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RSC Historical Group Newsletter No. 79 Winter 2021

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From the Editor

Welcome to the winter 2021 RSC Historical Group Newsletter. I sincerely hope it finds you and your loved ones keeping safe and well and that it provides some interesting reading during the ongoing crisis. This issue includes a bumper crop of short articles and I am most grateful to everyone who has contributed: Alan Dronsfield and Pete Ellis for their timely article “Chemistry and the Flu Pandemic”; Michael Jewess for his article “A Catalytic Catastrophe, a quarter-century on”; Peter Morris for investigating “Who are the chemists in the picture of Henry Roscoe and Dimitri Mendeleev?”; John Nicholson on “Who discovered Rhenium?”; and Anthony S. Travis for marking the one hundredth anniversary of the foundation of the chemical engineering contractor, Ammonia Casale SA. There are also two articles focusing on the online resources available through the RSC Library and the Science History Institute and information on the CHEM-HIST list-serv. Bill Griffith reviews Geoff Rayner-Canham’s *The Periodic Table – Past, Present and Future* and also reports on the William Nicholson Event at the 2020 Bloomsbury Festival. As ever, I am indebted to the newsletter production team of Bill Griffith and Gerry Moss, and the Group’s Secretary, John Nicholson, for their assistance.

If you would like to contribute items such as news items, short articles, book reviews and reports to subsequent issues please contact me. The deadline for the summer 2021 issue will be Friday 11 June 2021. Please send your contributions to a.simmons@ucl.ac.uk as an attachment in Word.

The Historical Group posts the hard copy version of the newsletter to those members who request it. Printing and posting the hard copy version is expensive and if you receive the newsletter in hard copy and would be happy to read it online, please send an email to our Membership Secretary, Bill Griffith (w.griffith@ic.ac.uk). Similarly, email Bill if you don’t currently receive the hard copy and would like to do so. Group members should receive an email from the RSC informing them when the latest version is available, but for the record the Newsletter appears twice each year – usually in January/February and July/August. It is often available online before official notification is sent out by the RSC, so please do look out for the newsletter on both the RSC and Queen Mary Historical Group websites:

<http://www.rsc.org/historical> or <https://www.qmul.ac.uk/sbcs/rschg/>

Anna Simmons, UCL

Letter from the Chair

As I write to you, the Covid-19 pandemic is continuing and there are still many restrictions in place across the United Kingdom of varying severity. As I said in the summer newsletter, I hope that you and your loved ones are keeping well and that you all continue to be well until the vaccine finally arrives. The good continuing health of all of us is most important. Unfortunately, this pandemic has led to the continuing postponement of our meetings until the second half of 2021. “The Handed World: 150 years of Chiral Molecules”, organised by Michael Jewess, will now take place, one hopes, on 13 October 2021 at Burlington House. This will be followed by the meeting on Sir George Porter, organised by Frank James, on 6 December 2021. The meetings on Sir Geoffrey Wilkinson and Women in Chemistry will now be held in 2022 and we will keep members updated.

The group continues to produce the newsletter and is holding a series of monthly online talks on Zoom (we now have our own Zoom account!). So far, we have had talks on methylene dichloride as an anaesthetic and novocaine as a local anaesthetic by Alan Dronsfield; the early life of Joseph Priestley by Helen Cooke; William H. Perkin and mauve by Henry Rzepa; a History of Pigments from Cave-painting to the Twentieth Century by Christine Holdstock; and I gave a talk about the early history of NMR in Britain which was attended by a large number of NMR scientists, some of whom have joined the Historical Group subsequently. These talks have been very successful and I would encourage members to log on to the forthcoming talks in 2021 (see next item).

I would like to thank Michael Jewess for his sterling service to the group, as he has left the committee to become chair of the IOP History of Physics Group, and in particular for all his hard work setting up the meeting on chirality which, I am glad to say, he will continue to organise. I wish members all the best for the new year and a much improved 2021.

Peter Morris

ROYAL SOCIETY OF CHEMISTRY HISTORICAL GROUP NEWS

The “Lockdown” Webinar Series Continues

With seven webinars now successfully completed, the webinar series will run until April. At that point, we will decide whether to continue with the web talks in what hopefully will be a post-pandemic (if not quite post-Covid) world. On 19 January Helen Cooke will pick up where she left off in September and talk about the later life of Priestley after he left Nantwich. Frank James will speak on Humphry Davy, Michael Faraday and the origins of electrochemistry on 16 February – members of the RSC Electro-chemistry Group will also be invited to this talk. On 23 March, Diana Leitch will give a talk about the history of the weedkiller Paraquat. The ICI connection continues into April when Viviane Quirke will discuss the development of drugs at ICI (exact date tbc). Members of the Historical Group will receive an e-alert about these talks from the RSC early in the month. If you are not receiving e-alerts and wish to receive them, please email me at doctor@peterjtmorris.plus.com. If you are not a member of the Historical Group, please email me and I will add you to the mailing list of current “subscribers”.

Peter Morris

Secretary’s Annual Report for 2020

Once again, I prepared a brief report on the group’s activities for the RSC. This year has, understandably, been very different from previous years, and what follows is the basis of what was submitted.

Like all Groups, the Covid-19 pandemic has meant that all in-person activities were cancelled for the year. That meant two one-day symposia, and also two meetings of the committee. Both planned symposia are postponed, and provisional dates for them have been agreed. Committee business has been mainly conducted by e-mail, though we did have a Zoom meeting in October.

The committee took the initiative to run a series of “lockdown webinars” during the second half of the year, and these have proved to be extremely successful. Lasting about an hour, they have given Group members the opportunity of presenting a topic on the history of chemistry to an on-line audience. Pre-registration has been necessary, due to the limitations of Zoom, and we have attracted audiences of between fifty and seventy for each webinar. These webinars will be

continuing on a monthly basis for a while, so do check when the next one is, and think about joining us if you haven't done so already.

Finally, despite the problems of lockdown, we have been able to publish two editions of the Group's Newsletter during the year. They continue to be of a high standard, and as ever our thanks go to Anna Simmons, the editor. We owe her a real debt of gratitude for her hard work in preparing such a high-quality publication.

John Nicholson

ROYAL SOCIETY OF CHEMISTRY HISTORICAL GROUP MEETINGS

Provisional dates for the following meetings originally planned for 2020 and 2021, but postponed due to the coronavirus pandemic, have been set. Further updates will be available in the summer 2021 newsletter.

The Handed World: 150 Years of Chiral Molecules

Wednesday 13 October 2021, Royal Society of Chemistry Burlington House, London

The meeting will review optical activity and molecular chirality from a historical perspective.

George Porter Meeting

6 December 2021, Royal Society of Chemistry, Burlington House, London

This meeting will explore the life and career of the Nobel Prize-winning chemist George Porter (1920-2002), on the day which would have been his 101st birthday.

Geoffrey Wilkinson Meeting

22 March 2022, Royal Society of Chemistry, Burlington House, London

This meeting will explore the life and career of the Nobel Prize-winning chemist Geoffrey Wilkinson (1921-1996) a pioneer in inorganic chemistry and homogenous transition metal catalysis.

FOLLOW-UP FROM THE SUMMER 2020 RSC HISTORICAL GROUP NEWSLETTER

A Wooden Justus Liebig

Following the previous report of the muted centenary celebrations of the 100th anniversary of the opening of the Liebig Museum in Giessen in the

last *Newsletter* (No. 78, Summer 2020, pp. 17-18 hard copy, p. 9 e-version), readers will be pleased to learn that a huge wooden carving of Liebig has been temporarily erected on the portico of the Museum. It is the work of the tree artist Axel Wilisch, an art teacher from Nidda, near Bad Salzhausen some 26 miles (42 km) south-west of Giessen. The carving weighs nearly 300 kilograms and stands 2.2 metres in height. Reminding historians of chemistry of the giant bronze statue of Robert Bunsen that stands outside Bunsen's old laboratory at Heidelberg, it was carved from an oak tree in the park at Bad Salzhausen that had been planted in the 1820s. It is intriguing to think that Liebig himself might have seen the sapling during his government-financed investigation of the health-giving salts in the waters of Salzhausen between 1824 and 1831 during which he missed the discovery of bromine.



The carving of the head has produced a remarkable likeness achieved by copying the marble bust of Liebig moulded by the sculptress Elisabet Ney in 1868, a copy of which is in the museum's collections. The image is, therefore of Liebig in his sixties during the Munich period. The artist has also, quite remarkably, managed to carve a replica of the Kaliapparat which Liebig holds in his left arm.

It is understood that the statue will stay in Giessen until the end of the centenary year before being returned to the Sculpture Park at Salzhausen. Giesseners have already expressed a hope that a bronze version of the Liebig tree could be made to stand as a permanent fixture outside the Museum. But finding sponsorship during a pandemic could be difficult.

With acknowledgements to Karola Schepp and the *Giessener Allgemeine* of 21 April 2020. We thank Prof. Eduard Alter for the photograph.

William H. Brock

A PS to John Nicholson's review of Claire Wilkes' biography of Col. Shaw Framed by a Smoking Gun: The Explosive Life of Col. B. D. Shaw

Readers of John Nicholson's review of Claire Wilkes' biography of Col. Brian Shaw (*Newsletter* No. 78, Summer 2020, pp. 53-55 hard copy, pp. 25-26 e-version) will recollect Shaw's famous lecture on *Explosives*. Wilkes writes "As Brian (Shaw) didn't keep a definitive record, it is impossible to know for certain how many times he 'exploded', but a minimum of 1,500 times would seem realistic, and to audiences totalling over a quarter of a million". His first performance was in 1930 and the last in 1987, at the age of eighty-nine.

Newsletter readers who would like to revisit his famous lecture might like to know that the full version is available on YouTube at:

<https://www.youtube.com/watch?v=QZoFFRCGZHc>. It's about 1 hr 35 min in length, preceded by a somewhat pointless four-minute introduction. The quality is so-so, I suspect from a much-copied VHS tape, but as an historical record, and a trip down memory lane, it is invaluable.

Alan Dronsfield

MEMBERS' PUBLICATIONS

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

Chris Cooksey, "Hematoxylin in the 21st century", *Biotechnic & Histochemistry*, published online: 10 Jul 2020; <https://doi.org/10.1080/10520295.2020.1786725>.

Hematoxylin continues to be a popular substance in the twenty-first century. This paper presents some recent developments including the use and misuse of the terms, hematoxylin and hemalum, in biological staining. The medical use of hematoxylin and its application as a dye for hair or textiles continues to be of interest. Unusual applications including its use as a biosensor and for study of vibrational properties of wood are included.

Anthony S. Travis, with Simon P. Forster, and Stefan Seeger, "Saccharin beyond Serendipity: A German-American *Wechselspiel* of Invention and Industry", in: S. Katzir, S. Schaefer und G. Shahar, eds, *Made in Germany: Technologie, Geschichte, Kultur*, Tel Aviver Jahrbuch für deutsche Geschichte, 48 (Göttingen 2020), 83-121.

Academic aromatic organic chemistry in the United States owed its emergence to the German-trained Ira Remsen, at Johns Hopkins University. It was in Remsen's laboratory that his assistant Constantin Fahlberg, an expert in sugar chemistry, in 1878 discovered saccharin, though Remsen claimed priority. Manufacture was first taken up by Fahlberg, in Germany, during 1887. In 1901, John F. Queeny, with the aid of Swiss chemists, founded the Monsanto company to undertake manufacture in the United States. Because saccharin was a food additive without nutritional value, its use was restricted by Harvey Washington Wiley, chief chemist at the US Department of Agriculture. That changed at the outbreak of the First World War I with the shortage of sugar. Though the essential intermediate was no longer available from Germany, Queeny's chemists made saccharin by a novel synthetic route, which enabled the growth of Monsanto.

PUBLICATIONS OF INTEREST

Carolyn Cobbold, *A Rainbow Palate: How Chemical Dyes Changed the West's Relationship with Food* (Chicago: Chicago University Press, 2020)

We live in a world saturated by chemicals - our food, our clothes, and even our bodies play host to hundreds of synthetic chemicals that did not exist before the nineteenth century. By the 1900s, a wave of bright coal tar dyes had begun to transform the Western world. Originally intended for textiles, the new dyes soon permeated daily life in unexpected ways, and by the time the risks and uncertainties surrounding the synthesized chemicals began to surface, they were being used in everything from clothes and home furnishings to cookware and food. In *A Rainbow Palate*, Carolyn Cobbold explores how the widespread use of new chemical substances influenced perceptions and understanding of food, science, and technology, as well as trust in science and scientists. Because the new dyes were among the earliest contested chemical additives in food, the battles over their use offer striking insights and parallels into today's international struggles surrounding chemical, food, and trade regulation.

See also:

<https://www.sciencefocus.com/science/e-numbers-synthetic-food-dyes-and-the-problem-of-policing-additives/>

The following journal issues have been published since the summer 2020 *Newsletter* was completed.

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

vol. 67, issue 4, November 2020

Thijs Hagendijk, Márcia Vilarigues and Sven Dupré, “Materials, Furnaces, and Texts: How to Write About Making Glass Colours in the Seventeenth Century”.

Theodore R. Delwiche, “*Fuit Ille non Empiricus Mercenarius*: Apprehensions to Alchemy in Colonial New England”.

Jole Shackelford, “Chemical Paradigm vs. Biological Paradigm in the Biological Clock Controversy”.

William H. Brock, “The Curious Story of the Chemical Society’s Missing Obituary of John Lloyd Bullock”.

Essay Reviews

Cornelis J. Schilt, “A True Adept”. Essay Review of William R. Newman’s *Newton, the Alchemist*.

Bruce Janacek, “The Historic Role of Alchemy in the Holy Roman Empire”. Essay Review of Tara Nummedal’s *Anna Zieglerin and the Lion’s Blood: Alchemy and End Times in Reformation Germany*.

***Bulletin for the History of Chemistry*, vol. 45, number 2, 2020**

Liliane Catone Soares, “From ‘Blue Pills’ to the Minamata Convention: Mercury, A Singular Metal”.

E.J. Behrman, D.M. Behrman, and Manuela Davis, “Introduction to and Translation of ‘Ueber Nitrohydrochinon’ by Karl Elbs”.

Marelene Rayner-Canham and Geoff Rayner-Canham, “Edith Pechey and Professor Crum Brown: A Key Part of the Edinburgh Seven Saga”.

Seth C. Rasmussen, “From Polymer to Macromolecule: Origins and Historic Evolution of Polymer Technology”.

Bill Streifer, “Dr Fritz J. Hansgirg and Heavy Water Production: The Untold Story”.

Dudley Herschbach, “In Remembrance of I. Bernhard Cohen”.

Carmen Giunta, Review of *A Field on Fire: The Future of Environmental History*, Mark D. Hersey and Ted Steinberg, eds, 2019.

Jeffrey I. Seeman, “The Back Story: Carl Djerassi (1973-2015). The Man of Multiple Lives”.

Philosophical Transactions of the Royal Society A

Themed issue “Mendeleev and the periodic table” compiled and edited by Peter Edwards, Russell Egdell and Dieter Fenske. *Philosophical Transactions of the Royal Society A*, Vol. 378, No. 2180 (September 2020). This specially commissioned volume, aims to honour and celebrate Dmitri Mendeleev and includes articles by authors well-known to the Historical Group such as Liz Bruton, Russell Egdell and Eric Scerri.

ACS DIVISION OF THE HISTORY OF CHEMISTRY NEWS

Paul R. Jones Outstanding Paper Award

The recipient of the 2017 Paul R. Jones Outstanding Paper Award of the Division of the History of Chemistry of the American Chemical Society is Emeritus Professor of Chemistry Carmen Giunta, Le Moyne College, Syracuse, NY. The paper was “Isotopes: Identifying the Breakthrough Publication”, *Bulletin of the History of Chemistry*, vol. 42 (issue 2), 2017, pp. 103-111. The award is presented to the author of the best paper published in the *Bulletin for the History of Chemistry* during the previous three years, 2015, 2016, 2017. The Paul R. Jones Outstanding Paper Award consists of an engraved plaque and a cheque for \$250 and a book award plus a cheque for \$150 from the Science History Institute.

CALL FOR NOMINATIONS

SHAC 2021 Morris Award: Call for Nominations

The Society for the History of Alchemy and Chemistry solicits nominations for the 2021 John and Martha Morris Award for Outstanding Achievement in the History of Modern Chemistry or the History of the Chemical Industry. This award honours the memory of John and Martha Morris, the late parents of Peter Morris, the former editor of *Ambix*, who has contributed the endowment for this award. The recipient chosen to receive the Morris Award will be expected to deliver a lecture at a meeting of SHAC, where the awardee will be

presented with an appropriate framed photograph, picture or document and the sum of £300.

A complete nomination consists of

- a complete curriculum vitae for the nominee, including biographical data, educational background, awards, honours, list of publications, and other service to the profession;
- a letter of nomination summarising the nominee's outstanding scholarly achievement in either the history of the chemical industry or in the history of recent chemistry (post -1945) and the unique contributions that merit this award; and
- names of two or three individuals for the panel to contact for further information if needed.

Only complete nominations will be considered for the award and the nomination documents must be submitted in electronic form. The Award will be judged by the selection panel on the basis of scholarly publication. All nomination materials should be submitted by e-mail to Peter Morris at doctor@peterjtmorris.plus.com and a separate email which indicates that the material has been submitted should be sent to the same address (a precaution in case of incomplete transmission of documents) for arrival no later than 1 May 2021.

SHORT ESSAYS

Chemistry and the Flu Pandemic 1889/90

In May 1889 a few cases of influenza were reported in Bukhara, a town in eastern Russia, now one of the principal cities in Uzbekistan. Recent evidence suggests that it was a coronavirus much like the current SARS-CoV-2 outbreak [1]. The cases rapidly spread westwards and multiplied into a pandemic, vectored by the late nineteenth century growth in transport links. Known as Russian or Asiatic flu, it is estimated to have caused about a million deaths across Europe and the eastern part of the USA, including Prince Albert Victor, the grandson of Queen Victoria and eldest son of the Prince of Wales. Although dwarfed by the 50 million deaths during the 1918/19 flu pandemic, it was comparable to the present coronavirus outbreak (1.5 million, but still increasing). While the 1889 outbreak brought with it misery and great sadness, of course, for many German dyestuffs manufacturers it engendered great opportunity and commercial success.

For the influenza sufferers, much as now, the best they could have hoped for was some alleviation of the symptoms until the body's

defences prevailed against the virus, despite the hopeful claims of some (see box). By 1889 there was a handful of synthetic medicines, mostly discovered during the previous decade, that could relieve the fever, headaches and general aches that marked the disease. All were coal tar derived products, though two had older botanical associations

President Donald Trump's speculation on a possible anti-viral treatment using "disinfectant, taken internally"...

...has an historical precedent. A Dr Simpson reported treating some of the 1889 flu victims "...with quinine, but did not find any improvement. I then contracted the disease itself...and concluded that my blood must be full of some very reproductive microbes. I treated myself, three times a day, with 2 minims of pure carbolic acid (= 0.12 cm³ of phenol) I was much more quickly cured (compared to the quinine-treated patients). Many hundreds of patients have been treated in my Practice with this drug, sometimes as many as 80 patients with influenza being seen in one day and every case has made a complete and quick recovery, the temperature falling from 102° to normal in 24 hours with no after-complications being left behind...Many of the cases have been of a very severe type" [2].

Salicylic acid is the key pharmacological component of ground willow bark and had been used from the late eighteenth century to reduce fevers. In 1829 French chemist Henri Leroux extracted some 30g of the active ingredient, salicin, from 1.5 kg of the powdered bark. Raffaele Piria investigated this glycoside further and converted it through a combination of hydrolysis and oxidation into salicylic acid (1838), which had the same medicinal properties as the parent compound. It became much more readily available after Hermann Kolbe's 1860 discovery of a route to this acid from phenol. This involved heating an aqueous solution of its sodium salt with high pressure carbon dioxide. Although using pure salicin or salicylic acid permitted precise patient dosing, the amounts necessary for therapeutic action provoked gastric irritation, the carboxylated phenol especially so [3]. It was not until 1899, some years after Russian flu had finally remitted, that this was remedied through the acetylation of salicylic acid by Felix Hoffmann at *Bayer AG* [4].

The other traditional antipyretic (fever reducing agent) was quinine, an alkaloid derived from the bark of the cinchona tree. Although better known for treating malaria, it also reduced fever and alleviated some of the symptoms of the common cold. As it was expensive, the organic chemists of the second half of the nineteenth century aspired to produce

his way through its chemistry. He found that it reacted with acetone to yield a condensation product, m.p. 42° which underwent further reaction in the presence of ZnCl₂ to yield 2-methylindole, an example of what soon became known as a Fischer Indole synthesis [12]. There were two possible structures of the low melting intermediate product. Initially, Fischer decided it was based on a highly strained three-membered N-N-C ring, but in 1888 he reformulated it showing a direct condensation between the oxygen atom of the acetone's carbonyl and the two terminal hydrogens of the phenyl hydrazine (Fig. 2).

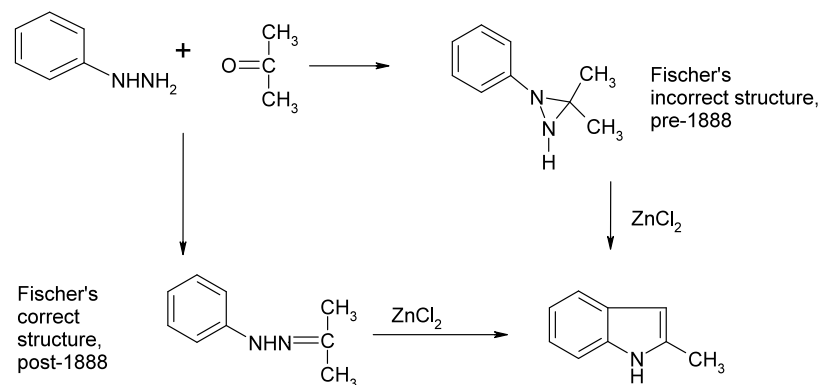


Fig 2. Fischer's indole synthesis

Elaborating, Fischer and his assistant Ludwig Knorr attempted to react phenyl hydrazine with more complicated ketonic products, including ethylacetoacetate, first reported in 1865 and already showing a rich and exploitable chemistry. At this distance in time, we cannot say if the driving force was simply a spirit of enquiry, or whether they spotted the product (as they initially formulated it) had a quinoline connection and thus might compete with the lucrative Kairin. Though Fischer has an additional reputation for his research in biochemistry, he also had a passing interest in medicinal chemistry, reporting on the barbiturate sedatives in 1904. Knorr's first product was routinely sent, presumably with its formula attached, for testing as an antipyretic alternative to Kairin, but the results were disappointing. However, perceiving the likely presence of a NH group in the molecule, it was decided to methylate it, resulting in a structure closer to that of Kairin itself. Animal tests and, later human trials, revealed that it was an antipyretic as effective as Kairin but with less dramatic side-effects. Knorr must have had doubts about the presence of a highly strained three-membered

ring structure in his product and whilst the medicinal evaluation was taking place, he reformulated the structure of his product. He no longer saw it as a quinoline derivative, and instead proposed a pyrazolone structure attached by a single bond to the aromatic ring, derived from the phenyl hydrazine (Fig. 3).

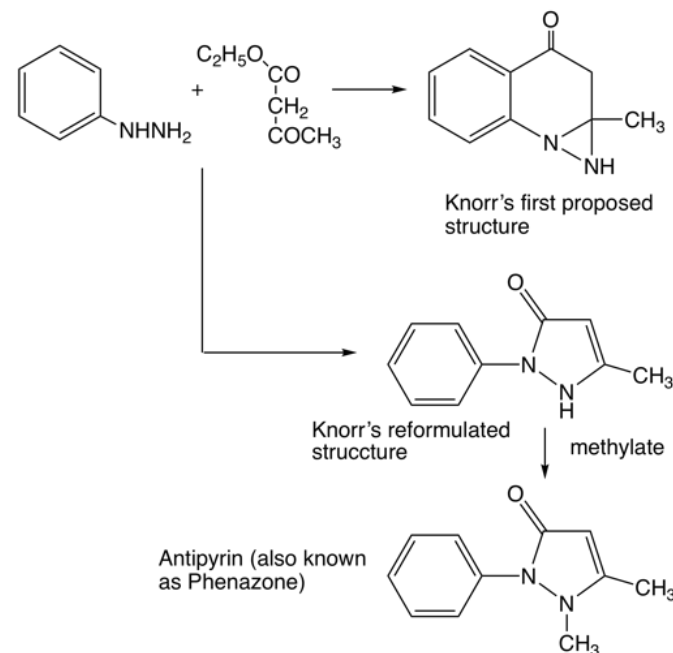


Fig. 3. Knorr's route to Antipyrin

It was marketed as Antipyrin, again by *Farbwerke Hoechst AG*, from 1884. In reviewing its success, Walter Sneader writes:

The new compound turned out to be an antipyretic that was more palatable than either quinine or salicylic acid. It was marketed under a proprietary name chosen by Knorr while on his honeymoon in Venice. By the time it reached the market, Knorr had established that it was a pyrazolone derivative. It was recommended for its use in rheumatic fever as early as 1885. Two years later a report of its value in relieving headache appeared in the *British Medical Journal*. However, its greatest triumph, however, was in 1889, when Antipyrin became a household name as an antipyretic after a major influenza

epidemic of that year swept through Europe. It then remained the most widely used drug in the world until aspirin began to outsell it in the early years of the twentieth century. If any single product can be said to have established the commercial viability of synthetic drugs, it was Antipyrin [13].

A contemporaneous antipyretic agent has a curious history. Working in the medical faculty of the University of Strasbourg, two young doctors, Arnold Cahn and Paul Hepp, were trying out an unconventional treatment for intestinal worms, namely doses of solid naphthalene. At the time it was perceived to have disinfectant powers, possibly due to its “peculiar” odour. Their agent appeared to leave the worms alone, but on one patient also suffering from a fever, it appeared to have an antipyretic effect. They followed up their observation and found that they had been supplied with acetanilide, not the naphthalene they had ordered. Both are greyish-white flakes of similar appearance and we conjecture this is a possible reason for the mistake. Paul Hepp’s brother worked at a nearby small firm, the *Kalle Chemical Company*, which as part of its activities, manufactured dyes and a few specialist chemicals, including acetanilide. It saw the opportunity for diversification and in 1887 began to market its product under the commercially-appealing name, Antifebrin [14]. Knowing that N-methylation has been advantageous in the synthesis of earlier antipyretics, they exploited a similar procedure on acetanilide. The derivative, N-methylacetanilide had already been reported in 1873 by A.W. Hofmann and thus, like acetanilide itself, could not be patented. Cahn and Hepp lost interest in methyl acetanilide as a potential medicament, but they passed its details on to Messrs *Brigonet and Naville*, manufacturers of pharmaceuticals, based in Paris. Their product was named Exalgin, perhaps not as evocative or descriptive as its cousin, Antifebrin, but memorable enough. Its antipyretic effect was inferior to that of acetanilide itself (which may account for Cahn and Hepp’s lack of interest) but its analgesic powers were greater and for a few years (from 1889) it remained a popular preparation for the treatment of neuralgia and headaches. Thomas Fraser, Professor of Clinical Medicine at the University of Edinburgh, wrote:

the requirements of therapeutics have not been entirely satisfied by them (the earlier pain-relieving medicines): for, while they may remove (neuralgic) pain by any action on pain-conducting or pain-perceiving structures, they cause, when used in doses required for this purpose, other actions which have nothing to do with the relief of pain and, besides, are often injurious to the

patient. We recognise these disadvantages in Antipyrin and Antifebrin, probably the most efficient analgesics in this series, for analgesia can rarely be produced by them, except in large doses, and therefore, with the inconveniences and dangers of gastric disturbance, deafness, profuse sweating, disturbances of the circulation and changes in the blood...Methylacetanilide is found to be a more powerful analgesic than the acetanilide from which it is derived, and the doses by which pain may be removed...are too small to produce any of the inconvenient or dangerous effects which may be caused by larger doses [15].

Also in the same year (1890) Fraser endorsed its use against the flu pandemic: “Its actions indicate it is likely to be serviceable, especially in the numerous cases in which pain is a prominent symptom” [16].

Our final analgesic/antipyretic was discovered as a result of a firm (*Bayer AG*, of Leverkusen, Germany) wanting to make use of a by-product arising from the manufacture of the dye Benzazurin G. Success gave the world Phenacetin (Fig. 4) which was introduced into medical practice in 1887, just in time to fight the 1889 flu pandemic.

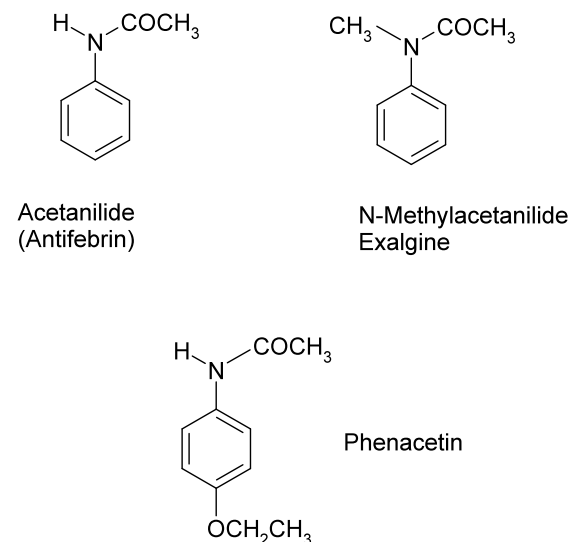


Fig. 4. Phenacetin, Exalgin and Antifebrin

The predominance of the German pharmaceutical firms in these developments can be attributed to their chemical expertise which

resulted in their international leadership in the period prior to World War I. By 1913, four of the five largest pharmaceutical firms in the world were German, and among the leading twenty-one, fifty-nine percent of the collective revenue was earned by German firms [17].

Most of the synthetic drugs discussed in this paper had brief-to-medium lifetimes as effective, cheap over-the-counter medicines. Antipyrin replaced those shown in Fig. 1 (above) in the 1890s. This itself had disappeared for routine medication by the 1930s other than for some limited indications. Aspirin (introduced in 1899) proved to be a game changer. In the first half of the twentieth century, it supplanted almost all the antipyretics and analgesics apart from Phenacetin. This latter drug had an eighty-year pharmaceutical lifetime and its rise and fall will be documented in our next paper in this Newsletter.

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Alan Dronsfield and Pete Ellis

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A Catalytic Catastrophe, a Quarter-Century on, Compared with Earlier Chemical and Materials Failures

Technological Failures Generally

The author “collects” historical technological failures, and indeed has witnessed some technological failures at first hand.

He classifies these failures as follows:–

- (i) Failures resulting from pursuing a good idea for which the supporting technology or the marketplace is not, in the event, ready.
- (ii) Failures after which one wonders, “How on earth could anyone competent have thought that what was done could be effective/economic/safe?”

Failures in category (i) are the price paid for successful innovations: good ideas will always encounter unexpected snags, and only some will survive being tried out.

Brunel's Leather (1846-1848); Pilkington's Float Glass (1952-1959) as a Counterinstance

In category (i) of failures, the author places the construction of an "atmospheric railway" by the British engineer Isambard Kingdom Brunel (1806-1859) [1]. Contemporary steam locomotives were slow on steeper inclines, because of the mass of the locomotive and its fuel. A possible solution was to separate the consumption of primary fuel from the locomotive (as was later achieved in electric trains). In Brunel's day, although the railways used electric telegraphy, electric locomotion was not yet an option.

Pneumatic locomotion was, however, an option. Brunel laid a pipe 15 inches (38 cm) in diameter between the rails of his line. In the pipe travelled a piston connected from behind to the first carriage of the train, which replaced the normal steam locomotive. Ahead of the piston, the pipe was pumped out to 16 inches of vacuum (i.e. down to 0.53 bar). Behind the piston, the pressure was atmospheric, so that the piston was propelled forward with a calculated force of ca. 0.5 tonne weight. Running along the entire upper side of the pipe was a longitudinal valve of the best oxhide leather riveted to iron reinforcement, with a soap-based sealant. The valve was closed ahead of the piston, while behind the piston it opened for the connecting arm from the piston to the carriage, and closed after the connecting arm passed. The track was in sections averaging 4.5 km long with steam-powered air pumps alongside the track where the sections ended.

Brunel's atmospheric railway was the westward extension ("the South Devon Railway") towards Plymouth of the conventional railway from London Paddington to Exeter (completed in 1844). After initial difficulties, the extension operated "atmospherically" from September 1847 to January 1848 between Exeter and Teignmouth, and thereafter as far as Newton Abbot, over a total track length of 31 km. Parts of the system beyond Newton, with pipes 22-inch (56 cm) in diameter, had already been constructed when, in June 1848, it was discovered that from Exeter to Newton the valve leather had seriously degraded through the effects of vacuum, winter, and chemical reactions. Regular, expensive replacement of the valve would alone have rendered the atmospheric railway uneconomic. On Brunel's advice, the atmospheric equipment was sold off (some as scrap) and conventional steam locomotives were used over the entire line from Exeter to Plymouth (reached in April 1849). The railway company had suffered, according to Rolt, "the most costly engineering failure of its time".

Any chemist in 2020 (or indeed 1920) would of course say that the leather should have been tested for medium-term degradation under simulated conditions, not in the course of full-scale field use. But nevertheless, Brunel had not been alone in thinking atmospheric railways would work, which is why the author places this failure in category (i).

An instructive comparison can be made with the successful development of the float glass process by the UK company Pilkington Brothers [2]. Before the float glass process, large sheets of distortion-free parallel-sided glass, e.g. for shop windows, were made by precision-grinding inferior glass sheet on both sides, which was expensive. The principle of the process, proposed in 1952, was simple: if one floats molten glass on molten tin, it becomes flat under gravity. Tin recommends itself because (a) it is readily available, (b) it is dense enough to support glass, and (c) it has a very low vapour pressure at the temperatures required so that it does not distil off and condense in undesired places. Tests were made, a pilot plant was built, and finally a full-scale plant.

Numerous problems were encountered including chemical ones: contamination of the glass by the spout from which it was poured, molten, onto the tin; and the reaction of parts per million of oxygen and sulfur with the tin, affecting the glass. It was fourteen months before the full-scale production plant first made glass of saleable quality. Pilkington announced their success in 1959, after which the process was licensed worldwide. Whereas for Brunel to have persisted after June 1848 would have been folly, in this case brave persistence resulted in success.

NASA's Rubber, 1986

This section of the paper, and the next, final section, deal with category (ii) failures, ones that one feels contemporary scientists and engineers should have foreseen and prevented.

Particularly notorious and well documented [3]-[5] is the disaster of NASA's space shuttle system on 28 January 1986, killing the crew of seven in the orbital vehicle *Challenger*. The orbital vehicle was a winged craft which went into orbit, later to re-enter the earth's atmosphere and to glide back to earth. For launch, it was attached to a huge external fuel tank containing liquid hydrogen and liquid oxygen which umbilically supplied the orbital vehicle's motors. The tank was attached in turn to two solid fuel rocket boosters. The boosters and the external fuel tank were jettisoned, in that order, before the mission in

orbit began. Each booster was assembled at the launch site, with three sections jointed at their outer metal casings. The joints contained O-rings of speciality rubber, 3.7 m in diameter and 6 mm thick, intended to seal in the pressures generated as the solid fuel burnt. These were “Criticality 1” components, for if the relatively cool gas at the outside of the booster got past them, that gas would soon be followed by hotter gas and flame. Now, even at the launch site in Florida it could be cold in winter. The night before the launch, the ambient temperature had fallen to -13 °C, so the metal casings and rubber must have become very cold and would be slow to warm up the next day. It was known from previous launches that the O-rings performed best at ambient temperatures on launch above 17 °C. No tests had been made on the rubber under conditions similar to those which actually would apply the next day. On launch at 11.38 am, a shower of ice came from the launch platform. Virtually anyone working with rubbers knew in 1986 that rubber got less rubbery (or resilient) as it was cooled, and therefore less likely to form a seal if used as an O-ring. The present author, as an employee of the UK company Laporte 1976-1980, knew that the rubber in ski boots, subject in use to winter cooling, were made of expensive synthetic polyurethanes so as to ensure resilience that could not be provided by normal shoe rubber.

Brunel had been taken aback by the degradation of his leather in 1848. In contrast, the experts who had advised against the *Challenger* launch (and had been overruled) were not surprised when, seventy-three seconds from launch, a hydrogen-oxygen explosion sent the orbital vehicle hurtling away to crash into the ocean,* when any surviving crew would have died. O-ring failure had indeed occurred, and a flame from a rocket booster joint had penetrated the orbital vehicle’s external fuel tank.

* Their only surprise was that the failure did not occur sooner after launch.

Because people were killed and because the ultimate responsibility lay with a public body, NASA, there was an extensive official enquiry. The detail, with names of individuals opposing the launch and insisting on the launch, was published, and the disaster is used as a case study in ethics training [4]. One is still left asking, “How could individuals interact so badly that the launch was allowed to occur?” The obvious answers – fear arising from job insecurity, flawed exercise of authority to break pre-set mission rules – are uncomfortable ones.

Unilever’s Manganese Catalyst, 1994-1995

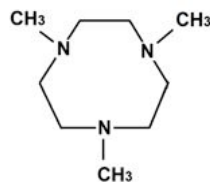
Another category (ii) failure, the “catalytic catastrophe” of the title of this article, occurred a quarter-century ago. No one was killed, some individuals may have had their clothes prematurely faded, and the failure affected mainly private companies, which suffered severe financial losses. Therefore, details such as are available for the *Challenger* disaster are not publicly available. Nevertheless, this failure is worthy of consideration because it may be closer to the personal experience of *Newsletter* readers. The product in question was PERSIL POWER, differing from products previously sold under the name PERSIL in containing a manganese catalyst.

The PERSIL POWER story is a particularly sad one, for PERSIL was the first outstandingly good domestic washing powder (launched in Germany in 1907 by the local company Henkel). The brand PERSIL was in 1927 territorially divided between Anglo-Dutch Unilever and Henkel (the former taking the UK, Ireland, and other territories, the latter taking Germany and other territories) [6] [7]. As we shall see, in UK and Ireland at least in 1994-1995, the basic brand PERSIL lost reputation because of its use in the Unilever’s disastrous product PERSIL POWER.

The original PERSIL of 1907 [8] contained a carboxylate soap made from natural fats, together with sodium perborate, sodium silicate, and sodium carbonate. The brand name PERSIL was derived from the first syllables of “perborate” and “silicate”. The perborate acted as a mild bleach (promoted in the UK in 1909 as the “Amazing Oxygen Washer” [9]), while the silicate facilitated the making of the composition into a powder. In subsequent decades, the formulation of washing powder was subject to many improvements, including the substitution of naturally-derived soaps by synthetic ones [10], but the essential idea of using a mild bleach remained unchanged, such as would remove stains while causing the colours of a garment to fade only slowly in repeated washes, acceptable relative to the expected lifetime of a garment.

The manganese catalyst in PERSIL POWER was advertised as an “accelerator” for the peroxygen bleach in the composition. The manganese was complexed, apparently recycling between the (IV) and (III) state without ceasing to be complexed (free aqueous manganese ions would have left brown manganese dioxide stains on the clothes) [11]-[13]. Unilever evidently persuaded *Nature* of the commercial and environmental importance of their researchers’ work: a three-page letter from them, with scientific embellishments such as EPR results,

specified three of the complexing ligands they had worked with: 1,4,7-trimethyl-1,4,7-triazacyclononane –



– and two closely related compounds, also with 1,4,7-triazacyclononane rings.

Unilever's people did not disclose any actual washing powder compositions in their paper. Presumably by arrangement, Alan Comyns, writing in the same issue of *Nature* (23 June 1994), did identify the catalyst in PERSIL POWER with compounds containing such ligands. (Comyns was a consultant, with previous experience of detergent compositions at Laporte.)

So to the commercial disaster when PERSIL POWER was launched [13]-[17]: – Unilever claimed that stains were removed faster and/or at lower temperatures. Procter & Gamble, Unilever's principal competitor, commissioned independent tests and made statements to the Dutch press about the damage to clothing resulting from the use of PERSIL POWER. Unilever began an action in the Dutch Courts alleging that Procter & Gamble had made untruthful and misleading statements, but withdrew. Unilever conceded that repeated "abuse washing" of clean garments at temperatures exceeding 90 °C could cause damage. But pictures were published of viscose shirts which had lost most of their colour in eleven washes at 40 °C. Even after five washes, there was appreciable fading, but if the user thereafter switched to a conventional powder, the accelerated fading continued, presumably because manganese from the earlier washes was retained on the fibres.

In response, Unilever reformulated PERSIL POWER with only one-fifth of the original amount of manganese catalyst. However, the product was soon withdrawn altogether. By the end of 2005, Unilever had formally written off £57 million of stocks of powder, while the Irish company Hickson, which had supplied the manganese catalyst, estimated that its profits had been reduced by £8 million as a result of the failure of PERSIL POWER. Much larger numbers for money wasted (development costs and marketing costs) are given by Childs, plausible in that these would not necessarily be separated out in company accounts. Other analysts estimated total losses at £250 million.

Unilever's chairman described the launch of PERSIL POWER as the worst marketing setback the group had ever experienced. By the use of the word "marketing", he was probably referring to diminished sales of regular PERSIL not containing the catalyst, whose reputation among consumers had been damaged by imperfect recollection, with a consequent decrease in Unilever's overall market share, and an increase in that of its competitor Procter & Gamble.

But the underlying problem was not in marketing: the Unilever chairman simultaneously announced that the company was reviewing the entire company process from research to innovation,⁺ an admission, in the author's terms, that a technological failure in category (ii) had occurred. This technical problem was foreseen by Procter & Gamble, who warned Unilever before launch that PERSIL POWER was unsuitable for domestic use. Unilever's scientists must have been experienced in simulating domestic use of products, including by consumers who failed to observe instructions or warnings on the pack. So why was the risk not identified – and if it was, why were the results not taken account of? This may never be known, and in particular whether dysfunctional relationships as in the *Challenger* case were involved. The author's first-hand experience suggests two additional, less extreme possibilities. Firstly, people can focus narrowly on specific problems allocated to them in projects, and tend not to interfere when colleagues are failing in their own tasks. Secondly, once substantial money has been spent, managers are reluctant to admit that it has been wasted and to advise that good money should not be thrown after bad. In contrast, that is exactly the reluctance that Brunel overcame in June 1848 when he realised that his leather valves could not be economically remedied. He knew better than to proceed from a category (i) failure to a category (ii) failure.

⁺ In "strategy-speak" as used by chairmen and others, "innovation" had – and still has – a narrow meaning: the first successful intrusion into the "real world" of a new concept (with business, economic, and/or social benefits).

General notes

(A) PERSIL is a registered trade mark of Unilever in some territories, and of Henkel in others.

(B) PERSIL POWER is a registered trade mark of Unilever. Henkel were unconnected with the product.

(C) The PERSIL POWER mark has been used within the last five years by Unilever in the forms Persil POWERGEMS and Persil

POWERCAPS. These products are unrelated technically to PERSIL POWER as launched in 1994.

(D) The references to *two* ex-Laporte employees in this article have a non-coincidental connection. Laporte was the principal UK manufacturer of hydrogen peroxide, which was used on-site to make peroxygen compounds for detergents and also ϵ -caprolactone, ultimately incorporated in polyurethanes for ski boots.

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Who are the Chemists in the Picture of Henry Roscoe and Dimitri Mendeleev?

This short paper arises from the difficulties I had in trying to identify the chemists in the group photograph of Roscoe and Mendeleev used by Gordon Woods in his article "Mendeleev and Great Britain" (*RSCHG Newsletter*, Summer 2020, pp. 44-52 hard copy, pp. 20-24 e-version).



Only Roscoe, Mendeleev and Roscoe's Marxist colleague Carl Schorlemmer in the front row are identified in this article. As it happens, this group photograph is a variant of a much better-known group photograph of Roscoe and Mendeleev which was published in his biography of James Joule by Donald Cardwell [1]. Cardwell identifies everyone in the photograph so it looks like case closed. However, David Allen from the RSC Library contacted me to say that the RSC has another copy of the Cardwell photograph, which remarkably has some of the sitters identified on the mounting:



Some of the identifications on the mount are rather surprising (e.g. Martius) and some are not identified at all. The identifications are as follows with Cardwell's identifications in brackets. Back row: Carl Martius (Johannes Wislicenus), Thomas Carnelley (Georg Quincke), William James Russell (Edward Schunck), Schorlemmer (same), unidentified (James Joule); front row: unidentified (Lothar Meyer), Mendeleev (same), Roscoe (same). It can be seen that Cardwell's identifications are almost entirely at variance with the attributions on the mount of the RSC photograph.

Then there was another breakthrough. Gisela Boeck (Rostock) sent me yet another group photograph of Mendeleev and Roscoe discovered by chemical historian Ralph Oesper [2].



This photograph was obtained by the physical chemist Fritz Paneth in 1930 from Meyer's son Waldemar Lothar Meyer. It is a crucial piece of evidence as several of the chemists identified by Cardwell as being in his photograph are unambiguously identified as being in this photograph. The back row here is Johannes Wislicenus, Lothar Meyer, Edmund Atkinson (Sandhurst), and Georg Quincke. The woman in the front row between Mendeleev and Roscoe is Johanna Meyer (née Volkmann). It is possible that Cardwell knew this photograph and assumed that some of this group were also in his group photograph despite clear differences in appearance.

Now let us turn to Cardwell's identifications. He identified the man with the long white beard on the far left at the back as Wislicenus, but comparing it with the other photograph, he is practically bald whereas Wislicenus has a full head of hair. There is a slightly earlier photograph of Carl Martius in the archives of the Deutsches Museum, which looks much more like the figure in the RSC picture if perhaps not exactly the same. He looks more like the same person in the photograph used by Gordon Woods.



Carl Martius, c. 1876. Courtesy
Deutsches Museum



Enlargement from the
RSC photograph

So this implies we can be reasonably confident of the inscriptions on the RSC photograph. It is not clear who may have written these inscriptions but it may have been Roscoe or someone else with Roscoe's assistance. Cardwell identified the second man on the left as Quincke, but again we have the same situation, the man in the RSC photograph has a full head of hair whereas Quincke is completely bald. Unfortunately there does not seem to be any extant photograph of Thomas Carnelley, who died at the age of thirty-six in 1890, in the public domain, but there is a photograph in private hands which confirms that it is indeed Carnelley. According to Cardwell, the man in the middle at the back was Edward Schunck, the dye chemist. Here we can draw on the pictorial collections of the RSC for a suitable photograph.



Edward Schunck,
Courtesy RSC Library



William James Russell,
Courtesy RSC Library

While there is a vague resemblance, it cannot be considered to be a good match. It is attributed to William James Russell who was president of the Chemical Society in 1889-1891. Again we can use the pictorial collections of the RSC and it is clear that he is a much better match, although whether anyone would have thought of him in the absence of the inscription is at least moot. I will pass over the man on the far right with the twinkly eyes for the time being for reasons that will become clear.

The man on the front left sitting on the arm of Mendeleev's chair was identified by Cardwell as being Lothar Meyer. If one compares the two group photographs, he looks nothing like Lothar Meyer and he is clearly much younger. He also seems to be at ease with Mendeleev in a way that would be unlikely for any German chemist. He is not identified on the mount of the RSC photograph which hints that he was not well known to Roscoe (or whoever wrote these inscriptions). However, he has long been identified by Russian (and East German) chemists as being Nikolai Aleksandrovich Menshutkin who would have been forty-four at the time of the photograph which is about right. Fortunately, once again, we can use the RSC's pictorial archives.



Nikolai Aleksandrovich Menshutkin,
Courtesy RSC Library



Enlargement of the RSC photograph

The photograph on the left is clearly a much later photograph but the similarity is striking, especially the widow's peak and the bushy moustache. I have to say, though, that not every scholar has been persuaded by this identification.

Finally we come to the figure who was crucial to Cardwell's use of the photograph in his biography of Joule. For Cardwell identified the figure at the back on the far right as being Joule himself. This identification mattered to Cardwell because it apparently showed that Joule attended the famous BAAS meeting in Manchester in 1887 despite his ill-health and the opposition of his family to his attendance of this meeting. However even on the basis of Cardwell's own volume, it is clear that there is no evidence that Joule was at the meeting (and much that he was not) apart from him being in this group photograph. As support for his view, Cardwell called Lucy Roscoe's famous photograph of Joule as evidence. Yet to me the difference between the two photographs is much stronger than the resemblance. Joule has a fairly dark beard even in old age whereas the man in this photograph has a pure white beard although he looks younger than Joule who was eighty-seven at the time.

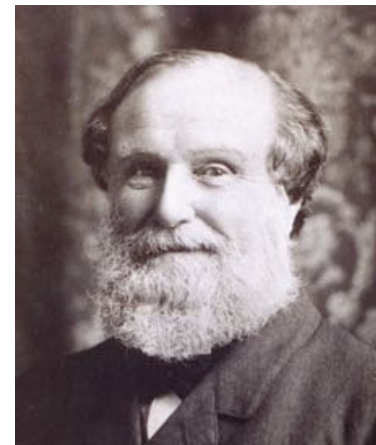


James Joule by Lucy Roscoe,
Courtesy RSC Library



Enlargement of the RSC photograph

Joule was unwell in 1887 and as evidence of him being Joule, Cardwell claims this man has to steady himself by leaning on the table. To me this mystery chemist does not look remotely like Joule, he is bald whereas Joule had a comb-over (why did Cardwell have such a blind spot about hair?). And the evidence in all the biographies of Joule (even Cardwell's) clearly show Joule was not at the BAAS meeting. But in that case, who was he? Unfortunately he is the second unidentified person in the RSC photograph (which is also indirect evidence that he is not Joule). Armed with a list of attendees at the chemistry sessions from *Chemiker Zeitung* [3], I searched through RSC's pictorial archives looking for someone with the same twinkly eyes and a white beard. I was on the point of giving up, when I saw his eyes staring at me: William Odling! Unfortunately there is no photograph from this exact period, there are ones from somewhat earlier and much later, but not from the 1880s. It is the eyes that confirm the identification for me, but there are other similarities (look at the nose and the almost invisible eyebrows) if not quite as marked as in other cases. He was also about the right age, having turned fifty-eight about the time this photograph was taken. This makes good sense, Odling was at the meeting and was interested in the periodic table. He was not however a close friend of Roscoe or Mendeleev which may explain why he is on the edge of the group in both photographs.



William Odling,
Courtesy RSC Library



Enlargement of the RSC photograph

To return to the photograph which sparked this research off, the figures in the back row of the photograph used by Gordon Woods can now be identified: Odling, Menshutkin, Carnelley, Russell and Martius. So as a result of trying to identify the chemists in this photograph, and largely thanks to the existence of the RSC photograph, I have now overturned all but the most obvious identifications asserted by Cardwell in his biography of Joule. This is important because his identifications have been widely accepted (for example by Colin Russell [4] in his BSHS presidential address in 1988 and by the University of Manchester's chemistry department on their website [5]) and I hope the correct identifications will now be used, at least in the cases where the identification is beyond doubt.

Acknowledgements

A large number of people have helped me with this identification exercise and it would be impossible to thank them all, but above all I wish to thank David Allen (RSC) for drawing my attention to the RSC group photograph and giving me several images from the RSC pictorial collections, Gregory Girolami for a copy of the article in *Chemiker Zeitung*, Gisela Boeck for a copy of the article by Ralph Oesper in *J. Chem. Ed.*, and Elisabeth Vaupel for her help in getting an image of Carl Martius from the Deutsches Museum pictorial archives. I also wish to thank David Allen, Alan Rocke and Bill Brock for their comments on an earlier version of this article.

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Who Discovered Rhenium?

Introduction

I published a piece in the *RSCHG Newsletter* of summer 2019 (No. 76, pp. 22-31 hard copy, pp. 12-16 e-version) on the life and work of Dr Gerald Druce, a chemist whose name has been associated, wrongly as I demonstrated, with the discovery of rhenium. In this article, I want to consider another chemist for whom claims have been advanced, namely Masataka Ogawa (1865-1930). He was a Japanese chemist who briefly worked at University College London, and who in 1908 claimed to have discovered the element nipponium. It was, according to his claim, element 43 in the Periodic Table. Many years later, the suggestion was made that he actually discovered element 75, modern day rhenium, and that he therefore deserves credit for this discovery [1]. That view is strongly supported by the Wikipedia entry on rhenium [2]. However, as I will show, it is a flawed suggestion, and should go the same way as the claims of Gerald Druce.

The Accepted History of the Discovery of Rhenium

There is no doubt that the discovery and isolation of rhenium were achieved in Germany in 1925 by Walter Noddack, Ida Tacke (later Noddack) and Otto Berg [3]. Noddack and Tacke worked at the Physico-Technical Testing Office, Berlin, Germany, mainly on analytical and mineral chemistry. The third member of the team, Otto Berg, was at the

company Siemens and Halske, and this was where the facilities for X-ray spectroscopy were located [4]. In the paper of 1925, the two elements 43 and 75 were claimed on the basis of very small peaks in X-ray spectra. They named element 43 masurium (after a region of Prussia) and 75 rhenium (after the Rhine). In 1925, neither element was obtained in amounts that could be weighed and in the case of masurium, they never were. Claims for this element were eventually dropped quietly [5].

Walter Noddack and Ida Tacke were married in 1926, and they worked together until Walter died in 1960. They were nominated for the Nobel Prize in chemistry for the discovery of rhenium a number of times during the 1930s, but were never successful. Later, after World War II, there were rumours that they had been Nazi sympathisers, and this counted against them. They had continued to work in Germany throughout the time of the Third Reich, and had benefited from Nazi anti-Semitism when Walter was promoted to the position of Full Professor of Physical Chemistry at Frieberg University in 1935 following the dismissal of his Jewish predecessor, Georg Hevesy [6]. Against that, when the extent of Nazi sympathies was examined by tribunals after the war, the Noddacks were exonerated. Ida was not actually employed for much of this time, but was officially only an unpaid assistant to her husband.

Despite her formal status, Ida was actually a full partner in the work [6]. She seems to have been the first person to draw attention to the fact that the odd-numbered elements are less abundant than the even-numbered ones, and that led her to realise that eka- and dvi-manganese would be rare. She also reasoned that the region of the Periodic Table in which they occurred was one in which so-called diagonal relationships are strong [8]. This would mean that elements 43 and 75 would be found associated with molybdenum (Group 6) or even palladium (Group 10) rather than manganese (Group 7). Hence, the Noddacks selected the mineral molybdenite and minerals of the platinum group metals to work with rather than manganese minerals.

The claims for Masataka Ogawa

Ogawa was given the chance to visit London in 1904, to work at University College, London (UCL) under the supervision of Sir William Ramsay (1852-1916). Ramsay was Professor of Chemistry at UCL from 1887 to 1912, and had found particular fame for discovering the noble gases neon, argon, krypton and xenon. This added a previously

unsuspected whole group to the Periodic Table [9]. The work earned Ramsay the Nobel Prize for chemistry in 1904 [10].

When Ogawa arrived at UCL, Ramsay gave him the mineral thorianite to study, thinking that it contained at least one unknown element. Not long afterwards Dr Claire Evans in the same department published a paper claiming to have discovered a new element related to tin in thorianite [11]. The claim was soon refuted [12].

Ogawa found the analysis of thorianite challenging, but eventually obtained a small amount of something that appeared to be a new element. It seemed to be element number 43. Ramsay suggested the name nipponium for it in honour of Ogawa's home country, Japan being called Nippon in the Japanese language [8]. The proposed chemical symbol was Np.

Ogawa returned to Japan and continued to work on this topic. In later years, he claimed to have found nipponium in Japanese molybdenite, a mineral whose main component is MoS_2 [8]. In 1909, Frederick Loring included nipponium in his published Periodic Table, placing it in position 43 as per Ogawa's claim [13]. Unfortunately Ogawa's colleagues in the Chemistry Department of Tohoku University could not replicate his results and, despite his best efforts, neither could he. It took until 1937 for element 43 to be isolated, and then it was a product of a nuclear reaction. Unambiguous isolation was achieved by Perrier and Segrè working in Palermo in Italy [15]. As a result, nipponium was replaced in published Periodic Tables and Ogawa's claim came to be seen as just another mistake among the many concerning the discovery of elements.

Then in 1997, Yoshihara of the Japan Isotope Data Institute revisited Ogawa's work, and after studying it carefully concluded that the solution was simple. Ogawa, he said, had actually discovered rhenium (element 75) [1]. His reasons are summarised in the table below [14].

Table: Comparison of Nipponium and Rhenium

Feature	Nipponium	Rhenium
Spectral line/nm	488.2 ± 1.0	488.9
Relative atomic mass	100 (recalculated as 185.2)	186.2
Source	molybdenite mineral	molybdenite mineral

Yoshihara expresses the view that the most important reason to equate nipponium with rhenium is the optical spectral line at around 488 nm. It is certainly true that this is the strongest line in the visible emission spectrum of rhenium [16]. However, Yoshihara also goes on to claim that the chemical properties of nipponium, notably of the oxide and hydroxide, are similar to those now known for rhenium. However, careful inspection shows that this is not true.

According to Yoshihara, Ogawa assumed nipponium was divalent, and from this he arrived at an atomic weight (relative atomic mass) of 100 for the element. In fact, in his papers Ogawa hardly mentioned atomic weight. Instead, he mainly discusses equivalent weight, and he estimates this as 50.3 from two analyses and 48 from a third [17]. This means he would have obtained values of between 96 and 100.6 for the relative atomic mass, assuming nipponium to be divalent. If we follow Yoshihara's reasoning and assume the element to be Np(IV) , these would be changed to between 192 and 201.2. However, in his papers [1, 14] Yoshihara recalculates this value to 185.2, but the reason for this is not clear. It obviously suits his argument, but does not follow from Ogawa's results.

Ogawa published his original data in detail, and in English [17], which means it is possible to recalculate the value of atomic weight. Ogawa records that 0.0625 g of the chloride reacted with an excess of acidified (with HNO_3) silver nitrate to give 0.1120 g of AgCl . The amount of chloride in the precipitate would have been 0.0277 g, equivalent to 7.81×10^{-4} moles. If the initial compound had been ReCl_4 , as claimed by Yoshihara, this amount (with 0.0347 g metal) would have contained 1.953×10^{-4} moles, which gives a value of 178.19 for the relative atomic mass.

Is this close enough to be considered a reasonable approximation for the currently accepted value of the relative atomic mass of rhenium? The answer seems to be a matter of opinion. What is not a matter of opinion is that the substance analysed by Ogawa was the wrong colour. It was pale yellow compared with purple-black for authentic ReCl_4 [18]. All of the known rhenium chlorides are deeply coloured [18], so what the pale-yellow substance was that Ogawa analysed is a mystery.

There are two other pieces of chemistry in Ogawa's paper that need to be considered in assessing Yoshihara's claims for him. First, he reports that the chloride was completely oxidised with the following results. An original mass of 0.1092 g of chloride was converted into 0.0742 g of oxide, a loss of 0.0350 g. Calculation shows that this transformation

involved 0.0006363 moles of oxygen replacing 0.00127 moles of chloride. This shows that the amount of metal present was 0.0641 g. Taking the reaction to be the conversion of MCl_4 to MO_2 , we obtain values of 201.89 and 201.48 respectively for the relative atomic mass of the metal. This is very different from the value obtained from analysis of the chloride, even though it reasonably consistent with Ogawa's estimate for the equivalent weight.

The other chemical reaction that Ogawa reports is the oxidation of the sulfate. For this reaction, 0.1253 g of the sulfate gave 0.0747 g of the oxide, which leads to a relative atomic mass for the unknown element of 204.21. Like the results for the chloride, this is also larger than the known value for rhenium, and raises yet more doubts about what Ogawa really found.

Yoshihara's investigations included re-examining a photographic plate that had been kept by Ogawa's family and that it appeared to be of an X-ray spectrum [14]. Though unlabelled, it seems to show evidence of the presence of rhenium in that there are $L_{\beta 1}$ and $L_{\beta 2}$ peaks plus a small L_{γ} peak in the positions known for rhenium. Unfortunately, this is not necessarily conformation that nipponium and rhenium are the same, because, after the Noddacks had reported the existence of rhenium, Ogawa recognised that this element was present in his sample. Despite that, he never published anything to associate it with his element nipponium.

Conclusion

On balance, then, the evidence does not support Yoshihara's claim that Ogawa really discovered rhenium. He certainly found the strong rhenium line in the optical spectrum, but his other findings are at complete variance with what is currently known about this element. The chloride was the wrong colour, and the analysis of the chloride as well as the oxidation of the chloride and the sulphate, give wrong values for the relative atomic masses. Given that a large number of trace elements are found in the minerals thorianite and molybdenite, it is not surprising that Ogawa found traces of something unusual. Thorianite, for example, is known to contain around 500 ppm of rhenium [14], so observing its emission line in the spectrum can be explained readily. Certainly, Ogawa never recognised that his nipponium and genuine rhenium might be the same element, and he never claimed to have discovered element 75. On balance, therefore, it seems that Yoshihara's claim on behalf of Ogawa lacks substance. It also seems that the only people who should

really be associated with the discovery of rhenium are Noddack, Tacke and Berg.

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A Life of Its Own: How Luigi Casale's Enterprise Launched and Still Nurtures the Global Nitrogen Industry

April 2021 marks the hundredth anniversary of the foundation in Lugano, Switzerland, of the chemical engineering contractor Ammonia Casale SA. The driving force behind this enterprise, the oldest in continuous existence in the field of synthetic ammonia and related catalytic high-pressure processes, was the Italian chemist Luigi Casale. He developed a process that offered a number of important advantages over the Haber-Bosch ammonia process. Today, Ammonia Casale, rebranded as Casale SA, is a global leader in the design and revamping (upgrading or retrofitting) of ammonia plants, and provides engineering services for urea, methanol and nitric acid plants.

Luigi Casale (1882-1927), born in Langosco, Lomellina region, was the third of eleven children of Santino Casale, administrator of the properties of the dukes of Langosco. In 1908, he graduated at the Royal Polytechnic of Turin, under Arturo Miolati (1869-1956). Luigi received his postgraduate degree in 1910 from the Turin Institute of Chemistry and Electrochemistry. During 1912-1913 he undertook research under Walther Nernst in Berlin, which brought him in touch with the latest developments in the thermodynamics of gas reactions.

Luigi Casale developed his synthetic ammonia process just after World War I at a workshop located next to the steel works in Terni, northeast of Rome. The arrangement of the internals of his high-pressure reactor, or converter, enabled production of ammonia in an apparatus made of normal steel (Fig. 1). The high operating pressure, of 800 atmospheres, gave, directly, liquid ammonia. This was not possible with the Haber-Bosch process, which operated at 200-250 atmospheres. Casale's process, which used a less active catalyst based on iron, enabled a far higher yield (15 to 18 %) than the Haber-Bosch process (5-8 %). The source of hydrogen was electrolytic; pure nitrogen was obtained by the burning of air with hydrogen. The six-stage reciprocal compressor, capable of reaching 1,000 atmospheres, without leakages, was the first of its kind, manufactured by the firm of Pignone of Florence.

Luigi Casale succeeded in marketing his invention because the Haber-Bosch synthetic ammonia process of BASF in Germany was not available to outside firms. Casale, without the vast resources of the German firm, took a very different approach, the licensing of his process. Significantly, Casale's process, and another Italian process, that of Giacomo Fauser, were, in addition to Georges Claude's process, lone

breakthroughs of outliers to the chemical industry. Fauser's process was favoured by the Italian conglomerate Montecatini, which placed restrictions on the use of Casale's ammonia process in Italy, and was not at first prepared to license the Fauser process. (Claude's process, which operated at 1,000 atmospheres, faced teething problems until the mid-1920s.) Casale opened his business, Ammonia Casale, in Switzerland, where financial backing was available. Casale's headstart with his proven technology found its first major application on Japan's third largest island, Kyūshū, at the works of Shitagau Noguchi whose ammonia factory, drawing on electrolytic hydrogen, was opened in 1923. This was the starting point for the emergence of the modern Japanese chemical industry.

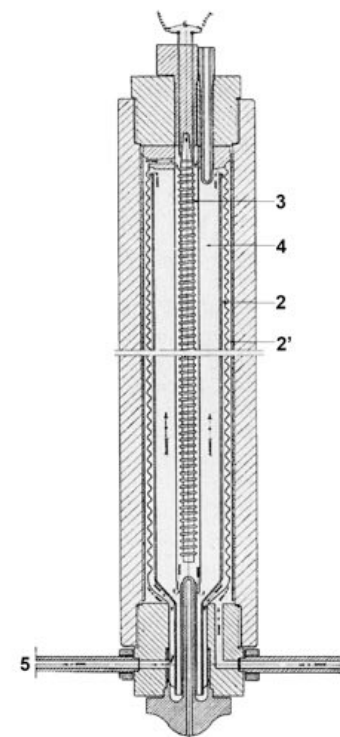


Fig. 1: Casale ammonia reactor, 1920s. Key: 1, gas (nitrogen-hydrogen) inlet; 2, 2', concentric annular spaces, divided by corrugated partition; 3, electrical heater; 4, catalyst space; 5, ammonia and unreacted nitrogen-hydrogen outlet. (Casale SA)

Numerous licensing arrangements followed, though mainly in Europe. Licensing, backed up with procurement of Italian-made machinery, including Pignone compressors, enabled Casale's process to become widely dispersed (Fig. 2). Methanol production followed within a few years, as did the invention of a urea process [1].

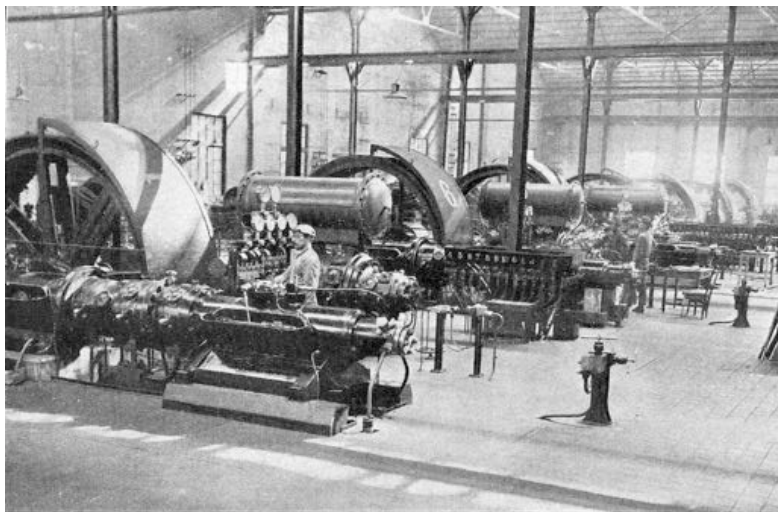


Fig. 2: Compressors, supplied by Pignone, for use with Luigi Casale's ammonia process, at one of Noguchi Shitagau's factories, on Kyūshū, mid-1920s. From A. Miolati, *Synthetic Ammonia and the Casale Process. Amplified edition of a lecture delivered the 27th February 1927 at the Institute of Chemistry of the Polytechnic School of Prague.* (Rome: "L'Universale" Tipografia Poliglotta/Ammonia Casale SA, 1927), fig. 19.

For all the ammonia processes, the source of pure hydrogen, the most expensive input, depended on available resources, and economic conditions. As a result, hydrogen was generated by electrolytic, water gas, and coking oven gas processes. One of the first successful uses of the latter in the 1920s was at Ostend, Belgium, in conjunction with the Casale process. However, from the 1940s hydrocarbon processes, based mainly on natural gas (methane), became increasingly favoured.

In one instance only, Ammonia Casale became engaged in the manufacture in synthetic ammonia. This was in the United States, at Niagara Falls, in partnership with a major electrical utilities corporation. The factory relied on electrolytic hydrogen. However until the late

1920s North America, with its near total reliance on imported Chilean nitrate and improved coking processes for nitrogen fertilizers, was not yet ready for large scale high-pressure chemistry. Moreover, the main interest in ammonia was in industrial refrigeration, for which the market was restricted. In the mid-1920s, Du Pont toyed with Claude technology, which did not live up to its promise. That changed in 1928, after Du Pont acquired the Casale technology as used at Niagara Falls in order to overcome the severe problems experienced with the Claude process. This was a major contributor to Du Pont's manufacture of nitric acid by catalytic oxidation of ammonia, as well as novel Du Pont high-pressure processes developed during the 1930s, including in production of nylon.

An important innovation introduced by Luigi Casale was an injector which replaced the circulation pump in the ammonia synthesis loop. This reduced the number of moving parts. In 1925, Casale set up Italy's first industrial research laboratory focused on chemical investigations. He died in early 1927 as a result of injuries sustained while working on toxic gases for the Italian war effort during the World War I. His wife, Maria Sacchi-Casale (1889-1950), a competent chemist, and colleagues took over the running of Ammonia Casale and its research centre. Business remained brisk until the outbreak of World War II. During the next two decades there were no major innovations in the ammonia synthesis.

Prior to the 1960s, the maximum daily output of ammonia reactors was around 300 tonnes. Factories that produced ammonia on a larger scale employed batteries of ammonia trains, each train (loop) made up of identical units, including the reciprocating compressor, recirculating pump, and reactor. In response to the challenges posed by the evolving Green Revolution, with its vastly increased demand for fertilizers, the American engineering contractor W.M. Kellogg combined new innovations, including those invented at ICI, to develop a single train synthesis unit that incorporated a centrifugal compressor and produced 1,000 tons (US) of ammonia per day [2, 3]. The main initial impact was in Asia, notably in India.

The Ammonia Casale business was revived in the late 1970s following the tremendous increase in the price of oil. Under new ownership by the Altech group, the firm designed a new and more efficient reactor incorporating modular catalyst cartridges, with intercooling by gas injection. By 1980, three of the new synthetic ammonia units, each of 1,000 tons daily capacity, were in operation, two in France, and one in Romania [5]. Heading the design team was Umberto Zardi, an

experienced engineer who had previously led Snamprogetti's inorganic engineering division, where he developed new urea processes.

That was just the beginning. Older ammonia plants, some with downstream urea and methanol facilities, dating from the mid- and late 1960s, the time of a tremendous evolution in high-capacity ammonia technologies, were less than energy efficient. In many cases the cost of building completely new replacement plant to satisfy the demand could not always be justified. The challenge was taken up by Ammonia Casale. In an almost singular first response within the industry, Ammonia Casale offered a service for revamping of existing ammonia reactors, in order to both extend lifetimes and make them more efficient.

An important development in this direction involved changing the then standard axial flow reactors to axial-radial operation, following on from the pioneering work of the Danish contractor Haldor Topsøe with a radial flow vessel. Ammonia Casale's design of a low-pressure drop axial-radial ammonia synthesis reactor gave a considerably increased yield. It was announced by Zardi at the British Sulphur Corporation's Fourth "Fertilizer Nitrogen" Conference, held in London in January 1981. While the main theme of the three-day event was the challenge, at that time, of more expensive energy, many other aspects of state-of-the-art ammonia technology were discussed. The novel Ammonia Casale reactor, suited to retrofitting, offered the audience plenty of potential, not only in energy saving, but also in cost savings, through upgrading of existing equipment.

The first major success with the axial-radial reactor took place in 1986, with the upgrading of four Kellogg ammonia units for C.F. Industries (Central Farmer Industries) in Louisiana (C.F. now operates the former ICI Billingham facility). What was particularly remarkable about the project was that the contract was obtained on the basis of calculations alone because at the time Ammonia Casale not only had no prior project as a reference but had not even had an opportunity to undertake early-stage tests!

This happened at the onset of a new economic crisis. The sharp fall in the price of oil as demand fell forced countries in the Middle East to cancel construction of new processing plants. As a result of the contraction of business activity, many large international engineering contractors, some also engaged in the synthetic ammonia sector, suffered. The ramifications, particularly cutbacks, went beyond large projects in the Middle East. There was also a downturn in the fortunes

of Altech. To meet its financial obligations, Altech divested its holding in Ammonia Casale [4].

The changed situation, however, created more opportunities for revamping. Zardi and a group of young engineers developed further improvements for ammonia reactor revamping, irrespective of the process originally worked. Outdated reactors were made reusable by partial or total replacement of internals.

Ammonia Casale, by introducing energy saving features, and novel reactor designs offering greater capacities, became a world leader in the technologies of nitrogen products. Over 200 ammonia reactors, many of the Kellogg type, were retrofitted with Ammonia Casale axial-radial internals. Overall performances were brought to a level that was comparable to that of newly built vessels.

It was as a direct consequence of the success of the C.F. Industries project that Ammonia Casale entered into the vast Chinese market. Soon after, Ammonia Casale was undertaking revamping in Russia and India. In the years that followed, Ammonia Casale cornered most of the global revamp market, upgrading ammonia reactors of all types, corresponding to more than forty percent of global production capacity. Urea and methanol units were also revamped using axial-radial technology. Ammonia Casale moved on to complete plant design, including ammonia units with capacities of thousands of tons a day. They found application in the hydrocarbon-rich nations in the Middle East, where several mega-nitrogen projects were incorporated into national infrastructure programmes.

The outcome of these several developments at Ammonia Casale (since 2014 Casale SA) and elsewhere is that synthetic ammonia, through its derived products, nowadays mainly urea and ammonium nitrate fertilizers, contributes through energy saving technologies to the bumper crops that many regions of the globe have enjoyed since the 1960s. Synthetic ammonia is a huge story, of which the one-hundred-year history of Casale SA is an important part.

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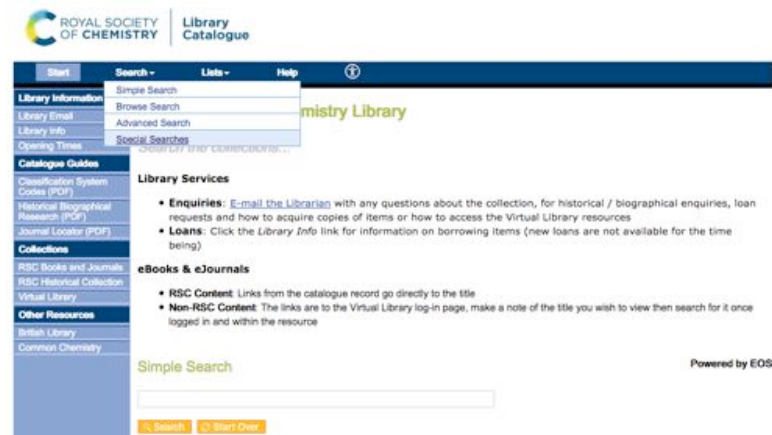
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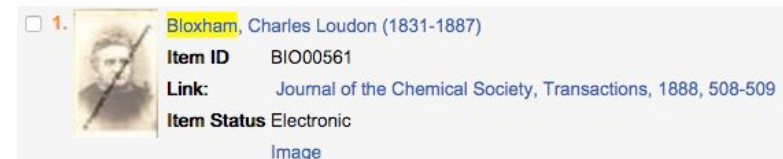
Since the Royal Society of Chemistry's Historical Collection was digitised in 2014, the archive has been available to many more people who are unable to visit the Library at Burlington House in person. Digitising the collection has also enabled us to ensure the collections are preserved for the use of future generations. With Covid-19, providing online access to the collection has taken on an even greater importance, with it currently being the only way to view the collection.

However, the Historical Collection is not the only resource available for online research; we also have the RSC Publishing archive, the Biographical Database, and eBooks in the Virtual Library. The Library catalogue <http://www.rsc.org/opac> is where all these resources come together so this is often the best place to start using the collections. The catalogue is available for anyone to use and does not require a log-in. When searching, there are three main options, as well as the Simple and Advanced searches, a number of predefined 'Special Searches' have been created. Access this list by clicking 'Search' on the top menu bar, then 'Special Searches' and click the search title to run it. You can then either scroll through the results or adapt the search to find something more specific.

The Biographical Database of historical profiles and obituaries of past Society fellows and scientists was imported to the catalogue in February 2020. Over the past months, a lot of work has been done to edit and augment the information, and this work continues. Moving the database to the catalogue has created a more integrated search experience for the end user; instead of searching multiple platforms for information on an individual, you can now use one resource to find biographical information and images as well as other information by or about them.



To find information on an individual, you can perform a 'Simple Search'. Biographical records will have a tree icon underneath them (as in family tree – see image below). This type of search may return a lot of irrelevant records so one can narrow the search by adding more terms in an 'Advanced Search'. If you only want to see biographical records, use the 'Special Search' of the same name and enter the person's surname as an additional search term.



Members have full access to the entire Historical Collection: <https://pubs.rsc.org/historical-collection/>; click either of the collection links and sign in using your standard RSC credentials. The search tool can be useful, but it is in need of some further work. If you cannot find something, it is inadvisable to use this as conclusive evidence that something does not exist in the collection. One particular issue with the search function is that because many of the earlier publications were written by hand or have obscure typefaces, performing a keyword search on these won't be effective. If a user cannot find something using the search, but has an idea of where it might be, one should either peruse the collections as you would if you were looking at the real thing or ask for some help from the RSC Library. This collection is a real

treasure trove of hidden gems and it is often fruitful just to have a browse through its various parts. The collection of *Society Publications and Minutes* is the section that is truly unique to the RSC, with most of the collection of our own publications not available elsewhere, and certainly not all in one place.

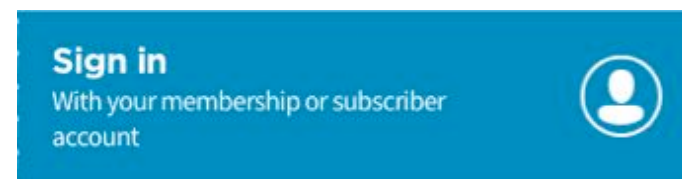
Chemistry in Britain (1965-2003) has featured articles displayed in the main part of the screen; the collection can be navigated by year and issue using the menu on the right-side, with the link to 'Download full PDF' of the issue just above it. As well as some interesting articles on a wide variety of topics in the chemical sciences, this periodical has monthly news items relating to the Society and the chemistry community over its thirty-eight-year lifespan; it is also the source of many of the obituaries found in the Biographical Database. Of special interest to historians is the collection of *Lectures, Monographs and Reports (1949-1967)*. These lectures were often on such topics as "The Chemistry of Opium" and "Borides" but there were also some more historical lectures including "The Discovery of Polythene", "British Coinage", and a lecture on the life of Percy Faraday Frankland, former President of the Chemical Society.

When undertaking biographical enquiries sent into the Library, after searching for biographical records in the Library catalogue, I would consult the *Lists of the Officers and Fellows of the Chemical Society (1843-1953)*. In this resource I can confirm whether someone was a Fellow, when they were elected, where they lived, and sometimes information on where they studied. From this, I can then find their *Certificate of Election* which will contain further information, with the added element of being able to see their handwriting. Unfortunately, as the certificates are still only available in their original paper form, this is a resource I currently have little access to. However, we are in the planning stages of getting the certificates digitised and possibly made available on the Historical Collection within the next couple of years. As an interim source of information, the text of quite a few certificates can be found in the RSC Publishing journal archive. Please be aware that searching for these can be hit and miss, especially if the person has a popular surname; knowing their date of election will help narrow the search down.

The Historical Books and Papers collection is one of the largest and most comprehensive collections on the chemical sciences, with items dating from the sixteenth to twentieth centuries. Included is an excellent collection of nineteenth century chemical textbooks from authors

including Andrew Ure, Thomas Thomson, William Brande, Fredrich Accum and Jöns Jacob Berzelius, alongside some seminal works from Michael Faraday, Jane Marcet and Henry Watts.

The RSC Publishing archive <https://pubs.rsc.org> is indexed on the catalogue by journal or book title so advanced searches are recommended when looking for specific articles in the Publishing platform. Members are given ten to twenty-five current journal articles for free (depending on their level of membership) and there is unlimited access to the entire archive from 1841 to 2007. The archive includes all the back issues of journals from the Royal Society of Chemistry and its former constituent societies. Members do not require a separate account to access this platform; you can use your standard RSC credentials as usual. When prompted to log in, you should use the third (blue) 'Sign in' button on the right of the page.



As with the Chemical Society, the Institute of Chemistry had its own registers of members but as these are not available as a collection in their own right, much of the information can be found in the *Proceedings of the Institute of Chemistry of Great Britain and Ireland (1877-1919)* and some of its subsequent titles.

To access the Virtual Library <http://www.rsc.org/library>, click on the 'Virtual Library' tab and then the 'Virtual Library sign-in' button. One then uses your standard RSC credentials to log in. The Membership area on the website was upgraded in late August 2020 so members should notice some improvements, the main one being that this is a single sign-in and one no longer has to log in to each Virtual Library resource separately. If you haven't logged into the system since the upgrade, please note that you may be asked to reset your password.

In July, we purchased a further twenty-one eBooks from EBSCO to add to the existing ninety-seven in our collection. Use the 'eBooks (EBSCO)' 'Special Search' on the catalogue to see the list of what members have access to. There are also many titles on the platform that are in the public domain so it is worth having a browse to see what else is available. The emphasis of the newly acquired titles is on the history of chemistry and includes *The Chemistry Department at Imperial*

College London: A History, 1845-2000; Hallelujah Moments: Tales of Drug Discovery; and Women in their Element: Selected Women's Contributions to the Periodic System. Links from the catalogue will take you to sign into the Virtual Library rather than directly to the title, so make a note of the title you're interested in so that you can find it in the resource.

If you experience difficulties accessing any of the resources mentioned in this article, it's always a good idea to delete the cookies and cache from your browser or to try a different browser altogether. Please contact the RSC Library library@rsc.org if you require any further information on what is available to you as members, guidance on resolving access issues or advice on where you might find information to aid your research. We would also be interested in any suggestions for future eBook acquisitions; we are currently only purchasing individual eBooks via EBSCO, but we can look into using other providers as long as they are compatible with the Virtual Library system.

David Allen, RSC Library

Introduction to Science History Institute Digital Collections

"So, what do you have, pictures of chemical formulas or something?" Such is the common refrain when I introduce myself as the Chief Curator of Audio-visual and Digital Collections at the Science History Institute (formerly Chemical Heritage Foundation) in Philadelphia, Pennsylvania. The quick answer to this question is yes, we have some pictures of chemical formulas, but we also have so much more, a cornucopia of rare and modern books, manuscripts, photographs, advertisements, oral histories, scientific instruments, glassware, and fine art reflecting the history of science from the Roman Empire through to the twenty-first century. As I like to say, we collect a little bit of everything and we are delighted to share those materials with the Royal Society of Chemistry Historical Group via our Digital Collections site.

Launched in February 2018, the Science History Institute's Digital Collections (digital.sciencehistory.org) is a curated selection of items showcasing the particular strengths of our diverse collecting areas, including alchemy, scientific instruments, food science, health and medicine and scientific education. We also select materials for digitization with an eye towards what's unique, interesting, and different, often asking ourselves "Are we the only ones that have this?" or "Would people be surprised to know we have this?" Currently, over 8,200 items are available on the site and new materials are added on a regular basis, often with an eye towards specific anniversaries or

historical milestones. For example, in 2019 we added a bevy of materials related to the periodic table and chemical elements in celebration of the International Year of the Periodic Table. Similarly, in 2020 we focused on materials related to women and science to commemorate the 100th anniversary of women's suffrage in the United States.

In addition to some of the subject areas mentioned above, other materials of particular note in the Institute's Digital Collections include:

Phil Allegetti Pesticide Collection

Pesticide cans, sprayers, and diffusers, collected over several decades by Phil Allegetti, an exterminator and weed-control specialist. This collection of 3-D objects and ephemera is a lens into a time when DDT was hailed as a "miracle pesticide" and aerosol spray cans were common household objects.

Witco Stamp Collection

Spanning the years 1910-1983, this collection of international postage stamps and philatelic material offers a unique view into how scientific achievements have been celebrated and commemorated and also boasts portraits of many notable scientists, including Marie Curie, Albert Einstein, Louis Pasteur, and George Washington Carver.

Roy G. Neville Historical Chemical Library

Collected by Roy G. Neville (1926-2007) between approximately 1950 and 2004, this collection includes many landmark titles in the history of science and technology, such as a first-edition of Robert Hooke's *Micrographia* (1655) and Michael Maier's famed alchemical emblem book *Atalanta Fugiens* (1618). The collection is also especially strong in a range of topics, including chemistry, mining and metallurgy, dyeing and bleaching, gunpowder and fireworks, and pharmaceutical chemistry.

Underwood & Underwood Stereographs of Manufacturing Industries

Often used for teaching, stereographs were a kind of proto-Power Point popular in the Victorian era, creating an immersive, 3-D effect when viewed through an optical device known as a stereoscope. This collection, which came to us from the Chemistry Department at Oberlin College, depicts various stages in the industrial manufacture of glass, steel, iron, and salt.

Edward G. Mazurs Collection of Periodic Systems Images

Of course, no history of science collection is complete without some periodic tables, but the Mazurs collection notably focuses on alternative layouts and designs, including circular, cylindrical, pyramidal, spiral, and triangular forms ranging in date from the 1860s to the 1950s. This is truly the periodic table as you've never seen it before!

In addition, one of the most exciting developments of the past year has been the addition of over 200 comprehensive oral history interviews conducted by the Institute's Center for Oral History. With interviews dating back to 1979, the collection includes many leading figures in chemistry, chemical engineering, life sciences, and related fields, including Nobel Prize winners Roald Hoffmann, Alan MacDiarmid, Mario Molina, and Linus Pauling. The oral history interviews in the Digital Collections are full-text searchable and include both PDF transcripts and audio files, which can be downloaded or streamed directly through the site. And the rich content of these interviews is becoming more discoverable all the time, thanks to a recently-added feature: the Oral History Metadata Synchronizer (OHMS). At its most basic level, OHMS is a tool that syncs audio recordings with transcripts in discrete segments, allowing for a more robust use of the oral history collection. It is labour-intensive work, but a task we are regularly undertaking in order to provide more direct access to the prolific scope of topics captured in our oral history interviews.

These highlights are just the tip of the iceberg and we hope you'll visit digital.sciencehistory.org to explore and discover the true breadth of our Digital Collections. Not sure where to dive in? On the Digital Collections homepage, you'll find a gallery of recently-added items, as well as links to our Featured Topics and Collections landing pages. Researchers interested in browsing the full scope of materials can easily do so at digital.sciencehistory.org/catalog. There, a robust menu of options allows you to narrow your search using a variety of metadata fields, including date, subject, creator, genre, and language. And, underscoring our commitment to make our collections accessible, all of the images in our Digital Collections are freely available for download in a variety of sizes and formats, including TIFF, JPEG, and PDF. The site includes nearly 2,500 items in the public domain and we have also applied standardized rights statements to provide clarity on copyright and facilitate reuse so there is nothing to stop you from finding the perfect alchemical illustration for your next holiday card or whatever else your imagination dreams up. Happy searching!

Hillary Kativa, Science History Institute

CHEM-HIST: The Roots of the History of Chemistry Networks

The existing networks in our field have a twofold origin: The Working Party of EuChemS, founded in 1977 in Budapest, and the European Science Foundation (ESF) Programme *The Evolution of Chemistry in Europe (1789–1939)*, which brought together a total of 135 scholars from twenty-four countries in a series of thirteen conferences between 1992 and 1997. While the EuChemS Working Group maintains stronger connections to the chemical community and the national chemical societies, the ESF programme was explicitly aimed at including historians of science, business and general historians alike.

In its final conference, two follow-up projects were envisaged: the setting up of an international network devoted to the history of twentieth-century chemistry, and the creation of a permanent communication hub for chemist-historians, historians of chemistry and historians of science in general.

The first aim was realised by the creation of an International Commission on the History of Modern Chemistry as a subdivision of the International Union for the History and Philosophy of Science and Technology, Division on the History of Science and Technology (IUHPST/DHST), set up at the International Congress of History of Science in Liège, in 1997, and renamed Commission on the History of Chemistry and Molecular Sciences (CHCMS), in 2017.

The second aim was achieved by creating the mailing list CHEM-HIST, which became the official messenger of CHMC, in 1998. CHEM-HIST is nominally supported by the Fachgruppe Geschichte der Chemie der Gesellschaft Deutscher Chemiker, the Historical Group of the Royal Society of Chemistry, the Science History Institute in Philadelphia, the Sidney M. Edelstein Center for the History and Philosophy of Science, Technology and Medicine in Jerusalem, and the EuChemS Working Party on History of Chemistry. The list server is administered and hosted at the University of Regensburg, Germany.

CHEM-HIST is meant to be the principal means of rapid communication and exchange for information and discussion related to the history of chemistry and chemical industry. The list is open to anyone with an interest in any facet of the history of chemistry internationally. CHEM-HIST aims to announce conferences, new projects and forthcoming events; to inform about seminars, exhibitions, and museums; to advertise jobs, grants, scholarships, and prizes; and to carry inquiries of whatever colleagues feel appropriate asking the community. During the past twenty years, the number of subscribers has

risen to a level of 380-400 throughout the world. Since 2006 all postings are stored in a publicly accessible list archive.

Please, do feel invited to join the world-wide CHEM-HIST community

To join the mailing list simply send an email with nothing but the line subscribe chem-hist to mailman-request@mailman.uni-regensburg.de

Christopher Meinel

BOOK REVIEW

Geoff Rayner-Canham, *The Periodic Table – Past, Present and Future* (World Scientific: London 2020, Pp. xiv + 296, ISBN 978-981-848-4, £85-00 (hardback).

This wide-ranging book enters what is now quite a crowded field. At first sight it might be thought, despite its title, to be of little interest to the chemical historian since it is not really a history of the Periodic Table as such – the reader will not find Mendeleev in the index. Rather it is an exposition of the many chemical and physico-chemical principles responsible for the arrangement of elements in the Table, each of these principles being seen in historical as well as chemical perspectives. A number of ‘historical’ tables are reproduced including Mendeleev’s seminal one of 1871, so the book is of interest to the historian as well as the working chemist.

There are fourteen chapters, each ending with a useful Commentary (summary). The first chapter covers basic principles such as electronegativity, ionisation energies, relativistic effects and many others: the level of chemical understanding required is quite high. Subsequent chapters focus on chemical and structural aspects of the Table, e.g. selected trends in atomic properties and the specific problems which groups and periods pose – the text is particularly successful at pointing out patterns amongst these. Sometimes the topic is not universal enough to justify the space it occupies. An example is the chapter on the ‘Knight’s Move’, in which there are similarities between one element and another one period below and two groups to the right, e.g. zinc and tin. This is too long and some of the space would have been better used on more material on the transition metals.

I found this to be an interesting book and learned much from it. Its strengths lie in the presentation of patterns amongst the elements and their chemical properties. The author displays a wealth of knowledge - there are 516 references - and his book is full of surprising facts. Just two, selected at random, are that the mineral dolomite, $\text{CaMg}(\text{CO}_3)_2$, found in the mighty Dolomite Alps and elsewhere, was not prepared in

the laboratory until 2013; and that the many colours in Jupiter’s moon Io derive from its sulfurous atmosphere. In the unlikely event of there being a Periodic Table pub quiz this would be an excellent source book.

Astonishingly for a book on the Periodic Table there is no ‘complete’ modern table; the nearest is the long form embossed on the cover, but this features symbols only, and ends at Meitnerium (element 109). The reason given for this foreshortening is that there are as yet no chemical studies on the later elements recognised by IUPAC (110 - 118; darmstadtium to oganesson, 118). The absence of such a table is a serious omission, and unnecessarily dates the book. A reproduction of the latest IUPAC full table (https://iupac.org/wp-content/uploads/2018/12/IUPAC_Periodic_Table-01Dec18.pdf) could easily have been printed on a flyleaf.

The book is well-referenced, but the index is poor. Recommended reading for chemists and for those interested in the history of some chemical and Periodic concepts, but it is expensive, though apparently the publishers may issue a soft cover version.

Bill Griffith

HISTORY OF CHEMISTRY EVENTS AND MEETINGS

William Nicholson Event at the 2020 Bloomsbury Festival

The annual Bloomsbury Festival was held from 16 to 25 October, and this year included a special event on William Nicholson, *In Conversation with Mr Nicholson – fine print, foresight and fuel cells*, presented live from St George’s Gardens. These were opened in 1714 as the first burial ground in London not built as part of a church. It is a tranquil green space close to Coram’s Fields, and Nicholson (1753 – 1815) is buried there in an unmarked location. The celebration was held on Saturday 17 October with a live webinar on Tuesday 20 October which I saw. I am indebted to the organiser Sue Durrell who kindly checked this account.

After an introduction by Nicole Atkinson from the Bloomsbury Festival and Ian Brown of the Friends of St. George’s Gardens, Nicholson’s biographer Sue Durrell in the gardens interviewed Nicholson’s ghost brilliantly played by Julian Date, in which he reminisced about his life at the crossroads of Georgian arts, literature, science, and commerce. Nicholson was born near St. Paul’s in December 1753 and educated at a boarding school near Richmond, Yorkshire. At the age of sixteen he was indentured as a bosun’s mate on a ship of the East India Company;

two years later he was promoted to seaman and sailed to Canton. On his father's death in 1774 he returned to London and became a great friend of Josiah Wedgwood (1730 - 1795), working for him at his Amsterdam office. He maintained his contact with Wedgwood and thereby met many of his wide circle of friends, including members of the Birmingham Lunar Society. Nicholson was married in 1782 to Catherine Bouillie and they had twelve children, ten surviving to maturity. He became interested in the London theatre in Drury Lane in association with the radical playwright Thomas Holcroft (1745 – 1809), writing a prologue for his play *Duplicity*. Nicholson and Holcroft were friends of the writer William Godwin (1756 - 1836), and Catherine was a close friend of Mary Wollstonecraft (1759 - 1797).

Around this time Nicholson's interest in science, always strong, manifested itself in his book of 1782, *An Introduction to Natural Philosophy*, which ran to five editions. He published a number of chemical texts and in April 1797 launched his celebrated monthly *Journal of Natural Philosophy, Chemistry and the Arts*, generally referred to as *Nicholson's Journal*. Many chemists and others contributed to it in its early days including Davy, Wollaston, Smithson Tennant and Charles Hatchett.

Nicholson was a polymath, inventing a number of mechanical devices including a hydrometer. In 1780 he moved to Soho Square where he became a noted tutor of science. He was greatly intrigued by the galvanic experiments of Alessandro Volta (1745 – 1827); in May 1800 he made his most famous discovery together with his friend Sir Anthony Carlisle. This was the first-ever electrolysis of water to hydrogen and oxygen, using an improved version of Volta's battery involving 36 silver/zinc discs with salt water paper separators.

The second part of the event saw Nicholson in the gardens being introduced to three electrochemistry PhD students of UCell (the electrochemical energy outreach group at UCL) who re-enacted his original electrolysis of water using a series of 0.5 volt cells similar to those that he had used, followed by use of one of their own superior 3 volt lithium-based graphite cells. Finally, they showed him the principles of a modern hydrogen-based fuel cell, the development of which marks the culmination of his discovery of electrolysis 220 years ago. The event ended as Nicholson recalled the Frost Fair of 1814 (when an elephant walked across the ice on the Thames) and the UCell team described the potential benefits of hydrogen fuel cells in the fight against global warming, before taking questions from the audience.

This was a highly enjoyable and well-organised occasion, and I hope that future Bloomsbury Festival organisers will consider celebrating other scientists who lived in that area.

Bill Griffith

Dyes in History and Archaeology Meeting Report

Following the successful twenty-fifth meeting of Dyes in History and Archaeology at Suceava in Romania in 2006, the 39th meeting was planned for 2020 at Sibiu in Transylvania. DHA39 happened, but not quite as planned, on 15 to 16 October 2020 using the Google meeting platform. Like DHA25, the principal organizer was Irina Petroviciu of the National Museum of Romanian History, Bucharest, assisted this time by Iulia Teodorescu and Andrea Bernath (who did all the local platform organization) of the ASTRA Center for Heritage, Sibiu. Over the two days there were twenty-seven presentations, thirteen lasting twenty minutes and the rest five minutes. Eight of the presenters were from Romania, with five from Portugal out of a total of thirteen countries.

The presentations covered a wide range of topics. For example, there was a study of samples of 2000 year old Paracas textiles in Swedish and Peruvian museums using XRF to identify the mordants used and HPLC–DAD and HPLC–HRMS to identify the colorants used. In another presentation, investigations were reported into the identity of artists' colorants from the early twentieth century.

Details of these presentations and those as far back as DHA30, with a book of abstracts, can be found here:

<http://www.aslab.co.uk/dyes-in-history-archaeology/dha-abstracts/>

Chris Cooksey

The Mond in Swansea

In September 2019 the Watford and District Industrial History Society (WADIHS) had a long weekend in Swansea. There were guided tours of the Aberdulais copper and tinplate refinery and Neath Abbey iron works before lunch on the Saturday and of the White Rock Copperworks and the Haford-Morfa Copperworks on the Sunday. The afternoons were for museums and boat trips. Monday morning was different, with a visit to a functioning industry at "The Mond" which is not located in Swansea but six miles to the north east in the village of Clydach and about twenty WADIHS people attended. In 1902 it was here that a nickel refinery was established using a process devised by Ludwig Mond (1839–1909)

and implemented by Carl Langer (1859–1935), who at that time lived nearby at Ynspenllwch.

The crucial observation was first made by Carl Langer in 1889 in the stables of Ludwig Mond's residence at 20 Avenue Road, Regent's Park, London. He found that heating nickel in a stream of carbon monoxide produced carbon dioxide. When the experiment was concluded, the carbon monoxide was burned off in a Bunsen burner and the apparatus was allowed to cool. He noticed that the colour of the flame, blue, changed to green. These observations were recorded and "After further investigating this subject, we found that the gas contains a compound of nickel and carbon monoxide, which we propose to call nickel-carbon-oxide" [1]. They found that after cooling, a volatile liquid could be condensed which analysed as $\text{Ni}(\text{CO})_4$ and is now better known as nickel carbonyl.

The Mond Nickel Company was situated at Clydach between the River Tawe and the Swansea Canal a location chosen for its transport links. Nickel ore was mined in Sudbury, Ontario, partially purified and then shipped to Clydach. Since the refinery opened there have been many changes to the raw materials and the processes used. The changes up to 1950 have been documented [2]. In summary, nickel ore, as the oxide, is reduced by hydrogen to give the metal. Carbon monoxide is then passed over the metal at 40–50 °C, with cooling to control the exothermic reaction, to give the nickel carbonyl vapour, which when heated to 180 °C decomposes to give pure nickel and releases carbon monoxide.

As might be predicted, the site visit was exciting, given that the company produces about 40,000 metric tons of nickel products per year, a figure from 2015. The Ludwig Mond statue just outside the site is a reminder of how it all started.

1. L. Mond, C. Langer, F. Quincke, "Action of Carbon Monoxide on Nickel", *J. Chem. Soc.* 1890, 57, 749–753, quote on p. 750.
2. J. Gwynne Morgan, "Some Observations on the Incidence of Respiratory Cancer in Nickel Workers", *Brit. J. Ind. Med.* 1958, 15, 224–234.

Chris Cooksey



Fig. 1. Ludwig Mond Statue, Clydach, Swansea

FUTURE WEBINARS, MEETINGS AND CONFERENCES

Society for the History of Alchemy and Chemistry Webinars and Meetings

The next SHAC webinar will be live on Zoom on Thursday 21 January 2021 beginning at 5.00pm GMT (6.00pm CET, 12 noon EST, 9.00am PST). Jo Hedesan will be speaking on "The Promise of an Alchemical Panacea: Francis Anthony (1550-1623) and his Potable Gold". Anthony, an English physician active at the beginning of the 1600s was included C.J.S. Thomson's *Quacks of Old London* (1928) as an archetypal marketplace charlatan. Although scholarship has nuanced this view since, there is still limited academic treatment of his career and medical practice. Yet in his day Anthony was famous for his 'English Potable Gold', an alchemical medicine that he pandered to the middle and upper classes, but drew the ire and persecution of the Royal College of Physicians. The talk will focus on understanding Anthony's flagship 'English Potable Gold' medicine and its appeal in the period.

The format will be a talk of twenty to thirty minutes, followed by a moderated discussion of half an hour. Anyone, member of SHAC or not, may register to attend the seminars by e-mailing meetings@ambix.org; a link to the seminar will be sent the day before. (If having registered you do not receive a link please check your junk folder). Subsequent SHAC webinars will be given by Megan Piorko of the Science History Institute (Thursday 18 February 2021) and Simon Werrett of UCL (Tuesday 23 March 2021) at 5 pm GMT.

Preliminary Announcement: Wedgwood250

15 May 2021 (or 14 and 15 May 2021 if held virtually)

Royal Photographic Society House, Bristol, BS4 3AR

This meeting, arranged jointly by the Royal Photographic Society and the Society for the History of Alchemy and Chemistry, will mark the 250th anniversary of the birth of Tom Wedgwood on 14 May 1771. The youngest son of the prominent potter Josiah Wedgwood, Tom was very well known in the intellectual and scientific circles of his day and today is chiefly remembered for developing what was later identified as a very early form of chemical photography. Speakers at this meeting will discuss his life, work, friendships and legacy. A programme will be issued early in 2021. Should it appear by mid-April that Covid restrictions will not have eased sufficiently to permit a face-to-face meeting, then it will be held virtually over two half days on 14 and 15 May. In any case provision will be made for live transmission over the internet. Further details will be available from Michael Pritchard (michael@rps.org) or Frank James (frank.james@ucl.ac.uk).

International Conference on the History of Chemistry

The 13th International Conference on History of Chemistry (13ICHC) organized by the EuChemS Working Party on the History of Chemistry (WPHC) was to be held in Vilnius, Lithuania, in May 2021 but has been postponed to May 2023 due to the Covid-19 pandemic. In order to fill the gap between conferences and promote exchanges in the history of chemistry, a one-day online event will be held on 20 May 2021. The provisional programme includes the Working Party Business Meeting (10:30-12:00 European Central Time), then a key-note lecture and a group of short talks on Chemical Landmark Projects and Heritage Initiatives (13:00-14:30 European Central Time), and finally a group of short talks on Chemical sites, collections and preservation (15:00-16:30 European Central Time). For more information please visit: <https://www.ichc2021.vilnius.chgf.vu.lt/>