CHEMICAL INTELLIGENCE

Winter 2022 issue

Society for the History of Alchemy and Chemistry

SHAC

Society History Alchemy Chemistry

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BJHAM

The Journal of the Society for the History of Alchemy and Chemistry, vol. 68, issue 4, November 2021

Book reviews for *Ambix*

Book reviews are an important part of *Ambix* and of our scholarly community. Please feel free to contact book reviews editor Tillmann Taape (tillmann.taape@cantab.net) with any books that you would like to see reviewed, that you would like to review yourself, or simply to register your interest in reviewing books for *Ambix*, with a note of your preferred topic areas.

Folio 5r from the Codex Amiatinus (Florence, Biblioteca Medicea Laurenziana, MS Amiatinus 1), Ezra the scribe. "When the sacred books had been consumed in the fires of war, Ezra repaired the damage."

SHAC

webinars

SHAC has continued to run webinars via Zoom, which are also streamed live on its YouTube channel. Past webinars can be viewed on SHAC's YouTube Channel.

Please subscribe and share the information with your colleagues.

Workshop announcement: CHEMISTRY OUTSIDE THE LABORATORY
Two-day virtual workshop
May 13-14, 2022

Organizers:
Alison McManus, Princeton University
Sarah Hijmans, Université Paris Diderot
Sarah Lang, Karl-Franzens-Universität Graz
Silvia Pérez-Criado, Universidad de Valencia

The Society for the History of Alchemy and Chemistry (SHAC) will host its 13th annual postgraduate workshop, "Chemistry Outside the Laboratory," in May 2022. This two-day virtual workshop follows the (al)chemical sciences beyond their traditional laboratory remit (which has long been a productive object of historical inquiry) and focuses instead on less archetypal locations of chemical substance and practice: mines, libraries, courtrooms, ecosystems, hospitals, domestic spaces, classrooms, and so forth. What happens to our understanding of alchemy, chemistry, and (al)chemical practitioners once we highlight these (secondary) spaces? How might key insights from laboratory studies, such as the attention to apparatus and other chemical materialities, inform historical work on alchemy and chemistry once they exit laboratory walls? How have chemical practitioners adjudicated the boundary between laboratory and not-laboratory at different times and places, with what consequences for the discipline and its participants?

This year's keynote speakers are **Robin Scheffler** (MIT) and **Eugenia Lean** (Columbia University). The rest of the program will consist of short, 15-minute virtual talks by graduate students, postdoctoral researchers, and other early career scholars. The finalized program will be circulated in March.

Pre-registration for the workshop is possible here. Please address any questions to SHAC Student Representative Alison McManus, at studentrep@ambix.org.

Early 2022 Turba Programme

Note: The meetings start at 5pm UK, 6pm Central Europe, 7pm Eastern Europe, 12 (noon) East Coast, 9am Pacific. This is an online discussion group taking place on Zoom. Some of the meetings will also be broadcast on YouTube. For a recurring link, please write to johedesan@gmail.com

Convenor: Jo Hedesan
(University of Oxford)

Sponsored by The Society for the History of Alchemy and Chemistry

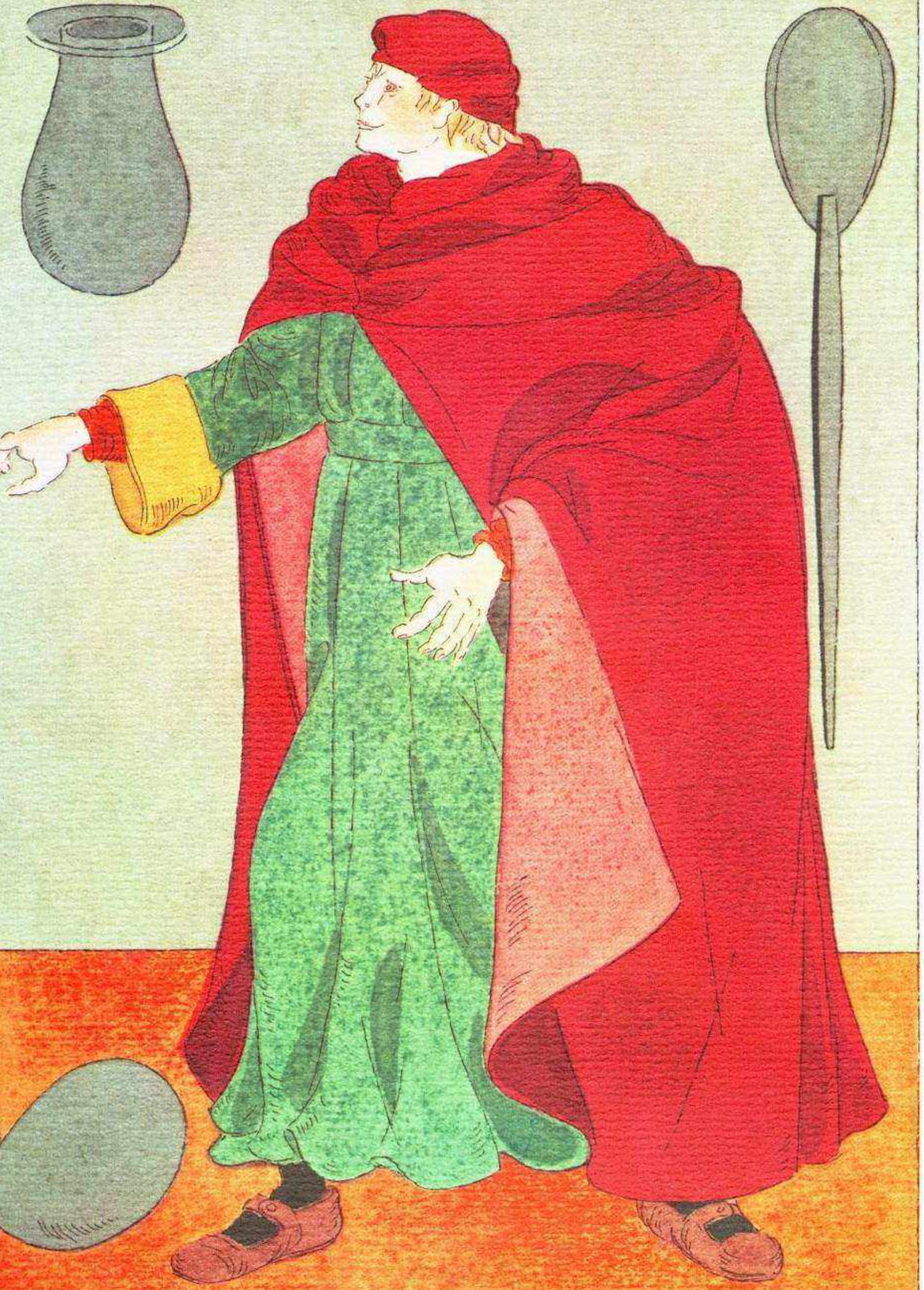
§ 4 February - 'Decrypting the Philosophers' Stone in Sloane MS 1902'
Megan Piorko (Science History Institute) and Sarah Lang (Graz)

§ 18 February – 'Poisons and Alchemy'
Yan Liu (SUNY Buffalo): 'Dying to Live: Elixirs and the Transformation of the Body in Medieval Chinese Alchemy'
Alisha Rankin (Tufts): 'A Universal Cure: Poison Antidotes, Alchemy, and Panaceas in Early Modern Europe'

§ 4 March - 'English Alchemy';
Chair: Stephen Clucas (Birkbeck)
Sara Norja (Turku): 'Translating Alchemy in Manuscript and Print: From Speculum alchemiae to The Mirror of Alchemy'
Zoe Screti (Birmingham): 'Reformed Responses to Genesis in Early Modern Alchemical Treatises'

§ 18 March – 'Tria Prima: Experimenting with Material Transformation'
Tina Asmussen (Deutsches Bergbau-Museum | RUB): 'I was Iron, I am Copper, I will be Gold'
Tianna Uchacz (Texas A&M): 'Transmuting Design and (Re)Mediating Knowledge-How: Recipes for Ornament Then and Now'
Donna Bilak (Historian and Goldsmith): 'Prima Materia, Jewelry and Alchemy'

§ 8 April – 'Toward a VR Alchemy Lab'
Arnaud Zimmern (Notre Dame) and Adam Heet (Notre Dame)



"The largest and best": A symposium to mark the 350th anniversary of the Society of Apothecaries' laboratories — Friday 6 May 2022, Apothecaries' Hall, London

2022 sees the 350th anniversary of the opening of a laboratory at Apothecaries' Hall for manufacturing chemical medicines and one hundred years since its closure. With its creation rooted in the burgeoning popularity of chemical medicines and the ongoing disputes with the College of Physicians, it expanded during the eighteenth century to be a major supplier of medicines to the Navy and East India Company. In the nineteenth century, under the direction of William Brande, Henry Hennell and Robert Warington, all Fellows of the Royal Society, new directions of research and consultancy developed, whilst the Society of Apothecaries struggled to reconcile its new role as a medical licensing corporation with that of a wholesale drug manufacturer.

To register please visit:
https://www.apothecaries.org/events/event/history-of-laboratories/

Meeting Fee: £30 full rate, £15 student rate

This is a joint meeting between the Society for the History of Alchemy and Chemistry and the Faculty of the History and Philosophy of Medicine and Pharmacy of the Worshipful Society of Apothecaries.

Call for Posters

As part of this event, there will be an opportunity for participants to showcase their work and ideas in the form of a poster. Posters should relate to the broad theme of laboratories and medicines and do not need to be linked to the history of the Society of Apothecaries. Posters related to the shared interests of the Society for the History of Alchemy and Chemistry and the Faculty of History and Philosophy of Medicine and Pharmacy are particularly welcome. These include chemical medicine, pharmacy, and interactions between alchemy, chemistry and medicine from any historical period to the present day.

Accepted posters can be submitted in two formats:
- brought on the day as hard copies for display
- emailed in advance for display on screens during the breaks and lunchtime.

Presenters will be asked stand near their poster to discuss with participants for at least half of the lunchtime period.
Abstracts should be no more than 300 words, outlining the nature and purpose of poster presentations. Abstracts should include the title of the poster, the names of presenting and other authors, and their professional role and affiliation.
Deadline for abstract submissions is Friday 11 March 2022

Abstracts should be sent to facultyhp@apothecaries.org with the subject line “Laboratory symposium poster abstract” and the abstract as a Microsoft Word document attachment.

Abstracts will be reviewed by the organising committee, and those accepted will be notified by email by Friday 25 March 2022 or sooner.

PROGRAMME

From 09:45 am: Registration

10:15: Welcome from Faculty President, Briony Hudson and SHAC Chair, Frank James

10:20: Anna Simmons (UCL) – A Potted History of the Apothecaries’ Hall Laboratory, 1672-1922 and its Place in the Development of Drug Manufacturing

11:00: Patrick Wallis (LSE) - The Wonders of the Apothecary’s Shop

11:40: Coffee Break and Tours of the Hall

12:20: Peter Elmer (Exeter University) - Challenging the Medical Status Quo: The Society of Chymical Physicians, 1665

13:00: Poster viewing - Theme: Medicines and Laboratories - and break for lunch. (Lunch not provided - there are various cafes and sandwich bars nearby).

14:00: Groups viewing archive material including laboratory glassware, pharmacopoeias, drug jars, process books, plans, photographs and sketches of laboratories and apparatus, plus chemical, pharmaceutical and trade records from the Hall Laboratory

14:50: Anna Marie Roos (University of Lincoln) - The Royal Society Repository: Museum, Library, and Working Laboratory

15:30: Break

15:40: Lightning Talks: the Society of Apothecaries’ Archives in wider research
1) Rosemary Baird Andreae – Huguenot Apothecaries and the Royal Hospital Chelsea: Isaac Garnier (1631-1712) and Family
2) Pierre Lack (LSE) - Opium Prices and Demand in the Nineteenth Century
3) Frank James and Anna Simmons (UCL) - A Multiple Post-Holder in Nineteenth-Century Scientific London: William Thomas Brande
4) John Ford (Society of Apothecaries) – The Chase Family: Royal Spies to Gin Distillers

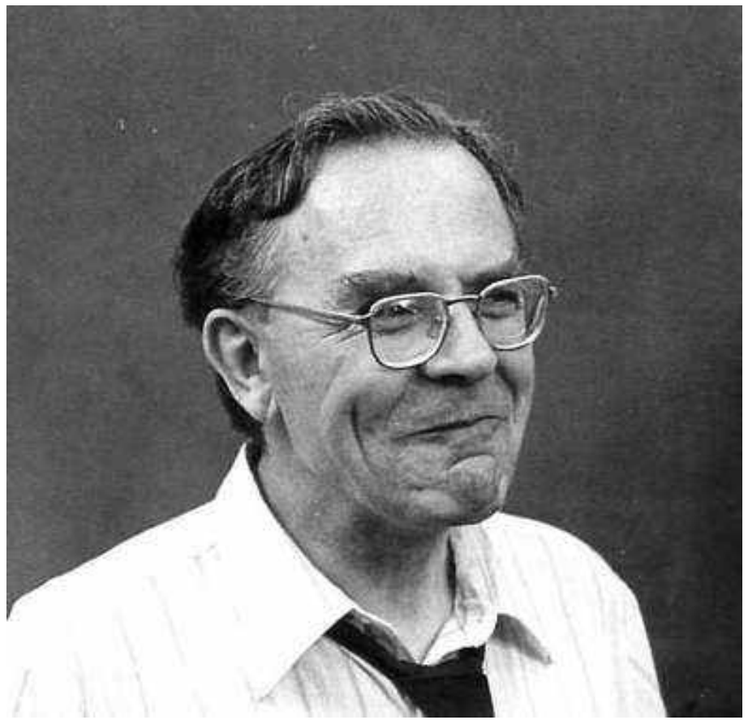
16:40: Discussion and Closing Comments

17:00: Drinks

18:00: Meeting Closes

ROYAL SOCIETY OF CHEMISTRY HISTORICAL GROUP MEETINGS

Geoffrey Wilkinson Meeting 23 March 2022 Royal Society of Chemistry, Burlington



By Smokefoot - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=17786808

This meeting is co-organised by the RSC Historical Group and the chemistry department at Imperial College London and will explore the scientific life of Professor Sir Geoffrey Wilkinson (1921-1996), a pioneer in inorganic chemistry and homogenous transition metal catalysis, from the perspective of collaborators, friends and family. It will celebrate three anniversaries, the centenary of his birth (2021), the half-century anniversary of the Nobel Prize (2023) and seventy years since the publication of the seminal article on ferrocene (2022). The meeting will include short talks on topics ranging from the historical aspects of Wilkinson's legacy to exciting new chemistry evolving from it, given by sixteen speakers and with a packed programme that will run from 9 am to 6 pm.

The meeting is free of charge and registration will be essential. Lunch will be provided free, but attendance at the evening dinner at Burlington House (3 courses plus wine) must be booked via the registration form and will be chargeable. For further information, including a list of speakers, and booking details please visit:

https://www.rsc.org/events/detail/47050/sir-geoffrey-wilkinson-an-anniversary-celebration

Save the date: SHAC summer party

On Friday 17 June 2022, SHAC will hold a summer party at the Chelsea Physic Garden from 1 pm to 5 pm. Attendees will be able to explore the garden and there will be talks from Elaine Leong and Ernst Homburg, before the presentation of the 2021 Morris Award to Ernst Homburg. It will conclude with a drinks reception and the launch of Bloomsbury's Cultural History of Chemistry.

Further details will be sent to members and will be available on www.ambix.org nearer the time.

“Science Policy and the Politics of Science”

Conference for the European Society for the History of Science (ESHS)

The Tenth Conference of the European Society for the History of Science (ESHS) will take place in Brussels (Belgium), from 7 to 10 September 2022. The theme will be “Science Policy and the Politics of Science”.

The venue in and of itself supports the theme of the conference. Since the foundation of the Royal Academy of Science, Letters, and Fine Arts of Belgium in 1772, Brussels has been the home and venue of significant scientific institutions, from the Solvay Conferences in Physics and Chemistry to the European Commission and Research Council, which have shaped the present state of the sciences as well as their impact on our world.

From a historiographical perspective, this will be an opportunity to showcase new histories of scientific institutions and modes of knowledge, networks, and nodes.

Visit the website https://eshs-brussels2022.com/ for updates and information on the venue, the organization, and the calls for proposals. Call for symposium is now closed but the call for individual papers is open until February 21.

Please note that the conference is planned as a physical, in-person event in Brussels. The final decision on the format of the conference will be made before the registration opens.

New publications

The Chemical Intelligence features a new section on recent publications that might be of interest to our members. If you have suggestions for books, articles, and blogposts to include, please contact the editor.

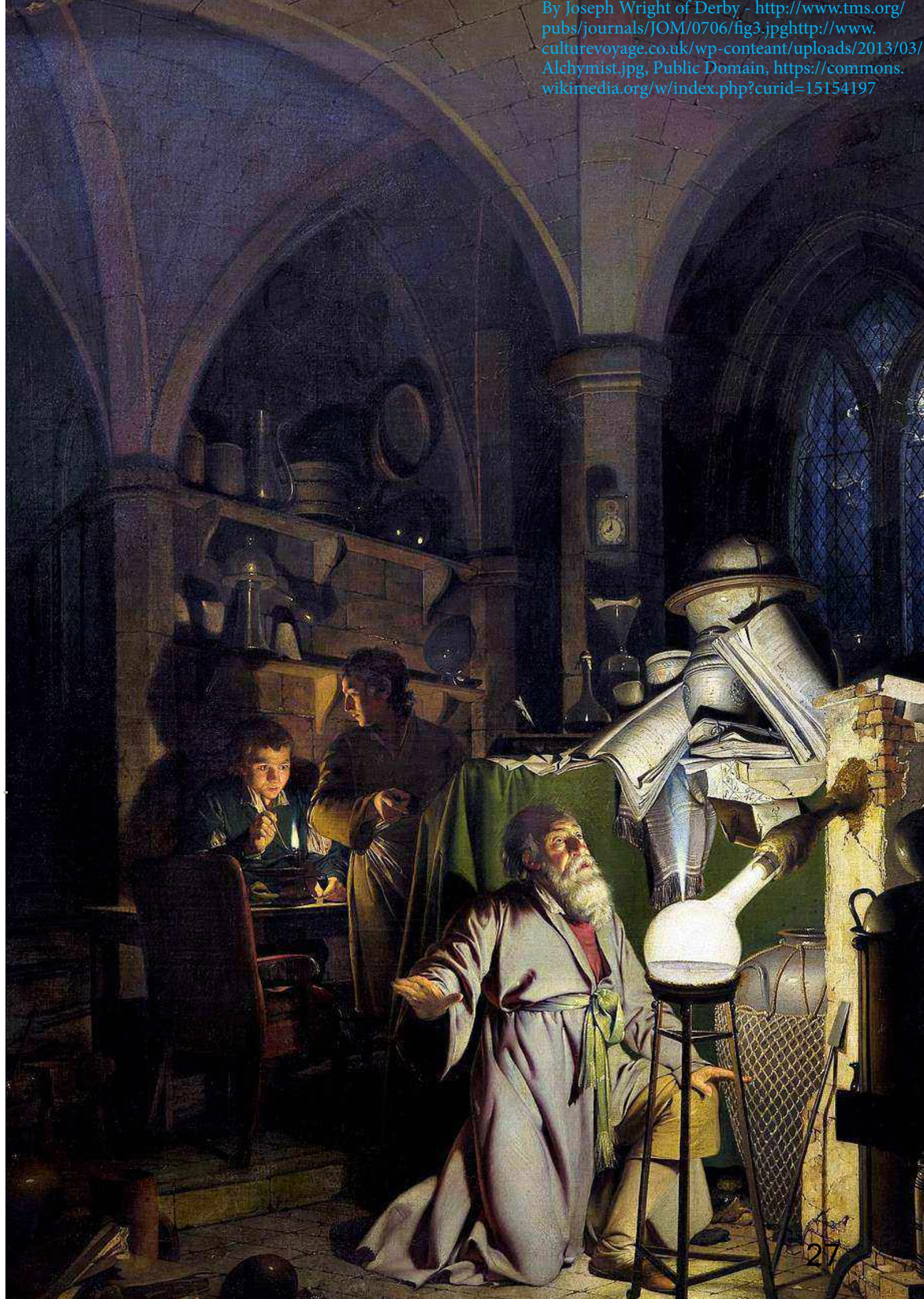
Reformation, Revolution, Renovation The Roots and Reception of the Rosicrucian Call for General Reform

Lyke de Vries

At the centre of the Rosicrucian manifestos was a call for 'general reformation'. In Reformation, Revolution, Renovation, the first book-length study of this topic, Lyke de Vries demonstrates the unique position of the Rosicrucian call for reform in the transformative context of the early seventeenth century. The manifestos, commonly interpreted as either Lutheran or esoteric, are here portrayed as revolutionary mission statements which broke dramatically with Luther's reform ideals. Their call for reform instead resembles a variety of late medieval and early modern dissenting traditions as well as the heterodox movement of Paracelsianism. Emphasising the universal character of the Rosicrucian proposal for change, this new genealogy of the core idea sheds fresh light on the vexed question of the manifestos' authorship and helps explain their tumultuous reception by both those who welcomed and those who deplored them.

Deciphering the Philosophers' Stone: how we cracked a 400-year-old alchemical cipher

What secret alchemical knowledge could be so important it required sophisticated encryption?
Richard Bean, Megan Piorko and Sarah Lang's piece on decrypting a recipe for the Philosophers' Stone can be accessed on *the Conversation.*



By Joseph Wright of Derby - http://www.tms.org/pubs/journals/JOM/0706/fig3.jpghttp://www.culturevoyage.co.uk/wp-conteant/uploads/2013/03/Alchymist.jpg, Public Domain, https://commons.wikimedia.org/w/index.php?curid=15154197

JARGONIUM

Established by early-career researchers with a shared research interest in history and philosophy of chemistry, *Jargonium* showcases short essays on chemistry and alchemy from the perspective of humanities. *Jargonium*'s objective is to show that chemistry is a source of insight not only for those inherently curious about oxidation states, but for anyone with an interest in philosophy, history, art, sociology, or any other facet of humanistic inquiry. Together with our contributors, we show how looking at chemistry gives rise to reflections that often extend the chemical realm.

We would be more than happy to accept contributions from anyone interested in chemistry! If you wish to share with us your ideas, feel free to contact us at jargoniumblog@gmail.com or karoliina.pulkkinen@helsinki.fi

Some of our recent posts include:

The True Story of How a False Theory Led to the Discovery of Boron
by Jonathon Hricko

Understanding chemical substance (is harder than you might think)
Marabel Riesmeier

How to identify simple substances: chlorine vs. oxymuriatic acid
by Sarah Hijmans

Papers on Humphry Davy (1778–1829) Chemistry, culture and society in early nineteenth–century England

The first is the recent inaugural Ambix Edited Collection featured on the Ambix T&F website, "Papers on Humphry Davy (1778-1829): Chemistry, culture and society in early nineteenth-century England," edited by Frank James. https://www.tandfonline.com/journals/yamb20/collections/Papers-on-Humphry-Davy

All articles in the collection are open access for two months from the publication date. We will be doing more Edited Collections to promote Ambix and upcoming events in the history of alchemy and chemistry.

In the early nineteenth century, Humphry Davy was almost certainly the best-known English chemist in Europe. The son of a bankrupt yeoman farmer in Cornwall, he served part of an apprenticeship as an apothecary before moving to Bristol where he discovered the extraordinary physiological properties of nitrous oxide (laughing gas). In Bristol he formed close friendships with Robert Southey and Samuel Taylor Coleridge who both greatly admired his poetry. In 1801 Davy moved to the Royal Institution where for a decade he was the most popular lecturer in London and initiated the institution's reputation for research by, for example, electro-chemically isolating and naming chemical elements such as sodium and potassium. He was Professor of Chemistry to the Board of Agriculture and there and at the Royal Institution, he formed links with members of the aristocracy whose great houses he enjoyed visiting, sometimes writing from them, otherwise inconsequentially, to his mother to show how her son had risen in the highly stratified society of early nineteenth-century Britain. His rise continued in 1812 by being knighted by the Prince Regent and marrying a wealthy widow (whose money came from her father, an Antigua merchant and corrupt prize agent). He and Lady Davy toured the Continent between 1813 and 1815 meeting, ex-Empress Josephine and the Queen of Naples. Shortly after his return Davy in the closing months of 1815 invented a form of the miners' safety lamp. This crucial device allowed industrialisation to continue, and, possibly more than anything else, is what he is remembered for today. In 1820 he became President of the Royal Society of London, succeeding Joseph Banks who had occupied that role for forty-two years. In the circumstances, any successor to Banks would have had a difficult time and Davy's temperament meant he was unsuited to the role. After a stroke he resigned in 1827 and spent most of the rest of his life on the Continent, dying in Geneva in 1829.

Awards

Robert Franklin Bud, Keeper Emeritus and museologist, has been awarded an MBE (Member of the British Empire) for his for services to the Science Museum and northern industrial heritage.

Society for the History of Alchemy and Chemistry Award Scheme 2022

Opening date: 1 March 2022
Closing date for applications: 31 May 2022

The Society for the History of Alchemy and Chemistry invites applications for its Award Scheme for 2022. SHAC offers two types of award: support for research into the history of chemistry or history of alchemy by both new and independent scholars and support for Subject Development of either history of chemistry or history of alchemy. It is expected that applicants will be advised of the outcome of their application by 31 July 2022. The Awards are most suitable for activities planned to be undertaken during the academic year October 2022–September 2023. However, there will be a two-year window for completion due to ongoing uncertainty over plans for future research projects, conferences, workshops etc.

Research Awards are open to post-graduate students (both masters and doctoral students), those who have obtained a PhD since 1 January 2012 and also to independent scholars. Given that the circumstances of independent scholars differ we are letting members 'self-define' and if there are any unclear cases it will be left to the discretion of the Awards Panel.

Awards of up to £750 will be made to cover research expenses, including travel, accommodation, the reproduction of documents, and library fees. Applications may also include the costs of reproducing images for publication. The Scheme does not fund the purchase of equipment or course fees. It does not cover the costs of Open Access publication.

In addition, post-graduate students only may apply for the costs of travel to conferences and accommodation, but only in order to give a paper. The Scheme does not pay conference registration fees. Subject Development Awards of up to £750 may be made to support activities such as seminars, workshops, colloquia, lecture series, conference sessions, conferences, exhibitions and outreach activities that support either the history of chemistry or history of alchemy as academic subjects. The Awards do not cover the costs of refreshments or catering for these events. The Scheme does not cover the costs of Open Access publication.

Please note that activities covered by the Awards do not have to occur in the UK, and that the Awards are open to members of the Society resident both in the UK and elsewhere. Members who have applied to the Scheme in previous years, whether successfully or not, are entitled to make an application in 2022.

Applicants must be members of the Society in good standing at the time of making an application, and, if successful, throughout the period of an award. For more information and application forms, please contact grants[at]ambix.org. Membership enquiries should be made to newjoiner[at]ambix.org.

An activity report must be submitted at the end of the Award. This will usually be published in SHAC's *Chemical Intelligence* newsletter.

The call is open for nominations for the 2022 Franklin-Lavoisier Prize, jointly awarded by the Science History Institute (Philadelphia, USA) and the Fondation de la Maison de la Chimie (Paris, France).

Named for Antoine-Laurent Lavoisier and Benjamin Franklin, two of the 18th century's greatest minds, this prize recognizes unusually meritorious efforts in the preservation or promotion of the entwined scientific heritage of France and the United States. This award acknowledges commendable work in the preservation and highlighting of any aspect of common scientific or industrial heritage in the fields of chemistry and its related applications, the promotion of the history of the chemical and molecular sciences and industries, or the fostering of closer Franco-American ties and the promotion of significant activities in the chemical sciences or industries. The award ceremony for this award will be held in autumn 2022 at the Institute in Philadelphia; winners will receive €15,000.

Anyone is eligible to submit a nominee for the prize. Nominees can be individuals, a group of individuals, or an organization - for reference a list of past winners can be found here. A full list of rules and regulations, as well as the nomination forms (in French and English can also be found on that page).

Download the official rules and nomination form here.

All completed nominations with supporting documentation should be emailed to presidence@maisondelachimie.com or physically mailed to the Maison de la Chimie in Paris (mailing address included in attachment). Email is preferred, but materials can also be mailed to:

Fondation de la Maison de la Chimie
28, Rue Saint-Dominique
5007 Paris
FRANCE

Nominations are due March 31, 2022.

Project reports

Sergei Zotov

During my research trip, which I've undertaken with the help of the SHAC research award, it was possible to consult many alchemical manuscripts in the Edinburgh University Library, Edinburgh, Royal College of Physicians Library, Glasgow University Library and St Andrews University Library. Library rules and pandemic-related restrictions changed every week, so I planned my trip at the last minute. Nevertheless, I managed to handle slots in every library I wanted to visit, even in the libraries, which were officially closed to external visitors (Glasgow, St Andrews). The negative consequence was that I booked accommodation during the COP26, of which I was not aware. As a result, all the cities in the area were almost 100% booked, and despite the fact that for almost the entire stay I was able to find hotels in Edinburgh, it was impossible to stay there or in Glasgow on the 30th of October (the night before COP26), what led to that I was forced to stay one night in a neighbouring town, Balloch (which eventually turned out as a pleasant coincidence).

The main goal of my archival research was the Glasgow University Library, where I worked with the copies of the treatise Crowning of Nature (Ms. Ferguson 8, Ms. Ferguson 208, Ms. Ferguson 110, Ms. Ferguson 245, Ms. Ferguson 253, Ms. Ferguson 320), Buch der Heiligen Dreifaltigkeit (Ms. Ferguson 4), Aurora consurgens (Ms. Ferguson 6), Rosarium philosophorum (Ms. Ferguson 6, Ms. Ferguson 29, Ms. Ferguson 74, Ferguson 96, Ms. Ferguson 149, and Ms. Ferguson 210), Donum Dei (Ms. Ferguson 6, Ms. Ferguson 112, Ms. Ferguson 113, Ms. Ferguson 270), Margarita preciosa… (Ms. Ferguson 6, Ms. Ferguson 248), Solidonius… (Ferguson Ms. 130, Ferguson Ms. 220, Ferguson Ms. 326), Atalanta fugiens (Ferguson Ms. 154), Splendor solis (Ferguson Ms. 170), Thesaurus mundi (Ferguson Ms. 306), Hieroglyphic Figures of Nicolas Flamel (Ferguson Ms. 17), The Twelve Keys of Basil Valentine (Ferguson Ms. 24, Ferguson Ms. 143), Opus magnum… (Ferguson Ms. 271), The alchemy of Hermes… (Ferguson Ms. 324).

In sum, thanks to the kindness of library workers, I was able to see and take photographs of 55 alchemical manuscripts, which is an invaluable contribution to my research. The second library which was crucial for my research is St. Andrews University Library, where I have checked copies of the Crowning of Nature and Hieroglyphic Figures of Nicolas Flamel (Ms. 38190), as well as a rare copy of Hermaphroditisches Sonn- und Monds-Kind (Ms. 38188). In Edinburgh University Library I found out a very special miscellany, written around 1629 (Ms. Dc.1.30), not only containing some unique examples of alchemical iconography, but also an alchemical ciphertext recently described by SHAC fellows and Philadelphia Science History Institute fellows Megan Piorko and Sarah Lang in an article: surprisingly, the hand of Patrick Ruthven has deciphered the entire alchemical text in 1629 already. Important were also Edinburgh, Royal College of Physicians Library Ms. ERG/2 (Ripley Scroll), and ERG/6, which contains hand-drawn title pages from originally printed Musaeum Hermeticum, Speculum Sophicum, and many more.

Showcasing the Davy Notebooks Project in 2021

Prof. Sharon Ruston

We (the Davy Notebooks Project; wp.lancs.ac.uk/davynotebooks) applied to SHAC for funds to produce a short film (around two minutes in length, and therefore suitable to be shared across a range of social media channels) in order to reach new 'at home' audiences – audiences we previously (pre-pandemic) had assumed would be interested in attending our 'in person' public events. Having being awarded £300, we recruited Sarah Wagstaffe, a doctoral student in the Department of English Literature and Creative Writing, Lancaster University, and an expert film-maker, to produce a short promotional video for the Davy Notebooks Project.

Between July-October 2021, Sarah worked closely with the Davy Notebooks Project team, attending regular meetings and producing around five draft versions of the film in the process. The film was completed on 8 October 2021, and has now been uploaded to YouTube; please see https://youtu.be/bNFeqoO9BXk. The film is now embedded on the front page of our project website, and will soon be shared widely on our social media channels. We are very grateful to SHAC for making this award, and acknowledge SHAC prominently at the start and the end of the film.

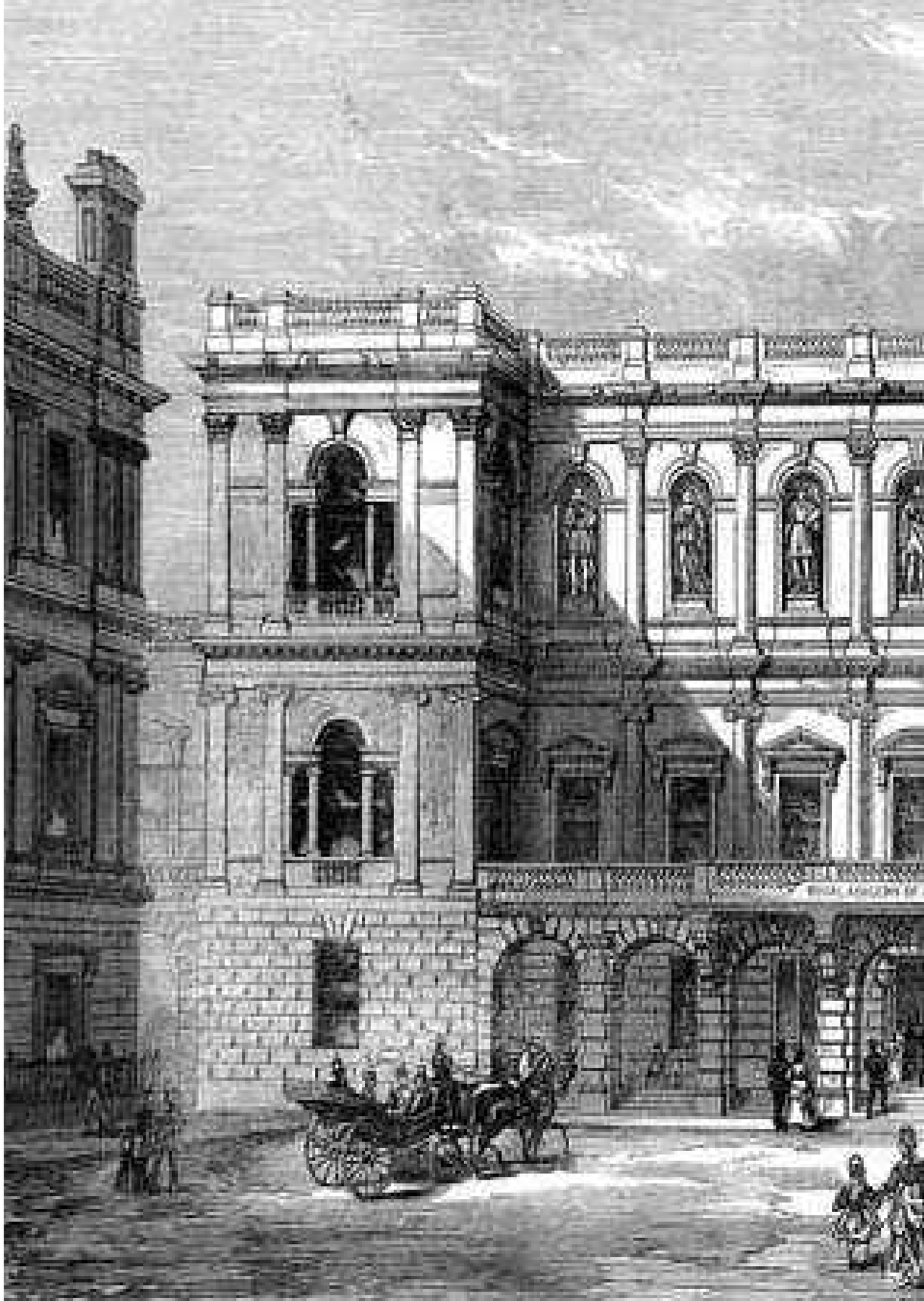
[Dr Andrew Lacey (a.lacey2@lancaster.ac.uk), Senior Research Associate on the Davy Notebooks Project, on behalf of Professor Sharon Ruston, 20/10/21].

RSCHG MEETING REPORTS

The Handed World - 150 Years of Molecular Chirality

Wednesday 13 October 2021, RSC Library, Burlington House, Piccadilly.

This report was first published in the Royal Society of Chemistry Historical Group Newsletter, Winter 2022, 81, 47-55.



"Perhaps Looking-glass milk isn't good to drink". From Through the Looking-glass, and What Alice Found There, by Lewis Carroll (1832-1898), illustration by John Tenniel (1820-1914).

This meeting, postponed from 2020 because of Covid, celebrated the sesquicentenary (150 years) of molecular chirality. The RSC Historical Group could have chosen some years on either side; our sesquicentenary is of an idiosyncratic weighted average of events from 1860 (Pasteur) to 1874 (van't Hoff and Le Bel). The meeting was inspired in 2017 by Alan Dronsfield's observation that 2019 would be the sesquicentenary of Paterno's ball-and-stick representations of molecules including tetrahedral carbon (discussed below in this report). The postponement of the meeting from 2020 because of Covid did, however, make 2021 the precise sesquicentenary year of the publication of Lewis Carroll's T*hrough the Looking-glass*, and *What Alice Found There*. In this (published on 27 December 1871, not in "1872" as indicated inside the book), shortly before Alice jumps through the "Looking-glass" from the chimney-piece, addressing her cat Kitty, she speculates: "Perhaps Looking-glass milk isn't good to drink", and she may be right at least in relation to the sugar lactose in the milk. In addition, the postponement meant that the meeting took place exactly a week after the award of the 2021 Nobel Prize in Chemistry to Benjamin List and David MacMillan "for the development of asymmetric organocatalysis".

The Historical Group was pleased to welcome two members of the Lewis Carroll Society, one of whom, Dr Jane Skelly, a biochemist and editor of the scholarly journal *The Carrollian,* chaired the second of the three sessions of the day.

A list of seventy-six relevant historical characters is available at: https://www.researchinip.com/20211013/0.2histfigs.pdf

Introduction to the Day

Dr Michael Jewess
(RSC Historical Group, Chair of the Meeting Organising Committee)

Chemists in the nineteenth century achieved great feats of inductive reasoning. From purely macroscopic observations they drew conclusions that were confirmed in the twentieth century by means of observations on the atomic scale, for instance by X-ray crystallography. From Dalton early in the nineteenth century to Cannizzaro in 1860, reasoning from combining ratios, chemists concluded that molecules comprised known atoms in known numbers bound closely together. From 1860 to 1874, reasoning from optical activity, they created a picture of molecules in 3-dimensional space with known or knowable geometries. In particular, they concluded that a molecule in which a carbon atom was bonded tetrahedrally to four different groups could exist in two mirror-image forms. Each form was unsuperimposable on the other no matter how it was moved about in space, the phenomenon we now describe as molecular chirality. Consistently with Alice's speculation, chirality matters to life; biological processes often, though not always, rely on and generate molecules in just one of two chiral forms.

Discovery of the Phenomenon of Polarisation of Light Prof. John Steeds, FRS (University of Bristol)

Over a period of 250 years, experiment led to our current understanding that light propagates in the form of transverse waves. The chief pioneers whose work was discussed were as follows: Hooke, Newton, Bartholinus, Christiaan Huygens, Malus, Arago, Fresnel, Foucault, Fizeau, Breguet and Maxwell. The key steps that led to this conclusion were described, together with the reasons why this conclusion took so long in coming. Not only was Newton with his great authority in favour of a corpuscular theory of light, but also observations with polarised light (no interference when two beams linearly polarised at right angles were recombined) seemed to be against the wave theory so long as one imagined the waves to be longitudinal rather than transverse.

The three commonly used ways of generating plane polarized light (absorption, reflection, and birefringence) were discussed together with their use in creating left- or right-handed circularly polarized light. A particularly successful polariser operating by absorption is "Polaroid" invented and commercialised by the American Edwin Henry Land (1909-1991), who consciously modelled it on "herepathite" studied by the English physician William Bird Herepath (1828-1868).

Optical Activity – A Century of Perplexity. Prof. Alan Dronsfield (University of Derby)

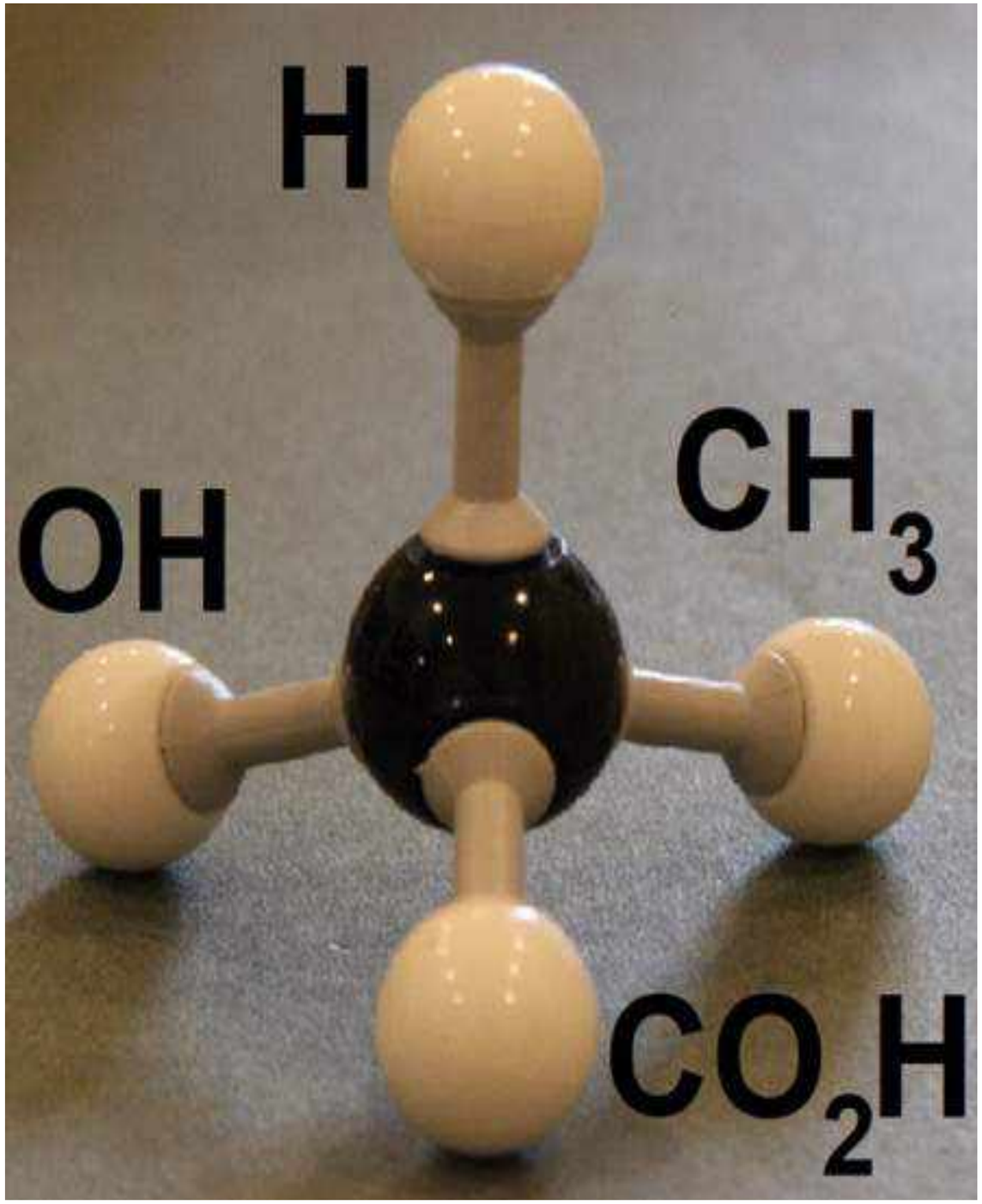
In 1809 Etienne Malus discovered that light reflected off a crystal of quartz was, to use today's terminology, plane polarised. When this light was passed through a crystal of quartz, the light was rotated, sometimes in one direction, sometimes in the other and the direction of rotation was a characteristic of the crystal's shape. Inexplicably (at the time) when the quartz was melted and allowed to resolidify this power to rotate light was lost. This was the first of many perplexities associated with the phenomenon of optical activity. Quartz's behaviour was in contrast with that of barley sugar that showed the ability to rotate the light in the solid state, when molten, when allowed to resolidify and when dissolved in water to form a syrup. Further examples were soon identified which showed barley sugar behaviour, including a few which exhibited rotatory power even in the vapour state.

It was a further perplexity that laboratory-synthesised chemicals were always optically inactive. Those that were active were obtained from Nature. The behaviour of the two types of (visually different) quartz crystal pointed to a difference in underlying morphology or molecular structure, but this could not be extended to the molecular level until chemists agreed on what constituted a molecule, and further, how one was made up of constituent atoms and bonds. Alexander Crum Brown suggested molecular representations very close to today's structural formulae and Auguste Hofmann used croquet ball models in his lectures, but only constructed

There is some evidence that Auguste Kekulé advanced the notion of the tetrahedral carbon atom, but he left it to his disciples to promulgate the idea. Emanuele Paterno drew 3D structures identical to those we use today, but did not connect them to optical activity. This was left to the seminal (and independent) work of Le Bel and van't Hoff, from whom we get the notion of the "asymmetric carbon atom" and the idea that molecules whose mirror images are non-superimposable should display optical rotation in opposite directions. The applicability of these ideas was rapidly and extensively tested. Did the asymmetric atom have to be carbon? Could the idea of non-superimposable object and mirror image be applied to species that did not contain a formal "asymmetric" central atom? Can enantiomers exist for molecules that contain no carbon atoms at all?

Prof. Dronsfield concluded by looking at the history of attempts to achieve enantiomeric excesses by conducting syntheses in the presence of magnetic fields, including some of his own work in the 1990s. He then reviewed "fraudulent" chemistry more generally – including, in a light-hearted vein, that conducted in Adolf Baeyer's laboratory, around 1890.

Dramatis Personae: Jean Baptiste Biot, 1774-1862; Louis Pasteur, 1822-1895; Alexander Crum Brown, 1838-1922; Joseph Achille Le Bel, 1847-1930; Jacobus Henricus van't Hoff, 1852-1911; William Jackson Pope, 1870-1939; Alfred Werner, 1866-1919; Eberhard Breitmaier, 1931- present.



If, of the four H atoms of methane (white balls), three are replaced by different groups so as to form a lactic acid molecule, there are two ways of doing this: to form the molecule shown above, and to form its mirror image. Courtesy Michael Jewess.

From d and l to R and S: Discovery of Absolute Configuration
Prof. Henry Rzepa (Imperial College)

The main actor in the prologue to this story is Emil Fischer, who in the 1890s set out on an odyssey to prove by chemical synthesis van't Hoff and Le Bel's famous 1874 hypothesis that for an organic molecule containing *n* asymmetric carbon atoms (carbons bearing four different substituents in a tetrahedral arrangement), there could be up to 2^n three-dimensional stereoisomers. This in turn led to the development of Fischer's famous notation, a map-like projection from three into two dimensions applied to the carbon backbone of the linear forms of glucose and its fifteen stereoisomeric forms (24 = 16), of which Fischer actually made twelve. Historical accounts however rarely note Fischer's remarkable proof in 1914 that if two different substituents on a tetra-substituted asymmetric carbon are transposed by chemical transformations without breaking any of the bonds to that carbon to produce a non-superimposable stereoisomer (a process equivalent to reflection of the three dimensional structure of the molecule in a mirror), the sign of the measured optical rotation (known as [α]D) inverts but its numerical value is unchanged. Fischer thus set a formidable challenge; how to link the signed value of [α]D measured for an asymmetric molecule with the one or other of its mirror image forms.

This became known as the problem of absolute configuration and is encapsulated in his reference molecule for sugars, D-(+)-glyceraldehyde. Here D is the (modern) notation for the absolute configuration of one of the mirror image forms (L being the other) and (+) is the sign of its measured optical rotation at the wavelength of sodium D-line (589 nm). Fischer's association of D with (+) was a pure guess. But how to prove this guess was correct?

Having thus set the scene, the main act of Prof. Rzepa's talk told of attempts by three later actors to respond to this challenge. The first notable attempt was by Werner Kuhn in 1936 and the next a most intriguing and largely unheralded effort in 1937 by John Kirkwood, both using the new theories of quantum mechanics which had been introduced well after Fischer's guess. The final denouement in 1951 was by Johannes Bijvoet using experimental crystallography and which finally proved Fischer's guess to be correct. Nowadays, the latter receives most of the credit, but was it an erroneous sign in his (1937) equations that resulted in Kirkwood's theoretical attempt being scuppered? Or was it that chemists (unlike physicists, *viz* Einstein predicting gravitational waves or Dirac predicting the positron) were not yet ready to trust theoretical over experimental verification? In his 1937 analysis, Kirkwood candidly sets out an important uncertainty in his linkage between the sign of [⍰]D and absolute configuration as being the flexible shape or conformation of the molecules.

In this he prepared the stage for players such as Derek Barton in 1948 to formulate a Nobel prize-winning area of chemistry, conformational analysis. Only in 1952, a few months after Bijvoet's work, did Kirkwood report a way of side-stepping the conformational ambiguities of his original choice of molecule with a more rigid system, thus (independently of Bijvoet) verifying Fischer's guess. Bijvoet's assignment of absolute configuration to sugars, and by inference to amino acids, was rapidly accepted and in turn set the stage for two further Nobel-worthy scientific advances to be made at around the same time, the three-dimensional helical structures of some proteins and of DNA by respectively Pauling and Watson and Crick. Both discoveries relied on the absolute configurations of amino acids and sugars to infer, inter alia, the right-handed nature of the helical motifs in both proteins and DNA.

The epilogue to Prof. Rzepa's talk noted that although Fischer's stereochemical notation was a great advance, it applied only to sugars and was also associated with much confusion (such as two quite different meanings of the d/l notations). This problem was soon solved with articles written between 1951-56 by Cahn, Ingold, and Prelog (known affectionately as CIP). These changes in nomenclature, along with advances in representing the stereochemistry of molecules using line diagrams with perspective after the 1950s, mean that confidently comparing pre-1950s literature with modern CIP notations remains a challenge, especially when writing talks such as this one! The reader can see one part of this story retold at DOI: 10.14469/hpc/6368 with more detail.

The cast: Emil Fischer, 1852-1919; John Kirkwood, 1907 – 1959; Johannes Bijvoet, 1892 – 1980; Derek Barton, 1918 – 1998; Linus Pauling, 1901- 1994; Francis Crick, 1916 - 2004 and James Watson, 1928 – present; Robert Cahn, 1899 - 1981 and Christopher Ingold, 1893 - 1970 and Vladimir Prelog, 1906 - 1999 (CIP).

Molecular and Supramolecular Chirality Prof. Giuliano Siligardi (Diamond Light Source Ltd)

This talk gave an overview view of chirality, both in molecular and supramolecular terms, the tools to measure it, and the people who laid the foundations.

A molecule is said to be optically active or chiral or dissymmetric if it is not superimposable on its mirror image as firstly described in 1848 by Louis Pasteur (1822-1895). The configuration of D sugars and the L amino acids, the building blocks of terrestrial life identified by Fischer (1852-1919) recipient of 1902 Nobel Prize in Chemistry, have higher stability than their respective enantiomers (mirror images) due to parity-violating of the electroweak force established in 1956 by Lee and Yang, for which they were awarded the Nobel Prize in Physics (1957). This different stability, amplified through the vast timescale of the universe, has led to the terrestrial homochirality.

Chiral molecules rotate the plane of polarization of linearly polarized light, the variation with the rotation with wavelength being known as optical rotatory dispersion (ORD). Chiral molecules also absorb differentially the left and right circularly polarized light (CPL), this phenomenon being known as circular dichroism (CD). Modern CD instruments modulating the CPL with photo-elastic modulators can also measure ORD with appropriate modifications (Velluz, Grosjean and Legrand, 1965).

For small, flexible chiral molecules, the optical activity from electronic and vibrational CD must be calculated using quantum mechanical theory for all the stable conformations present in solution. This is now the method to assign the absolute configuration of therapeutic drugs as recommended by the Food and Drug Administration. For larger molecules like proteins, nucleic acids and chiral polymers, this is still difficult and expensive to accomplish. As the function and activity of proteins are directly related to their structure, the ability to characterise their conformational behaviour in solution as a function of environment (temperature, solvent and drug binding interactions) is invaluable information that can be used to verify the correctness of molecular modelling in silico. This combination is guiding the basic research that, when successful, has led to commercial applications. The pharmaceutical industry is an important example.

Supramolecular chirality is a younger research field of self-assembly of even larger systems that are observed in the solid state for organic optoelectronic and photovoltaic materials, nanocrystalline cellulose, and artificial retina that, if dissymmetric, can be studied with chiroptical spectroscopic techniques. Like for molecular chirality, the physical properties of materials are optimised if the supramolecular chirality is homogeneous.

For example, the efficiency of optoelectronic and photovoltaic devices is maximised for specimens prepared with homogeneous supramolecular chirality.

However, these systems are more complex than those in solution because for solid-state the observed CD can have linear dichroism (LD), linear and circular birefringence (LB and CB) contributions hampering any CD analysis. Using the Mueller matrix calculus for manipulating the polarization states of light (Mueller, 1900-1965) these contributions can be extracted and quantified enabling the imaging of optical activity in the visible region pioneered by B. Kahr (2003) and in the UV region with the novel Mueller Matric Polarimeter (MMP) recently installed at B23 beamline of Diamond Light Source. Only with the MMP tool, the homogeneity of supramolecular chirality can be assessed and measured at higher spatial resolution guiding the optimization of the parameters to achieve reproducible specimens, which is the sine qua non for any commercial application.

Does the Right Hand Know What the Left Hand is Doing? - Chirality in Real Life
Dr Ian Blagbrough (University of Bath)

Dr Blagbrough has an active interdisciplinary research group working in phytochemistry. This requires an understanding of the application of different aspects of handedness. Today it has been set out clearly and elegantly, unambiguously and without room for contradiction that an optically active molecule is chiral and non-superimposable on its mirror image, as first described in 1848 by Louis Pasteur (1822-1895). Thus, the reflection of its three dimensional structure in a vanity mirror affords a different molecule, its enantiomer, which displays optical rotation equally, but in the opposite direction. This led on to the crucial building blocks of terrestrial life being determined as D-sugars and L-amino acids by Emil Fischer (1852-1919) in the 1890s. That such molecules have higher stability than their respective enantiomers is deeply significant for their biological activity. The plethora of chiral natural products and the importance of molecules arising from the pharmaceutical industry provide simple and then more complicated examples. Of course, handedness without receptors (proteins, DNA, RNA), did not speak to the conundrum that laboratory synthesized molecules were always optically inactive.

Those that were active were isolated natural products. What of the molecule displaying handedness not only at chiral carbon atoms, but by its three dimensional helical structure, e.g. proteins (Linus Pauling), DNA (Francis Crick and James Watson)? Such natural helices were initially determined to be right-handed, but then left-handed examples were shown. This interconversion was (perhaps of course) shown to be biologically important.

The chemical cast: barley sugar, glucose, fructose, sucrose, lactate, alanine, glutathione, LLD-ACV, penicillins, cefalosporins, monobactams, microcystins, brevetoxin, oranges and lemons, spearmint and dill, thalidomide, ibuprofen, dexibuprofen, handedness in DNA with respect to RH and LH helices for packing and unpacking.

The players: poisonous plants, beneficial plants, bacteria, fungi, algae, venomous animals.

Communicated by Michael Jewess and John Hudson

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