. But when someone writes a superb biography, that's when I'm really blown away. When an author balances insight into a period with detailed description of a person's narrative, while also resisting the temptation to fall in love with their subject – that's my real favourite. Jan Golinski's *The Experimental Self* is simply stellar and I'm currently reading Andrea Wulf's *The Invention of Nature*, which is turning out to be deeply worthy of all its accolades and prizes.

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

Perhaps I'd be a lawyer or a civil servant? I just don't know where I would have ended up. I had never intended to take up further study when I started university, but after three years at STS, UCL, I realised just how much I didn't know and how exciting that was. As I worried about the depth of my undergrad dissertation literature review in his office, Hasok Chang verbalized my situation with the famous metaphor: as our circle of knowledge expands, so does the circumference of darkness surrounding it. That metaphor has always been of great comfort to me as I explore new research ideas and no matter where I would have or will end up that concept will always help me face new challenges.

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

Fund it properly and drastically diversify our scholarly community, as soon as possible.

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

It's in the circumference of darkness, I can't tell!

The British Journal for the History of Science

Forthcoming papers include:

- Guiliano Mori, 'Mathematical subtleties and scientific knowledge: Francis Bacon and mathematics, at the crossing of two traditions'
- Alex Csiszar, 'How Lives Became Lists and Scientific Papers Became Data: Cataloguing Authorship during the Nineteenth Century'
- Bonnie Effros, 'Berber Genealogy and the Politics of Prehistoric Archaeology and Craniology in French Algeria (1860s to 1880s)'
- Thomas Mougey, 'Needham at the Crossroads: History, Politics and International Science in Wartime China (1942-1946)'
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