Historical Group

NEWSLETTER
and
SUMMARY OF PAPERS

No. 74 Summer 2018

Registered Charity No. 207890

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http://www.sbcs.qmul.ac.uk/rschg/
http://www.rsc.org/historical/

RSC Historical Group Newsletter No. 74 Summer 2018

Contents

From the Editor

Welcome to the summer 2018 RSCHG Newsletter. The autumn RSCHG meeting on the History of Dyes will commemorate the 150th Anniversary of the Synthesis of Alizarin. It will be held on Wednesday 17 October 2018 at Burlington House and during the meeting Roy Macleod will give the tenth Wheeler Lecture on the 150th Anniversary of the Birth of Fritz Haber. 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. To find out more about these two significant anniversaries please read Anthony Travis' short article

This issue contains a wide variety of news items, articles, book reviews and reports, in addition to details of the RSCHG's AGM, which will take place during the group's autumn meeting. Five short articles also appear in this issue. Anthony Travis contribution is entitled *Creative Chemistry for Industry: Two Anniversaries*. Brian Vincent explores the historical content of the RSC and SCI Joint Colloids Group's three awards and the legacies of Thomas Graham, William McBain and Eric Rideal; Chris Cooksey writes about Capsaicin; and Gordon Woods provides some thoughts on Henry Moseley. Peter Spargo has also written a short piece which will amuse those who remember the British Museum Reading Room.

There are two book reviews in this issue with the titles featured as follows: Iwan Rees Morus, *The Oxford Illustrated History of Science* and Sue Durrell (ed.), *The Life of William Nicholson, 1753–1815*. A report also appears of the RSCHG meeting held in March 2018 entitled "Some Chemical Consequences of World War I".

Finally, I would like to thank everyone who has sent material for this newsletter. I also want to particularly thank the newsletter production team of Bill Griffith and Gerry Moss and John Nicholson, who liaises with the RSC regarding its online publication. 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 2019 issue will be **Friday 7 December 2018**. Please send your contributions to a.simmons@ucl.ac.uk as an attachment in Word. All contributions must be in electronic form. 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.sbcs.qmul.ac.uk/rschg/

Anna Simmons
UCL

ROYAL SOCIETY OF CHEMISTRY HISTORICAL GROUP AUTUMN MEETING

The History of Dyes on the 150th Anniversary of the Synthesis of Alizarin followed by the Wheeler Lecture on the 150th Anniversary of the Birth of Fritz Haber

Wednesday 17 October 2018, Burlington House, Piccadilly, London

Programme

10:00 Registration and tea or coffee

First Session "Other Dyes"– Chair: John Hudson

10:30 Welcome (Dr Peter Morris, Treasurer, Historical Group)

10:35 David Peggie (National Gallery)

Pigments from natural dyes: their manufacture and use in paintings at the National Gallery

11:05 Matthew Paskins (LSE)

Dye chemistry and substitutes: Sir Robert Robinson between industry and government 1922-1947

11:35 J. Sergio Seixas de Melo (University of Coimbra)

In the footsteps of Perkin's and Caro's (synthesis of) mauveine

12:05 Lunch. This is not provided but there are many cafés and bars close by.

13:20 **Historical Group AGM** (members only)

Second Session "Alizarin"– Chair: Peter Morris

13:30 Mohammed Shahid (University of Glasgow)

Turkey red industry in 19th c.: Transition from natural madder to synthetic alizarin

14:00 Vincent Daniels (British Museum)

Mysteries of the Madder Vat

14:30 Alan Dronsfield (University of Derby)

Madder root to synthetic alizarin - transformations that changed the world

15:00 Ernst Homburg (Maastricht University)

From madder to alizarin: Practicalities concerning the transition from natural to synthetic dyes

15:30 Tea interval

Wheeler Lecture by Roy MacLeod – Chair: John Hudson

15:50 Introduction of Roy MacLeod as the Wheeler Lecturer by John Hudson

16:00 Roy MacLeod (University of Sydney)

Wheeler Lecture: *Chemistry in War and Peace: Reflections on the Legacy of Fritz Haber*

17.20 Concluding remarks by John Hudson

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, or email 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 17 October 2018 at the Royal Society of Chemistry, Burlington House, London on "The History of Dyes".

Name……………………………………………………………………

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

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

ROYAL SOCIETY OF CHEMISTRY HISTORICAL GROUP AGM

The forty-third Annual General Meeting of the Group will be held at the Royal Society of Chemistry, Burlington House, at 13:20 on Wednesday 17 October 2018.

Agenda

1. Apologies for Absence.
2. Minutes of AGM at Burlington House, 18 October 2017.
3. Matters arising from the Minutes.
4. Reports:
   - Chairman's Report.
   - Secretary's Report.
   - Treasurer's Report.
5. Future Meetings.
6. Appointment of Officers and Committee.
7. Any Other Business.
8. Date, time and place of next meeting.

Minutes of the Forty-Second Annual General Meeting of the Royal Society of Chemistry Historical Group

Held at Burlington House, London, at 12.20 pm on Wednesday 18 October 2017.

1. Apologies for absence: Received from Professor Jack Betteridge and Dr Gerry Moss.

2. Minutes of AGM at Burlington House, Wednesday 19 October 2016. Having been published in the Newsletter, these were accepted as a true record without amendment.

3. Matters arising from the minutes: None.

4. Reports:

a) Chairman's Report (Dr John Hudson): Dr Hudson reported on another year of commendable activity by the Group, which included two Newsletters and three symposia. In May 2017, we held a meeting on Robert Woodward at Burlington House, London, and in July we had a joint two-day meeting with the Institute of Physics History Group on Rutherford's Chemists. Unfortunately, attendance at the latter had not been good. Shortly, we were to have our third meeting, on the theme of "Chemistry and anaesthesia – Some historical perspectives".

Dr Hudson reported that membership was good, with just under 700 members. He asked members to encourage any RSC members they knew who might be interested to join, as membership of up to three groups within the Society is free. Finally, he thanked the committee for their support over the past year.

In reply to questions, Dr Hudson agreed to contact the RSC about issues of non-communication with members, which might arise due to members ticking a box on the renewal form requesting no e-mail contact. He also explained that officers were elected by the committee, but if anyone would like to join the committee, they should contact him, and that joining could be arranged subject to normal RSC procedures.

b) Secretary's Report (Professor John Nicholson): Professor Nicholson had nothing to add.

c) Treasurer's Report (Dr Peter Morris): This had previously been published in the Summer Newsletter 2017 (Number 72) and showed that the Group's finances to be sound.

5. Any Other Business: None.

6. Date of next AGM: 17 October 2018, as part of our one-day symposium on the Life and Work of Sir Robert Robinson at Burlington House, London.

Editor's Note: The Robert Robinson meeting has subsequently been replaced with a meeting on The History of Dyes.

Accounts for RSC Historical Group for 2017

Receipts	£	£
RSC Deposit Account	23.42	
Annual Grant	1 995.75	
Meetings and Conferences	1 442.81	
Total Income	3 461.98	
Payments		
Meetings and Conferences		4 730.44
Committee Meetings		711.33
Committee Travel Expenses		1 429.61
Stationary and Postage		1 314.02
Total Expenditure		8 185.40
Surplus (Deficit) for the year		(4 723.42)
Summary		
Balance at 31st December 2016		11 053.38
Surplus (Deficit) for 2017		(4 723.42)
Balance at 31st December 2017		6 329.96
Cash at Bank		
Current (Bankline)		3 030.41
RSC deposit		3 299.55
Balance as at 31st December 2017		6 329.96

RSCHG NEWS

Message from the Retiring Chairman

My term as Chairman of the Historical Group finishes at the end of December 2018. Someone once said that if you are in charge of an organisation, however large or small, you have three main responsibilities. Firstly, you have to keep the show on the road. Secondly, you have to deal with crises. And thirdly, you should seek to expand the activities of the organisation where appropriate. Over the last four years the show has stayed on the road - the Group has continued to provide its members with an interesting and varied programme of symposia on a wide range of topics, and to produce a Newsletter of which we can be extremely proud. There have been no major crises – any problems that have arisen have been behind the scenes and have been successfully managed. As far as expanding the activities of the Group is concerned, we can list three examples. There has been an increase in the number of meetings with historical organisations outside the RSC (the History of Anaesthesia Society and the History Group of the Institute of Physics). A complete set of *Occasional Papers* published by the Group is now deposited at the Whipple Library in Cambridge, thus ensuring these contributions to historical scholarship will be preserved. Finally we have provided assistance on historical topics to the RSC when necessary, most significantly for the joint event with the Gesellschaft Deutscher Chemiker in October 2017. I hasten to add that I can claim very little personal credit for any of this – most of the work has been done by the Committee and other members of the Group, and I wish to express my gratitude to all those involved.

The next Chairman is Dr Peter Morris, a highly distinguished historian of chemistry with an international reputation. I am confident that under his Chairmanship the Group will be in good hands, and I wish him well.

John Hudson

Vacancy for Treasurer

At the end of the year Peter Morris will vacate his present position as Treasurer, and we are therefore looking for someone who will take on this task. The Treasurer has to be a member of the Historical Group Committee and must be an RSC member. None of the current members of the Committee are in a position to take on this role, and I am therefore appealing for someone willing to stand for election to the Committee, and if elected, act as Treasurer. Having previously been Treasurer myself, I can honestly say that the task is not onerous. We expect the Treasurer to attend Committee meetings (two per year at Burlington House), and ideally attend our symposia as well. At the symposia the Treasurer receives the expenses claims of the speakers and also collects the cash contributions of Committee members attending the lunch for the speakers. Aside from that the Treasurer pays the various expenses of the Group and prepares the annual financial return. If the Treasurer is unable to attend a symposium, another Committee member can deputise for her or him on that occasion. It is essential that the Group finds a new Treasurer, so if you are at all interested, please give the matter serious thought. If you have any questions about the role and duties of the Treasurer, please contact either Peter Morris (doctor@peterjtmorris.plus.com) or myself:
(johnhudson25@hotmail.com) by email.

John Hudson

New RSCHG Wheeler Lecture Published Online

Since 1997 the Royal Society of Chemistry Historical Group have published Occasional Papers, which are the texts of lectures given by notable historians of chemistry to the Group. From occasional paper number three, published in February 2003, the papers record almost all of the Wheeler Lectures given to the Group. In June 2018, Jeffrey I. Seeman's Wheeler Lecture *Woodward's Unpublished Letters: Revealing, Commanding and Elegant. Part 2*, was published in hard copy and online. The paper presents a collection of excerpts from letters written by R. B. Woodward to his friends, colleagues and others. These are representative of his lengthy correspondence and illustrate many aspects of his personality and philosophies of life.

In addition to Jeff Seeman's paper, Peter J.T. Morris, *Robert Burns Woodward in His Own Words* (April 2017); Anthony S. Travis - *Nitrogen, Novel High-Pressure Chemistry, and the German War Effort (1900-1918),* (April 2015) and Frank A.J.L. James - *'the first example … of an extensive scheme of pure scientific medical investigation': Thomas Beddoes and the Medical Pneumatic Institution in Bristol, 1794 to 1799,* (November 2016) have been published as PDFs, and copies can be downloaded from the following websites:
http://www.rsc.org/Membership/Networking/InterestGroups/Historical/occasional-papers.asp
http://www.sbcs.qmul.ac.uk/rschg/

The first six Occasional Papers by Mary Archer, Robert G.W. Anderson, Seymour H. Mauskopf, David Knight, William H. Brock, David Knight and Colin A. Russell are currently only available in hard copy and can be found in the Royal Society of Chemistry Library, the British Library and the Whipple Library. It is hoped they will all be available online in due course.

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.

Bill Griffith's *Published Histories of British and Irish Chemistry Departments* has now appeared on the group's RSC website (www.rsc.org/historical) under Downloadable Files. An earlier version was published in the Winter 2015 *Newsletter* (issue 67, pp. 5-7 online, pp. 8-12 hard copy); in that Bill asked for comments or corrections and these now appear on the current website version. If anyone has any corrections or additional items to add, please let Bill know (w.griffith@ic.ac.uk) and he'll make sure that the necessary amendments are made.

Anthony S. Travis, *Nitrogen Capture: The Growth of an International Industry (1900-1940),* (Springer, 2018). Pages: XXI, 411, 69b/w illustrations, 48 colour illustrations.

This monograph provides an account of how the synthetic nitrogen industry became a forerunner of the twentieth-century chemical industry in Europe, the United States and Asia. Based on an earlier Springer Brief by the same author, which focussed on the period of the First World War, it expands considerably on the international aspects of the development of the synthetic nitrogen industry in the decade and a half following the war, including the new technologies that rivalled the Haber-Bosch ammonia process. Travis describes the tremendous global impact of fixed nitrogen (as calcium cyanamide and ammonia), including the perceived strategic need for nitrogen (mainly for munitions), and, increasingly its role in increasing crop yields, including in Italy under Mussolini, and in the Soviet Union, under Stalin. The author also reviews the situation in Imperial Japan, including the earliest adoption of the Italian Casale ammonia process, from 1923, and the role of fixed nitrogen in the industrialization of colonial Korea from the late 1920s. Chemists, historians of science and technology and those interested in world fertilizer production and the development of the chemical industry in the first four decades of the twentieth century will find this book of considerable value.

Chris Cooksey, "Quirks of dye nomenclature. 10. Eosin Y and its close relatives", *Biotechnic & Histochemistry*, http://dx.doi.org/10.1080/10520295.2017.1413207

The long history of eosin Y, eosin B and the methyl and ethyl eosins is recounted as well as their synthesis, the variety of their molecular species and some of the myriad applications of these dyes.

Chris Cooksey, "Recent advances in the understanding of the chemistry of Tyrian purple production from Mediterranean molluscs", in *Treasures from the Sea; Sea Silk & Shellfish Purple Dye in Antiquity,* in Hedvig Landenius Enegren and Francesco Meo (eds.), (Oxford & Philadelphia: Oxbow Books, 2017), pp. 73–78. Proceedings of a conference in Lecce, Italy, May 2013.

PUBLICATIONS OF INTEREST

Rutherford's Chemists

Following the joint meeting held with the Institute of Physics, History of Physics Group in July 2017, a special issue of the History of Physics Group's newsletter has been published. The newsletter contains the papers given by four of the speakers at the meeting: Linda Richards, Pierre Radvanyi, Siegfried Niesse and Neil Todd.
http://www.iop.org/activity/groups/subject/hp/newsletter/file_71517.pdf

***Mitteilungen GDCh-Fachgruppe Geschichte der Chemie*, Nr 25. Gesellschaft Deutsche Chemiker: Frankfurt. 2018. 366pp, illus. ISSN: 0934-8506**

Professor Christoph Meinel (Regensburg) has edited this membership journal of the German Chemical Society's History Division since 1988, having copy-edited and typed out each annual issue on his own computer. With this twenty-fifth bumper issue of over 300 pages he leaves the editorial chair in good hands. Apart from two articles in English, the majority (twelve) of the fully-referenced essays are written in German, but in most cases accompanied by English abstracts. Early modern historians will find here studies of Joachim Tancke (1857-1609), the iatrochemical publisher (and possibly real author) of Basil Valentine's *Triumphal Chariot of Antimony* (1604), and a study of the alchemical correspondence between Fredrich I of Sachsen-Gotha-Altenburg and a captain of his cavalry; the eighteenth-century historian is served by a study of the emerging German cyanide industry, and a study of Swedish agricultural chemistry established by Wallerius. The nineteenth-century historian is also well served by studies of Kolbe's revision of Berzelius's radical theory of organic chemistry, the development of the contact process for manufacturing sulfuric acid in Germany, and a modern chemical study of samples of Scottish Turkey-red dyestuffs. And finally, for twentieth-century historians, there are essays on German research on radioactivity, Ostwald's voluminous correspondence, the German plastics industry, and a detailed examination of Wilhelm Traube's synthesis of purines.

However, the two highlights for Anglo-historians are undoubtedly the major illustrated study by Christine Nawa of the third chemistry laboratory to be built at the University of Tübingen in 1846; and the publication of the annual Paul Bunge Lecture for 2016 by Robert Anderson, CEO of the Science History Institute in Philadelphia and former Chairman of SHAC. Anderson asks polemically, "Where has all the Chemistry gone?" from the world's science museums. It is an essay that must be read by all chemist historians and historians of chemistry.

The volume is freely available electronically at: www.gdch.de/netzwerk-strukturen/fachstrukturen/geschichte-der-chemie/mitteilungen-der-fachgruppe-online.html.

William H. Brock

The Life of William Nicholson (1753-1815) – A Memoir of Enlightenment Commerce, Politics, Arts and Science edited by Sue Durrell, Peter Owen, 2018

"The true origin of all that has been done in electro-chemical science was the accidental discovery of Messrs Nicholson and Carlisle, of the decomposition of water by the pile of Volta, 30 April 1800".

Humphry Davy, Bakerian Lecture, 1826

In the autumn of 1799, William Nicholson opened a Scientific and Classical School at his home in Soho Square, number 10, across the square from Sir Joseph Banks and around the corner from his good friend Dr Anthony Carlisle.

It was here that, with Carlisle, Nicholson famously decomposed water into hydrogen and oxygen using the process now called electrolysis.

In his memoir of his father, Nicholson's eldest son (also called William) remembers bringing the washing basin to the front room, how Carlisle had been attending one of his sisters and how the Voltaic pile had been borrowed from William Stodart (patentee of the upright piano) whose sons attended the school. It is a wonderfully human scene, combining domesticity with medical, musical and chemical skills.

From the account of *The Life of William Nicholson, by his Son,* recently published 150 years after it was written in 1868, it seems that Nicholson's life was a series of very happy coincidences bringing him into contact with many of the most famous characters from the second half of the eighteenth century.

His circle included the radical liberals Joseph Johnson, Thomas Holcroft, William Godwin and Mary Wollstonecraft; industrial pioneers Josiah Wedgwood, Matthew Boulton, Jabez Hornblower and Richard Trevithick. His scientific associates included Richard Kirwan, Friedrich Accum and Humphry Davy, establishment figures Sir Joseph Banks, Count Rumford, the Earl Dundonald and the "half-mad Lord" the 2nd Baron Camelford.

Nicholson is well known among historians of science for *A Journal of Natural Philosophy, Chemistry and the Arts* which ran between 1797 and 1813 and was the first monthly scientific journal in Britain, revolutionising the speed at which scientific information could spread. Nicholson's works were extensive, including two dictionaries of chemistry and several translations of the French chemists. Aside from publishing, he earned a living from work as one of the earliest patent agents and later as a civil engineer.

There is much in this memoir that will be of interest to historians of literature, commerce and inventions, as well as to historians of science and the Enlightenment. Frank A.J.L. James of UCL and the Royal Institution has contributed the Afterword "Locating William Nicholson" placing Nicholson's "critically important contributions" in the context of revolutionary Enlightenment – positing one theory why Nicholson was never made a fellow of the Royal Society.

A full list of Nicholson's publications and inventions can be found in *The Life of William Nicholson, by his Son,* (£13.99). Free postage and packing is offered to members of the RSCHG when purchasing direct from www.PeterOwen.com. Simply use the Coupon code "1753-1815" in the shopping cart before proceeding to checkout.

For more information on William Nicholson, see www.NicholsonsJournal.com or you can follow him on Twitter @Wm_Nicholson.

***Ambix* – The Journal of the Society for the History of Alchemy and Chemistry**

Contents of Recent Issues

November 2017, volume 64, issue 4 – 80th Anniversary Issue

Jennifer M. Rampling, "The Future of the History of Chemistry".

Stephen T. Irish, "The Corundum Stone and Crystallographic Chemistry".

Matteo Martelli, "Translating Ancient Alchemy: Fragments of Graeco-Egyptian Alchemy in Arabic Compendia".

Angela N.H. Creager, "A Chemical Reaction to the Historiography of Biology".

Hasok Chang, "What History Tells Us about the Distinct Nature of Chemistry".

To commemorate eighty years of *Ambix* this issue is available free online for all to access until the end of 2018. Please visit:
https://www.tandfonline.com/toc/yamb20/64/4?nav=tocList

February 2018, volume 65, issue 1 – Special Issue Paper Tools from the 1780s to the 1960s.

Mary Jo Nye and Stephen Weininger, "Paper Tools from the 1780s to the 1960s: Nomenclature, Classification, and Representations".

Wolfgang Lefèvre, "The *Méthode de nomenclature chimique* (1787): A Document of Transition".

Michael D. Gordin, "Paper Tools and Periodic Tables: Newlands and Mendeleev Draw Grids".

Stephen J. Weininger, "Delayed Reaction: The Tardy Embrace of Physical Organic Chemistry by the German Chemical Community".

Evan Hepler-Smith, "Paper Chemistry: François Dagognet and the Chemical Graph".

May 2018, volume 65, issue 2

Ignacio Suay-Matallana and Ximo Guillem Llobat, "Poisoned Wine: Regulation, Chemical Analyses, and Spanish-French Trade in the 1930s".

Mike A. Zuber, "The Duke, the Soldier of Fortune, and a Rosicrucian Legacy: Exploring the Roles of Manuscripts in Early-Modern Alchemy".

Andrei Vinogradov and Stanislav Petriashin, "Chemical Industry, the Environment, and Russian Provincial Society: The Case of the Kokshan Chemical Works (1850–1925)".

Amy Fisher, "Robert Hare's Theory of Galvanism: A Study of Heat and Electricity in Early Nineteenth-Century American Chemistry".

Articles on History of Chemistry that you Might Otherwise Miss

Robert Lancashire, "Jamaican chemists in early global communication", *Chemistry International*, April-June 2018, pp. 5-11. An illustrated article on Liebig's Jamaican pupils Edward Turner, Wilton George Turner, and John Blyth, and their roles in translation and textbook writing.

Christoph Meinel, "Prominent positioniert", *Nachrichten aus der Chemie*, 66 (April 2018), 437-39 (in German). An illustrated article on the curious history of a bust of A.W. Hofmann that originally was one of a set of thirty-two figures at the entrance to Berlin's Tiergarten erected in October 1903 to commemorate Kaiser Friedrich III and his English Empress Viktoria (Queen Victoria's daughter) and Prussian culture. Severely damaged during the Second World War, Hofmann's bust is one of the few pieces to survive and can now be seen at the Spandau Citadel.

William H. Brock

Former Ashgate Titles

Many expensive Ashgate books of interest to historians of chemistry in the "Science, Technology & Culture 1700-1945" series are now available as cheaper paperbacks from Routledge. Bill Brock's *William Crookes (1832-1919) and the Commercialization of Science* (2008) is, for example, now available at the price of £39.99 compared with the hardback which is ridiculously priced at £120.00. Some of Ashgate's Variorum volumes may also be available for example David Knight's *Science in the Romantic Era* (1998) has been reissued in Routledge's Romanticism series. But, probably most are still hardbacks at £105.00 (like Bill Brock's *Science for All*).

SOCIETY NEWS

British Society for the History of Pharmacy

The archive of the *Pharmaceutical Historian*, from 1967 to the end of 2016, published by the British Society for the History of Pharmacy, has been digitised and is available on an open access basis. The work has very generously been carried out by the Technical University of Brauschweig and can be accessed at

https://publikationsserver.tu-braunschweig.de/receive/dbbs_mods_00065362?lang=en

All issues from the start of 2017 are available as open access PDFs through Ingenta Connect.
http://www.ingentaconnect.com/content/bshp/ph

Society for the History of Alchemy and Chemistry: Morris Award 2018

The Society for the History of Chemistry wishes to announce that the Morris Award for 2018 has been given to Yasu Furukawa for his outstanding work on the history of chemistry and its relationship with the chemical industry, specifically for *Inventing Polymer Science: Staudinger, Carothers, and the Emergence of Macromolecular Chemistry* (1998) and *Chemists' Kyoto School: Gen-itsu Kita and Japan's Chemistry* (2017). There is a unifying theme to Yasu's scholarship across *Inventing Polymer Chemistry*, the *Chemists' Kyoto School* and other publications, including his *Social History of Science*. His work is in part an exploration of relationships between industrial applied chemistry and fundamental theoretical chemistry.

In addition to his publications, Yasu Furukawa has given great service to the history of chemistry community. He was the editor of *Kagakushi* (Journal of the Japanese Society for the History of Chemistry) for five years and the president of the Japanese Society for the History of Chemistry for six years up to 2016. Internationally, he has also served on Commission on the History of Modern Chemistry and played an important role in organising some of its sessions. Yasu Furukawa took his PhD in the history of science at the University of Oklahoma in 1983 with a thesis entitled "Staudinger, Carothers, and the Emergence of Macromolecular Chemistry". He was a professor at Nihon University, one of Japan's largest private universities, for fourteen years until his recent retirement.

The Morris Award is given every three years for outstanding scholarly work in either the history of chemical industry or the history of chemistry since 1900. The recipient of the award is given £300 and a framed picture or document. They give the Morris Award Lecture at an appropriate meeting and this is usually published in *Ambix*. Previous holders of the award are Ray Stokes (2009), Mary Jo Nye (2012) and Anthony Travis (2015).

SHORT ESSAYS

Creative Chemistry for Industry: Two Anniversaries

This is a year of two chemical anniversaries, each of which led to an impressive story of invention and innovation connected to major eras of technological transition for the chemical industry: the 150th anniversary of the synthesis of alizarin; and the centenary of the 1918 Nobel Prize in Chemistry, awarded (in 1919), for the synthesis of ammonia, to the leading physical chemist Fritz Haber. It is also the 150th anniversary of Haber's birth.

The synthesis of the red dye alizarin, which occurs in the root of the madder plant, was achieved early in 1868 by Carl Graebe and Carl Liebermann, assistants of Adolf Baeyer in Berlin. The significance at the time was the tremendous importance to the European textile industry of the natural dye, second only to indigo. During 1869-1870, as an outcome of its synthesis, alizarin was manufactured on a vast scale in Britain and Germany, at a stroke wiping out much of the cultivation and trade in the natural dye.

The success of alizarin stimulated studies into the chemical constitutions and molecular structures of both natural and synthetic dyes. In 1868, alizarin was found to be a dihydroxyanthraquinone (a derivative of the aromatic compound anthracene). However, at that time only its partial structure could be determined. The elucidation of the complete structure of alizarin became a challenging research topic, characterised by scientific rigour and experimentation. The modern structure was published in 1874 in a paper co-authored by the academic chemist Adolf Baeyer (then at Strasbourg) and the industrial chemist Heinrich Caro at BASF of Ludwigshafen. This achievement drew on, and in many ways reinforced, the acceptance of Kekulé's six-membered benzene ring, and contributed to the development of organic synthesis and structure determination. It was the main stimulus for the emergence of the science-based synthetic dye industry, far more so than the invention and production of so-called aniline dyes. Thus the *Journal of the Society of Arts* reported, on 5 June 1874, that while aniline production was increasing it "is almost put in the shade by the gigantic trade in artificial alizarin". The new approach to science-based discovery based on aromatic compounds was diffused widely, at least in Germany and Switzerland. In 1883, Baeyer (then at Munich) revealed the structural formula of indigo.

By then, Germany practically dominated the industry of making synthetic dyes. Success relied on the opening of dedicated research laboratories, and collaborations between industry and technical institutes. In 1897, the German firms BASF and Hoechst commenced the manufacture of synthetic indigo, which within a few years displaced the blue natural colorant imported into Europe from India.

By around 1900 the dye-making companies were engaged in diversification, mainly into pharmaceuticals, photo products, and, especially, nitrogen fixation for production of fertilizer. BASF backed Fritz Haber, at Karlsruhe, who, in 1909, jointly with his English research assistant Robert Le Rossignol, achieved the difficult synthesis of ammonia from its elements in a steel bomb by subjecting the nitrogen-hydrogen gas mixture to high pressures and temperatures in the presence of a catalyst. Since the yield was low, no more than five per cent, they came up with a solution to increasing the overall output of ammonia: the apparatus was designed to recirculate unreacted gases. This became the basis of a manufacturing process, developed by Carl Bosch and his team at BASF. It was inaugurated in September 1913. The synthetic ammonia was converted into the nitrogen fertilizer ammonium sulphate. The process proved its worth during World War I after Germany was denied access to Chilean nitrate late in 1914, and most especially with the creation of the total war economy in 1916. Synthetic ammonia was converted into nitric acid, essential to the production of explosives.

When in 1919, the Swedish Royal Academy announced recipients of the 1914-1919 Nobel Prizes, Fritz Haber was included among the five German laureates. Haber received the 1918 chemistry prize for the ammonia synthesis. What by then was known as the Haber-Bosch process became the principal driver of new technologies introduced into the chemical industry between 1920 and the late 1930s. Today, the statistics suggest, half of global agricultural productivity is achieved with the aid of nitrogen-based fertilizers that arise from applications of Haber's method; it was arguably the greatest innovation of the twentieth century. On the darker side, Haber, is closely associated with the first large scale and effective use of a toxic agent in warfare, directed at the trenches and dugouts of Flanders (1915). As a consequence, he remains a controversial figure.

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The RSC and SCI Joint Colloids Group's Three Awards: the Legacies of Graham, McBain and Rideal

Introduction

Thomas Graham
(1805-1869)

William McBain
(1882-1953)

Sir Eric Rideal
(1890-1974)

The UK Joint Colloids Group (JCG) is a joint working group of the Royal Society of Chemistry's Colloid and Interface Science Group and the Society of Chemical Industry's Colloid and Surface Chemistry Group. The JCG committee administers three joint RSC/SCI awards. These awards recognise and honour current outstanding researchers in the subject, at varying stages of their careers: the Thomas Graham Lecture for persons in mid-career, the McBain Medal for early-stage researchers and the Sir Eric Rideal Award and Lecture for life-time achievement.

Thomas Graham, James William McBain and Sir Eric Rideal are three of the "big names" in the history of colloid and interface science in the UK. They were the leading lights in the establishment of three pioneering academic centres of research in this subject: University College London (UCL), Bristol University and Cambridge University, respectively.

The purpose of this article is to discuss the contributions to colloid and interface science made by Graham, McBain and Rideal, at their respective institutions, and to describe briefly how research in this field continued at each of these major centres in their wake.

Thomas Graham and University College London

Thomas Graham was born in Glasgow in 1805 and educated at Glasgow High School. He enrolled at the University of Glasgow in 1819, to study chemistry, receiving his MA in 1824. He subsequently studied medicine at the University of Edinburgh and then taught chemistry at different institutions in Scotland, before moving in 1837 to University College, London (UCL, founded in 1826) as professor of chemistry [1]. He was a founder member of the Chemical Society of London in 1841 and indeed its first President. In 1855 he was appointed *Master of the Mint*, a prestigious position, founded in 1331 and held previously by other scientists such as Sir Isaac Newton and Sir John Herschel. When Graham died in 1869, the position was abolished and subsequently taken over by the Chancellor of the Exchequer. Graham was buried in Glasgow Cathedral. He did not marry and had no children.

Graham's most important contributions to science were made at UCL. He was the first person to study diffusion and effusion in the gas phase, as well as diffusion in solution. He invented the dialysis technique, based on the concept of diffusion of solutes through a porous membrane. He classified substances into two types: "crystalloids", substances (such as sugar) that pass through a porous membrane, and "colloids", substances (such as gelatin, glue and starch) that do not. Since it was Graham, in 1861, who coined the term "colloid", he is widely regarded as the principal "founding father" of colloid science.

A few years later, in 1864, Graham noted "the power possessed by salts of destroying colloidal solutions", i.e. the process we would now call "coagulation". In that regard, he was not the first person to make this observation. In 1847, Francesco Selmi, at the University of Modena in Italy had made the first systematic studies of inorganic and their coagulation by added salts. Also, in 1857, Michael Faraday (1791-1867), at the Royal Institution in London, had reported his classical investigation of the colour changes that gold sols undergo (red to blue) on adding salts to induce coagulation. Graham's work on coagulation was followed up at UCL, from about 1892 by Ernest Linder and Harold Picton. They were particularly interested in the role that surface charge of the particles played [2].

The next major developments in colloid and interface science at UCL came when Frederick George Donnan was the Professor of Physical Chemistry (1913-1937). He succeeded Sir William Ramsay at UCL. Donnan himself is best known for establishing the equilibrium potential (the "Donnan potential") which exists across a semi-permeable membrane separating two electrolyte solutions, one of which contains dispersed colloidal particles, which cannot pass through the membrane. In this respect, Donnan's work follows on directly from Graham's earlier ideas on diffusion across membranes. Donnan must also take credit for appointing at UCL a number of scientists who went on themselves to make major contributions to colloid and interface chemistry, in particular, E.K. Rideal (who went to Cambridge), W.E. Garner (who moved to Bristol), N.K. Adam (who moved to Southampton), G.S. Hartley (who was the first to postulate the spherical structure of surfactant micelles, following McBain's pioneering work) and Herbert Freundlich (at that time a refugee from Germany, who subsequently moved to Minnesota in the US). Joseph Kitchener, who was a research student at UCL in Donnan's time, was later appointed to the staff of Imperial College, London, where he established a world-famous school of research in surface chemistry, initially in the physical chemistry department and then in the Department of Mining and Mineral Technology.

The tradition of research in interfacial chemistry at UCL was continued during the second half of the twentieth century by such renowned men as Ken Ives and John Gregory, working more on the engineering aspects of processes such as filtration, flotation and flocculation. More latterly, it has been continued by others such as David Williams, who held the Thomas Graham Chair of Chemistry at UCL (1991 to 2002), and who worked on the surface chemistry of semi-conductors and sensors, and on interfacial electrochemistry.

McBain and Bristol University

University College Bristol (UCB) was founded in 1876, with E.A. Letts, an organic chemist, appointed as the first professor of chemistry. He was succeeded in 1880 by William Ramsay. Ramsay was not really a surface chemist, *per se*, but one of his research projects was concerned with the adsorption of dyes onto wool; this arose through his association with several of the wool processing companies in the south west of England. In 1887 Ramsay moved to UCL, where he began the research which led to the award of the Nobel Prize for his discovery of the inert gases.

UCB became the University of Bristol, in 1909, upon receiving its royal charter. Since 1906, until the present day, there has been ongoing research activity in colloid and surface science. It commenced with the appointment that year of James William McBain as lecturer in physical chemistry. McBain was born in New Brunswick in 1882, and went to the University of Toronto, gaining an MA in chemistry and mineralogy in 1904. He then went to Germany to extend his research experience. He went first to work with Professor Luther at the University of Leipzig. At that time the university had on its staff two men who became "giants" of surface and colloid science in Germany: Wolfgang Ostwald and Herbert Freundlich. McBain then moved to Heidelberg University to work with Georg Bredig. There, significantly, he met Friedrich Krafft who had been the first person to report the anomalous colligative properties of dilute soap solutions in water, although he did not offer any satisfactory explanation at that time.

When McBain first came to Bristol he worked on a variety of topics, including silver-tin alloys, the effects of adding dye molecules to a silver iodide sol (clearly of significance in the wet photographic process), and the effects of adding small amounts of albumin to a ferric hydroxide sol. However, he soon turned his attention to the study of soap solutions. He undoubtedly drew on his first-hand knowledge of the earlier work of Krafft in Heidelberg, and on the experience of an organic chemist at Bristol, Professor Francis Francis, who had shown how to purify fatty acids. In 1919 McBain was appointed to the Leverhulme Chair of Physical Chemistry, which was created for him, largely to fend-off an approach by his old *alma mater*, the University of Toronto, to recruit him. McBain's work on soap systems was well known to the Lever Bros. company. The Leverhulme chair was destined to become the established physical chemistry chair in the area of colloid and surface chemistry at Bristol.

McBain first described his experimental work on the association of soap molecules (such as sodium oleate and sodium palmatate) in solution at a meeting of the Faraday Society in London in 1913. He showed that a discontinuity occurred in plots of the electrical conductance as a function of concentration, leading to the idea that such molecules associated in solution at concentrations greater than a critical concentration (which we would now recognise as the critical micelle concentration) [3].

In 1926 McBain was finally tempted back to North America, to Stanford University. He published more than 450 scientific papers and two major textbooks: *The Sorption of Gases and Vapours by Solids* (1932) and *Colloid Science* (1950).

In 1927 William Ernest Garner, from UCL, was appointed to the Leverhulme Chair in Bristol. He was responsible for major advances in the surface chemistry of solids and in heterogeneous catalysis. Two of his research students in Bristol went on to found schools of surface and colloid science in other universities: Dan Eley at Nottingham (in 1954) and Frank Stone at Bath (in 1972). When Garner retired in 1954, Douglas Everett became the third Leverhulme Professor in Bristol. He made major contributions in applying thermodynamic concepts to the adsorption onto (porous) solids from the gas phase and from solution. Everett was also responsible for establishing, in 1964, the first postgraduate (MSc) course, by advanced study and research, in colloid and surface chemistry. To this end he brought Ron Ottewill from Cambridge to set up the course. Although, his research work was multi-facetted, Ottewill's principle research interest was in applying scattering methods (light and neutron) to studying interparticle interactions in, and the structure and properties of, concentrated, monodisperse colloidal dispersions. In 1982, Ottewill became the fourth holder of the Leverhulme chair. He was succeeded by Brian Vincent (in 1992) and then Terry Cosgrove (in 2008), as the fifth and sixth holders of this chair.

Rideal and Cambridge University

Although the strong reputation of the Cambridge school in colloid and interface science largely stems from the enormous contributions made by Sir Eric Rideal and his group, the origins *per se* of research in colloid science in Cambridge can be traced back to another, earlier great Cambridge scientist, Sir William Bate Hardy (1864-1934). Hardy was essentially a physiologist, whose primary interests were concerned with the properties of biological cells, particularly cell division; he thought that colloid science might help in understanding this process. However, he also made a major contribution to the study of the coagulation of colloidal dispersions.

Eric Rideal, born in Dulwich, was the son of a consulting chemist [4]. He was educated at Oundle School and from there he won a scholarship to Trinity Hall, Cambridge, from where he graduated in 1910. He then went to Bonn, Germany for his PhD. In 1913, he returned to England to work with his father. He joined the Royal Engineers in the First World War and was injured in the Battle of the Somme in 1916. He returned home and after the war joined Donnan's lab at UCL, where his lifelong interest in catalysis began. In 1918 he moved to the University of Illinois, where he met Irving Langmuir. He also met Hugh Taylor at Princeton, then the world's leading authority on catalysis. With Taylor, he wrote his first book: *Catalysis in Theory and Practice*.

In 1920 Rideal returned from the USA to a fellowship at his old college in Cambridge and the Humphrey Owen Jones lectureship in physical chemistry. Co-workers of Rideal during that period included R.G.W. Norrish, J.K. Roberts, V.K. La Mer and C.P. Snow. Rideal was appointed Professor of Colloid Physics in Cambridge in 1930 and in 1931 founded the famous "Colloid Science Laboratory" in Free School Lane [5]. Many well-known surface scientists worked with Rideal in that laboratory over the next 15 years. To pick out a few: Frank Bowden (who pioneered work on friction and lubrication), Jack Schulman (who discovered transparent microemulsions; Harry Melville (who moved to Birmingham University); Geoffrey Gee (who, after a period in industry, moved to Manchester University, where he developed its polymer group); A.S.C. ("Soapy") Lawrence (who moved to Sheffield University); Frederick Eirich (who moved to Brooklyn Polytechnic, New York, and became an authority on rheology); A.E Alexander (who returned to Sydney University, to launch the famous colloid school there); Sam Levine (a theoretician, who moved to Manchester University); Dan Eley (who moved to Bristol University – see earlier); and Charles Kemball (who moved to Queens, Belfast and then to Edinburgh University).

In 1946 Rideal left Cambridge for the Royal Institution in London. He was succeeded as the Humphrey Plummer Professor of Colloid Science in Cambridge, by Francis Roughton. Like Hardy earlier, Roughton was primarily a physiologist with interests in physical chemistry.

However, Jack Schulman continued the mainstream surface chemistry research and in 1959 his group moved to a new, second location, the Ernest Oppenheimer Laboratories on Madingley Road. One of his assistants there was Brian Pethica (who went on to head-up the Unilever research laboratories at Port Sunlight). Schulman departed for Columbia University, New York, in 1957.

Another key member of staff in the Free School Lane laboratory, during Roughton's time, was Paley Johnson, who completed his PhD under Rideal during the Second World War. He developed a strong interest in applying physical techniques, such as ultracentrifugation and light scattering, to studying biological systems. Ronald Ottewill worked with him, as a Nuffield Fellow, from 1952 on antibody-antigen interactions, before Ottewill turned his interests to mainstream colloid science following six months in Theo Overbeek's lab in Utrecht. Ottewill moved to Bristol in 1964, the year that Roughton retired. Paley Johnson continued at Cambridge and it seemed natural that he would be the next head of the colloid science group. However, university politics intervened, and the Department of Colloid Science was closed. Johnson's group moved to the Department of Biochemistry until his retirement in 1984. However, colloid and interface science research continued in the newly established Department of Biophysics, led by Dennis Haydon, who in 1980 was appointed Professor of Membrane Physics, the post he held until his premature death in 1988. One of Haydon's co-workers was Bob Aveyard. In 1972, Bob moved to the University of Hull, where he founded its famous, ongoing school of surface and colloid science.

David Tabor (like Hardy earlier, a fellow of Gonville and Caius College) was appointed Reader in Physics in 1964 at the Cavendish Laboratory in Cambridge, and then Professor in 1973, until his retirement in 1981. He strongly developed the earlier work of Bowden in Cambridge on the friction between solid surfaces, and really was the person who should be credited with the invention of the modern "surface forces apparatus", now widely used for measuring both the normal and the lateral (frictional) forces between two surfaces close to contact.

In 1972 research at Cambridge (especially theoretical work) in soft matter physics (which incorporates many aspects of colloid science) received an enormous boost when Sam Edwards (also a fellow of Gonville and Caius College) was appointed John Humphrey Plummer Professor of Physics (and then Cavendish Professor of Physics in 1984, until his retirement in 1995). He led a powerful, world-renowned research group, which continues to this day with former protegeés such as Athene Donald and Mark Warner. Other current, world-renowned scientists in soft matter, who have passed through the Edwards group in Cambridge, are Michael Cates (who moved to Edinburgh, but is now back in Cambridge), Tom McLeish (who went to Sheffield, then Leeds and now at York), Richard Jones (who went to Sheffield), Colin Bain (who moved to Oxford, then to Durham), Robin Ball (now at Warwick) and Joe Keddie (now at Surrey).

Conclusions

Colloid and interface science research in the UK is alive and well and spread over many universities, although to some extent these days, perhaps somewhat "hidden" within more fanciful, "modern" research topics, such as "nanoscience" or "soft matter". As I have tried to demonstrate in this article, many of the current UK research centres within the family-tree of colloid and interface science, can trace their roots back to three, long-standing research centres: University College London, Bristol University and Cambridge University, whose own foundations will always be associated with the names of three men: Thomas Graham, James William McBain and Sir Eric Rideal, respectively.

Finally, I should state that, in a short, *historical* article of this nature, I have not been able to mention many of the excellent *current* UK research leaders in the field. If anyone should feel "aggrieved", then I apologise.

Acknowledgements

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Capsaicin

One highlight of a visit to Castle Ashby near Northampton in August 2017 was finding a greenhouse packed with many different varieties of chilli. The most notable property of this fruit is to deliver pain to mammals, including humans. Here, some of the key events in the long history of the component responsible are recounted.

Chillies belong to the genus *Capsicum*. The first recorded attempt to isolate the pungent principle in chillies was by Christian Friedrich Bucholz (1770–1818). Following several positions with apothecaries he moved to Erfurt in 1794 where he took over the pharmacy which was owned by his father. He was appointed Professor of Chemistry at Erfurt in 1809. He obtained an impure product in 1816 which he called *capsicin* [1]. Details of this early work may be conveniently found in a recent thesis [2].

In 1876 John Clough Thresh (1850–1932) announced that he had obtained a purer sample of the hot component of capsicum fruits and renamed it *capsaicin* [3]. The process was long and complicated. And not without risk: "Capsaicin is powerfully pungent, the most minute portion, if volatilised, causing severe fits of coughing". An improvement was soon reported – in the final steps, the crude capsaicin is extracted with petrol and the solution evaporated to give a residue which was dissolved in potassium hydroxide solution and carbon dioxide passed in whereupon the capsaicin was immediately precipitated [4]. Thresh's final contribution was presented to the Pharmaceutical Conference in 1877. Working on thirty pounds of cayenne pepper, he obtained a disappointingly low amount of capsaicin, 1 dram, "of perfectly pure crystalline material". Combustion analysis gave an estimated carbon and hydrogen content which suggested a chemical formula $C_9H_{14}O_2$, which appears as $C_6H_{14}O_2$ in the abstract [5]. But the formula is not correct –

Thresh did not appreciate that capsaicin contains nitrogen too. He moved on to other things, qualifying as a medical doctor in 1896, when he was awarded the gold medal for his M.D. thesis, and then spending twenty-two years as County Medical Officer of Health for Essex [6].

The next significant advance was made by Karl Micko, who worked at the Staatlichen Untersuchungsanstalt für Lebensmittel in Graz, in 1899. He obtained 5.5 g of crude capsaicin from 1 kg of cayenne pepper, found that the substance contained nitrogen, and determined the molecular formula to be $C_{18}H_{28}NO_3$ which was very nearly correct [7]. It should be $C_{18}H_{27}NO_3$. He also showed that the capsaicin molecule had one phenolic OH group and one methoxy group.

Before the structure of capsaicin was known with certainty, there was much interest in measuring the pungency of different capsicum species. Wilbur Lincoln Scoville (1865–1942) was professor at the Massachusetts College of Pharmacy between 1892 and 1904. He then moved to the Parke-Davis pharmaceutical company, retiring in 1934. In 1912, he devised a test, the Scoville Organoleptic Test, to measure the spiciness of various chilli peppers [8]. The procedure was to add 1.0 g of dry powdered chilli to 50 cm^3 of ethanol in a stoppered flask and stand for 24 hours. Then 0.1 cm^3 of the clear supernatant liquid was diluted with 140 cm^3 of 10% aqueous sugar solution and a sample tasted by a panel of five testers. The solution was diluted repeatedly and tested until the heat is not detected by three of the panel. The dilution factor endpoint is the Scoville heat unit, SHU. The larger the number, the hotter the chilli [9]. The hottest chilli grown in the UK, the Komodo Dragon, rates 1,400,000 SHU, the very hot Scotch Bonnet 350,000 SHU and the plain hot jalapeño pepper 3,500 SHU [10]. Bell peppers score zero and pure capsaicin 16,000,000. Since the 1980s, the preferred technique for determining the hotness is HPLC [11].

Elnathan Kemper Nelson (1870–1940) was born in Cincinnati and graduated with a BSc degree in chemistry at the University of Illinois in 1894. He moved on to work as a chemist in Chicago's packing house industries and as a private consultant. In 1909 Nelson joined the Bureau of Chemistry, part of the US department of Agriculture, in the essential oils laboratory, and remained in that field until his death, a few days before he was due to retire. Nelson found that the correct molecular formula for capsaicin was $C_{18}H_{27}NO_3$ in 1919, and suggested a partial structure, an amide of vanillyl amine with a non-linear decylenic acid [12]. Further progress was made when Nelson teamed up with L. E. Dawson of the Chemical Warfare Service. Because there was only a small amount of capsaicin available, they approached the problem by first reducing the double bond of capsaicin with hydrogen and a colloidal palladium catalyst, to give dihydrocapsaicin. They then made a number of 10-carbon carboxylic acids and converted them into the corresponding vanillyl amides. The carboxylic acid which gave dihydrocapsaicin was found to be 8-methyl-nonoic acid. The position of the double bond was determined by hydrolysing capsaicin and cleaving the resulting carboxylic acid with 5% aqueous $KMnO_4$ solution which gave a mixture of adipic acid and isobutyric acid. Consequently, it was shown that the carboxylic acid part of capsaicin was 8-methyl-6-nonenoic acid [13].

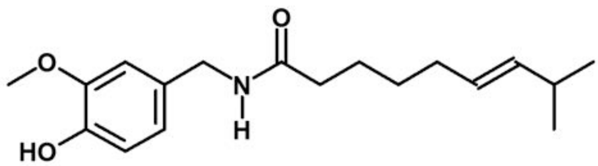

Fig. 1. The chemical structure of capsaicin.

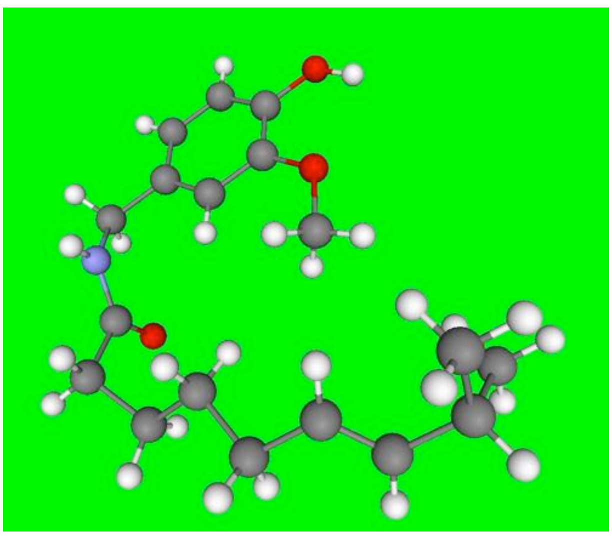

Fig. 2. The X-ray determined structure of capsaicin.

Coincidentally, in the same month, July, that the 1919 Nelson paper was published, Arthur Lapworth and Frank Albert Royle, at the University of Manchester, submitted a paper for publication in the Journal of the Chemical Society with the title "Capsaicin. Part I". By the time the paper was published, they had seen the Nelson paper and added a note to their paper proposing a different non-amide structure: “The present authors are not fully disposed to accept Nelson’s view of the constitution of capsaicin as final.” [14] “Capsaicin. Part II” never appeared.

Part of the reason that it took more than a century to elucidate the structure of capsaicin could be that there are other very similar hot components in chillies, known as capsaicinoids. The major one is dihydrocapsaicin. The minor ones are derived from capsaicin or dihydrocapsaicin by the addition of a CH_2 group to the chain, the *homo*- derivatives, or by the removal of a CH_2 group from the chain, the *nor*- derivatives. For example, see [15].

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Chris Cooksey

Some Thoughts on Henry Moseley: His First and Last Years

Birth and Background

Henry Gwyn Jeffreys Moseley was born on 23 November 1887 at 11 Wellington Terrace, Weymouth. Henry (Harry within family) Moseley had a uniquely aristocratic academic ancestry. His father and both grandfathers were scientific professors and elected Fellows of the Royal Society in their thirties. His father Henry Nottidge Moseley, Oxford Professor of Anatomy and Physiology, was elected FRS aged thirty-eight. His grandfathers, Henry Moseley Priest, Professor of Natural and Experimental Philosophy and Astronomy at King’s College, London, was elected FRS aged thirty-eight and John Gwyn Jeffreys, Oxford Professor of Conchology was elected FRS aged thirty-one. The Royal Society appeared unaware of this distinction because their records are kept by surname but they did mention two relatives for Darwin, Krebs and Braggs. Moseley’s father died when Henry was only three so he and his two sisters were brought up by their mother, initially at her sister’s house at Chilworth in Surrey.

Schooling

Moseley went first to Summerfields, an Oxford preparatory school focussing on entry to Eton College. He was awarded a Kings Scholarship (KS) to Eton which was honorary because of the family wealth. Eton has extensive records including the Science Society minute book. This contains handwritten descriptions of experiments performed by Moseley and inspired by Reverend Dr Thomas Porter, Head of Chemistry. The book mentions his exhibits on seahorses, Neolithic implements and a lantern lecture on Deep Sea Fauna and a lecture on phosphorers (perhaps today called phosphors). He was clearly an able, articulate, all round scientist.

In 1903 Moseley scored 104/140 so he was only runner up for the Chemistry Prize. However, he won both Chemistry and Physics Prizes in his final year [1]. His friend and rival Julian Huxley, another future FRS, had won the scholarship to Balliol so Moseley had to become (honorary again) Millard scholar next door at Trinity College. The family background and his academic ability suggested an outstanding scientific future.

Army 1914

Moseley volunteered for Army service contrary to the advice of Ernest Rutherford who believed that his scientific skills would benefit Britain more in a civilian military-oriented research role. His decision was probably influenced by Eton's military tradition. 1157 Etonians, almost all officers, were killed in World War I, the most of any school [2]. Their names are on the honours boards around the Memorial Cloisters at Eton and they include "Moseley 2nd Lt HGJ KS 1906".

His Final Year

Moseley took his invalid mother across Canada by rail and then on to Australia for the British Association for the Advancement of Science Meeting (the BAAS occasionally held its Annual Meeting in the Empire) where he described his recent researches. During August 1914, Britain declared war on Germany and he returned to England to enlist, taking part in the Gallipoli campaign.

First Lord of the Admiralty Winston Churchill regarded Turkey as "the sick man of Europe" among the Axis powers opposing Britain. Hence, he ordered a naval attack on their Dardanelles Straits and by land on the Gallipoli peninsula. An initial military stalemate ensued and a further landing in August 1915 was planned. Moseley's scientific skills meant he was made a Lieutenant in the Signals, then part of the Royal Engineers, with a role as a Communications Officer. He learnt 'modern' electrical techniques using Morse code in addition to traditional methods: flag waving, using the heliograph and telescope, where his science ability was less relevant. On 4 June 1915, before sailing from Avonmouth to the Mediterranean, Moseley mailed his latest key research results to his mother who forwarded them to Rutherford but their current whereabouts strangely remain unknown.

On 27 June 1915, at Alexandria, Moseley made a soldier's will, i.e. one made shortly before battle.

> I give and bequeath all my estate, real and personal (i.e. apparatus) ... to the Royal Society ... for furtherance of experimental research in Pathology, Physiology, Physics, Chemistry or other branches of science but not pure mathematics and astronomy ... which aim merely at describing, cataloguing or systematising.

On 7 August 1915 Moseley landed at Suvla Bay on the western Gallipoli coast. (Incidentally Clement Attlee was amongst other British officers in this landing.) The capture of high ground about five miles inland was crucial to taking the peninsula. On 10 August 1915, Moseley was telephoning headquarters for assistance when he was shot by a Turkish sniper. His 38th Infantry Brigade was decimated on the western slope of Chanuk Bair. Surely Moseley is among its 600 men buried at The Farm cemetery there. He is listed among those with no known grave at the memorial on the southern tip of the peninsula. A fellow officer present at his death wrote "In him the brigade has lost a remarkably capable signalling officer and good friend: to him his work always came first and he never let the smallest detail pass unnoticed".

After Moseley's Death

Various memorials exist by individuals in publications (for example Louis de Broglie, Ernest Rutherford, and Georges Urbain) and on buildings where he had worked. (Eton College, Manchester University and the Clarendon Laboratory.) Some abbreviated samples follow.

De Broglie stated in *Scientia* in 1920 that Moseley's law justifies Mendeleev's classification: it even accounts for the modifications needed to be given to the classification (author's translation) [3].

At Eton on the Science Department walls there are two carved stone tablets. The upper reads "H.G.J. Moseley (K.S. 1901-1906) began his study of physics in this laboratory. He was killed in the Gallipoli Peninsula on 10th August 1915. In his short life he gave to science the Discovery of the Atomic Numbers of the Elements". The other, by Porter's rival William Eggar and Head of Physics, is a poem referring to Moseley's work and death.

> *The rays whose path here first he saw*
> *were his to range in ordered law.*
> *A nobler law made straight the way*
> *That leads 'neath him a nobler ray*

Two quotes from non-scientific sources include Moseley's obituary in the *Eton College Chronicle* "frequently expounding scientific theories to a slightly unsympathetic audience of his contemporaries" [4] and in *The Times*, "the early death of this brilliant young physicist is a great loss to science" [5].

The Royal Society passed a special law for those killed in the Great War to overturn their rule that only obituaries of Fellows were published in their *Proceedings*. Rutherford wrote "This proof by Moseley will, in my opinion, rank in importance with the periodic law and of spectrum analysis, and in some respects is far more fundamental than either", "a born investigator", "a skilful experimenter", "equipped with good mathematical training" [6].

In *Nature*, Rutherford wrote “To use such a man as a subaltern is economically equivalent to using the liner Lusitania to carry a pound of butter a long distance” [7].

Moseley left £1799 6s 1d to the Royal Society which, with extra money from sale of his mother’s house Picks Hill in West Wellow, Hampshire, gave £10,000 which was used to create a research scholarship, the first two holders being H.R. Robinson and P.M.S. Blackett, former colleagues at Manchester University. (The author would be interested to know what happened to the scholarship afterwards.)

Moseley’s estate, a gratuity by royal warrant, plus an allowance for his unused tropical outfit, was valued at £64-3s-3d but reduced by £8-18s-6d as he had been paid a month in advance by the army but only served eleven days! [8]

Svente Arrhenius had nominated him for the Nobel Prizes in both chemistry and physics for 1915 but Nobel Prizes are not awarded posthumously.His mother successfully lobbied the War Ministry for the medals warranted by his service.

Many items and archives are owned by the Ludlow-Hewitt family, descendants of his sister Margery.

The author discovered a handwritten letter, dated March 1914 from Moseley to W.H. Bragg in which he details his recent work and its significance. It ends “Your offer to publish at the same time as us is most generous and Darwin and I gladly accept …. with the understanding (we) do not delay you” [9].

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6. *Proc. Roy. Soc.* A., No.665, 1917, **93**, xxii-xxviii.
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8. National Archives, Kew, Lieutenant Henry Gwyn Jeffreys MOSELEY. Royal Engineers, WO 339/32272, ref 60977.
9. WHB_4c_42_Royal Institution Miscellaneous Correspondence (Bragg Papers).

For further information please see Gordon Woods, “Henry Moseley: A Sad Loss to the World of Science”, *School Science Review,* December 2015, **97**, 359ff.

Gordon Woods

Recollections of a Reader: The Famous Echo in the Reading Room of the British Museum

In the 1950s Gerard Hoffnung, that wonderful cartoonist and humourist whose family had fled Germany to Britain in 1938 and who was later to be expelled from the Hornsey College of Art in London for bad behaviour, made a number of humorous presentations which were to become famous. In one of these, delivered at the Oxford Union in 1958, he listed some of the things that foreign visitors should remember on a visit to London. Four of these have become legendary: “On first entering a carriage on the London Underground it is customary to shake hands with all the other passengers in the carriage”; “It is easy to identify brothels in London because they all have a blue lamp outside them”; “Never attempt to tip a London taxi driver” and, perhaps most memorably, “Have you ever tried the famous echo in the Reading Room of the British Museum?”

Some years ago, just before the British Library moved from the British Museum to its new home in St. Pancras, I was working late on Newton’s alchemy. As the call came to vacate the Reading Room, it suddenly occurred to me that this was almost certainly my last opportunity to test Hoffnung’s thesis. Packing up very slowly I made sure that I was the last reader to leave that huge and glorious room. Near the printed catalogues, i.e. close to the centre of the room, I met one of the guards. “Do you mind if I check to see whether the Reading Room really does have an echo?” I asked him with a completely straight face. He looked at me rather strangely, hesitated for a moment, and then said “Well, all right …” Before he could change his mind, I clapped twice very sharply and let out a loud yell. To my great pleasure both produced the most magnificent echoes. Surprisingly, I was neither questioned nor detained by any of the other guards and, like the Ethiopian eunuch in the Book of Acts, I went on my way rejoicing. Not many day’s work end on such a high note, I reflected.

As I left I also couldn’t help wondering what another previous regular occupant of that great room, Karl Marx, would have thought if he had happened to observe the incident. I would like to think that even he, extremely serious as he was, would have managed a smile!

Anyway, I am sure that, up there where past great humourists gather, Hoffnung must have chuckled happily. The next time I visit London I must check Hoffnung’s advice concerning fellow travellers in railway carriages as well, of course, as buildings with blue lamps outside them.

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Peter Spargo

BOOK REVIEWS

Iwan Rees Morus (ed.), *The Oxford Illustrated History of Science* (Oxford: Oxford University Press, 2017, Pp. 436 ISBN 978-0-19-966327-9, £25 (hardback).

This claims to be the first fully illustrated global history of science from Aristotle to the atomic bomb and beyond. Its sweep is certainly majestic, with thirteen contributors from Europe, the USA and Canada.

There are two parts. Part I, "Seeking Origins", is broadly chronological, dealing with science in the ancient Mediterranean, ancient China, medieval Christian, Islamic and pre-modern East; it also contains essays on the scientific revolution and enlightenment science. Part II, "Doing Science" is broadly thematic, with six chapters on experimental cultures, exploring Nature, mapping the Universe, the meaning of life, theoretical aspects and the communication of science. There are no references, but extensive lists for further reading are provided for each chapter. There are some 150 illustrations of which about half are in well-reproduced vibrant colour, many full-page, consistent with the Editor's belief that science is a largely visual culture.

After a brief introduction, the first chapter has good sections on Egyptian and Babylonian mathematics; Greek natural philosophy with particular emphasis on planetary astronomy; cartography, mathematics, and Greek and Roman medicine. Ancient China follows with emphasis on cosmogony and medicine. The third chapter concerns medieval Christian and Islamic worlds – astrology, cartography, translations of early Greek work. Early universities, medieval science and religion, and the intertwining of Christian and Islamic cultures are covered; there are some ravishing illustrations. "Science in the Medieval East" deals with Chinese scientific matters during the Song, Yuan and Ming dynasties. The fifth essay, on the Scientific Revolution, covers the work of familiar Renaissance names such as Paracelsus, Copernicus, Harvey, Newton and many others. Part I concludes with the eighteenth century "Enlightenment Science". Part II starts with an essay by the editor on "Experimental Cultures", featuring the laboratory as a new means to research. In "Exploring Nature", Amanda Rees looks outside the laboratory to field work, while in "The Meaning of Life" early attempts to explain the origins of life are explored by Peter Bowler. "Mapping the Universe" describes astronomy, cosmology and our views on the universe. "Theoretical Visions" is a wide-ranging essay on the nature and application of theory. The concluding Anglocentric chapter, "Communicating Nature", covers places and events (for example, the Great Exhibition and the Royal Institution), gifted communicators (for example T.H. Huxley and David Attenborough) and recent technological methods.

Chemistry receives short shrift. What there is of it is mainly to be found in Jan Golinski's survey on Enlightenment Science. There is a good discussion of Priestley and Lavoisier. Bunsen, Davy, Faraday, Kohlrausch, Perkin and (*sic*) "Hoffman" gain brief mention, but Black, Boyle, Dalton, Liebig, Mendeleev and many others are notable absentees. Crick and Watson are mentioned in Part II, as are Kirchhoff, Wöhler, Haber, Heisenberg, Schrödinger, Rutherford and the Curies.

This is a handsome book, inexpensive but well produced and carefully edited. It has an adequate index and some magnificent illustrations. Those seeking a balanced account of the contributions of chemistry to the history of science will need to look elsewhere, but it is a most readable publication which many will enjoy.

Bill Griffith
Imperial College London

Sue Durrell (ed.), *The Life of William Nicholson, 1753–1815,* with an Afterword by Frank A.J.L. James. (London: Peter Owen Publisher, 2018). Pp. 123. ISBN 978-0-7206-1957-7. £14.99.

Many readers of the *Newsletter* will know of William Nicholson from *A Journal of Natural Philosophy, Chemistry, and the Arts* that he founded (in 1797) and edited, his experimental decomposition of water by electricity in 1800 and his translation of several works by the French chemist, Antoine François de Fourcroy. But Nicholson was a polymath, gaining knowledge and practical experience from the many ventures in which he engaged: working for the East India Company and making two voyages to China, inventing and patenting a cylindrical printing machine (1748) and a hydrometer (1784), and acting as commercial agent for Josiah Wedgwood in Amsterdam. He was also a member of the philosophical society that met regularly at the Chapter House in London, secretary of the General Chamber of Manufacturers, a waterworks engineer, a lecturer and a school teacher. Nicholson was a prolific writer, even impressing the critic and essayist, William Hazlitt.

Nicholson's engagement in these multifarious activities brought him into contact with a group of outstanding people of the time. These included Richard Kirwan, Thomas Holcroft, Richard Trevithick, William Godwin and Mary Wollstonecraft, Humphry Davy, Sir Joseph Banks and Count Rumford.

Sue Durrell, editor of the current book, had hoped to publish a full biography of Nicholson to coincide with the 200th anniversary of his death but the research and writing was taking longer than expected. In the meantime, *The Life of William Nicholson, 1753–1815* was published in 2018. The book's core is a memoir drafted by Nicholson's son, William Junior, some fifty years after his father's death and that has remained unpublished in the collection of the Bodleian Library in Oxford. Accompanying the memoir (corrected for any identified mistakes) is a short introduction outlining the context of the book and an Afterword by Frank James that locates Nicholson Senior in "London's rich scientific culture" (p. 99). The book is also well served by a timeline covering the period of Nicholson's life and several appendices. The timeline is especially useful, placing Nicholson's activities in the context of events of the time, while the appendices include: Nicholson's published works; his inventions and patents; a list of members of the Coffee House Philosophical Society, 1780-7; a list of members of The Committee of the Society for the Improvement on Naval Architecture, 1791.

While there are a few mistakes, this book is a welcome addition to the literature focused on the period of Nicholson's life, highlighting his wide range of interests and his engagement with many intellectual circles. It is hoped the fuller biography will be published over the next few years so Nicholson's polymath contributions to science (and chemistry in particular) are more fully understood and widely acknowledged.

Peter Reed

RSCHG MEETING REPORT

Some Chemical Consequences of World War I

Royal Society of Chemistry, Burlington House, London Wednesday 14 March 2018

The First World War has been very much in everyone's thoughts in recent years, and naturally its terrible human cost has been uppermost in our minds. But the War was to have deep and enduring impacts on all aspects of society, and this meeting dealt with some of its consequences for chemistry and the chemical industry. There were eight short presentations, and we could easily have had eight more. The focus was principally on our own country, but we had one presentation relating to Germany. Attendees were also able to take away copies of the excellent booklet *Pro Patria* prepared by David Allen, which gave accounts of the members of the Chemical Society and the Institute of Chemistry who gave their lives in the conflict.

World War I and the Education of Chemists

Prof. John Nicholson (Queen Mary University of London, Secretary RSC Historical Group)

Those aiming to become chemists were affected by a number of changes in education that arose from WW1. One important change was that school examinations were reformed and regularised, and the *School Certificate* and *Higher School Certificate* were introduced in 1918. Opportunities to study beyond school were limited. There were only fourteen universities in the UK, and before the War, only 9,000 university students (compared with almost 60,000 in Germany). One new university was established (Reading 1926), as well as a few small university colleges. However, these made little impact on the production of chemists; the "bulge" classes at existing universities were more important. It was also possible to take the Associateship examinations of the Institute of Chemistry. These were equivalent to university degrees, and obtainable only after full-time study. Again numbers were small, and there were only about 2,500 qualified members of the Institute in 1918 (AIC and FIC). The PhD degree, which originated in Germany in the 1850s, was introduced to Britain from around 1917. There was already a research doctorate in the UK, the DSc, but it took four to five years to obtain. The PhD, by contrast, could be obtained after two years of study, and the first ones were awarded from 1921 onwards. An early PhD graduate, Hilda Ingold (née Usherwood), did so on the basis of a thesis of sixty-five pages submitted in 1923. Her husband, famous Christopher Ingold, had previously submitted his DSc thesis in 1921 for a thesis that was 151 pages long. This neatly illustrates the difference between the two degrees. Technician education also changed as a result of WW1, with the introduction of the National Certificate scheme in 1921. The Institute of Chemistry was involved, but chemistry numbers were never large, and ONC/HNC did not provide exemption from the Institute's examinations. This was in contrast to the engineering institutions, where numbers were reasonable and where both ONC and HNC provided exemption from examinations. Lastly, the options for women should be considered. Contrary to what is widely believed, the position of women did not improve after WW1. Rather obstacles increased. The *Sex Discrimination (Removal) Act* of 1919 forced the Chemical Society to admit women as Fellows, but it did not stop other forms of educational discrimination. For example, the Hadow Report of 1923 argued in scathing terms that girls were more suited to the study of biology than chemistry or physics. As a result, fewer and fewer girls' schools taught chemistry. Consequently, the number of girls qualified to pursue the subject at university dwindled to a trickle.

Porton Down after World War I

Brian Balmer (Professor of Science Policy Studies, University College London)

Porton Down was established as the UK's main site for chemical (and later biological) warfare research during World War I in response to the German use of chemical weapons. Initial research centred on materials such as chlorine, mustard gas and phosgene, and methods of delivering them on the battlefield. After the war, staffing levels at Porton Down reduced and work focussed more on anti-gas measures than on offensive capabilities. After World War II the emphasis shifted to work on nerve agents and incapacitating agents. In particular, the early 1950s saw Porton scientists - via the Ministry of Supply - contacting pharmaceutical and pesticide companies to solicit information on any new toxic compounds they had discovered. These contacts led to the discovery of the V–series nerve agents, thus underlining how the history of chemical warfare is rooted in the civilian chemical industry. Britain abandoned its offensive chemical weapons programme in the late 1950s. The current work of the Porton Down facility was highlighted by its investigations into the Salisbury nerve agent attack, which took place a few days before the meeting.

Fighting Cancer with Chemicals: The Mustard Gas Connection
Prof. Alan Dronsfield (University of Derby)

Mustard gas was first used by the Germans in 1917. Despite its name, it is a high boiling *liquid* and was dispersed by artillery shells, contaminating the ground where they exploded. If encountered, it caused a blistering of the skin, incapacitating the victims for long periods. Assuming the blisters remained free from infection, most sufferers recovered, but a few soldiers succumbed to a more generalised infection that would normally be thrown off by a healthy individual. These were traced back to a low white cell count, these cells being responsible for fighting infections such as pneumonia. The mustard gas had caused a diminution in the rate of white cell production, and the body became susceptible to opportunistic attack. At around the end of WW1, the only effective treatments for cancer were surgery or radiation (x-rays or from radium). Drug treatments were ineffective, though they were still being peddled by unscrupulous vendors. In the 1940s the nitrogen variant of mustard gas was tried on mice that had been transplanted with a lymphoma, a cancer that was characterised by a lethal proliferation of white cells. The disease regressed, only to return later. A repeat treatment with the nitrogen mustard achieved another, but shorter, period of remission and so on. The mice eventually died from the cancer but had had a significant prolongation of life. Similar remissions occurred when the mustards were tried out on human patients. This success, though limited, showed that some cancers would respond positively to drug treatment. This was an important discovery. The next step was to find other reagents, apart from the mustards, that also caused remission. The breakthrough came when some of these species were used in combination. It was found that in some cases, notably Hodgkin's Lymphoma, that the periods of remission extended sufficiently such that the treatment regime could be regarded as curative.

Munitions, Mergers and Military Imperatives: from WW1 to ICI
Dr Mike Sutton (Formerly Senior Lecturer in History of Ideas at Northumbria University)

In 1914-15 all belligerents experienced ammunition shortages as expectations of a short decisive war proved mistaken. Britain's arms procurement system was inadequate, though improvements were becoming visible when the 'shell scandal' of May 1915 broke. Various individuals exploited this crisis for political purposes, leading to the introduction of a coalition government. The new ministry of munitions, headed by David Lloyd George (who became Prime Minister the following year) oversaw a massive expansion of arms production, enforcing collaboration between former rivals.

Major bottlenecks in explosives production - particularly of trinitro-toluene and its chemical precursors - were addressed by Lord Moulton FRS, the chair of the government's explosives committee. He exploited alternative sources of toluene and helped conserve the still-scarce supplies by enforcing the mixing of TNT with ammonium nitrate to make 'Amatol'.

The other essential ingredient of TNT - nitric acid – was traditionally manufactured from imported Chile nitre, but sea warfare threatened the supply (already too small to meet the increased demand). In Germany BASF upscaled their Haber-Bosch process to convert atmospheric nitrogen into ammonia (and thence into nitric acid via the Ostwald process). British firms used the less efficient but simpler Frank-Caro cyanamide process, though by 1918 the Ministry of Munitions had acquired a site at Billingham for building a Haber-Bosch plant.

After the war, the ministry sold this site to the Brunner Mond company, but despite getting the Haber-Bosch patents as 'war booty' (and a government-sponsored tour of the BASF works) they could not make the process work until two ex-employees of BASF sold them vital technical secrets. Eventually the Billingham plant became a key asset of Brunner Mond, and - following a state-encouraged merger with three other major chemical manufacturers in 1926 - of Imperial Chemical Industries.

James Morton and the Formation of Scottish Dyes Ltd
Dr John Hudson (Formerly Anglia Ruskin University. Chair RSC Historical Group)

At the outbreak of war, a textile manufacturer in Carlisle, Morton Sundour Fabrics Ltd., faced a crisis when its supplies of dyes, imported from Germany, were cut off. The dyes in question (called indanthrenes by the Germans) had remarkable resistance to fading in sunlight, and the company was determined to continue the manufacture of the Sundour range of textiles if possible. The Carlisle company was the sole importer of indanthrene dyes which had never previously been made in this country. The owner of the Carlisle company, James Morton, tried to get British dye makers to make the dyes for him, but they said that to do so was quite beyond their capabilities. Morton resolved to make the dyes himself in Carlisle and recruited a team of chemists who not only replicated the German syntheses but also made new dyes. By the end of the war the Carlisle operation was making dyes in tonnage quantities and supplying other textile manufacturers. Morton was determined to continue making dyes after the war, He bought eighty acres of land at Grangemouth in Scotland and floated the dye-making operation as a separate company, Scottish Dyes Ltd. He built a large plant on the Grangemouth site, which eventually employed around 1,800 people. Although not a chemist himself, Morton received the Faraday medal in 1925, awarded to commemorate the centenary of Faraday's discovery of benzene. The medal is now in the possession of the RSC and was on display at the meeting. The Grangemouth site was later to become an important part of ICI, manufacturing not only dyes, but medicinal and veterinary products, agrochemicals, intermediates, etc. Morton always regarded himself as a weaver rather than a chemist, but when he was knighted in 1936 the citation read "for services to the dye and colour industries". The presentation showed how a crisis affecting a single company when war broke out was to have major consequences for the British chemical industry.

World War I – The Catalyst which spurred the Development of Britain's First Onshore Oil Wells

Cliff Lea (*Retired European Product Manager, Fuchs Petrolub AG*)

[Cliff Lea was unable to attend because of family illness, but wished his abstract to be included in the meeting report]

When Winston Churchill was appointed First Lord of the Admiralty in 1911, one of his early decisions was to change the Royal Navy's battleships from using coal to oil. This could mean a ten percent increase in maximum speed, and the difference between success and failure in war. But Churchill also recognised the threats to Britain and the Royal Navy should our oil supplies from overseas be interrupted. As WW1 commenced, the Government's dependence on oil was thrown into sharp focus when submarines were to sink many Britain-bound oil tankers with great loss of life. It was no surprise therefore that the Government allocated a £1 million budget for the very first systematic search for oil on British soil. Oil was known to occur at various sites around the country, particularly in Derbyshire, Staffordshire, Dorset, Lancashire, Shropshire and the Lothian area of Scotland. But the main area to be covered in the search was to be Derbyshire. Immediately the Parliamentary Bill was in place, the contractor Lord Cowdray's Pearson & Co. commenced operation. The geologists decided there would be seven exploratory oil wells sunk in Derbyshire stretching along a broad anticline running North-South to the East of the county. The first was on the Duke of Devonshire's Hardstoft estate, and this was to strike oil at 3,070 ft. It produced oil for the next twenty-five years, right through to the end of WW2, and was Britain's very first successful oil well. Other wells were sunk in Staffordshire and Lothian, but none of these – nor the other six Derbyshire wells - produced commercial quantities of oil although gas was struck and put into use at two, and, for seven months, a well in Lothian produced. The Derbyshire crude was a dark brown paraffinic oil with green fluorescence, low sulphur, of light gravity, with good potential for gasoline, kerosene, light diesel fuel and for paraffinic lubricating stocks. The quantity of oil generated was approximately seven barrels per day. The Duke of Devonshire on whose land the well was sited took over the Hardstoft unit from the Government in 1923, sinking a further two oil wells close by, but finding them unproductive apart from limited gas. These later wells were shut down, but Hardstoft 1, produced oil for twenty-five years. This action taken by Government on commencement of WW1 served as a catalyst to awaken the oil industry: in just five years by 1919 three British oil companies had been catapulted into our top-ten industrial companies.

Ersatz Rubber in Germany

Dr Peter Morris (*Senior Research Fellow Emeritus, Science Museum; Treasurer RSC Historical Group*)

Perhaps surprisingly research into synthetic rubber and the development of the reclaimed rubber industry owed more to the price surge of natural rubber in 1900-1906 than the First World War. In particular Wyndham Dunstan at the BA meeting at York in 1906 scored a spectacular own goal by warning natural rubber growers of the (then non-existent) threat from synthetic rubber, a lecture which sparked off the synthetic rubber research at Bayer in Germany. However, Bayer's original synthetic rubber was extremely poor. But in Britain, Synthetic Products Ltd, a company backed by William Ramsay, had high hopes of making synthetic rubber using F.E. Matthews' sodium polymerisation of butadiene and butanol made by Chaim Weizmann's new process. Both the hopes of Bayer and Synthetic Products were completely undermined by the six-fold crash in the price of natural rubber in 1912. When war broke out in 1914, Germany quickly ran out of natural rubber despite the best efforts of its blockade runners. The first step was to stop using natural rubber altogether, rubber tyres being a relatively new product at the time. However, this may have scuppered any possibility of Germany developing the tank. The second step was to use more factice, an extender for natural (or reclaimed) rubber made from rape-seed oil. A new type of factice for hard rubber, called Ernolith, was made from formaldehyde and yeast. Although it was not highly regarded, synthetic rubber also came back into the picture. Fortunately for the Germans, two chemical firms - Wacker and Hoechst - had just developed the manufacture of acetone from acetylene; acetone being for the basis for Bayer's methyl rubber. Bayer set up a production plant at Leverkusen, but the polymerisation was very slow, taking several months. BASF also made some synthetic rubber. By the summer of 1918 production was running at over 110 tonnes a month and a synthetic rubber factory was planned. When the war ended production continued until June 1919 because the polymerisation was still going on. Reclaimed rubber, based on the alkali process introduced by the American chemist Arthur Marks in 1899, was much more important as reclaimed rubber was much easier to use (and to blend with factice) than synthetic rubber. Production in 1918 was about 305 tonnes a month, almost three times more than synthetic rubber. There are three key points in assessing the rubber situation in the First World War. The need for rubber or a rubber substitute was desperate, but the alternatives were not very good. However they were not strictly wartime Ersatz, but products which had already been available before the war. While the wartime synthetic rubber was very good, it laid the foundations for the later synthetic rubber industry in terms of giving Bayer and BASF experience in making a synthetic rubber and in gaining popular support (and Hitler's support in particular) for synthetic rubber as an iconic German innovation. As a result synthetic rubber became a major industry in Germany in the late 1930s and in the USA during the Second World War.

The Hesitant Emergence of Chemical Engineering in the Aftermath of the Chemists' War
Peter Reed (*Independent Researcher, Carmichael, USA*)

Even by the early 1900s industry and many others regarded chemical engineering as a crude amalgamation of mechanical engineering and chemistry. The few practising as chemical engineers were designated as chemical consultants. Chemical engineering was not an accepted academic discipline and there was no professional body to foster and promote its interests. The period leading up to WW1 saw greater complexity in chemical plant and its operation that embraced advances in thermodynamics, chemical kinetics and the phase rule. These advances also helped to make chemical production more efficient in the utilization of materials and energy and reduce the high level of waste associated with production during the previous fifty years. The national crisis of WW1 was to demonstrate the remarkable and yet unexpected benefit of employing those few chemists who were fully qualified chemical engineers. When private chemical companies were unable to meet the urgent production targets demanded of the battlefield, the government was forced to develop several national factories. These remarkable factories were designed and overseen by a small team led by the American chemical engineer, Kenneth Quinan who was recruited from South Africa. Subsequently, many prominent figures (including Lord Moulton, Director of the Explosives Supply Department for the Ministry of Munitions) expressed the view that the war might not have been won without chemical engineers such as Quinan. But in the post-WW1 period in Britain, there remained a hesitant emergence of chemical engineering and chemical engineers. Though the Institution of Chemical Engineers was formed in May 1922, there were few first-degree graduates in chemical engineering before 1930 and industry remained reluctant to recruit chemical engineers until well into the 1930s.

Conclusion

As the centenary of the end of World War I approaches, it is appropriate to reflect on how dramatic and widespread were the changes that the conflict brought about. This meeting served to emphasise that among those changes were many experienced by chemistry - some sudden and dramatic, some more gradual. But the post-war landscape was very different for chemistry as it was for almost every other aspect of life, and the legacy of World War I is with us to this day.

John Hudson

FORTHCOMING MEETINGS

Society for the History of Alchemy and Chemistry Autumn Meeting
Saturday 24 November 2018, UCL

The autumn SHAC meeting for 2018 is being arranged for Saturday 24 November at UCL. The meeting will not address any particular theme but will consist of a succession of papers on topics appropriate to the Society's interests.

Will those wishing to present papers please contact the organiser of the meeting, Frank James (FJames@ri.ac.uk) by 30 September 2018 at the latest. Please include an abstract (maximum 300 words) of your proposed paper in your email.

A full programme and details on how to register will be available on the SHAC website www.ambix.org in October.

FORTHCOMING SYMPOSIA

Drugs, Trade and Empire, 1650-1950
Friday 9 November 2018

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 running a one-day symposium on *Drugs, Trade and Empire: How the British pharmaceutical Industry Sold Medicines to the World* on Friday 9 November 2018 at Apothecaries' Hall, Black Friars Lane, London EC4V 6EJ.

As the British Empire grew, it offered markets for the British pharmaceutical industry to explore and exploit. Medicines were developed, promoted and traded to capitalise on relationships with British colonies. Many were based on raw drugs that had themselves been imported from the colonies. There was also movement of knowledge, people and practices across the world. But what patterns did this movement take? How did relationships between Britain and its colonies play out pharmaceutically? And what was their legacy? These and other issues will be explored in this one-day symposium.

For full programme details, please visit:

http://www.apothecaries.org/wp-content/uploads/2017/11/Pharmacy-Flier-Prog.pdf

For more information please contact Maria Ferran: facultyhp@apothecaries.org

FORTHCOMING CONFERENCES

37th International Conference for Dyes in History and Archaeology (DHA37)
25–26 October 2018, Portugal

The 37th Dyes in History and Archaeology Meeting will take place from 25-26 October 2018 in Portugal. The oral and poster sessions will be held at Caparica Campus, near Lisbon. The meeting will be organized by IST (Universidade de Lisboa) and the Department of Conservation & Restoration and Requimte (Faculty of Sciences and Technology, Universidade NOVA de Lisboa). The topics presented will be of interest to conservators, curators, art historians, craftsmen, artists and scientists.

The deadline for early registration is 15 September 2018. All participants must register by 15 October 2018. More details can be found at: http://eventos.fct.unl.pt/dha37 or email Maria João Melo (mjm@fct.unl.pt) with queries.

UNESCO/UN International Year of the Periodic Table, 2019
26-28 July 2019, ITMO University, St Petersburg

To celebrate the UNESCO/UN International Year of the Periodic Table, 2019, ITMO University is hosting the 4th International Conference on the Periodic Table: Mendeleev 150. Dmitri Mendeleev published the first mature periodic table in Saint Petersburg in 1869 which makes ITMO University the most appropriate venue for this sesquicentennial.

Please visit either: http://mendeleev150.ifmo.ru/ or
https://global.acs.org/events/4th-international-conference-on-the-periodic-table-mendeleev-150/

Twelfth International Conference on the History of Chemistry
29 July to 1 August 2019, Maastricht

The 12ICHC will take place in Maastricht from Monday 29 July until 1 August 2019, instead of 6-9 August 2019.

This is to coordinate with the dates of the HSS (History of Science Society) meeting, to be held in Utrecht, NL, which have shifted to 23-27 July 2019.

More information will appear in the winter 2019 *RSCHG Newsletter*.