Historical Group

NEWSLETTER
and
SUMMARY OF PAPERS

No. 70 Summer 2016

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http://www.rsc.org/membership/networking/interestgroups/historical/index.asp

RSC Historical Group NewsletterNo. 70 Summer 2016

Contents

From the Editor

Welcome to the summer 2016 RSCHG Newsletter. If you have received the newsletter by post and wish to look at the electronic version, it can be found at:
http://www.rsc.org/historical or http://www.chem.qmul.ac.uk/rschg/

The autumn RSCHG meeting is entitled H.G.J. Moseley (1887-1915): A Lost Nobel Laureate? and will be held on Wednesday 19 October 2016 at Burlington House. Full details on how to register for the meeting can be found in the flyer enclosed with the hard copy newsletter and also in the online version.

This issue contains a wide variety of news items, articles, book reviews and reports. Continuing the commemorations of the 175th anniversary of the foundation of the Chemical Society, Bill Griffith's short essay "The Chemical Society and the Royal College of Chemistry" looks at Royal College of Chemistry students who played significant roles in the Chemical Society. The second short essay by Alan Dronsfield and Pete Ellis is entitled "Fighting Infections – A Chemical History". 2016 also sees the centenary of the death of Sir William Ramsay, discoverer of the noble gases. Since 1735 the French Académie des Sciences has operated a system by which a researcher or inventor could lay claim to a discovery or invention without publishing it. In 2004 the *Commission des Plis Cachetés* opened packet 5038, which turned out to be written by William Ramsay in 1894. Alwyn Davies discusses this in his article.

There are five book reviews in this issue of the following titles: William H. Brock, *The History of Chemistry: A Very Short Introduction*; Masanori Kaji, Helge Kragh and Gábor Palló (eds.), *Early Responses to the Periodic System;* Otto Meth-Cohn, *The Nearly Man*; C.N.R. Rao and Indumati Rao, *Lives and Times of Great Pioneers in Chemistry;* and Peter Reed, *Entrepreneurial Ventures in Chemistry: The Muspratts of Liverpool, 1793-1934*. Reports also appear of the RSCHG meeting held in March 2016 "The Atom and the Molecule: A Symposium

Celebrating Gilbert N. Lewis" and of the RSC Chemical Landmark Plaques honouring Sir John Cornforth at the Kent Science Park, Sittingbourne

Finally, I would like to thank everyone who has sent material for this newsletter, with particular thanks to the newsletter production team of Bill Griffith and Gerry Moss. If you would like to contribute items such as news, articles, book reviews and reports to the newsletter please do contact me. The guidelines for contributors can be found online at: http://www.chem.qmul.ac.uk/rschg/Guidelines.html
The deadline for the winter 2017 issue will be Friday 2 December 2016. Please send your contributions to a.simmons@ucl.ac.uk as an attachment in Word. All contributions must be in electronic form.

Anna Simmons
University College London

ROYAL SOCIETY OF CHEMISTRY HISTORICAL GROUP MEETINGS

H.G.J. Moseley (1887-1915): A Lost Nobel Laureate?

Wednesday 19 October 2016, Royal Society of Chemistry, Burlington House, Piccadilly, London

Programme

10.30 Registration and tea or coffee

10.55 Welcome – Dr John Hudson (Historical Group, Chair)

First session – Chair Dr Michael Jewess (Historical Group)

11.00 Henry Moseley: The Formative Years
Clare Hopkins (Archivist, Trinity College, Oxford)

11.40 Moseley in Manchester
Dr Neil Todd (Universities of Manchester and Exeter)

12.20 Royal Society of Chemistry Historical Group, AGM

12.40 Lunch: This is NOT provided at Burlington House, but there are many cafés and bars nearby.

Second session – Chair Dr David Payne (Imperial College, London)

14.00 Counsellor Mr Cem Işık of the Embassy of the Republic of Turkey

14.20 Henry Moseley's Role as a Signals Officer; Signalling in the Gallipoli Campaign
Dr Elizabeth Bruton (University of Manchester)

15.10 Henry Moseley and the Politics of Nobel Excellence
Prof. Robert Marc Friedman (University of Oslo)

15.40 Tea

Third session – Chair Prof. Peter Edwards, FRS (University of Oxford)

16.05 Moseley's Legacy
Prof. Russell Egdell (University of Oxford)

16.45 Re-climbing Moseley's Staircase
Prof. Justin Wark (University of Oxford)

17.25 Concluding remarks: *Prof. Russell Egdell*

17.30 Close of meeting

REGISTRATION FORM

There is no charge for this meeting, but prior registration is essential. Please use the form below or the flyer included with the hard copy version of the newsletter and send it to Professor John Nicholson, 52 Buckingham Road, Hampton, Middlesex, TW12 3JG, jwnicholson01@gmail.com. **This is expected to be a popular meeting. If having registered, you are unable to attend, please notify Professor Nicholson.**

I wish to attend the HG meeting on 19 October 2016 at the Royal Society of Chemistry, Burlington House, London.

Name……………………………………………………………………

Address…………………………………………………............................

Email……………………………Acknowledgement required: Yes/No

Royal Society of Chemistry Historical Group AGM

The forty-first Annual General Meeting of the Group will be held at the Royal Society of Chemistry, Burlington House, at 12.20 pm on Wednesday 19 October 2016.

Agenda

1. Apologies for Absence.

2. Minutes of AGM at the Royal Institution, 13 October 2015.

3. Matters arising from the Minutes.

4. Reports:

   Chairman's Report.
   Secretary's Report.
   Treasurer's Report.

5. Future Meetings.

6. Election of Officers and other Members of the Committee.

7. Any Other Business.

8. Date, time and place of next meeting.

Minutes of the Fortieth Annual General Meeting of the Royal Society of Chemistry Historical Group

Held at the Royal Institution, London, at 12.30pm on Tuesday 13 October 2015

1. Apologies for Absence: Received from Professor Jack Betteridge, Professor Henry Rzepa and Dr Gerry Moss.

2. Minutes of AGM at Burlington House, Wednesday 22 October 2014. These had been published in the summer 2015 issue of the *Newsletter* and were accepted as a true record with one minor amendment.

3. Matters arising from the Minutes. None.

4. Reports:

***Chairman's Report* (Dr John Hudson)**

The Chairman reported on another successful year, in which two well-attended meetings were held and two copies of the Newsletter were published. The first meeting had followed last year's AGM and was on the contribution of chemistry to the First World War. It had attracted seventy-two delegates. The next meeting was on the Life and Work of Sir John Cornforth, which attracted sixty-four participants, including members of Sir John's family.

Reports of these meetings, and various other items of wide interest to members appeared in the Newsletter, and Dr Hudson thanked the editor, Dr Anna Simmons, for her hard work to make the Newsletter such a valuable publication. He also thanked Dr Gerry Moss for ensuring that every issue is made available on-line. He noted that there will also be a forthcoming Special Publication, namely the written version of the Wheeler Lecture by Frank James that had been delivered just before the AGM.

Dr Hudson reported that the Group has extremely good relations with the new RSC Outreach team, one of whose roles is to arrange the Chemical Landmarks programme. They consult the Group regularly on who and what should be honoured, and the new procedure led to the unveiling of a plaque to Humphry Davy in Penzance on 17 September, with which the Group was closely involved and indeed had proposed the site and subject for the plaque. The next such Landmark is a plaque to commemorate Sir Edward Frankland at his old school in Cumbria, on 3 November 2015, at which the Group will be represented.

Dr Hudson noted that the Group now has 662 registered members. However, only 14% of the approximately 54,000 members of the RSC take advantage of their right to join up to three subject groups for no extra charge, so he felt that there is scope for the Group to grow considerably if the remaining membership can be persuaded to join additional groups.

Finally, Dr Hudson thanked the officers and members of the committee for their support and hard work in the past year.

***Secretary's Report* (Professor John Nicholson)**

The Secretary had nothing to add.

***Treasurer's Report* (Presented by Dr John Hudson)**

The detailed financial report had appeared in the Newsletter, and it was reported that Group finances were healthy. In fact, by normal RSC rules, our balance was too high, but this is because we hold funds from the Wheeler bequest, which funds the award of our Wheeler lectureship. The Group had also received a contribution of £2,000 for our meeting on World War 1 to cover the cost of international speakers. We were also the conduit for money to fund a project at the Catalyst Centre, Widnes, for which we were joint applicants with the Chemical Information and Computer Applications Group.

5. Future Meetings

We have plans for meetings in the coming year, as follows:

An anniversary meeting celebrating the centenary of the Braggs' Nobel Prize, to be held this afternoon at the Royal Institution.

A meeting to commemorate the work of G.N. Lewis (15 March 2016).

A meeting commemorating the work of Henry Moseley (19 October 2016), where we will hold our next AGM.

6. Election of Officers and other Members of the Committee

The Chairman, Secretary and Treasurer positions were not due for re-election at this AGM, so the current incumbents in these roles will continue for 2015/16. It was proposed from the Chair that the Committee be re-elected to serve for a further year, and this was agreed by the meeting *nem. con*.

7. Any Other Business. There was none.

8. Date of next AGM. It will form part of our autumn 2016 meeting on 19 October 2016. Full details will appear in the Newsletter.

ROYAL SOCIETY OF CHEMISTRY

Name of Group / Section / Region: Historical Group

		Key	£	£
Receipts				
Interest	Current Account	1	0.00	
	RSC Deposit Acco	1	49.18	
	Other Savings Ac	1	0.00	
Annual Grant		2	4,103.00	
Grants	Outreach	3		
	Travel	3		
	Division	3		
	Other	3		
Donations		4	48.00	
Meetings and Conferences		5		
Other		6		
Total Income			4,200.18	
Payments				
Meetings & Conferences				
	General	7		3,118.58
	Committee Meeti	7		596.24
	External Events S	7		0.00
	RSC Events Servi	7		0.00
Donations/Sponsorship		8		0.00
Committee Travel Expenses		9		0.00
Stationary / Postage		9		1,126.15
Committee Lunches at RSC		9		129.60
Audit		9		0.00
Awards		10		0.00
Bank Charges		10		0.00
Websitr		10		0.00
Other		10		0.00
Total Expenditure				4,970.57
Surplus/(Deficit) for the year		11		-770.39
Check				
Balance at 1st January 2015				12,704.14
Surplus (Deficit) for 2015		11		-770.39
Balance at 31st December 2015				12,023.75
Cash at Bank				
Balance in Current Account				7,307.49
Balance in RSC Deposit Account				4,716.28
Balance inOther Savings Account				0.00
Balance as at 31st December 2015				12023.75

Hon Treasurer

Chairman

Auditor J. C. King BSc MRSCS

RSC NEWS

The Historical Group on *Breakfast in Dorset*

In preparing for the meeting on H.G.J. Moseley on 19 October 2016, it had mostly escaped the Historical Group's attention that Moseley had been born in Weymouth in Dorset. In contrast to Humphry Davy, who was born in Penzance (*Newsletter* No 69, pages 32-38), Moseley in his later career seemed to owe little to his place of birth, more to his schooling at Eton.

But Moseley's place of birth did not escape BBC Radio Solent, and I was asked *via* the RSC to give an interview for their *Breakfast in Dorset* programme. This can be heard at http://www.bbc.co.uk/programmes/p03hxbx0. The interview was most professionally conducted by Steve Harris and broadcast on 1 February 2016. The interview was in two parts. In the first part, I described the importance of Moseley's determination of atomic number, and in the second, his military career from membership of the Officers' Training Corps as an Oxford undergraduate to his death in the battle of Çanak Bayır in Turkey on 10 August 1915. The interview as broadcast was accompanied by subdued background music, the first part by something appropriately electronic and the second part by Samuel Barber's *Adagio for Strings*, which in the context is quite affecting.

Michael Jewess
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MEMBERS' PUBLICATIONS

If you would like to contribute anything to this section, please send details of your publications to the editor. Anything from the title details to a fuller summary is most welcome.

William H. Brock, *The History of Chemistry: A Very Short Introduction*, (Oxford: Oxford University Press, 2016). Pp. 151, with photos and illustrations. ISBN 978-0-19-87 1648-8 (Paperback). £7.99.

A review of this book appears later in this issue.

PUBLICATIONS OF INTEREST

Ambix, November 2015, volume **62**, issue 4
Special Issue: *Chemical Knowledge in Transit*
Edited by Ana Maria Alfonso Goldfarb, Hasok Chang, Marcia Ferraz, Jennifer Rampling and Silvia Waisse

Andréa Bortolotto, "Johann Andreas Cramer and Chemical Mineral Assay in the Eighteenth Century".

Robert G.W. Anderson, "Teaching the Chemistry of Platinum".

Cristiana Loureiro de Mendonça Couto, "The Chemistry of Diet: Medicine, Nutrition, and Staple Foods in Imperial Brazil".

Frank A.J.L. James, "'Agricultural Chymistry is at present in it's infancy': The Board of Agriculture, The Royal Institution and Humphry Davy".

Ambix February 2016, volume **63**, issue 1

Claus Priesner, "Legends about Legends – Abraham Eleazar's Adaptation of Nicolas Flamel".

G. Jeffery Leigh and Alan J. Rocke, "Women and Chemistry in Regency England: New Light on the Marcet Circle".

Ian D. Rae, "Theory versus Practice in the Twentieth Century Search for the Ideal Anaesthetic Gas".

Bulletin for the History of Chemistry, 2015, vol. **40**, No. 1

Guido Panzarasa, "Rediscovering Pyrotartaric Acid: A Chemical Interpretation of the Volatile Salt of Tartar", 1.

David E. Lewis, "Introduction to an English Translation, 'On the Different Explanations of Certain Cases of Isomerism'" by Aleksandr Butlerov, 9.

Primary Documents "On the Different Explanations of Certain Cases of Isomerism", Mr A. Boutlerow, translated by David E. Lewis, 13.

Jay A. Labinger, "Why isn't Nobel Gas Chemistry Thirty Years Older? The Failed (?) 1933 Experiment of Yost and Kaye", 29.

Sibrina N. Collins, "Robert Percy Barnes: From Harvard to Howard University", 37.

Nenad Raos, "Science and Politics: A Case Study of the Croatian Chemical Journal", 40.

Seth C. Rasmussen, "Early History of Polypyrrole: The First Conducting Organic Polymer", 45

Book Reviews

The Lost Elements: The Periodic Table's Shadow Side, 56.

Great Minds: Reflections of 111 Top Scientists, 58.

Bulletin for the History of Chemistry**,** 2015, vol. **40**, No. 2

Vladislav Suntsov and David E. Lewis, "Introduction to an English Translation (abridged) of Kizhner's Pioneering Papers on Deoxygenation", 61.

Primary Documents 25. "The Catalytic Decomposition of Alkylidenehydrazines as a Method for the Preparation of Hydrocarbons", N. Kizhner, Translated by Vladislav Suntsov and David E. Lewis, 64.

Primary Documents 26. "The Catalytic Decomposition of Alkylidenehydrazines (second part)", N. Kizhner, Translated by Vladislav Suntsov and David E. Lewis, 69.

Helge Kragh, "From Cosmochemistry to Fuel Cells: Notes on Emil Baur, Physical Chemist", 74.

Joseph B. Lambert, Jorge A. Santiago-Blay, Yuyang Wu and Allison J. Levy, "The History and Structure of Stantienite", 87.

Pierre Lazlo, "Tools for Chemists: The Desreux-Bishoff Viscosimeter", 95.

Martin Saltzman, "A Pioneering Course in Physical Organic Chemistry: J.W. Baker's 1942 Third-year Lectures to Undergraduates", 103.

Norman C. Craig and Ira W. Lewin, "A Compelling Example of Scientific Integrity", 109.

Richard E. Rice, "A Reverie, Kekulé and his Dream: An Interview", 114.

Book Reviews

The Limits of Matter: Chemistry, Mining and Enlightenment, 120.

Medical Monopoly: Intellectual Property Rights and the Origins of the Modern Pharmaceutical Industry, 122.

Science History: A Traveler's Guide, 123.

Proceedings of the International Workshop on the History of Chemistry

The Proceedings of the International Workshop on the History of Chemistry, which was held on 2-4 March 2015 at the Tokyo Institute of Technology, Japan, are now available online. The conference theme was the "Transformation of Chemistry from the 1920s to the 1960s". The workshop aimed to stimulate discussion of the tremendous and important changes in chemistry in Japan, as well as worldwide, which occurred during this period. The proceedings contain papers by keynote speakers including Jeffrey Johnson and Mary Jo Nye. The proceedings (as well as individual papers included in it) can be downloaded from the following website: nhttp://kagakushi.org/iwhc2015/proceedings

Explore Early Chemical Developments through Nicholson's Journal

A new website http://www.nicholsonsjournal.co.uk/ has been launched to improve awareness of William Nicholson's many contributions to developments in science, manufacturing, business, publishing and civil engineering via the index of articles published within Nicholson's Journal between 1797 and 1813. The database has been created by Sue Bramall, who is a descendant of William Nicholson and is writing his biography, due to be published in 2017.

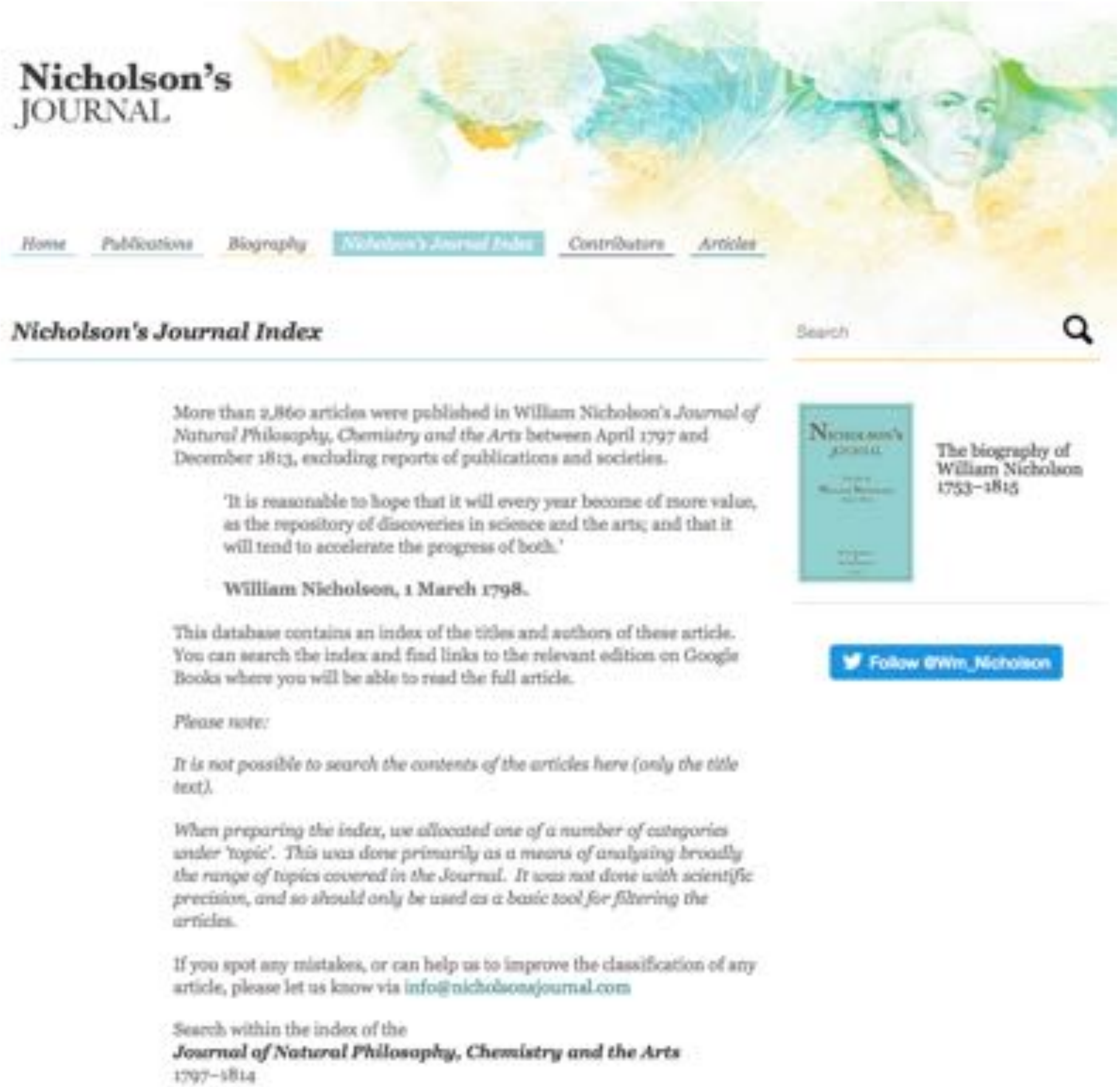
Sue Bramall writes:

William Nicholson (1753–1815) seems to be one of the best kept secrets in enlightenment history, yet his accomplishments were many and he was consulted and respected by some of the best-known figures of that period. He is perhaps most recognised for his work on the decomposition of water in May 1800, in conjunction with his friend Anthony Carlisle. Humphry Davy wrote about this to Davies Giddy with palpable excitement to say, "An immense field of investigation seems opened by this discovery: may it be pursued so as to acquaint us with some of the laws of life!"

Alessandro Volta also credited Nicholson with his important hint regarding the torpedo fish in the development of the pile, saying "The hypothesis of this learned and laborious philosopher …. is indeed very ingenious". But Nicholson never sought the limelight. His great desire was to be useful and he believed that sharing scientific knowhow as widely and as speedily as possible would be of great benefit. In April 1797, he launched his *Journal of Natural Philosophy, Chemistry and the Arts* – the first monthly scientific journal in Britain. Nicholson believed "It is reasonable to hope that it will every year become of more value, as the repository of discoveries in science and the arts; and that it will tend to accelerate the progress of both". Hasok Chang, in his book *Is Water H_2O?,* describes how Nicholson "in running his journal, in which he presented various viewpoints to readers and published a wide variety of work, was an independent act of institutional maturity at a very early time during which many of the sciences featured in his journal were quite immature".

More than 2,860 articles were published by several hundred authors between April 1797 and December 1813, excluding reports of publications and societies. The titles of all these articles may now be searched online via the website

http://www.nicholsonsjournal.co.uk/nicholsons-journal-index.html



This database contains an index of the titles and authors of these article. You can search the index and find links to the relevant edition on Google Books where you will be able to read the full article. For example, the terms below yield the following number of results:

"Chemical" = 115 results
"Chemist" = 24 results
"Galvanism" = 30 results
"Metal" = 112 results.

Please note: It is not possible to search the contents of the articles in the database (only the title text). When preparing the index, a number of categories were allocated under 'topic'. This was done primarily as a means of analysing broadly the range of topics covered in the Journal. It was not done with scientific precision, and so should only be used as a basic tool for filtering the articles.

The website also includes a list of Nicholson's publications with online links where available. This includes his *First Principles of Chemistry (1790),* his two Dictionaries of Chemistry (1795 and 1808), and translations of works by Antoine Fourcroy, Jean-Antoine Chaptal, Giovanni Battista Venturi and C. Pajot de Charmes.

Sue Bramall
info@nicholsonsjournal.com

NEWS AND UPDATES

Royal Institution

Michael Faraday Laboratory Notebooks on UNESCO Memory of the World Register

The Royal Institution's unique collection of Michael Faraday's original laboratory notebooks (RI MS F/2/A-J), in which he charts some of the most important physical and chemical discoveries made during the nineteenth century, have received international recognition as one of the latest additions to the UNESCO UK Memory of the World Register. These laboratory notebooks are the only science representation out of the list of seven items added this year. Established by UNESCO in 1992, the vision of The Memory of the World programme is that the world's documentary heritage belongs to all, should be fully preserved and protected for all and permanently accessible to all without hindrance.

Frank James, Professor of the History of Science at the Royal Institution, editor of Faraday's correspondence and a RSCHG Committee Member, said:

I am delighted that Michael Faraday's laboratory notebooks have received this UNESCO recognition. They contain the origins of now familiar technology such as the electric motor and generator. Furthermore, in his formulation of the field theory of electro-magnetism, Faraday provided the theoretical foundation of modern communications technology, illustrating the value and legacy of his non-material understanding of the world.
For further details, see http://rigb.org/about/news/summer-2016/faraday-notebooks-added-to-unesco-register.

200 years of using Humphry Davy's Miners' Safety Lamp

This year marks the bicentenary of the deployment of the Miners' gauze safety lamp invented in December 1815 following two months of concentrated work by Humphry Davy assisted by Michael Faraday in the basement laboratory of the Royal Institution. Davy's lamp was first tested in Hebburn colliery, County Durham, on 9 January 1816 and in the years following it was manufactured in its tens of thousands and widely used throughout the world. The use of the lamp both saved the lives of countless coalminers, but also permitted increased coal production vital to continuing industrialisation.

In the absence of entries in the Royal Institution's laboratory notebook, one of the few sources which sheds light on Davy's path to the successful invention is a manuscript volume held in the archives of the Royal Institution (RI MS HD/11) that contains Davy's drafting and redrafting of his first paper on the miners' safety lamp. Davy's path to this invention in those weeks was a very intense process involving changing his mind rapidly several times about the best form that a safety lamp should take. The unpredictable way in which Davy's thought and work progressed during this period is reflected in this volume. Davy's original paper was copied by Faraday and sent to the Royal Society of London where it was read on 9 November 1815. However, following its reading, Davy developed further ideas and these were reflected in a second copy, also made by Faraday, to which Davy added significantly and moved whole passages around as cross referencing the two versions illustrate. Davy also made many alterations and additions to this text, including removing a less than favourable comment on contemporary chemists. He originally thought that this would be the final text, as evinced by the production of an illustrative plate, which would have cost some money. However, he then found that all he had to do was to enclose the flame in metal gauze which absorbed the heat (thus preventing explosion) and allowed light to pass through the holes. This discovery of the properties of gauze necessitated withdrawing the plate (thus making the example in the manuscript the only surviving copy). Faraday then made the final version of the paper for the Royal Society of London for publication the following year.

To mark this key anniversary in coal mining history the Royal Institution is partnering with ArchAlive to publish a unique edition of this manuscript volume. The book, which will be available by subscription only, will be produced to the highest standards by Blissetts, bookbinder to HM The Queen, with subscribers listed in the book. Further details can be found at www.archalive.co.uk/

SOCIETIES NEWS

History Division of the American Chemical Society

The History Division of the American Chemical Society is delighted to announce that Professor Dr Ursula Klein of the Max Planck Institute for the History of Science in Berlin, Germany has been awarded the HIST Award for 2016. This award is the successor to the Dexter Award (1956-2001) and the Sydney M. Edelstein Award (2002-2009), also administered by the Division of the History of Chemistry. The HIST Award will be presented to Prof. Klein at the fall national meeting of the American Chemical Society in Philadelphia, PA, on 23 August 2016

Society for the History of Alchemy and Chemistry

The Partington Prize 2017

The Society for the History of Alchemy and Chemistry established the Partington Prize in memory of Professor James Riddick Partington, the Society's first Chairman. It is awarded every three years for an original and unpublished essay on any aspect of the history of alchemy or chemistry. The prize consists of five hundred pounds (£500) if awarded to a single essay of sufficient merit. Alternatively, it may be divided, or not awarded at all.

The competition is open to anyone with a scholarly interest in the history of alchemy or chemistry who, by the closing date of 31 December 2016, has not reached thirty-five years of age, or if older is a student in the history of science or has been awarded a masters degree or PhD in the history of science within the previous three years. No restriction is placed on the nationality or country of residence of competitors. Only one entry is permitted from any competitor.

The prize-winning essay will be published exclusively in the Society's journal, *Ambix*. It must not have been submitted to any other journal at any time before 30 April 2017.

Essays must be submitted in English. Essays must be fully documented using the conventions used in the current issue of *Ambix*. Essays must not exceed 10,000 words in length, including references and footnotes.

All entries should be sent to The Hon. Secretary at prizes@ambix.org in the form of two separate e-mail attachments in Microsoft Office Word (preferably 2013 or later). The first attachment should be headed "Partington Prize Entry 2017" and should give the author's name, institution, postal address, e-mail address, date of birth (and, if relevant, the date of the award of the masters degree or PhD), the title of the essay, and the word count. The second attachment should be the essay, which should not identify the author either by name or implicitly.

Entries must arrive before **midnight GMT on 31 December 2016.** The decision of the Society will be final on all matters. The result of the competition will be announced by 30 April 2017.

SHORT ESSAYS

The Chemical Society and the Royal College of Chemistry

"it is difficult to over-estimate the significance of the Royal College of Chemistry as a factor in the development of the (Chemical) Society". [1].

The Royal College of Chemistry (RCC)

The RCC was founded in 1845, just four years after the Chemical Society (CS); Bill Brock wrote about the foundation of the latter in our *Winter 2016 Newsletter* [2]. The RCC changed its name to the Normal School of Science (NSS) from 1881-1890, but was then comfortingly re-named the Royal College of Science (RCS), its chemistry department becoming part of Imperial College (IC) in 1907. Here we seek to justify James Philip's epigraph above [1] by identifying RCC/NSS/RCS figures who played influential roles in the CS from 1845-1900, concentrating on presidencies, journal editorship and the position of women in the Society.

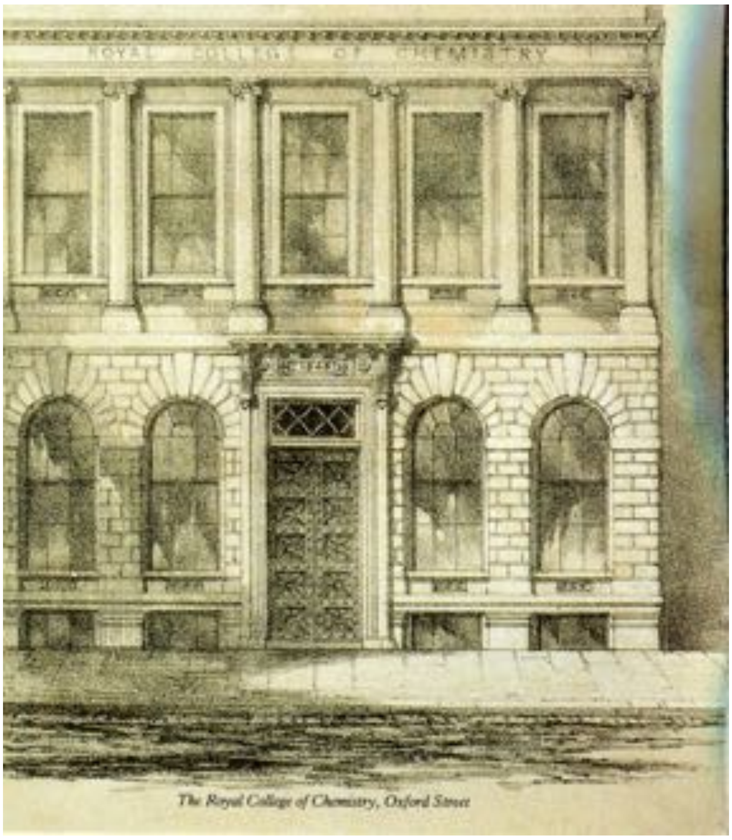


Figure 1: Print of the RCC Building (Image courtesy of Imperial College Archives)

The RCC was conceived in 1842 as "a College of Chemistry for promoting the science and its application to agriculture, arts and medicine". Its original promoters were the pharmacist John Lloyd Bullock (1812-1905) and apothecary John Gardner (1804-1880), both followers of Liebig [3]. Gardner had spent time in Giessen with Liebig and Hofmann. Initially a commercial enterprise, the RCC rented temporary laboratory space in Great George Street and leased a house (16 Hanover Square – the building still stands) with a large piece of land fronting on to Oxford Street [4-6]. Liebig was invited to be its first professor but declined, suggesting that his ex-students Carl Fresenius, Heinrich Will and August Wilhelm Hofmann be approached. Will and Fresenius refused, but Hofmann, who knew Sir James Clark, Queen Victoria's doctor, and a staunch RCC supporter, was persuaded by Prince Albert to take the job. This was a brilliant choice: Hofmann, then only twenty-seven, was an established chemist and inspirational teacher.

In October 1845, twenty-six students enrolled at the RCC. It became clear that its accommodation was inadequate, and a foundation stone of the new Oxford Street premises was laid by Prince Albert, who had donated £100 to the building in 1846 (the stone is preserved in the IC chemistry department). The original 1846 building was later demolished; the present 299 Oxford Street bears a grubby steel RSC Landmark plaque of 2003 which the RSCHG hopes to persuade the RSC to renew in blue.

There were financial troubles from the start, though scientifically the College was a resounding success. Questions arose about Bullock and Gardner having used the college name to further their business interests. In 1846 Gardner was sacked as secretary (Sir James Clark is said to have physically ejected him from his first-floor accommodation at Hanover Square). Hofmann took a salary cut and relinquished his free accommodation. In 1853 the Government purchased the RCC from its shareholders and it became part of the Metropolitan School of Science but retained its name, identity and location.

The Royal College of Chemistry and the Chemical Society

An aim of the CS, founded in 1841, was "The promotion of Chemistry and those branches of Science immediately connected with it…". Likewise, the creation of a forum in which people from different fields could learn and carry out practical chemistry was envisaged for the RCC; these and other objectives, like those of the CS, were much influenced by Liebig's philosophy [3]. Robert Warington (1807-1867), an analytical chemist and active promoter of the RCC, was the prime founder of the Society and its first Secretary. His son Robert (1838-1907) wrote a history of the CS for its 1896 Jubilee [7] and later worked with Frankland in 1876 at the RCC. Edward Teschemacher (1843-1877), son of the Society's first foreign secretary, worked with Hofmann at the College in 1859. The seventy-seven-strong provisional CS committee on 23 February 1841 included de la Rue, Thomas Graham, Lyon Playfair, Teschemacher, and Warington [8]. By 1843 Bullock, Faraday, Gardner and Liebig were members and Graham its first president [9].

The CS outgrew its accommodation at the Society of Arts and moved to 42 The Strand and then 5 Cavendish Square, having unsuccessfully tried to rent space at the RCC. Perkin proudly remembered giving papers to the Society when it met at Dr Pepper's Cavendish Square house.

We now consider prominent RCC/NSS/RCS students/staff who were at these colleges from 1845-1900 and became deeply involved in the CS. All became FRS and most received knighthoods; there were two baronetcies (Playfair, Abel). Many other college members of course joined the Society. The closeness of the CS and RCC is attested by papers covering 157 pages devoted to it in the Society's *Journal* in its Jubilee year (1896) by four CS presidents – Playfair, Abel, Perkin and Armstrong [10-13].

Warren de la Rue (1815-1899) is the only person to have been both a founding CS member (1841) [8] and to be in the first group of RCC students (1845). At the RCC he learned about colours useful to the still-existent family business, becoming a close friend of Hofmann. He subsequently worked on dyes for postage stamps, astronomy and photography, and invented the first envelope-making machine. He was twice a CS President in 1867–1869 and 1879–1880.

Lyon Playfair (1818-1898) was also a CS founder (1841), and although not an RCC member had a substantial and beneficial role in its early history [10]. He served as CS president from 1857-1859.

Wilhelm Augustus Hofmann (1818-1892) was the first RCC professor, from 1845-1865. Students were impressed by his enthusiasm and intellect, charmed by his geniality and high spirits, proud that this brilliant foreigner was living in their midst and adding lustre to their college. His chemical contributions include developmental coal tar chemistry, the theory of types as exemplified by nitrogenous bases, and many organic syntheses [5, 6, 10-14]. From his earliest days in London he was an enthusiastic supporter of the then only five-year-old Chemical Society, becoming its foreign secretary from 1847-1862 and president from 1861-1863). In 1847 he founded the *Quarterly Journal of the Chemical Society,* which appeared from 1849-1862, and in 1867 he set up the German equivalent of the CS, the *Deutsche Chemische Gesellshaft*.

Frederick Abel (1827-1902; RCC 1845-1851). Like de la Rue, Abel was one of the twenty-six original RCC students. He succeeded Faraday as chemistry lecturer at the Royal Military Academy, Woolwich. Together with Dewar he invented cordite and was involved in a long legal dispute (which they won) with Alfred Nobel on priority.

He became president of the CS from 1875-1877, and of the Institute of Chemistry (later the RIC) from 1880-1883 [11].


Figure 2: The First RCC Professors: Hofmann (1845-1865) and Frankland (1865-1885).
(Images courtesy of Imperial College Archives).

William Crookes (1832-1919; RCC 1848-1854) a brilliant scientist. later became a successful entrepreneur. With Hofmann he investigated the constituents of mineral soot from the Harz mountains. When he left the RCC he kept some of that soot, and in 1861 in his home laboratory noted that its atomic spectrum had a new green line, which he attributed to a new element, thallium. He knew Faraday and, inspired by him, was drawn toward the physical chemistry interests that occupied much of his later life [15]. He founded *Chemical News* in 1859 and edited it until 1906. He became president of the Chemical Society in 1887-1889, of the British Association in 1898 and of the Royal Society in 1913.

William Odling (1829-1921; RCC 1848) in 1868 became Fullerian professor at the RI and in 1872 Oxford's Waynflete professor. He was President of the CS (1873-1875) and the Institute of Chemistry (1877-1880).

William Perkin Sr. (1838-1907; RCC 1853-1856). Perhaps the most celebrated of its students, Perkin entered the RCC aged 14. In his home laboratory in 1856 he tried to make quinine by dichromate oxidation of impure aniline, producing a black mixture, a methanolic extract of which dyed silk mauve – the first synthetic coal-tar dye. Disregarding Hofmann's advice, he left to set up a successful factory in 1857, making mauveine and other dyes [12]. He joined the CS in 1856, becoming its secretary (1869-1883) and then president (1883-1885), and was a founder member of the Society for Chemistry and Industry (SCI). His three sons studied at the RCC; W.H. Perkin Jr. (1860-1929; RCC 1887) was CS president from 1913-1915.

Henry Armstrong (1848-1937; RCC 1865-1866) became chemistry professor at the City and Guilds Central Technical College (C&GCTC) from 1883-1911. This became part of IC and its chemistry department closed in 1913; Armstrong became an RCS emeritus professor from 1913-1937. A chemical polymath, he dominated British chemistry. He was a CS president (1893-1895) [13].

Edward Frankland (1825-1899) succeeded Hofmann as professor of chemistry at the RCC (later NSS) from 1865-1885. He attended eight different schools (an RSC Landmark plaque has been placed at one of these, Lancaster Royal Grammar School, in November 2015 – John Hudson spoke at the unveiling [16]). In 1845 Frankland became a lecture assistant under Playfair at Putney College and there befriended Hermann Kolbe; from 1847 he and Kolbe worked with Bunsen at Marburg. He first met Hofmann when the latter visited Giessen in 1849; Frankland gave him glass-blowing lessons and they became firm friends. A brilliant chemist and fearless experimentalist, his work on alkyls and aryls of Group 12 and 14 elements was intricate and dangerous. Called 'the father of organometallic chemistry' (he coined the word organometallic), he was the first to use 'bond' in our modern chemical sense; and was a powerful proponent of a modern valency theory [17]. He was president of the Chemical Society, 1871-1873 and of the Institute of Chemistry from 1877-1880.

Frankland was also much concerned with structural formulae; his friend John Cargill Brough gently lampooned these, e.g. for $(NH_4)(HSO_4)$ [18]:

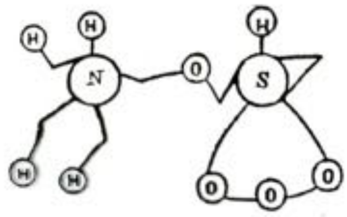


Figure 3: John Cargill Brough's Dancing Figures [18] (Image courtesy of RSC Library)

Raphael Meldola (1849-1915; RCC 1866-1868, 1872-1877). After leaving the College he discovered Meldola's Blue, the first oxazine dye; then becoming interested in entomology, his mentors were Charles Darwin and Alfred Russel Wallace [19]. He was president of the CS from 1905-1907 and of the Institute of Chemistry from 1912-1915. In 1921 there was a donation to the RIC funding a Meldola award, since 2008 called the RSC Edward-Harrison-Meldola award.

Percy Faraday Frankland (1858-1946; NSS 1880-1888), Frankland's son. His interests later turned to bacteriology. He was president of the Institute of Chemistry from 1906-1909 and the CS from 1911-1913.

Gilbert Thomas Morgan (1870-1940; RSC 1894-1912) studied at Finsbury College under Meldola, and became a founder of coordination chemistry. He edited the *J. Chem. Soc., Trans.* (JCS) from 1904-1906, becoming president of the SCI in 1931 and of the CS in 1933–1935. He left money to the CS, in memory of his parents Thomas Morgan and Mary-Louise Corday, for the prestigious Corday-Morgan medal and prize. Derek Barton was its first recipient.

Thomas Edward Thorpe (1845-1925) studied chemistry at Owens College Manchester, succeeding Frankland as professor at the RCS from 1885-1894 and 1909-1912**,** where he did much work on phosphorus and its compounds, and published his classic *Dictionary of Applied Chemistry*. He was CS president from 1899-1901.

William Augustus Tilden (1842-1926; RCC 1860-1862) wrote that Hofmann's lectures "came like a ray of light from heaven". A Clifton College Bristol graduate, he succeeded Thorpe as RCS professor from 1894-1909. Celebrated for his work on terpenes, he was perhaps the first to make synthetic rubber. Joining the CS in 1865 he became its president from 1903 to 1903, and of the Institute of Chemistry from 1891 to 1894. Founded in 1939, the prestigious RSC Tilden Prize is awarded annually for advances in chemistry.

Tilden played an active but unsuccessful role in trying to allow women to join the CS. A marked difference between the RCC, RCS and IC (who right from the start in 1845 admitted women as students/staff) and the CS is that it was not until 1920 that the Society admitted them [20]. Ida Smedley, originally a student at the C&GCTC, was the first woman to be granted full fellowship in 1920 and served on the Chemical Society's council (1931–34).

James Charles Philip (1873-1941; RCS 1900). With Philip, who wrote our introductory epigraph [1], we come full circle. He worked with Armstrong at the CG&CTC from 1897, entering the RCS in 1900 as demonstrator, becoming professor from 1914-1941. He was one of the most loved and respected professors, not only in the department, but of IC itself. He was a CS secretary from 1913-1924, becoming its president in 1941.

Presidents and Editors of the Chemical Society

Of the ninety-one Presidents of the CS and RSC from 1841 to 2016, a disproportionately high number (thirty-five) of these, in view of the national coverage of the Society, were associated with the RCC and its successors. We have noted Hofmann as a founder of the *Quart. J. Chem. Soc.* and Morgan as a JCS editor. Charles Groves FRS (1841-1920; RCC before 1862), edited the JCS from 1878-99, and Clarence Smith (1875-1945, RCS 1894-1897) edited it from 1924-1945.

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Bill Griffith
Imperial College

Fighting Infections – A Chemical History

Over half a century ago, in 1961, the medical community first began to notice reports of an infection that was resistant to methicillin, a semi-synthetic penicillin that, until then, was the reliable final defence against otherwise resistant strains of *Staphylococcus aureus* bacteria. Methicillin-resistant *Staphylococcus aureus* (MRSA) remains a major problem today. Dame Sally Davis, the government's Chief Medical Officer, has warned that antibiotic resistance is "as big a risk as terrorism" and that Britain faces returning to a nineteenth century world where the smallest infection or operation could kill [1].

Staphylococcus aureus is the cause of common boils and abscesses. It is called "aureus" because the pus produced by the body in fighting it is golden in colour. Indeed, the emergence of this pus from abscesses, which at times would allow the abscess to drain and eventually heal, led to surgeons calling it "laudable pus", in contrast to other forms presaging imminent disaster for the patient. Nonetheless, not every abscess or boil discharged so successfully, and deaths from septicaemia due to spread of the organism throughout the bloodstream were common. Although the sulphonamides had made inroads against streptococci [2], it was not until the 1940s that there was any prospect of arresting such septicaemia caused by staphylococci. It was investigations by the distinguished Scottish doctor Alexander Fleming in 1928 that made all this possible.

Fleming's discovery

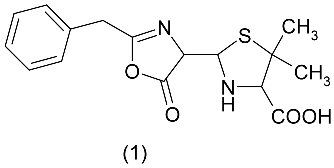
In 1928 Fleming was working in St Mary's Hospital, Paddington. Returning from holiday, he noticed that a mould had contaminated his petri dish of a culture of *Staphylococcus*. Intriguingly, there was a 'halo' of inhibited bacterial growth around the mould, which he concluded was due to a substance it must have exuded. This had both subdued the growth of new mould and destroyed some existing cells. He suggested this exudate might have potential as a disinfectant that, unlike existing agents, would have a benign effect on healthy tissue. Extracting the active principle, which he named penicillin, proved notoriously difficult due to its instability. Fleming was already eminent for his work on antiseptics, and his observation that inappropriate use of these could remove beneficial commensal bacteria on the surface of a wound and damage white cells, the body's natural defences. This left deeper-lying bacteria, which could flourish in an anaerobic environment, untouched [3]. Such bacteria did not stain with the standard Gram stain, and so were termed Gram-negative. Treatments for these organisms were the focus of his work at that time. He found penicillin was somewhat variably effective against gram-positive bacteria, but generally inactive against gram-negative ones. He also decided that even if penicillin could be isolated, its short duration of action in the body, and relatively delayed action on bacteria, would limit its therapeutic use. Nevertheless, in 1930 Cecil Paine, a former student of Fleming's, then a pathologist working at the Royal Infirmary, Sheffield, used penicillin to cure four out of five serious eye infections. Although Paine had been unimpressed with Fleming's distinctly unenthusiastic style as a lecturer, he had been inspired by his 1929 publication. Despite considering that his use of crude extracts of penicillin did not merit publication, he did discuss his work with a newly arrived Professor of Pathology, one Howard Florey – who appeared disinterested at the time. It seemed that Fleming's seminal paper had fallen on barren ground.

Over to Florey

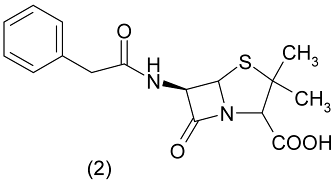
In 1935 Florey was appointed Professor of Pathology at Oxford University. Not long after, he re-read Fleming's 1929 Paper. He decided that isolating penicillin and manufacturing it on a large scale to explore its therapeutic potential was a realisable goal for his team of scientists. Work started in 1938 and by 1940 there seemed enough penicillin to treat the first human. An Oxford policeman was within hours of death from staphylococcal septicaemia when Florey gained permission to give him the first penicillin injections. The policeman made a miraculous recovery from certain death, but after five days all the penicillin had been used; sadly, he relapsed and died. But penicillin's reputation was established. Production increased and more formal trials followed, with similar extraordinary success. This catalysed the industrial production of penicillin, largely in the USA, and by the spring of 1944 2.3 million doses had been prepared to treat casualties anticipated in the Allies' invasion of Normandy. Penicillin was effective against a host of battlefield infections, pneumonia, and the venereal diseases syphilis and gonorrhoea. Despite its remarkable potency, the chemists of the late 1940s wondered if they could manipulate its molecular structure to produce a form that:

- was effective when taken by mouth. The Fleming/Florey form was only really effective if given intravenously, or if used topically for superficial infections. Acid in the stomach rapidly broke down the molecule, rendering it useless.
- was effective against a wider range of diseases, particularly extending its range from largely Gram-negative bacteria to Gram-negative infections as well.
- might yield antibiotics effective against the emergence of resistant bacterial strains. The phenomenon of drug-induced resistance was already well-known. As early as 1938 sulfonamide-resistant strains of gonorrhoea were problematic, and something similar was anticipated with penicillin. Indeed, Florey expressed concern about widespread indiscriminate use of antibiotics leading to resistance in his Nobel Prize acceptance speech in 1945.

But before this could happen, the chemists needed a structure to work on. By 1943 they had narrowed its formula down to two possibilities, one based on an oxazolone-thiazolidine core (1) and the other on a beta-lactam ring *fused* to thiazolidine ring (2).

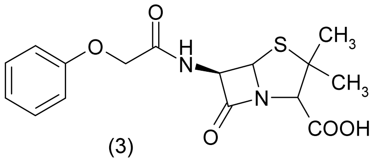


(1)



(2)

Studies by Oxford crystallographer Dorothy Crowfoot settled the matter in 1945 [4]. The more strained one of the two, the beta-lactam version, was correct. By now it was commonly known as *benzyl penicillin*. The right-hand portion of the molecule, the fused ring structure, would be difficult to elaborate, but the left-hand 'tail', $PhCH_2CONH$-, was thought to offer easier opportunities. Two approaches were used. The easiest was to let nature do all the synthetic work; the trickier one was to start from a naturally-produced 'core' of the molecule and work on that. In 1948 chemists at the Lilly Research Laboratories used the former approach and found that if they maintained a very low concentration of phenoxyacetic acid in the broth in which benzyl penicillin would normally be grown, then the product was almost wholly phenoxymethyl penicillin (3), later named *penicillin V*.

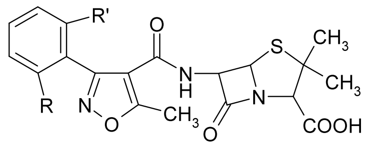


(3)

This appeared to have little advantage over benzyl penicillin until, some four years later, a chance observation showed that it could survive extraction from an acidic medium. This suggested it might withstand the acidic conditions within the stomach; and indeed it did. It was the first orally active penicillin, at least in low doses [5]. Somewhat less potent than benzyl penicillin, it did away with the need for repeated injections (or the administration of massive oral doses of benzyl penicillin combined with antacids, in the hope that *some* of the drug would find its way into the bloodstream) and thus had the great advantage of allowing less severely ill patients to be treated at home with tablets, rather than in hospital with injections and drips.

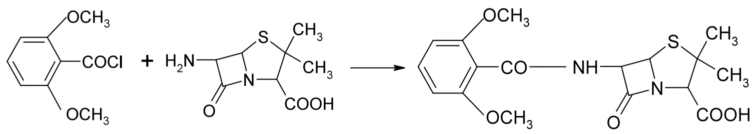
However, by the 1950s some infections were requiring larger and larger doses of penicillin to achieve a cure. Even by 1949 there were reports from hospitals of *staphylococcus pyogenes* infections that had become untreatable with penicillin. Typically, these involved bedsores, plaster-cast sores and a variety of neonatal infections; all infections likely to have been acquired in hospital. It would be these bacteria, already exposed to multiple antibiotics in the hospital wards, which would be most likely to have developed resistance.

Resistant bacteria were producing penicillinases, enzymes that cleaved the beta-lactam ring and thus destroyed the effectiveness of the antibiotic. It was argued that if the ring could be protected against attack by these enzymes, then the drug could continue to function. This might be achieved by modifying the side-chain tail of the molecule, particularly if groups were used that would nestle closely against the beta-lactam ring affording the desired protection. Beecham Research Laboratories developed and marketed oxacillin, cloxacillin, dicloxacillin and flucloxacillin in 1961, all of which had such groups (R, R' in 4 - 7) [6]. This last drug remains in current usage for the oral treatment of skin, soft tissue and respiratory tract infections, especially those in which beta-lactamase staphylococci and streptococci are involved.



R, R' = H, oxacillin (4)
R = H, R' = Cl, cloxacillin (5)
R = R' = Cl, dicloxacillin (6)
R = F, R' = Cl, flucloxacillin (7)

Some two years earlier, in 1959, Beecham had produced a simpler molecule that had an obvious connection with benzyl penicillin and named it *methicillin*. Its major disadvantage was that it had to be given by intra-muscular injection and this may have prompted the search for the orally-active antibiotics listed above. It was synthesised by the second of the two methods mentioned earlier, in which a natural compound was further modified. Most of these derivatives are based on naturally occurring 6-aminopenicillanic acid (8). Scientists working at Beecham examined the mould juice from which benzyl penicillin was being prepared and concluded that the acid (8), itself of low activity, was the key intermediate in the biosynthesis of Fleming's antibiotic [6]. Moreover, enzymatic cleavage of benzyl penicillin (by now available in huge amounts) was found to be a convenient source of aminopenicillanic acid in synthetically useful quantities. The NH_2 then lends itself to condensations with acid chlorides to form, for example, the penicillins (4) – (7) shown above. Condensation with 2,6-dimethoxybenzoyl chloride gives methicillin, which the Beecham chemists originally christened "celbenin".



6-aminopenicillanic acid (8)

methicillin

Writing in the *British Medical Journal* in 1960, Robert Knox, Professor of Bacteriology at Guy's Hospital London reported:

> It (methicillin) is the first penicillin which combines considerable antibiotic activity with almost complete resistance to the action of staphylococcal penicillinase…..The laboratory evidence available suggests that its greatest merit is its unique activity against penicillin-resistant staphylococcal infections for which the only antibiotics hitherto available have been toxic, difficult to administer, or only feebly bactericidal…It appears to be virtually non-toxic [7].

The same issue of the journal reported clinical trials from Queen Mary's Hospital for Children, Carshalton. Seventeen patients, all infected with staphylococcus aureus, had been treated with methicillin. Several had been previously treated with other antibiotics, including benzyl penicillin, presumably with no response. Three children died, but the remaining fourteen responded well, a testament to the effectiveness to methicillin treatment. The authors included a detailed case study that did not feature in the original cohort:

A 4-weeks-old infant was admitted to hospital gravely ill with a large abscess on the right hip. Staphylococcus aureus was isolated from this abscess, from a blood culture, from the urine and from an empyema (a collection of pus, usually in the pleural cavity in the lungs) in the right side of the chest. The infant did not respond to therapy with benzyl penicillin and streptomycin, to both of which the organism was found to be resistant and treatment with methicillin was begun. There was an immediate improvement: the blood culture and urine became sterile, and within five days the discharges from the abscess and empyema were also sterile. The infant's general condition improved and within two weeks he was lively and feeding well….There is little doubt that in this case a severe staphylococcal pyaemia (septicaemia caused by pus-forming bacteria being released from an abscess) was rapidly controlled and that methicillin had a life-saving effect [8].

Unfortunately, this optimism was misplaced. Just four months later an alarm was sounded by the Staphylococcus Reference Library, sited at Colindale, London. It was busy identifying various strains of the bacterium, and investigated some 5,440 samples over a two-month period at the end of 1960. Because of the interest generated by methicillin, they examined each strain for susceptibility against this new antibiotic. Three strains proved methicillin-resistant. Commenting on a subset of 4,430 strains the author concluded:

> …the great majority were penicillin-resistant hospital strains, and many of them were resistant to several antibiotics. The finding of these (two) strains does not therefore detract from the very great value of methicillin, but the fact that the occasional resistant strain does exist should be borne in mind [9].

Dr Knox, commenting on this finding, reassured physicians that the patients associated with the resistant strains had almost certainly not been previously treated with methicillin and were intrinsically resistant to the drug, and as of January 1961 there had been no reports of treatment failure where patients treated with it had developed methicillin-resistant staphylococci. This optimism was soon dashed by a report in the *British Medical Journal* in March 1963 [10]. Methicillin had been in use at the Paddington General Hospital since September 1960. The first methicillin resistant staphylococcus infection appeared in October 1962. The patient, suffering from complications following chest surgery, had never previously been treated with methicillin and had not visited any other hospital in the previous two years. Within four months four more cases of methicillin resistant staphylococcus infection were noted: two urinary infections and two respiratory infections. The inference that the first patient had subsequently infected the other four individuals was supported when the organism was identified in the dust on the floor of the ward concerned. The hospital adopted the following regime to reduce the risk of further infection:

- 'New' beds were made up with blankets that had been previously sterilised with formalin (methanal) and sheets by boiling
- All patients and staff associated with the ward were treated with a nasal cream containing chlorhexidine (an antiseptic) and neomycin
- The ward floor was washed with 'savlon' (a disinfectant/antiseptic containing chlorhexidine and another cetrimide)
- The bed curtains were laundered

With this regime in place the authors reported that they had encountered no further cultures of methicillin-resistant staphylococci.

Sadly, this too proved optimistic. While good hygiene remains the front line in prevention, particularly effective hand washing with alcohol gels or chlorhexidine antiseptic, MRSA is an increasing problem. This is particularly so for critically ill patients, or those with impaired immune systems, or generally poor health – MRSA is very common in large US prisons. A proportion of the population are healthy carriers, who can unwittingly infect patients while caring for them. As a result, hospital staff are now routinely tested for MRSA before starting work or moving hospitals. The current world population is nearly 7 billion people. It is estimated that about two billion of these carry some form of staphylococcus aureus, and some 53 million are carrying MRSA.

Although the term MRSA is still used, methicillin (renamed meticillin in 2005 in line with the International Pharmacopeia guidelines) is no longer used to treat patients. It can only be used intravenously, and is more likely to cause kidney damage than alternative penicillins. Current treatment relies on vancomycin, but resistance to this is also an increasing problem. Newer antibiotics carry significant toxicity of their own, and are increasingly difficult to identify. Teixobactin [11] is the first of a potential new class to be identified for thirty years. No doubt MRSA will become resistant to them in time, too. Curiously, tea tree oil, an ancient remedy from Australia, seems to kill all MRSA strains identified to date, at least *in vitro* [12]. The Bundjalung people of eastern Australia used to inhale the oils from crushed leaves to treat coughs and colds as a traditional remedy. A tenth century Anglo-Saxon mixture of garlic, wine, onion or leek and oxgall (cow's bile) was reported last year to be similarly effective, at least *in vitro* [13]. Ironically, it seems that Fleming's disparaged antiseptics may offer the best hope of containing MRSA!

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Alan Dronsfield and Pete Ellis

William Ramsay's *Pli Cacheté* of 1894

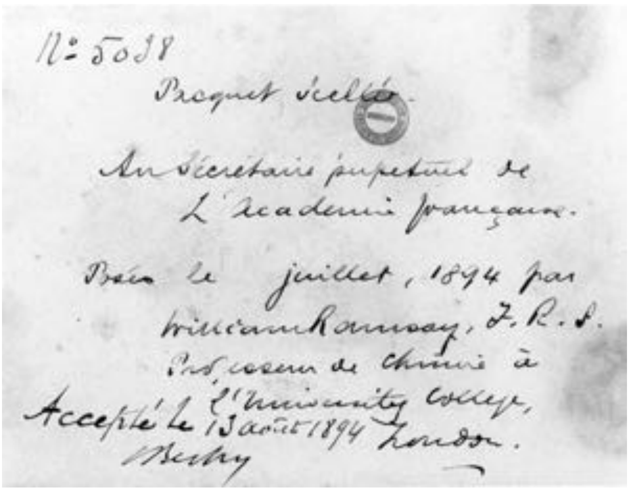
Since 1735 the French Académie des Sciences has operated a system by which a researcher or inventor could lay claim to a discovery or invention without publishing it. An account, signed by the author, is deposited with the Permanent Secretary of the Academy where it is put into a packet sealed with wax, called a *Pli Cacheté* or *Pacquet Sceleé* (Figure 1); thereafter it is known only by a registration number. The author can

then ask for it to be opened at a later date if he wants to make a claim for priority: in some ways it is the equivalent of a patent.

More than 18,000 were deposited between 1735 and 2012. In 1976, to keep the growing number in check, the Academy adopted a procedure by which *plis cachetés* are opened if they have remained sealed for one hundred years or more. Some can be discarded immediately but ones of historical interest are published, with commentaries, in the Academy's journals.

Figure 1: *Plis Cachetés*

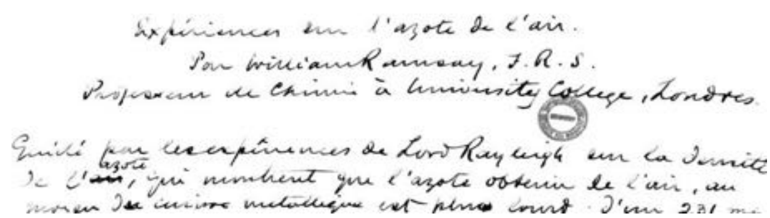
On 10 June 2004 the *Commission des Plis Cachetés* opened packet 5038 which turned out to be from William Ramsay. It is reproduced in *Comptes Rendus Chimie* with a commentary by Yves Jeannin [1]. Its title, in French, is *Experiments on the Nitrogen of the Air*, and it was deposited in July 1894. Unfortunately, the space where one would hope to find the precise date in the covering note is blank (Figure 2).



N° 5038
Paquet Scellé.
Au Secrétaire perpétuel de l'Academie française.
le juillet, 1894 par
William Ramsay, F.R.S.
Professeur de Chimie à l'University College, London.
Accepté le 13 août 1894
Berthelot

Figure 2: Ramsay's covering note

The paper occupies a single page in Ramsay's hand writing in French. The first few lines are shown in Figure 3.



Expériences sur l'azote de l'air.
Par William Ramsay, F.R.S.
Professeur de Chimie à University College, Londres.

Guidé par les expériences de Lord Rayleigh sur la densité
de l'azote, qui montrent que l'azote obtenu de l'air, au
moyen du cuivre métallique est plus lourd · d'un 231 me

Figure 3: The first few lines of Ramsay's Pli Cacheté.

A transcription of the writing is as follows [2].

Expériences sur l'azote de l'air
Par William Ramsay, F.R.S.
Professeur de Chimie à University College, Londres

Guidé par les expériences de Lord Rayleigh sur la densité de l'azote, qui montrent que l'azote obtenu de l'air, au moyen de cuivre métallique est plus lourd; d'un 231eme que l'azote obtenu par les moyens chimique de l'ammoniaque, ou de l'acide azotique, j'ai fait des recherches sur le résidu, après que l'on absorbe une grande quantité de l'azote de l'air, au moyen de magnésium, au rouge vif. J'ai commencé avec 20 litres d'azote, et après que j'ai réduit son volume à 200 centimètres cubes, sa densité s'est augmenté jusqu'à 16.1 fois celle de l'hydrogène. Il faut conclure que l'air contient un gaz inconnu, qui peut-être un nouvel élément ou bien une modification allotropique de l'azote. Qu'il ne s'agit des gaz déjà connus est prouvé par la circonstance que ce gaz, après avoir été passé sur le cuivre, l'oxyde de cuivre, tous deux à une chaleur rouge, le chaux-crude, et le pentoxyde de phosphore, n'altère pas son poids spécifique. Il ne peut pas contenir de l'hydrogène, qui, au reste ferait diminuer son poids spécifique, ni de l'oxygène, ni de l'acide carbonique, ni des oxydes de l'azote, ni d'un hydrocarbure, ni de l'ammoniaque, Enfin, il n'y existe pas un gaz qui échapperait à l'action de ces absorbants. Mais le gaz que je viens d'obtenir, contient encore de l'azote; au moins, il se laisse absorber encore par le magnésium. Je suis disposé à croire qu'il se forme, outre l'azote de magnésium, une combinaison entre le gaz X et le magnésium, mais que le métal nommé exerce une absorption préférentielle sur l'azote.

J'espère pouvoir décider prochainement si ce gaz X est une modification de l'azote, peut-être Nz_3, ou un élément nouvel, en faisant l'absorbe par le magnésium, remuant à chaque expérience une quantième de son volume, et en dosant l'ammoniaque ou la combinaison de X avec l'hydrogène, je pourrai décider quel est approximativement son poids atomique. S'il arrive que j'aie un nouvel élément gazeux dans les mains, je me propose de le nommer Eikazote, avec le symbole Ez. En terminant cette note, il faut remarquer que c'est à Lord Rayleigh, avec lequel j'ai été en communication, qu'on doit cette découverte; il a montré l'endroit qu'il faut explorer; j'ai trouvé les moyens pour isoler le nouvel gaz.

A translation is as follows.

Experiments on the nitrogen in the air
William Ramsay, F.R.S.
Professor of Chemistry at University College, London

Guided by the experiments of Lord Rayleigh on the density of nitrogen, which show that the nitrogen obtained from the air by means of copper metal is more dense by one part in 231 than the nitrogen obtained by chemical means from ammonia, or from nitrous acid, I have studied the residue after a large quantity of nitrogen from air has been absorbed by means of magnesium at red heat. I started with 20 litres of nitrogen, and after I reduced its volume to 200 cubic centimetres its density is increased to about 16.1 times that of hydrogen. We must conclude that the air contains an unknown gas that may be a new element or perhaps an allotropic modification of nitrogen. That it is not a gas already known is proved by the fact that this gas, after being passed over copper and copper oxide, both at red heat, slaked lime, and phosphorus pentoxide, does not change its specific weight. It cannot contain hydrogen, which would reduce its weight, nor oxygen, nor carbon dioxide, or nitrogen oxides, nor a hydrocarbon, nor ammonia. Furthermore, there is not a gas that would escape the action of these absorbents. But the gas which I have obtained still contains nitrogen; at least, it still is absorbed by magnesium. I am inclined to believe that there is formed, apart from magnesium nitride, a complex of gas X with the magnesium, but the metal preferentially absorbs nitrogen.

I hope to decide soon if the gas is a modification of nitrogen, perhaps N_3, or a new element, by carrying out the absorption by magnesium, making each experiment more quantitative by volume, and by measuring the ammonia or a combination of X with hydrogen, I can decide what is its approximate atomic weight. If it happens that I have a new gaseous element, I intend to name it Eikazote, with the symbol Ez.

To end this note, it should be recognised that it is to Lord Rayleigh, with whom I have been in communication, that this discovery is credited; he has shown the place to explore; I found the means to isolate this novel gas.

W. Ramsay

He describes briefly the isolation of a heavier gas when atmospheric nitrogen is passed over red-hot magnesium, and the inertness which this gas shows to a variety of potential absorbents. He accepts that he may have a new element (equation 1) but is inclined to believe that the nitrogen reacts with magnesium to form magnesium nitride but, less readily, also reacts to give new gas, perhaps a trimer of nitrogen (equation 2; this would be equivalent to ozone).

$$N_2 + Mg + X \longrightarrow Mg_3N_2 + X \qquad (1)$$

or

$$N_2 + Mg \longrightarrow Mg_3N_2 + N_3 \qquad (2)$$

If it is a new element he proposes to call it Eikazote and give it the symbol Ez.
It was on 4 August, within a month of having written the pli cacheté, that Ramsay wrote to Lord Raleigh to say that the new gas was a new element. His more quantitative experiments had presumably shown that all the nitrogen which was absorbed went to form Mg_3N_2 rather than some being diverted to form N_3.

It is rather surprising that Ramsay should feel the need to register his prior claim to isolating a new gas from the air. The only other person whom we know to have been working with the same aim at that time was Lord Rayleigh but he was a collaborator rather than a competitor and Ramsay generously acknowledges Rayleigh's work in the in the first and last paragraphs of the *pli*.

References

Yves Jeannin, *Comptes Rendus Chimie,* 2009, 8, 3-7.

Most of Ramsay's handwriting can be read with confidence but there are some words in the penultimate paragraph which we have found difficult to read and an alternative translation might be better, though this should not affect the overall meaning. Readers are invited to download the paper and suggest improvements.

I am grateful to Robin Clark for drawing my attention to Yves Jeannin's article, and to Paul Guermond and Sheila Garratt for helping to read Ramsay's writing.

Alwyn Davies
a.g.davies@ucl.ac.uk

Book Reviews

William H. Brock, *The History of Chemistry: A Very Short Introduction* (Oxford: Oxford University Press, 2016). Pp. 151, with photos and illustrations. ISBN 978-0-19-87 1648-8. £7.99 (Paperback).

Condensing the history of a discipline whose practices have been dated back to 12,000 BCE (as shown in chapter 1) means that deciding what, or indeed who, to include in a work of this kind is the primary problem for the author. Add to that the complications of defining what counts as chemistry – blurred boundaries between alchemy, chymistry and chemistry abound – and the task becomes ominous.

Brock has tackled this task by adhering to Friedrich Kekulé's 1861 definition of chemistry as "the study of the material metamorphosis of materials", and Brock's selection of what and who to include should be approached from that perspective. The book is structured into six roughly chronological yet overlapping chapters, Brock's cast of characters is impressive and the reader will walk away with many historical facts to impress others with (the story of the *bain marie* is my favourite).

In chapter one, "On the nature of stuff", Brock covers chemistry in the broadest and most diverse sense in the book, and treats the aforementioned blurred boundaries between chemistry, chymistry and alchemy with due sensitivity, referring to the historiography that shows that works published as chymistry often had content that would be described as alchemical, and vice versa. Chapter two, "The analysis of stuff", complements the first chapter by adding biographical detail, a narrative style that is continued throughout the rest of the book, in which the history of chemistry is told through the stories of numerous chemists, those better and lesser known.

If we stick to Kekulé's definition of chemistry, my only criticism of this book, as a feminist historian of science, is that the fluid boundaries of who does material metamorphosis in the first chapter of the book become too rigid as the book progresses – those who published theories become prioritised over those who practiced analysis and synthesis. Of course one cannot write people into history where they did not exist, yet, for example, the inclusion of X-ray crystallography would have partly addressed the gender imbalance in this history.

Oxford University Press's *Very Short Introductions* series are advertised as a "stimulating and accessible way into a new subject". The further reading provided is a valuable checklist for new scholars in the field, and part of the attraction of reading Brock's *The History of Chemistry* for a doctoral student is to prevent those awkward moments at conferences or seminars when you have to nod along to the words "Of course you are all familiar with the work of the nineteenth-century chemist Mr X" and hope that you won't get probed further on the subject. Indeed, anyone, however long a scholar of the history of chemistry, will learn something new from this book.

Hattie Lloyd
University College London

Masanori Kaji, Helge Kragh and Gábor Palló (eds.), *Early Responses to the Periodic System* (Oxford: The University Press, 2015). Pp. 314. ISBN 978-0-19-0200007-7. £23.49 (hardback).

In 1869 Dmitri Mendeleev published his paper "The correlation of the properties and atomic weights of the elements" in the *Journal of the Russian Chemical Society* [1]. In it, he advanced what he called The Periodic Law, i.e. the observation that the chemical properties of the elements show well-defined periodic similarities. The Periodic Table was seen by him as a consequence of the Periodic Law and it was the latter that he claimed to have discovered.

Interestingly, Mendeleev's paper had originally been read at a meeting of the Russian Chemical Society on 6 March 1869 by the Secretary, N.A. Menshutkin. This was because Mendeleev himself was away from Moscow at the time, on a tour of cheese-making factories. The paper included an early Periodic Table, though it failed to recognise the transition metals as a separate series. It did, though, include the well-known gaps as well as suggestions of the likely properties of the missing elements.

Russia was somewhat removed from the centre of the chemical world at the time. In order to spread the news of his discovery, Mendeleev published a long paper in the influential German journal *Annalen der Chemie und Pharmacie* in 1897 [2]. This introduced the concept to the wider world. What happened next is the question that the book *Early Responses to the Periodic System* seeks to answer.

It is a multi-author book comprising thirteen chapters, each written by a separate author and concerned with responses to the Periodic Law in various countries. These range from Russia (Chapter 1) to Japan (Chapter 13), and include Germany (Chapter 2), France (Chapter 5) and Britain (Chapter 4). The British chapter is contributed by Gordon Woods, the well-known member of the RSC Historical Group. It shows how the concept gained ground in the years 1876-1886 as several of the predicted elements were discovered and found to possess the anticipated properties. Increasingly textbooks for both school and university study were based on this approach and its acceptance proceeded smoothly and without serious opposition.

Most countries seem to have adopted Mendeleev's ideas fairly readily and in a similarly uncontroversial way. However, with very few exceptions, the notion of the Periodic Law did not inform chemical research in these countries. Sweden (Chapter 7) was typical of this. Inorganic chemistry there was a highly descriptive subject based on careful if tedious analytical methods. The introduction of the Periodic Law did little to change this approach. Analysis remained of primary importance for long after the Periodic Law was discovered and continued largely untouched by ideas of periodicity.

An exception was in the Czech lands (Chapter 6), where the chemist Bohuslav Brauner developed a research programme explicitly aimed at understanding the periodic system. In particular, through many years of study, he determined the position of the Rare Earths in the Periodic Table. He also determined the correct atomic weight of beryllium, which showed clearly that it belonged to Group II, and he carried out studies on cerium and placed it in Group IV. But this was unusual. Most chemists in most countries appeared to have accepted the Periodic Law without a fuss, then got on with work they were already doing.

This book describes all of this in a scholarly yet readable way. There is some repetition, which is inevitable given the multi-author nature of the book and the fact that the way in which the Periodic Law was accepted was similar in all the countries considered. However, this is not a major drawback, and the book is an important addition to the literature on the history of chemistry. It gives a sound answer to the question it posed itself: How did the Periodic system come to be accepted by chemists throughout the world?

References

1. D. Mendeleev, *Zh. Russ. Khim. Obshch*, **1**, (2/3), (1869): 60-77.

2. D. Mendeleev, *Annalen der Chemie und Pharmacie Supplementband*, **8**, (1871): 133-229.

John Nicholson

Otto Meth-Cohn, *The Nearly Man* (North Charleston, USA: CreateSpace Independent Publishing Platform, 2015). Pp. 234. ISBN 978-1518701689. £5.96 (paperback), £2.22 (Kindle), Free to *KindleUnlimited* subscribers.

In the February 2007 edition of our Newsletter, to mark (approximately) the sesquicentenary of William Perkin's discovery of Mauveine, I referred in some detail to the work reported in 1994 by Professor Otto Meth-Cohn which corrected the hitherto accepted structure for this epoch-making dyestuff, thus ensuring for him a place in the history of colour chemistry. I concluded:

> Otto Meth-Cohn gave me my first ever lecture in undergraduate chemistry at the Royal College of Advanced Technology, Salford (shortly to become the University of Salford). My enthusiasm for the subject, and its historical aspects, still persists, some forty-four years on.

Meth-Cohn has now published his autobiography covering, approximately, his first thirty years. There is virtually no historical chemistry in it, the closest being a short personal account of Salford's chemistry department in the 1960s. But we learn how four-year-old Otto, who arrived without family or friends, from Germany as part of the famous *Kindertransport* of 1939, was taken in by a succession of foster parents, orphanages and hostels, coped, formed friendships (some of which endure today) and then at the age of sixteen had to seek a job. Always interested in science, a place was found for him at *Lankro Chemicals* in Eccles, Manchester. Day-release for ONC study at 'Salford Tech' was part of the deal and Otto's academic career in chemistry started. I found this a moving book and a study in resilience when the author had to tackle adversity. Time and time again, Otto's 'sunny' disposition comes through. Well recommended.

Alan Dronsfield
University of Derby

C.N.R. Rao and Indumati Rao, *Lives and Times of Great Pioneers in Chemistry (Lavoisier to Sanger),* (London: World Scientific, 2016). Pp 312. ISBN: 978-981-4689-05-2. £19 paperback.

This book presents brief histories of twenty-one pioneering chemists, respectively Lavoisier, Dalton, Davy, Berzelius, Faraday, Wöhler, Kekulé, Mendeleev, van't Hoff, Emil Fischer, Ostwald, Arrhenius, Werner, Willstätter, G.N. Lewis, Robinson, Ingold, Eyring, Pauling, Woodward and Sanger. Each is given between ten and thirty-five pages; chapters having between twelve and thirty references, mostly from secondary sources. There is (at least in the galley proof reviewed here) no index and, unfortunately, no running title above each page referring to the subject, so the list of contents at the start is the only way to locate the subject.

It is not feasible to comment on each chapter. Those on Lavoisier ("Father of Chemistry" and Faraday ("the greatest scientist of all time") are typical. Lavoisier receives twenty-three pages and eighteen references, of which four are to original papers by him and the rest are to modern books or websites; Faraday gets twenty-six pages and thirty-five references. The format of each chapter is roughly the same. There is a short introduction explaining why the subject is eminent; his early years (no women are featured); main contributions to chemistry, which naturally provides the bulk of the chapter; honours received; and sometimes the circumstances of the subject's death. Most chapters contain boxed sections emphasising particular points. Thus for Faraday such boxes highlight Davy's recommendation for him ("Davy's greatest discovery"); his major contributions to chemistry; for electromagnetic rotation; for electroinduction; a timeline of his discoveries in physics and electricity; on his famous ice pail experiment, and his demonstration of the paramagnetism of oxygen. There is also a picture of Faraday, and two of his pieces of apparatus.

After attending the excellent RSCHG meeting on G.N. Lewis (23 March 2016) I looked that evening at the chapter on Lewis in the light of what I had learned that day. It did very well in outlining the work of this extraordinary man, and includes some inoffensive colloquialisms – "Berkeley (from Lewis' efforts is) the numero uno chemistry department in the world".

Brief comments on other articles: Robert Robinson and Ingold occupy adjacent chapters, and a chance has been missed to discuss the great controversies between them in any depth. The section on Linus Pauling is good, covering his second Nobel Prize (for Peace) in some detail, and mentioning Mulliken's MO theory in its coverage of Pauling's valence-bond approach. By comparison the other double Nobel laureate, Fred Sanger, who actually received two *chemistry* prizes, gets rather short shrift – thirteen pages and fifteen references against Pauling's twenty-seven pages and thirty-four references. There are inevitably errors, e. g. John Newlands, the early Periodic Table pioneer, is referred throughout the chapter on Mendeleev as 'Newland'. Kekulé never receives his customary accent ("Kekule") though there is some late historical precedence for this.

This is an amiable and eminently readable book, perhaps rather more for the novice in the history of chemistry, but none the worse for that.

Bill Griffith
Imperial College

Peter Reed, *Entrepreneurial Ventures in Chemistry: The Muspratts of Liverpool, 1793-1934* (Farnham: Ashgate, 2015). Pp. xiii + 329. ISBN 978-1-4724-4978-8. £75 (hardback).

For three generations the Muspratt family played a leading role in chemical manufacture in Britain. Following a brief apprenticeship to a wholesale chemist and druggist, a dispute over inheritance, service (and desertion) in the Peninsular War, James Muspratt (1793-1884) began manufacturing chemicals including acetic acid, hydrochloric acid and prussiate of potash on a small scale in Dublin in 1814. Six years later he decided to leave the city for better opportunities across the Irish Sea and he set up as a chemical manufacturer of soda (sodium carbonate) in Liverpool. James was the first person to make alkali on a large scale using the Leblanc process and was later acknowledged as the 'Father of the British Heavy Chemical Industry'. Through the nineteenth century, with his sons, Sheridan, Richard, Frederic and Edmund, this chemical business expanded across the North West of England and North Wales and trade developed with North America. An additional works was opened at Newton-le-Willows in 1831, but following its closure in 1851 new sites were established in Widnes and Flint. Whilst the Muspratts considered themselves as caring employers, conditions in alkali works were horrendous and the resulting waste products caused widespread problems for those living in the surrounding area. Employees suffered most of all. Saltcake workers usually lost their teeth in under twelve months and bleach packers were regularly exposed to poisonous chlorine gas. Alcoholism was endemic and medical problems widespread, with long, onerous working weeks when the trade flourished, but months of enforced idleness when it suffered.

The family business remained in private hands until 1890, when the United Alkali Company (UAC) brought together all of the Leblanc manufacturers in Britain in a combine of forty-eight works. Edmund Muspratt was instrumental in establishing the UAC's Central Laboratory close to the company's principal works in Widnes in 1892. As part of a rationalisation to rid the UAC of inefficient plant and uneconomical operations, the UAC Board decided to close the Liverpool works in 1896. This ended the family's seventy-four-year-old association with the site, although the Widnes and Flint works continued to operate. In 1895 Edmund's son Max joined the UAC after studying at Zurich Polytechnic. He rose quickly through the managerial ranks, being appointed as a Director in 1910 and becoming Chairman in 1913. Economic prospects looked bleak as the company continued to be dependent on the obsolete Leblanc system. However, with the outbreak of the First World War, government demands on UAC's technical expertise and the contracts which resulted drove the growth of the business. The wartime period demonstrated the benefits of collaboration and the increasing interdependence of different chemical companies for the supply of raw materials and intermediates. Despite initial reluctance from the UAC Board, Nobel, Brunner Mond, UAC and the British Dyestuffs Corporation combined in 1926 to form ICI.

By considering the Muspratts as a family group, this book provides a new insight into the dynamics of family firms and entrepreneurship. A vivid picture emerges of life at Seaforth Hall, the family home built in classical Greek style on the banks of the Mersey by James in the late 1830s and 1840s. The family's close involvement in artistic and literary circles, their extensive travels in Europe and America, and the longstanding friendship with Justus von Liebig and his family are of particular interest. Their activities in education, including Sheridan's establishment of the Liverpool College of Chemistry, are the focus of another chapter. Sheridan's wider career in chemistry, including his chemical dictionary *Chemistry, Theoretical, Practical and Analytical as Applied to and related to Arts and Manufactures,* is also explored.

The Muspratt legacy, the author argues, can be found in four broad areas. Firstly, with regard to business development, the Muspratts were closely associated with numerous advances in the chemical industry: adopting technical innovations; incorporating pioneering R&D; utilising new raw materials; engaging in overseas trade; and adopting new structures for their business. Secondly, family members played a key role in a number of professional and business organisations, including the Society for Chemical Industry, the Liverpool Chamber of Commerce and the Federation of British Industries. Thirdly, their activity in civic and political affairs was extensive. For example, Max was a Liberal MP in 1910, Lord Mayor of Liverpool in 1916-17 and, through his involvement in Liverpool City Council, he took a leading part in planning and financing the Mersey Tunnel and Liverpool Airport. Finally, it was in the field of education that the Muspratt legacy was most significant, particularly through Edmund's determination to establish the University of Liverpool in 1903.

A short review can not to justice to the wealth of social, business, civic, industrial and chemical history covered in this book. It is an impressive achievement to bring together all aspects of the family's life and work to explore the entrepreneurial spirit that they brought not only to chemical manufacture in Britain, but also to wider Victorian and Edwardian politics, culture and education. Peter Reed's book will certainly be of great interest to historians of chemistry, the chemical industry and family firms, but there is much content that will also be very relevant to those working more broadly on Victorian and Edwardian society, government and the history of the North West.

Anna Simmons
University College London

MEETING AND CONFERENCE REPORTS

The Atom and the Molecule: A Symposium Celebrating Gilbert N. Lewis

Royal Society of Chemistry, Burlington House, London, Wednesday 23 March 2016

This meeting was held to celebrate the impact of Lewis's famous article published in 1916 on "the Atom and the molecule" in which the shared-electron (covalent) bond is introduced. The speakers addressed a range of topics associated with Lewis across a broad swath of chemistry, many of which remain highly relevant to this day in terms of their continuing impact upon both teaching and research.

Does Personality Influence Scientific Credit? Simultaneous Priority Disputes: Lewis vs. Langmuir, and Langmuir vs. Harkins

Dr Patrick Coffey (Berkeley, USA)

The financial rewards for a career in science are generally modest when compared to those in business, medicine, or law. And scientists are usually not concerned with fame; only the rare scientist - Newton, Darwin, or Einstein - is widely known in his or her own time, and even then the general public usually has a poor understanding of his or her achievements. But scientists are not disinterested seekers after truth. What they want most is recognition by their peers for 'priority', being the first to make a discovery or to develop a theory. Priority disputes can be ugly. This talk concerned two that occurred almost simultaneously beginning in 1916: one between G.N. Lewis and Irving Langmuir over the chemical bond, and another between Irving Langmuir and William Harkins over surface chemistry. Lewis involved himself in the second dispute, at first on Langmuir's side and then on Harkins'. How much does a scientist's personality have to do with assignment of credit? Lewis was introverted and suspicious; Langmuir was warm, outgoing, and a charismatic speaker; and Harkins was self-aggrandizing and obviously deceitful. With little justification, Langmuir thought he deserved to share credit for Lewis's electronic theory, and many called it the "Lewis-Langmuir theory". Harkins, who in fact made substantial contributions to surface chemistry, was nearly drummed out of the scientific community for claiming a share of Langmuir's credit.

Lewis on Structure and the Chemical Bond

Professor Robin Hendry (Durham, UK)

G.N. Lewis' account of the chemical bond has a curious status. On the one hand it led directly to important developments, for instance in understanding reaction mechanisms in organic chemistry. On the other hand, it has come to be regarded as naive at best from a physical point of view. This paper argued that Lewis articulated a sophisticated unifying conception of structure in chemistry, and that some of its most important features withstand later quantum-mechanical objections.

An Organic Chemist Reflects on the Lewis Two-Electron Bond

Professor Alan Dronsfield (UK)

Arguably, most synthetic organic chemistry is a type of cookery. New reactions were initially discovered by chance. Later, patterns such as functional group reactivity gave the early chemists an insight as to what course a reaction would probably take. But most synthetic chemistry was (and still is) accomplished by visualising Hofmann 'ball and stick' representations of molecules and Crum Brown's carbon-to-carbon single, double and triple linear bonds. True, substitution patterns round benzene rings were bewildering, but by the end of the nineteenth century the practical chemist had various empirical 'rules of thumb' that would predict what structure a di-substituted aromatic product would take. However, an organic chemist worth his/her salt would want to know the reason behind such rules and in the 1920s two theories were in competition. One, advocated by the Arthur Lapworth/Robert Robinson camp, sought explanation based on the two-electron theory of the bond and the other, a construct by Christopher Ingold and Bernard Flürscheim, eschewed electrons and put its faith in a derivative of Thiele's partial 'affinities'.

Eventually it was agreed that the nitration of *N,N*-diacetylbenzylamine would solve the problem as Robinson's theory predicted *o*/*p* substitution and Ingold's predicted *meta*. When the experiment was carried out by one of Ingold's students, he reported that the substitution went *meta*. Robinson did not accept this result and immediately repeated the experiment, which in his hands gave indisputable evidence for *o*/*p* attack. Ingold conceded defeat and immediately took up Robinson's ideas with enthusiasm. His expositions of mechanistic organic chemistry had a clarity that Robinson's lacked and his 1953 textbook on this subject became a best seller with the consequence, much to Robinson's fury, that he began to be regarded as 'the father of mechanistic organic chemistry'. But the 'Ingoldsby legends' seldom influenced the bench organic chemist. Much of our work could still be handled by representations based on balls, sticks and lassos, paper and pencil doodling or a drawing package such as ChemDraw.

We had to wait until the late 1960s until Robert Woodward and Roald Hoffmann published their 'rules' that could predict the stereochemistry of pericyclic reactions, especially electrocyclisations. Chemists seeking a specific stereochemical outcome could apply their rules which identified the frontier molecular orbitals necessary for the transformation. Their symmetry would determine the geometry of the outcome when the components of the molecule rotated to enable the appropriate terminal lobes to overlap. These ideas were firmly grounded in the notion of the Lewis two-electron bond, and enabled the chemist to decide whether heat or light would effect the transformation they were after. This said, like the nineteenth-century workers substituting their benzene nuclei by 'rules of thumb', now we have simple rules of electrocyclisation that work perfectly satisfactorily, without a single (or double) electron having to cross our minds…. (almost)…!

Do Bonds Need a Name?

Dr Julia Contreras-García (UPMC, France)

The concepts of Lewis and the localization of pairs of electrons are lost within the Quantum Chemistry framework. However, it is this framework that we need to exploit if we want to understand the microscopic organization of matter in a quantitative and predictive way. Quantum topology is coupled to quantum chemical calculations to retrieve the classical ideas of pair localization and chemical bond. But since it derives from a quantitative theory it also enables us to go beyond Lewis concepts, obtain new insights and expand the original theories. This talk reviewed two topological tools: ELF (Electron Localization Function) for covalent bonds and NCI for Non Covalent Interactions. It checked their ability to recover old concepts, but also to enable us to understand new situations enabled by new experimental conditions, notably by high pressure. It demonstrated what insulating metals look like under pressure, how we can understand their properties, and how noble gases become reactive and stabilize solid structure. In conclusion, the non-covalent nomenclature, nowadays fixed in terms of atoms (halogen bonds, calchogen bonds), was revisited and new electronic-structure-based classifications (just like their covalent/ionic strong analogues) were proposed.

The Influence of Lewis on Organic Chemistry Teaching, Textbooks and Beyond

Professor Nick Greeves (Liverpool, UK)

The lecture reviewed the use of Lewis' ideas, including the origins and applications of 'curly arrows', in textbooks on Organic chemistry over the years before moving on to internet-based open educational resources such as ChemTube3D.com .

Lewis and Lewis-like Structures in the Quantum Era

Professor Clark Landis (UWM, USA)

Are Lewis structures consistent with high-quality electronic structures? Natural Bond Orbital (NBO) analysis of molecules across the periodic table supports the primacy of Lewis-like structures in many small molecules. Deviations from Lewis-like structures are described by consistent and logical donor-acceptor concepts. Key to judging the validity of Lewis-like structures is the difference between the ab initio one-electron density matrix and that of the idealized Lewis structure. This metric-of-quality reveals that many concepts – Lewis structures, hybridization, electronegativity, resonance, etc. – originating from pre- and early quantum days, not only survive scrutiny but form the basis for new insights into the electronic structures of transition metal, and other, molecules. Featured examples include hypervalency and 'long-bond' motifs, open shell molecules and the Different Lewis Structures for Different Spins (DLDS) paradigm, applications to transition metal complexes, and insights provided by the NBO facilities for deletion of Fock matrix elements as expressed in the NBO basis set.

The Inorganic Dimension to Lewis and Kossel's Landmark Contributions

Professor Michael Mingos (Oxford, UK)

This paper placed the impact of the seminal papers of Lewis and Kossel in 1916 on inorganic chemistry into a historical perspective. These insights depended on the attainment of inert gas configurations by the atoms either directly by electron transfer, or electron-pair sharing. The model incorporated an evolutionary gene which has enabled it to survive and grow by incorporating subsequent developments in quantum physics. The simplicity of the model has resulted in the development of a notation, which is universally used by chemists and has evolved to trace the course of chemical reactions and predict their regio-selectivities. The limitations of the model when applied to hypo- and hyper-valent inorganic molecules are discussed and the way in which the model has been extended to polyhedral and cluster compounds described. The model has been repeatedly enriched by quantum mechanically based theoretical insights.

Lewis's Life, Death, and Missing Nobel Prize

Dr Patrick Coffey (Berkeley, USA)

On 23 March 1946, G.N. Lewis died in a Berkeley laboratory filled with hydrogen cyanide gas. The coroner's report attributed his death to natural causes, but some of his closest colleagues believed it was a suicide staged as an accident. They believed that he was depressed, due in part to the fact that he hadn't received the recognition that he knew he deserved. His work on thermodynamics, strong electrolytes, the chemical bond, acids and bases, isotopes, and photochemistry had changed the very theoretical basis for chemistry, yet he'd been denied the Nobel Prize. Why? He'd isolated himself in California, he changed research fields so quickly that his work was often seen as obsolete by the time the Nobel Committee reviewed it, and he made or invented enemies, including four Nobel laureates – Walther Nernst, T.W. Richards, Irving Langmuir, and Harold Urey. That may have been what cost him the Prize. Wilhelm Palmaer, a friend of Nernst's who sat on the Nobel Chemistry Committee for years, manipulated the nomination and reporting rules to block the award of a prize to Lewis for thermodynamics. On the day of his death, Lewis was pressured into having lunch with one of those he considered to be an enemy, Irving Langmuir. He returned from the lunch in a somber mood, entered his laboratory for an experiment on the dipole moment of liquid HCN, and died.

Henry Rzepa
Imperial College

RSC National Chemical Landmarks

RSC Chemical Landmark Plaques honouring Sir John Cornforth at the Kent Science Park, Sittingbourne

On 1 April 2016, two RSC Chemical Landmark plaques to Sir John Cornforth were unveiled at the Kent Science Park, Sittingbourne. Kent Science Park was formerly Shell UK's Agricultural Research Centre, and in 1962 the "Milstead Laboratory of Chemical Enzymology" was established on this site for Sir John Cornforth and George Popják to continue their researches into the biosynthesis of cholesterol. Much of Sir John Cornforth's pioneering work on the stereochemistry of enzyme reactions, for which he was awarded the Nobel Prize in Chemistry in 1975, was carried out at these Sittingbourne laboratories. The wording on the two plaques reflects Cornforth's interest in cholesterol biochemistry and his association with this part of north Kent. One plaque will be placed on a plinth of Kentish ragstone [limestone] in the Japanese Garden at Kent Science Park, and the second plaque will be placed on an outside wall of Sittingbourne's main public library.

The Kent Science Park National Chemical Landmark Plaque honouring Sir John Cornforth
[Image courtesy of Kent Local Section of the Royal Society of Chemistry]

The Sittingbourne Public Library National Chemical Landmark Plaque honouring Sir John Cornforth
[Image courtesy of Kent Local Section of the Royal Society of Chemistry]

The two plaques were presented by former RSC President Professor David Phillips CBE. Recently retired site director James Speck received the plaque on behalf of the Kent Science Park, and the Sittingbourne public library plaque was accepted by Barbara Bragg, Area Library Manager for Kent County Council. The Kent Local Section of the RSC originally nominated Sir John Cornforth for the award of an RSC Chemical Landmark Plaque, and Mark Botting, other members from the Kent Local Section, Emma Elgar (Kent Science Park) and Jonathan Wells (RSC Cambridge) helped to organise the morning's proceedings.

Before the presentation of the two plaques, Dr Rupert Purchase (RSC Historical Group) introduced Cornforth's younger daughter, Philippa, and Professor Jim Hanson, a colleague of Cornforth from his time at the University of Sussex. To an audience of many of her father's former colleagues plus current employees at the Kent Science Park, Philippa recounted her happy memories of the family's time in Sittingbourne. In his talk, Jim Hanson delved more into Cornforth, the man and the scientist, who continued to explore organic chemistry as a practising chemist well into his eighties. A modified version of Jim Hanson's talk is given below.

Rupert Purchase and Jim Hanson

Sir John Cornforth AC CBE FRS

Sir John Cornforth was born in Sydney on the 7 September 1917 and graduated from the University of Sydney with the top B.Sc. in 1937, followed by an M.Sc. Three factors from that beginning contributed to his later success in chemistry. First, as a boy he had built himself his own laboratory at home. The innovative and adaptive skills he developed then were to stand him in good stead later on. Secondly, he was encouraged by an inspirational chemistry teacher, Laurence Basser. Thirdly, because by the time he went to University, he was almost completely deaf, he had to learn his chemistry from reading books and original scientific papers. From this training, he developed a thorough, careful and critical approach to the written communication of chemistry.

On the 12 August 1939 Cornforth, and his future wife Rita Harradence, sailed from Sydney on board the Orama bound for England. They were both holders of the very prestigious 1851 Scholarships. Rita, who was the year ahead of Sir John Cornforth at Sydney, had been the top chemist of her year and she was to make very significant contributions to Sir John's work including that at Sittingbourne.

In Oxford, they began their doctoral research work under the supervision of Sir Robert Robinson on the synthesis of sterols. They completed their D.Phil. degrees in 1941 and were married in that year. Because of the war effort in which other work took precedence, the final outcome of this synthesis was not published until 1951. The structure of the very important antibiotic, penicillin was unknown at the time and it was the subject of intense war effort in several laboratories including Oxford. The Cornforths joined the penicillin team in 1943 and within a few months, Sir John Cornforth had identified and synthesized a key fragment (D-penicillamine) of the core part of penicillin. This work provided a valuable clue when the X-ray structure of penicillin was finally established by Dorothy Hodgkin in 1945. Cornforth's perceptive work in areas of related chemistry led to investigations into the synthesis of oxazoles to which he made significant contributions, including the Cornforth rearrangement of oxazoles.

The post-war period was a time when a number of research institutes were established to facilitate inter-disciplinary research and these were funded on different models to the present one. In 1946, the Cornforths moved to the National Institute for Medical Research in Hampstead and then to the new NIMR building in Mill Hill, North London. At NIMR, the Cornforths began a fruitful partnership with the biochemist George Popják. The post-war availability of the radio-active isotopes of carbon and hydrogen, meant that chemists and biochemists were able to identify and label the underlying 'building blocks' from which nature assembled compounds of biological importance. In a collaboration in which Cornforth carried out the chemistry and Popják, the biochemistry, they began their very important ground-breaking work on the biosynthesis of cholesterol.

In 1962, at the instigation of Lord Rothschild and Sir Robert Robinson, Shell Ltd., established the Milstead Laboratory of Chemical Enzymology at Sittingbourne with Cornforth and Popják as co-directors. This enabled Cornforth to continue the collaboration in a very effective manner. Cornforth moved the study of biosynthesis forward from just identifying nature's building blocks to establishing the chemical mechanisms and in particular, the stereochemistry, of the way in which these building blocks were assembled. Initially the work was in the context of the precursors to the sterols but subsequently, in collaboration with a European biochemist, Hermann Eggerer, this was extended to some fundamental biochemical pathways involved in the citric acid cycle and fatty acid biosynthesis. The design of these experiments and the interpretation of the results led Cornforth to apply a chemical logic to enzyme systems which has had an impact on many subsequent studies.

In 1975 Sir John Cornforth was awarded the Nobel Prize in Chemistry for his work on the stereochemistry of enzyme reactions, most of which he had carried out at Sittingbourne. In his acceptance speech, Cornforth acknowledged the role that Rita had played in his scientific work:

She has eased for me beyond measure, the difficulties of communication that accompany deafness; her encouragement and fortitude have been my strongest support.

In the same year, Cornforth moved to the University of Sussex as a Royal Society Research Professor. At Sussex, he continued a project which he and Rita had started at Sittingbourne. It was to make a compound which might mimic the catalytic activity of an enzyme system in hydrating an alkene. He collaborated with a small group of post-doctoral fellows, mainly from his native Australia, and although they discovered some interesting chemistry and managed to establish a 'proof of concept', this work was severely hampered by lack of funds and Cornforth had to retire from active chemistry in 2004.

Cornforth was a warm approachable man, who despite his deafness, had an amazing, almost uncanny ability, not only to pick up what was being said, but also to make very apposite and helpful comments. He was very generous with his time. To watch him working logically through a chemical problem was to watch the master chess player that he was, evaluating every possibility methodically, step by step, in order to reach a final unambiguous answer.

On the day he was awarded the Nobel Prize he was wearing his customary white lab. coat and was working at the bench. Before he took off his lab. coat to celebrate with other members of his laboratory, as a true professional chemist, he tidied up and left his co-worker with instructions as to what to do.

His innovative ability in building his own equipment was invaluable in the laboratory, and many items migrated from Rita's kitchen in Lewes to the bench. For many years until he was well into his eighties, he lectured on a course for undergraduates. He was extremely patient with undergraduates including quite a number of third-year project students. He would give them an excellent training in lab. techniques and could be credited with saving a number of 'no-hopers'.

Deafness can be a very lonely thing. He valued the social environment of the laboratory and he was very sad when for economic reasons, he had to leave his laboratory at Sussex. He nevertheless retained his chemical interest and intellectual ability until his death.

The two National Chemical Landmark Plaques to Sir John Cornforth celebrate a truly great scientist who overcame adversity to enhance all of the areas of chemistry with which he was involved. He and his wife Rita were members of the scientific community of which Sittingbourne and the Kent Science Park can be justly proud.

Jim Hanson, April 2016

FORTHCOMING MEETINGS

Society for the History of Alchemy and Chemistry Open Meeting

Saturday 12 November 2016, Royal Institution, 21 Albemarle Street, London

The autumn SHAC meeting for 2016 will take place on Saturday 12 November at the Royal Institution, London. The meeting will not address any particular theme but will consist of a succession of papers on topics appropriate to the Society's interests. The Society's AGM will also be held at the meeting. If the last meeting of this type (in spring 2015 in Cambridge) is any guide, it is possible that there will be ten presentations each of 20-25 minutes' duration (including questions); but the final programme will of course depend on the submissions received. Further details are available on the SHAC website www.ambix.org

FORTHCOMING COURSES

History of Pharmacy and the Pharmaceutical Industry

Monday 28 to Wednesday 30 November 2016

The British Society for the History of Pharmacy (BSHP) and the Faculty of the History and Philosophy of Medicine and Pharmacy of the Society of Apothecaries are collaborating on a new three-day course in the history of pharmacy and the pharmaceutical industry which will be hosted across three venues: the Society of Apothecaries, the Wellcome Trust and the Royal College of Physicians, with an additional visit to the Museum at the Royal Pharmaceutical Society. The programme also includes a tour of Apothecaries' Hall and of the Medicinal Garden at the Royal College of Physicians.

There is a full programme of lectures, tours and sessions each day. The lectures cover themes of:

- the origin and development of pharmacy
- researching the history of pharmacy
- the history of drug development
- the history of the pharmaceutical industry

For full programme details, please see: http://www.apothecaries.org/faculty-of-the-history-philosophy-of-medicine-parm/who-we-are/history-pharm-course

The BSHP are supporting a subsidised student rate for the entire course on a first come first served basis. For more information and/or application form please contact Maria Ferran: facultyhp@apothecaries.org

FORTHCOMING CONFERENCES

2nd International Conference on the History of Physics

5-7 September 2016, Pöllau, Austria

For further information, please see the web site: http://www.historyofphysics.org

EuCheMs Chemistry Congress

11-15 September 2016, Seville

The congress will include the "John Dalton 250th Anniversary Symposium", a day-long event starting with a session, organised by the Division of Chemical Education and the Working Party on the History of Chemistry, which emphasizes the role of teaching as a place for ground-breaking conceptual innovation in the sciences. This will be followed by a plenary talk by Professor Paul O'Brien (University of Manchester) to introduce a series of flash lectures of three-minute duration (poster appetizers) in an entertaining and lively format. More information is available at:
http://euchems-seville2016.eu/jonh-dalton-250th-a-symposium/

35th International Conference for Dyes in History and Archaeology (DHA35)

5–8 October 2016, Pisa, Italy,

DHA is an annual series of conferences that covers all areas concerning dyes and organic pigments including their history, production, application, characterisation and analysis, properties and identification. The conference aims at attracting conservators, curators, art historians, craftsmen, artists and scientists from museums, universities, research institutions and other public or private entities as well as independent scholars.

The optional social programme includes a welcome reception in one of the museums of the city (Wednesday 5 October) and an excursion to the medieval city of Prato (Saturday 8 October). The registration deadline is 1 September 2016. For more information, see: http://www.scich.it/dha35/

Eleventh International Conference on the History of Chemistry

This will be held in Trondheim, Norway from 29 August to 2 September 2017.

Further details will appear in the next *RSCHG Newsletter*.

Editor's Note:

As this newsletter was going to press, I was very saddened to hear of the death of Professor Masanori Kaji of Tokyo Tech. Masanori played a central role in the international community of the history of chemistry, evidenced in this newsletter alone by his joint editorship of *Early Responses to the Periodic System* and his involvement in the most successful International Workshop on the History of Chemistry, which was held on 2-4 March 2015 at the Tokyo Institute of Technology, Japan.

On behalf of the Royal Society of Chemistry Historical Group, I would like to offer our sincere condolences to his family and friends. He will be much missed.