12TH INTERNATIONAL CONFERENCE ON THE HISTORY OF CHEMISTRY, MAASTRICHT 2019

BOOK OF ABSTRACTS

Edited by Ernst Homburg, Christoph Meinel
and Ignacio Suay-Matallana

Organised and hosted by

EuCheMS
European Chemical Sciences
Working Party on the History of Chemistry

KNCV

Maastricht University

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The Steering Organising Committee gratefully acknowledges the continuous support received from the members of the international Advisory Committee in preparing and organising the conference.

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Welcome Address
on behalf of the Local Organizing Committee

Dear participants,

After having served the Working Party on History of Chemistry for six years – from 2003 to 2009 – and having actively taken part in several of the previous biennial ICHC conferences, it is my great pleasure to welcome you now to my own university town, Maastricht.

Maastricht is one of the oldest towns of the Netherlands. It was a Roman settlement, it received city rights before 1204, and for many centuries it was one of the strongest fortified towns of the Low Countries. Its history is complicated. From 1204 to 1794 the town was under the sovereignty of two lords: the Bishop of Liège on the one hand, and on the other hand the Duke of Brabant in Brussels, in 1632 succeeded by the States General in The Hague. During the United Kingdom of the Netherlands, 1815-1839, the city belonged to the Southern Provinces. But after the Belgian war of independence of 1830-1839, it became part of the (Northern) Netherlands.

Being at the cross-roads of French, Dutch, and German cultural and linguistic influences was a great asset during the Middle Ages when the town flourished both economically and intellectually. Between about 1550 and 1800, though, the town suffered many wars and enemy occupations, and fell into decline, even in terms of its scientific and intellectual life. There was no university. Students went to Leuven, Cologne, Leiden, or Utrecht. The first chemist and physicist of any reknown was Jan Pieter Minckelers (1748-1824), whose statue is on the Markt square. The second star undoubtedly is the Nobel laureate in chemistry Peter Debye (1884-1966), born in the Maastrichter Smedenstraat, but – after a high-level secondary education in Maastricht – largely trained as an electrical engineer and physicist in Germany.

In the light of this complicated regional history, the start of Maastricht University in 1974 (formally founded in 1976) was a game-changer. It has given a strong impulse to the cultural and intellectual life of the town and the region, which was already highly industrialized – as explained well in the Greeting by the Head of the History Department, Cyrus Mody, that follows these words of welcome.

The Local Organizing Committee is very grateful that it can host 12ICHC this year, and hopes it can transmit to you the spirit of our young, vibrant Faculty of Arts and Social Sciences (FASoS) which is generously hosting the meeting.

Our words of thanks go therefore in the first place to Maastricht University and to FASoS, which have supported the organizing of the conference at all levels. Without the great devotion of the administrative staff of our faculty it would simply have been impossible to organize the conference within the constraints of the present budget. Also the Royal Dutch Chemical Society KNCV has been of great help by taking over registration of the participants. The European Chemical Society (EuChemS) was so kind as to officially recognize 12ICHC as one of its activities, which helped open doors for sponsorship.

The organizers of 12ICHC are also very grateful that they received funding from many parties, both inside and outside the Netherlands. Nationally, financial support was received from the Hoogewerff Fonds (for chemical technology), the Dutch Polymer Institute DPI, which stimulates polymer research on a global scale, and from Holland Chemistry, the Topsector platform of Dutch chemical science and industry. Foreign sponsors were the Science History

Institute of Philadelphia (Silver sponsor), ACS Publications in Washington, the Linda Hall Library of Kansas City, the Society for the History of Alchemy and Chemistry (SHAC) in the UK, and the Ernest Solvay Fonds of the King Baudouin Foundation, Belgium (Silver sponsor). All these sponsors deserve a great word of thanks, because it was their contributions that made the present conference possible.

Last but not least we thank the members of the Advisory and Programme Committees, and in particular Ignacio Suay-Matallana and Christoph Meinel. The number of hours spent by Ignacio and Christoph on 12ICHC is beyond imagination. Their help in bringing out the call for papers, selecting the papers for the conference, designing the program, and making the Book of Abstracts has been invaluable throughout the past year.

We are very grateful that almost 120 participants from more than 20 different nations from Europe, America and Asia will attend the conference. We wish you all a very pleasant and inspiring time in Maastricht, with many fruitful discussions and opportunities for new contacts that will be of importance for the future of our field.

Ernst Homburg
Professor of History of Science and Technology
Chairperson of the Local Organizing Committee

Greetings from the Head of Department

Dear attendees of the 12th International Conference on the History of Chemistry,

As chair of its History Department it is my pleasure to welcome you to the Faculty of Arts and Social Sciences. Our faculty was founded 25 years ago on the principle that active learning in the humanities and social sciences should be in mutual interaction with interdisciplinary research. We are a small faculty (~1500 students) with a global reputation in areas such as European Studies, Science and Technology Studies, Sound Studies, and Migration and Development Studies. The faculty is home to a large and collegial group of historians of science and technology – including historians of chemistry – specializing in particular in the business and environmental history of science and technology and the history of science and technology in diplomacy and international cooperation. I hope that you will meet some of these local colleagues over the next few days.

Maastricht stands at the center of the border-spanning Euregio, which also includes Liège, Aachen, and the surrounding area. Our region was the first in the Low Countries to experience industrialization in the early 19th century, particularly in steel and ceramics production as well as mining and quarrying of coal and other raw materials. The FASoS History Department and the Sociaal Historisch Centrum voor Limburg support research and outreach regarding the history of our region, which necessarily includes a significant dimension in the history of chemistry and related fields. The province of Limburg is also home to some of the oldest breweries in the Netherlands; I invite you to investigate this important aspect of the history of chemistry at your leisure.

The province is still home to one of the major clusters of chemical manufacturing in the Netherlands, centered on DSM (formerly Dutch State Mines). However, in the 1960s the local coal mines – which gave DSM its name – went into decline. In the 1970s it was decided to revitalize the regional economy by founding a university in Maastricht. The campus for the first faculty – medicine – was built on the east side of the Maas; FASoS and the medical school are involved in a number of activities to support local interest in the history of medicine. Later, the "inner city" faculties were established in Maastricht proper. These faculties are housed in renovated buildings, many of which formerly belonged to religious orders, the provincial government, or the military. Please take some time to view some of Maastricht's charming architectural heritage while you are here.

Many thanks for attending the conference and visiting our faculty.

Cyrus Mody

Head of Department
History Department, Faculty of Arts and Social Sciences
Maastricht University

Greetings from the EuChemS Working Party

Dear 12ICHC participants, dear Colleagues,

It is a great pleasure to welcome you to the 12th edition of our series of conferences. The first International Conference on the History of Chemistry took place on 1991, in Veszprém, Hungary. The meeting was organized by the Working Party on the History of Chemistry, then part of the Federation of the European Chemical Societies. Since then the meetings have travelled around Europe, but to Europeans, being welcomed in Maastricht is most special. This is the city where the Treatise on European Union was signed in 1992, which furthered European integration and paved the way for many features of the European Community we enjoy today, among others the Euro and open borders. Maastricht's history is however much richer, as the social events planned by the local organizing committee will reveal, and many of its facets relate to the core of chemical sciences and technologies.

For centuries, Maastricht has been a meeting place – and also sometimes a battlefield - at the borders of political, economic and cultural spaces. From Roman times, to early industrial age, to regional and European hub, the city has morphed according to the circumstances, playing the role of an open platform for exchange of goods and ideas. The ICHC conferences have played a similar role in our research field. Since the 5ICHC Estoril in 2005, the pace has been set to biennial. More important was the opening to a wider community in terms of styles of scholarship, diversity of topics, and international recruitment. The magnificent program of the days we are about to share is a perfect illustration to that constant growth.

This is the result of hard work, and undying dedication of individuals in service to the community.

Each edition of the ICHCs has been under the responsibility of one or a group of our colleagues who benevolently and relentlessly take up the challenge to host the meeting in their institution and hometown, keeping the quality high and the costs low. The members of the Local Organizing Committee, Thijs Hagendijk, Dr Marieke Hendriksen, Prof. Cyrus Mody, Dr Geert Somsen and Dr Andreas Weber, who operated under the leadership of the indefatigable Ernst Homburg, have put on a marvelous spread to welcome our scientific sessions and discussions, and invite us to explore what the city and its surroundings has to offer.

Similarly, for every edition of the ICHCs, the Program Committee braves the task of maintaining high standards and open-mindedness, and this has been masterfully accomplished once again by Prof. Christoph Meinel and Prof. Ignacio Suay-Matallana, supported by a broad international Advisory Committee.

In times where the notion of common good seems to shrink in many parts and aspects of our world, the commitment from these colleagues and the support given by many sponsors warms the heart and sheds a positive light on the future of our community. Thank you to all those who made this 12ICHC happen, and let us enjoy this edition to the fullest.

Brigitte Van Tiggelen
Mémosciences / Science History Institute
Chair of the EuChemS WPHC

Committees

Programme Committee / Steering Organising Committee:

Professor Christoph Meinel, Universität Regensburg (co-chair of the Programme Committee)

Assistant Professsor Ignacio Suay-Matallana, Instituto Interuniversitario López Piñero-Universidad Miguel Hernández, Alicante (co-chair of the Programme Committee)

Professor Cyrus Mody, Maastricht University
(for the Local Organizing Committee)

Dr. Brigitte Van Tiggelen, Mémosciences / Science History Institute (chair of the EuChemS Working Party on History of Chemistry)

Local Organising Committee:

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Thijs Hagendijk, PhD student, Utrecht University

Dr. Marieke Hendriksen, Utrecht University

Professor Cyrus Mody, Maastricht University

Dr. Geert Somsen, Maastricht University

Dr. Andreas Weber, University of Twente, Enschede

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Practical information and site map

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Venue

The Conference will be held in the buildings of the Faculty of Arts and Social Science in downtown Maastricht (Grote Gracht 90-92), of which some parts date back to the 18th century. The Faculty of Arts and Social Sciences (FASoS) is one of the six faculties of Maastricht University. It was founded in 1994. There are approximately 250 employees and around 1500 students. The format of the education is, similar to all the faculties of Maastricht University, based on the principle of Problem-Based Learning (PBL). The faculty is internationally oriented and most of the programs are offered in English. Students come from all over the world. There are five Departments: Philosophy, Literature and Art, History, Society Studies, and Political Science.

Maastricht is one of the oldest cities in the Netherlands. Originally an ancient Roman city, today it is the home of some 120.000 inhabitants in the south of The Netherlands. It has a beautiful medieval inner-city and is widely known for its history, culture, art, good restaurants, luxury shopping, and high-level interdisciplinary education. Generally known as the venue of the Treaty of Maastricht in 1992 and as “the balcony of Europe”, it has a distinctly international orientation. The center of Maastricht is very compact. Large parts of the center are for pedestrians only and most of the sights are within walking distance. In the early 19th century Maastricht became one of the largest industrial towns of the country. Recently many old factory buildings are renovated and adapted to new purposes.

The Opening Session will be held in the Aula in the University’s Main Building at Minderbroedersberg 4-6, a former Franciscan monastery. From there it is but a brief walk to the Welcome Party in the Town Hall of Maastricht, Markt 78. The other sessions will be in the Faculty of Arts and Social Sciences, Room [A] = Turnzaal and [B] = Room 1.018 / GG 76s. Inside the building the rooms are signposted.

Coffee / tea breaks and lunches will be served at the "Banditos" common room and garden, and an adjacent tent, in between the two lecture halls.

Evening Excursion, Tuesday, 30 July, 18:20-20:10

On Tuesday we are invited to visit Brouwerij Bosch, Wycker Grachtstraat 26, Maastricht. Bosch Brewery is the last remaining, fully equipped city brewery in town. Beer was brewed at this site since 1758. As an industrial heritage site, the brewery’s complex is unique to the Netherlands. The five-storey floor malt house, brewery facilities, and brewer’s house give visitors an insight into how local beer used to be brewed a century ago and how the Maastricht upper-class resided. *Sponsored by the Linda Hall Research Library, Kansas City.*

See: https://industriana.mobi/ibeakens/indu1096/view?utf8=%E2%9C%93&language=eng

Conference dinner, Wednesday, 31 July, 19:00 – 22:30

The Conference Dinner will take place on Board of the saloon boat “Jekervallei” and will take us on a tour over the Meuse River and nearby Canals. Assembly point for boarding and departure: Terminal Rederij Stiphout, Maaspromenade 58, Maastricht. Departure will be at 19:00 sharp, so be there at 18:45.

See: https://www.stiphout.nl/algemene-info/de-vloot/jekervallei (only in Dutch).

Additional information

We will place suggestions for additional visits to sights at Maastricht on the website of the conference. See also: https://www.visitmaastricht.com/things-to-do/guided-tours.

Recommended are in particular:
- The Onze Lieve Vrouwplein and “The Basilica of our Lady” (11th century).
- The Natural History Museum of Maastricht, with the important Mosasaur fossils.
- The Sint Pietersberg south of Maastricht, with its extensive North and South caves.
- The Boekhandel Dominicanen, a beautiful bookshop located in a 700 year old church.

Excursion to Liège, Kelmis and Stolberg, Friday, 2 August, 8:30 – 18:30

On the day after the conference an excursion to sites of particular interest for historians of science and technology will take us to the border region between The Netherlands, Belgium and Germany. We will visit three sites that are all related to the history of zinc. In the form of its alloy brass, zinc was known since Antiquity. That story is well documented. The history of the discovery of metallic zinc, by contrast, is very obscure. Somewhere between the 12th century and the 1740s the knowledge of the new metal, next to the seven ancient ones, gradually became more robust, in a large number of very small steps. And it would take until the early 19th century before a good quality of zinc could be made on a large scale, thanks to a process developed by the Liège chemist Jean Jacques Dony (1759-1819).

During the excursion we will visit:

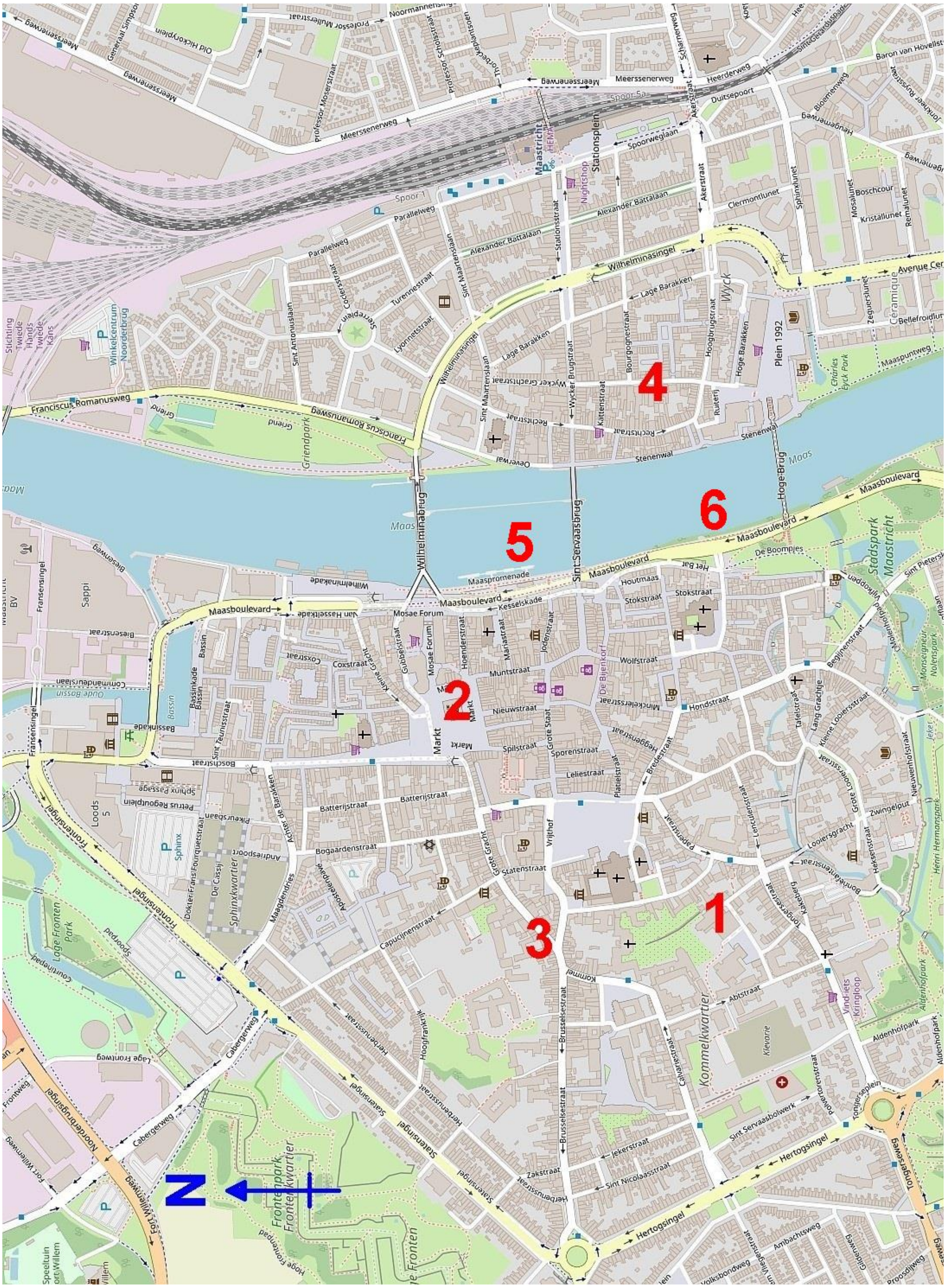
- The *Maison de Métallurgie et de l’Industry de Liège*, Belgium, devoted to the discoveries by Dony, and to the early industrialisation of the Liège region. The museum also has the first bath tub made of zinc, for Napoleon Bonaparte’s campaign to Russia.

- The *Museum Vielle Montagne at Kelmis*, Belgium, close to the site of the most important European deposits of the zinc ore calamine, which was excavated there since the early Middle Ages, and exported to the brass town of Dinant, and all over Europe.

- The *Museum Zinkhütter Hof at Stolberg*, Germany, devoted to the important brass industry of the Aachen-Stolberg region, that had taken over the leading role in brass making in Europe after the destruction of Dinant by the Bourgondians.

The excursion is for registered participants only. If you don’t have registered in advance, please ask at the registration desk for remaining places.

Assembly point for departure: 8:30 sharp on the Maasboulevard, in between the Graanmarkt and the ‘Hoge Brug’. Our bus is from the firm Heidebloem.



[**1**] Main Building of the University and Aula: Registration (29 July only) and Opening, [**2**] Town Hall: Welcome Party, [**3**] Faculty of Arts and Social Sciences: Sessions A and B, [**4**] Brouwerij Bosch, [**5**] Terminal Stiphout: boarding for Conference Dinner, [**6**] Departure of the touring car of Heidebloem for the day excursion on 2 August 2019.

Time Schedule

Monday, 29 July

Please note that papers are listed by short titles and first authors only.

Venue: Faculty of Arts and Social Sciences; Grote Gracht 90-92, Maastricht

Rooms: [A] = Turnzaal
[B] = Room 1.018 / GG 76s

Coffee breaks and lunches will be served at the "Banditos" common room and garden, and an adjacent tent, in between the two lecture halls.

14:00–18:00 Registration

Main Building of the University
Minderbroedersberg 4-6

16:00–17:30 **Opening Session**
Aula
Main Building of the University
Minderbroedersberg 4-6

16:00 Opening and Welcome Addresses

Brigitte Van Tiggelen, "Opening address"

Ernst Homburg, "Evoking the *genius loci*: Chemistry in the Netherlands"

16:30 Opening Key Lecture

Lissa Roberts, "What the History of Chemistry and Global History can offer each other"
(chair: B. Van Tiggelen)

18:00 – 19:00 **Welcome Party**
Town Hall of Maastricht, Markt 78

Tuesday, 30 July

08:00 Registration desk opens at Grote Gracht 90-92

09:00 Key Lecture [A]

Marco Beretta, "The Material Realm of Lavoisier's Chemistry: A Reassessment"
(chair: C Meinel)

10:15 Coffee Break

10:45–12:45
Session A1 [A]

Panel: 150 Years of the Periodic System
(organiser: G Boeck)

❖ G Boeck, chair

- A Rocke, "Lothar Meyer's path to periodicity"
- M P Gil, "Covered by dirt and dust: the oldest periodic table wallchart"
- I Malaquias, "Periodic classification in teaching in Portugal"
- M T Gomes, "Affinity and periodic tables out of the chemical environment"
- E V Babaev, "Periodic table in art and everyday life"

10:45–12:45
Session B1 [B]

Alchemy and Early Chemistry

❖ L Principe, chair

- T Delva, "ps.-Apollonius of Tyana's Secret and origins of chemical ontology"
- B Camen,"Chemistry at the Court of Rudolf II: The Significance of "Alchymistische Kunst-Stücke"
- G Hedesan, "Alchemical practice in the Fonderia di Antonio de Medici in Florence"
- M Vilarigues, "The chymistry of red glass: Reworking Kunckel's annotations"
- F Buyse, "Boyle, Spinoza and Glauber: On the Redintegration of Saltpeter"

12:45 Lunch Break

14:00–15:20
Session A2 [A]

Panel: The NMR Revolution
(organiser: P Laszlo)

❖ R Anderson, chair

- V Ptushenko, "EPR and NMR spectrometers in the USSR"
- P Morris, "Development of NMR in Britain"
- R Kaptein, "Birth of the radical pair mechanism"
- P Laszlo, "Scientist as pioneer: pre-MRI Lauterbur"
- C Reinhardt, commentator

14:00–15:20
Session B2 [B]

Panel: IUPAC and the other international scientific organisations
(organisers: B Van Tiggelen, D Fauque)

❖ B Van Tiggelen, chair

- Y Alexiou, "Solvay Councils and IUPAC in the 1920s"
- G Somsen, "Internationalism enacted: anti-IUPAC meetings"
- D Fauque, "IUPAC, ICSU and UNESCO"
- E Zaitseva (Baum), "V A Koptyug, IUPAC and SCOPE"
- J Smit, commentator

15:20 Coffee Break

15:50–17:50
Session A3 [A]

Analyses in Context

❖ R van Veen, chair

- A Cornu, "Moral economy of mineral waters"
- P Grapí, "Eudiometrical tests in the context of Dalton's law"
- Y Siderer, "Chemical ingredients in hot springs in Japan"
- H Chang, "Western analytical chemistry in China"
- J A Chamizo, "Epistemological-sciento–metric steroids"
- T. Mine, "A historical analysis of the coal liquefaction technology development in China"

15:50–17:50
Session B3 [B]

Communication and Education

❖ A Lykknes, chair

- K Kiprijanov, "The making of the modern chemical notation"
- B. Railienė, "Contributions of Vilnius University"
- M Saar, "Revolutionising teaching a century ago"
- S Rodrigues, "History of chemistry in textbooks"
- L Moreno-Martínez, "Chemistry teaching in 20th-c Spain"
- D Trivic, "History of chemistry as pedagogical content"

18:20-20:10 **Local excursion**

Brouwerij Bosch Brewery, Wycker Grachtstraat 26

Wednesday, 31 July

09:00 Key Lecture [A]

Carsten Reinhardt, "The Twentieth Century: Chemistry's Transformative Forces Unbound"
(chair: I Suay-Matallana)

10:15 Coffee Break

10:45–12:45
Session A4 [A]

Panel: European Alumina
(organisers: P Mioche, T Renaux)

❖ D Fauque, chair

- T Renaux, "Invention of a chemical material and of an industry"
- W Bayer, "Karl J Bayer and the early alumina industry"
- P Mioche, "European alumina industry in global history"
- M Carbonell, "Alumina industry and the environment"

10:45–12:45
Session B4 [B]

Instruments, Collections, Materials

❖ M Beretta, chair

- A Weber, "Hydrometers, Salpeter and Empire"
- K Ruthenberg, "pH value and the glass electrode"
- E Wyka, "Cryogenic instruments"
- A Lourenço, "Glass containers and conservation"

12:45 Lunch Break

14:00–15:20
Session A5 [A]

Panel: Sites of Chemical Knowledge
(organiser: C Halm)

❖ E Serrano, chair

- C Halm, "Chemists in Agriculture"
- M Carrier, "Forensic Toxicology"
- R Brashear, "The Observatory as a chemical laboratory"
- M Shindell, "Chemical Exploration of Mars' surface"
- J Christie, commentator

14:00–15:20
Session B5 [B]

Material and Visual Cultures of Chemistry

❖ F James, chair

- P Bret, "Guyton de Morveau's laboratory"
- J Mooij, "Chemical instrument market in the Netherlands"
- C Nawa, "Picturing Chemists"
- V Joyaux, "Materials and instruments of contemporary chemistry"

15:30 Coffee Break

16:00–18:00
Session A6 [A]

Panel: Women, Gender, and Chemistry
(organiser: J Mercelis)

❖ J Johnson, chair

- J Christie, "Gender and representation in chemistry"
- F Antonelli, "Madame Lavoisier's role in laboratory practice"
- E Serrano, "Food tests in the Madrid Foundling House"
- A Lykknes, "Women engineers in early 20th-c Norway"
- J Mercelis, "Gender discrimination in industrial research"

16:00–18:00
Session B6 [B]

Transitions in Twentieth-Century Chemical Industries

❖ A Petersen, chair

- R van Veen, "Catalysts for the conversion of coal to oil"
- R Bertomeu Sánchez, "DDT and the Spanish pesticide industry"
- E Maia, "Cholesterol between science and industry"
- K Angerer, "Producing knowledge and value in natural product chemistry"
- R Janneck, "Bayer AG and the transition to the life sciences"
- T van Helvoort, "Edible oil in food supply"

19:00–22:30 **Conference Dinner during a boat trip on the river Meuse**
(registered participants only)
Assembly Point for departure: Terminal Rederij Stiphout, Maaspromenade 58

Thursday, 1 August

08:15–08:45 Business Meeting CHCMS
08:50–09:50 Business Meeting Working Party
(for delegates, guests welcome)

10:00 Morris Award Lecture [A]

Yasu Furukawa, "Exploring the History of Chemistry in Japan"
(chair: P Morris)

10:45–12:45
Session A7 [A]

Panel: Material Research and its Toolkits
(organisers: J Martin, C Mody)

❖ B Gross, chair

- J Behrman, "Handbooks as objects of disciplinary division"
- C Mody, "Infrastructural Tools: Safety, Standards, Fume Hoods, Vacuum Chambers"
- M Paskins, "Tracing the Careers of Geraniol"
- J van Duijn, "Semiconductor manufacturing"
- J Martin, "New tools for characterising new materials"

10:45–11:25
Session B7a [B]

Chemists and Politics

❖ E Homburg, chair

- R van den Berg, "van't Hoff and the offers from Germany"
- MV Barbarulo, "Racial Laws in Italy"

11:25–12:45
Session B7b [B]

Methodological Approaches

❖ E Homburg, chair

- G Restrepo, "Chemical space and statistical regimes"
- J Shackelford, "Chemical vs. biological law"
- P Lo Nostro, "The Hofmeister series"

12:45 Lunch Break

14:00–15:20
Session A8 [A]

Panel: From the Lower Rhine area into the world
(organisers: J Schram, M Holly, S van de Kerkhof)

❖ J Schram, chair

- M Holly, "The Royal School for Dyeing and Finishing in Krefeld"
- Y Schulenburg, "Historical dyes: looking into a dyestuff collection"
- S van de Kerkhof, "'Rhenish Manchester' and chemical industry"

14:00–15:20
Session B8 [B]

Panel: Sanitary Fumigation (19th and 20th C)
(organisers: X Guillem-Llobat)

❖ A. Lundgren, chair

- PG Medina Alfonso "Fumigating Spain, 1770-1850"
- L Engelmann, "The Clayton Machine in Maritime Sanitation"
- X Guillem-Llobat, "Cyanide fumigation in Valencia"

15:30 Coffee Break

16:00–17:30
Closing Session A9 [A]

Round Table: Writing the History of Chemistry

Part I: A New Cultural History
(organiser: A Rocke)

❖ A Rocke, chair

- Commentators: E Homburg, P Ramberg, M Beretta, M Carrier

Part II: Writing the History of Twentieth-Century Chemistry
(organiser: P Morris on behalf of CHCMS)

❖ B Van Tiggelen, chair

- Commentators: J Christie, J Johnson, C Mody, A Lykknes, P Morris

Fri 2 Aug

08:30 – 18:30

Excursion to Liège, Kelmis and Stolberg (optional, advance booking required) Assembly point: Maasboulevard, near Stadspark

Plenary Lectures

Monday, 29 July, 16:00 **[Aula, Minderbroedersberg 4-6]**
(chair: Brigitte Van Tiggelen)

What the History of Chemistry and Global History can offer each other

Lissa Roberts
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While accepting the 1981 Nobel Prize for chemistry, Kenichi Fukui argued that chemistry could contribute to world peace by responding to the scarcity of global resources and energy. But his recognition of chemistry's relation with the world's past, present and future is far from unique. Well over 100 year before his comments, for example, Karl Marx drew on Justus von Liebig in his analysis of the threat posed by capitalist exploitation and production to the globe's socio-material 'metabolic system'.

To say that the history of chemistry and global history are related, however, tells us little unless we first consider how these two fields of research are – and perhaps ought to be – understood. How does it affect our understanding of their interplay, for example, if we equate the history of chemistry with the history of its disciplinary formation and/or global history with the history of globalization? What are the pitfalls of adopting a 'comparative history' approach to explore the history of chemistry, global history, and their relationship? What happens when we analyze the past by following materials instead of or along with people through history? Moving between historical examples and historiographical reflections, this talk will suggest ways in which bringing the history of chemistry and global history in closer contact with each other can bear fruit for both.

Tuesday, 30 July, 09:00 **[A]**
(chair: Christoph Meinel)

The Material Realm of Lavoisier's Chemistry: A Reassessment

Marco Beretta
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The most unique feature of Antoine-Laurent Lavoisier's laboratory is the survival of a significant part of his remarkable collection of instruments, machines, artefacts, chemicals and minerals. This extraordinary repository of information has no equal in the history of 18th-century chemistry. Despite this unprecedented wealth of material sources, historians of the Chemical Revolution have preferred to focus their attention on Lavoisier's printed works. Moreover, recent historiography tends to interpret Lavoisier's laboratory as an extravagant and exceedingly expensive site of experimentation. In a recent survey of Lavoisier's collections done in collaboration with Paolo Brenni, I was able to reassess Lavoisier's approach to chemical experimentation. In my presentation, I shall offer an overview of the Arsenal, based on new archival and museum findings. By briefly comparing its composition with apparatus and chemicals used by other 18th century Parisian chemists and apothecaries, I will also invite historians to further explore the historical context of the organization, composition and use of Lavoisier's laboratory.

Wednesday, 31 July, 09:00 [A]

(chair: Ignacio Suay-Matallana)

The Twentieth Century: Chemistry's Transformative Forces Unbound

Carsten Reinhardt
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Chemistry's impact is felt most strongly through its interactions with other scientific disciplines, technology, and society at large. I will argue that during the twentieth century, chemistry triggered transformations that in turn deeply influenced its own course. While this might be true for any period, in my view the twentieth century saw quite extreme changes, affecting chemistry's theoretical core, its methodological arsenal, and the spread of its products. For the purpose of analyzing this development, I will trace chemistry's roles in three main dimensions: scientific, industrial, and environmental. My focus is on chemistry's transformative forces in the forms of materials provided and methods developed. Over the course of the century, these forces were not just working in favor of chemistry, but turned against chemistry's long term development as a coherent and unified entity. Instead, chemistry's growing impact in parts led to its dissolution, or "delocalization" over many neighboring disciplines and technologies. Now, often, chemical methods and materials are deployed under the guise of different, even competing fields.

Morris Award Lecture

Thursday, 1 August, 10:00 [A]

(chair: Peter Morris)

Exploring the History of Chemistry in Japan

Yasu Furukawa
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Japan has a rich tradition of historical studies of chemistry. For example, first published in 1974, Kagakushi (the Journal of the Japanese Society for the History of Chemistry), with 165 issues to date, has carried articles on the history of chemistry. Though the quality varies, these articles have covered various aspects of the history of Japanese chemistry. Chemist-historians and historians of science have also published monographs on specific topics, as well as biographies of notable Japanese chemists. However, because most of these articles are written in Japanese, they are rarely used in research by historians of chemistry outside Japan. This is due largely to a language barrier among Japanese authors, who have seldom written in foreign languages, and non-Japanese scholars, who do not read Japanese. Nevertheless, some efforts are now being made to break this barrier. In this talk, I describe the state of the art of historical studies of chemistry in Japan and discuss problems and issues (such as institutionalization, industrial relation, war, and gender) in exploring the history of chemistry in modern Japan. In doing so, I attempt to present a perspective of the social history of Japanese chemistry from the late ninetieth century to the present.

Abstracts of Panels and Sessions

(in chronological order)

Tuesday, 30 July, 10:45-12:45, Session A1 [A]

Panel: 150 years of the Periodic System

Gisela Boeck, Annette Lykknes, Isabel Malaquias, Luis Moreno Martínez (organisers)

Gisela Boeck (chair)

The United Nations General Assembly has proclaimed 2019 as the International Year of the Periodic Table of Chemical Elements. We will take this opportunity to organize a special panel on the Periodic System, dedicated to its use in teaching and popular culture.

The session shall be a platform for discussing how the Periodic System was established, has been used and accommodated in teaching during the last 150 years. Questions of classroom practice, of several ways to integrate the Periodic System in textbooks and of the use of different presentations in dependence of the context and the time will be discussed.

The second focus of the session will be how the System of Elements appears in popular culture. The session shall try to answer the question in which context it is used and if it is an icon of chemistry and science or if there are other reasons.

Lothar Meyer's Path to Periodicity

Alan Rocke

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Over the past 150 years, the origin and development of Dmitrii Mendeleev's investigative pathway to the discovery and elaboration of the periodic system of the elements has justifiably been the subject of extensive scholarly interest and writing. The same cannot be said of his chief rival in this story, Lothar Meyer. The speaker will suggest how Meyer came to be interested in the subject, and what concerns drove him toward the composition, some months after the publication of Mendeleev's first periodic table, of his crucial 1869-70 article, with its atomic weight table and atomic volumes line chart, a paper that constitutes his chief subsequent claim to have been co-discoverer of the periodic system of the elements. The presentation is not concerned directly to provide an answer to the question of priority, but rather to understand Meyer's developing ideas in connection with his and others' ongoing research. This sesquicentennial year of the periodic table is a fitting moment to offer further insight into these important events.

Covered by Dirt and Dust: the story of the oldest periodic table wallchart

M. Pilar Gil,[1] R. Alan Aitken,[2] David O'Hagan[2]

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Four years ago, a cleaning up of a storage area underneath a lecture theatre in St Andrews School of Chemistry revealed a time-worn periodic table. Its significance was immediately recognized, despite its brittle and fragile condition that suggested an eventful life in a laboratory or classroom as well as long years of storage.

In consultation with experts, it emerged to be the earliest surviving teaching chart of the Periodic Table.

This paper will recount the discovery of the Periodic Table and our ability to date this artifact and determine its provenance, making reference to the relevance of the Periodic Table on how the teaching of chemistry was done at the time and its links to major Scottish chemists such as Thomas Purdie.

150 years of periodic classification – teaching and appropriation echoes in Portugal

Isabel Malaquias,[1] João A.B.P. Oliveira[2]

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Dmitri Mendeleev's "The Dependence between the Properties of the Atomic Weights of the Elements" is now 150 years old. This work would get repercussions everywhere, obtaining a progressive enlarging acceptation until today.

In the present communication, we will present results of an ongoing research that directed us from its reception in Portugal to the following use in teaching, trying to understand what questions arose by its use in the classroom and the different presentations emerged, from its primitive reception until 1974, date that marks a thorough reform of secondary scientific education.

We will emphasize actors and documents that enable to show how this subject was dealt in Portugal. The research involved the identification of reminiscent vestiges in different higher-level institutions, as well as on textbooks and programs for secondary and advanced levels that have been published during the period between 1876 and 1976.

Based on printed and handwritten material it is possible to conclude that the periodic classification was known since the end of 1870s, with some reactions to its publication; different perspectives on its teaching considering the secondary and higher education levels; a general introduction of it in the official programs of higher years of secondary school after 1930s.

Thanks are due for the financial support to CIDTFF (UID/CED/00194/2019), to FCT/MCTES through national funds, CESAM (UID/AMB/50017/2019), to FCT/MCTES through national funds.

Affinity and periodic tables out of the chemical environment

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The periodic table is a central systematic organization of chemical elements. It invaded other areas of knowledge, which is a major recognition of its importance. Following Bergman's affinity table, Goethe wrote his novel "elective affinities", whose characters, Eduard, Charlotte, Ottilie, the captain, Luciane, the Count, the Baroness, and Mittler occupy precisely places in a designed affinity table. Such affinities conducted the novel to a determined and predictable outcome. The periodic table invaded social sciences and a human periodic table could arrange contemporaneous individuals of different families in such a way that, like the elements, a void place have predictable characteristics. Thomas Dreier wrote his Human Chemicals, and recognized their different kinds, and that each human being obeys the law of its nature.

The Periodic Table is even the title of a book from Primo Levi. It defines the structure of the book consisting of autobiographical short stories, each of them around a chemical element. On other examples, only the Periodic Table layout is preserved. Its layout is then used to display information of varied fields, e.g. prose writers, poets, or literary terms.

Periodic Table in Art and Everyday Life: An Attempt of Overview

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An attempt is made to overview appearance of periodic table in art and everyday life according to the visual data published in the Internet sources. The talk starts with the application of periodic table in architecture (concept of Elementarium, external and internal parts of buildings), metro, cafés, halls, baggage storages, sculptures, cars, medical, kitchen, bathroom and musical devices, stamps, buttons, clocks, sweets, furniture, computer games, clothes etc. Special attention is paid to the objects of art.

Tuesday, 30 July, 10:45-12:45, Session B1 [B]

Alchemy and Early Chemistry

Lawrence M. Principe (chair)

Pseudo-Apollonius of Tyana's The Secret of Creation and the Origins of Chemical Ontology

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It has been shown by William R. Newman that the gradual displacement of Aristotelian hylomorphism by corpuscular theories of matter among seventeenth century natural scientists was partly inspired by the thirteenth century works of pseudo-Geber. In this paper, it will be argued that the break with hylomorphism, and the formulation of an alternative, 'chemical' ontology, can be traced back much further, at least to pseudo-Apollonius of Tyana's The Secret of Creation (Arabic Sirr al-khalīqa, written before 867 CE). This text contains a corpuscular theory of matter, but perhaps even more important are its basic ontological commitments. In The Secret of Creation, essential being is accorded primarily to four material essences (heat, cold, moisture, and dryness), while formal causation is explained as due to the inherent interactions (such as attraction and repulsion) between particles of these material essences, and their resulting composition. Specific form, which is not a causally efficacious ingredient but merely an emergent function of this composition, is seen as accidental in nature. Although this 'compositionalist' ontology will be analysed here in the context of The Secret of Creation, it will also be argued that its general structure lies at the origin of the specifically chemical approach to nature.

Early Chemistry at the Court of Rudolf II in Prague. The Significance of the Manuscript "Alchymistische Kunst-Stücke in gutter Ordnungk" (Artificia alchimica, Cod. 11.450 ÖNB)

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So far, the manuscript "Alchymistische Kunst-Stücke in gutter Ordnungk" from 1596, which is archived at the Austrian National Library in Vienna, has not been studied in-depth by chemical history research. However, a first analysis suggests that it could be an important document for chemical history. Due to a transcription error, the name and identity of the author of the manuscript "Artificia alchimica" remained unknown for several decades. This is not "Dr. Herrman (Herman, Heumann) Reising", but the correct name is "Dr. Johann Hennemann, genannt Reising" (June 11th, 1555 - August 29th, 1614). Hennemann wrote the manuscript of about 432 folios when he was a court physician of Emperor Rudolf II. It is a very extensive collection of alchemical recipes. The influence of Paracelsus is recognizable through the Triaprinicipia, which is an essential component of the content structure of the manuscript.

Compared with the contemporarily published “Alchemia” by Andreas Libavius, the content structure of the “Artificia alchimica” corresponds more to that of a modern chemistry textbook. As an example, the description for a preparation of hydrochloric acid (“oleum salis”) appears to be far ahead of its time.

Alchemical Practice in La Fonderia dell’ Signor Don Antonio de Medici (1604), Published at the Casino di San Marco Laboratory in Florence

Georgiana D. Hedesan
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Built in 1574 by Francesco I de’ Medici (1541-1587), Casino di San Marco became a famous alchemical laboratory under the patronage of Don Antonio de’ Medici (1576-1621), Francesco’s illegitimate son. The Casino is associated with the publication of Antonio Neri’s L’arte vetraria (1612). Another project that drew the attention of scholars was that of a compendium of recipes that Antonio de’ Medici intended to publish in 1604 presumably to advertise the alchemical accomplishments of his laboratory. Only an abridged version of this compendium was actually published, which most scholars deemed lost.

In fact, this abridgment survives in the British Library’s holdings. My analysis of this surviving copy reveals that, rather than being Antonio’s project to advertise the Casino, it is in fact the product of an alchemist that worked in the Casino and wrote the book for Antonio’s benefit.

My proposed presentation focusses on La fonderia and attempts to entangle some of the mysteries of its composition and publication. I will present the structure and contents of the book, which evinces the strong influence of Paracelsian spagyrics and alchemical mineral practice. Furthermore, I will discuss what this book may convey about alchemical laboratory practices at the Casino di San Marco.

The Chymistry of Red Glass: Re-working Kunckel’s Annotations to Neri’s Recipes

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In recent years we have seen a growing emphasis on the interconnectedness of alchemy/chemistry and the arts, which is especially strong in the case of glass manufacture (see Marco Beretta, Dedo von Kerssenborck-Krosigk, Sven Dupré). We have also seen a growing interest in textual technologies, or the reading and writing practices developed in the arts, including the recognition of the significance of processes of copying, translating, annotating and transforming recipes. This paper investigates the alchemist Johannes Kunckel’s Ars Vitraria experimentalis, first published in 1679, which includes a translation of

Antonio Neri's *L' arte vetraria* (1612), Christoph Merrett's comments upon his English translation of Neri, and Kunckel's annotations and comments. We focus on the re-working of the web of recipes, annotations and comments spun around five recipes for the production of rosichiero glass and enamels, which the ARTECHNE Project undertakes in collaboration with the VICARTE glass laboratories. This re-enactment throws light on the historicity of fire technologies (especially, furnace conditions), the functioning of textual technologies (especially, translation and annotation), and the interconnectedness of chymistry and the arts. It also allows us to reflect on the opportunities and challenges of performative methods, and the role of present chemical knowledge.

Boyle, Spinoza and Glauber: On the Philosophical Redintegration of Saltpeter

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Traditionally, the so-called 'redintegration experiment' is at the center of the comments on the supposed Boyle/Spinoza controversy. A. Clericuzio argued (refuting the interpretation by R.A. & M.B. Hall) in two influential publications (1990 & 2000) that, in *De nitro*, Robert Boyle accounted for the 'redintegration' of saltpeter on the grounds of the chemical properties of corpuscles and did not attempt to deduce them from the mechanical principles.

By contrast, this paper claims firstly that Boyle borrowed the experiment from the alchemist R. Glauber and used it as a tool to illustrate and promote his Corpuscular or Mechanical Philosophy which he introduced and defined for the very first time in *Certain Physiological Essays*. Secondly, this paper shows that Boyle did make significant attempts to explain the phenomena in terms of mechanical qualities.

Thirdly, this paper compares the interpretations of the 'redintegration' experiment by Boyle, Glauber, and Spinoza. It claims that the early engineer gave a Paracelsian interpretation applying the metaphor of the Griffon. The Anglo-Irish natural philosopher, by contrast, gave an interpretation within the conceptual framework of his corpuscular philosophy. Finally, this paper shows that categorizing Spinoza as a reductionistic, radical mechanist, as Clericuzio does, is for several other reasons problematic.

Tuesday, 30 July, 14:00-15:20, Session A2 [A]

Panel: The NMR Revolution

Pierre Laszlo (organiser)
Robert Anderson (chair)

NMR has been extensively documented as a gift from physicists to chemists, emphasizing the provision of methodologies and techniques. That chemists ran with it and made numerous discoveries, that changed the course of molecular science, has yet to be properly narrated.

This panel aims at remedying this lapse in the historical account. It will most usefully supplement the entries in volume 1 of the *Encyclopedia of Magnetic Resonance*.

Production of EPR and NMR spectrometers for chemical radiospectroscopy in the USSR

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Chemical radio spectroscopy in the USSR began in 1947. The active phase of research in this area bloomed since the late 1950s – early 1960s. It required development of appropriate instruments, initially as laboratory units and later as serial devices. The task was successfully solved in EPR spectroscopy till the early 1960s with the start of production of the first serial EPR spectrometer RE-1301. It was designed almost simultaneously with the release of the first spectrometers of “Varian” (USA), the world leader in this area of instrumentation, and had comparable characteristics. For chemical NMR spectroscopy, the task was much more difficult due to higher demands on the quality of the magnets. A set of serial devices, starting from SNMR-63 (22.7 MHz) in 1963 and including the most successful models RS-60 (60 MHz) and RYa-2305 (60 MHz) till 1967, was developed. However, the problem of instrumental support of chemical research was not completely solved. Since 1970s, a noticeable decline in Soviet ERP/NMR spectrometers quality compared with international analogs began (the only exception was presented by compact EPR spectrometers). We intend to discuss the characteristics of the best Soviet models and to compare them with the ones available on the worldwide market at the same years.

In the Beginning: The Development of NMR in Britain up to 1975

Peter J. T. Morris

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The early history of chemical Nuclear Magnetic Resonance in Britain has not been studied in depth. This paper will examine how chemical NMR reached Britain in the 1940s, the spread of chemical NMR to a number of key university departments (and the National Physical Laboratory), followed by the development of Magnetic Resonance Imaging (Nottingham) and biochemical Nuclear Magnetic Resonance (Oxford), ending with the arrival of Ray Freeman at Oxford. Important influences were the chemical industry (Imperial Chemical Industry), the instrument firms (no Nuclear Magnetic Resonance machines were made in Britain) and textbooks. The paper concludes by asking what general lessons we can draw from the British experience.

Birth of the Radical Pair Mechanism of Chemically Induced Dynamic Nuclear Polarization

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In 1967 two papers, by Bargon & Fischer and by Ward & Lawler, attracted much attention in the NMR community. Both papers described strongly enhanced NMR lines for products of free radical reactions. Bargon & Fischer also proposed an explanation of the phenomenon based on an analogy with DNP, hence the name CIDNP. In fact, Rex Richards had already predicted that when a chemical bond is broken, the electron spins of the resulting radicals are “saturated” (equal number of α and β spins), so that electron-nuclear relaxation processes could generate nuclear spin polarization like in the case of DNP. This theory looked perfectly reasonable, except for one detail: in the paper by Ward & Lawler the multiplet of a single nucleus showed both emission and enhanced absorption, which could not be explained by a DNP-like mechanism. Against the advice of my colleagues but with consent of my thesis supervisor Prof. L.J. Oosterhoff I set out to explain this anomaly. In 1969 we and independently Gerhard Closs published what became known as the Radical Pair Mechanism of CIDNP. This mechanism explains both the multiplet effect but also net nuclear spin polarization. In my lecture (50 years later!) I'll give you my account of this exciting period and discuss several other related phenomena.

The Scientist As Pioneer: pre-MRI Lauterbur

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Paul C. Lauterbur received in 2003 the Nobel Prize in Medicine, jointly with Peter Mansfield. It was widely speculated that the belated recognition — he had invented MRI in 1973 — stemmed from the intimidating claim by Raymond Damadian to share in the award. My talk will highlight Paul's earlier NMR contributions to chemistry, in the late 1950s and during the 1960s. He was a tireless explorer, a pioneer in many different areas: fluorine-19 nmr; carbon-13 and cobalt-59 nmr; tin-119 and lead-207 nmr; fluxionality in penta-coordinate entities. Having adopted for himself the Vietnam War motto «Search and Destroy», he would enter an area, make a foray and leave it almost as quickly. The profile of this genius will support an epistemological point: instead of the [leader-follower] distinction, historians of science might be well advised to return to the [pioneer-groupie] distinction.

Comments

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Tuesday, 30 July, 14:00-15:20, Session B2 [B]

Panel: IUPAC and the other international scientific organizations: competition or synergy?

Brigitte Van Tiggelen, Danielle Fauque (organisers)
Brigitte Van Tiggelen (chair)

IUPAC is set in a hierarchy: under the lead of the International Council for Science (formerly ICSU), itself linked with UNESCO, it cohabitates with other unions that deal with neighboring scientific topics such as Phyiscs (IUPAP), Biochemistry (IUB), Biochemistry and molecular biology (IUBMB), Geodesy and geophysics (IUGG), Cristallography (IUCr) ... etc. But many more similar organisation have existed since the foundation of IUPAC in 1919 with the aim at organizing and supporting of science and knowledge at the supranational level, to which is to be added the numerous initiatives taken to organize recurring international conferences. This panel will examine the articulation of these different levels of coordinated actions through case studies of specific interactions.

Solvay Councils on Chemistry and International Union of Pure and Applied Chemistry conferences in the 1920s: fundamental, applied and industrial chemists competing or working together?

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International Union of Pure and Applied Chemistry (IUPAC) is known as the former International Association of Chemical Society (IASC) who (allegedly) held the First Solvay Council on Chemistry in 1913. In the 1910s, Ernest Solvay wanted to create the International Solvay Institute of Chemistry but the IASC already existed. He negotiated with the founders of the IASC, among other things, the foundation of the International Solvay Institute of Chemistry in 1913. Obviously, both organizations share a common history. To what extent was this convergence pursued after the creation of IUPAC in 1919? The International Solvay Institute of Chemistry brought chemists together, just like the newly created IUPAC. Topics between both meetings differed slightly; the first organization focused on the fundamental chemistry whereas the second focused on applied and industrial chemistry. Commonalities seemed dominant. For instance, William Jackson Pope was scientific chairman of the International Solvay Councils on Chemistry held between 1922 and 1931. He was also president of IUPAC conferences from 1922 to 1925. How did these organizations that shared roughly the same objectives evolve after the First World War? The proposed paper intends to compare both organizations in the 1920s in terms of actors and topics addressed.

Internationalism enacted: Acts of reconciliation at anti-IUPAC chemistry meetings, 1921-1922

Geert J. Somsen
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Shortly after IUPAC was established and countries that had been neutral during World War I were invited to join it, the Dutch chemist Ernst Cohen organized two informal international conferences outside of its perimeter. The aim of these two meetings was to break the boycott of scientists from the former Central Powers that IUPAC upheld. Cohen rejected that policy and tried to reunite his German and Austrian colleagues with their French, Belgian, British, Russian, and American counterparts. The two Utrecht meetings were meant as an "experiment" at such reintegration.

This paper will examine the features of the conference, as a form of sociability, that Cohen et al. chose to employ. Precisely because reconciliation was the only objective of the two meetings, and their subject-matter was relatively unimportant, they offer a window on the practices of community-formation at conferences. What was articulated, for example, at the speeches and toasts? What was the function of the excursions and banquets with courses named after famous chemists? What was the role of spouses in the meetings? And what was the meaning of the various papers, on subjects like "free radicals" and "bonding through light", for the social aims of the conferences?

IUPAC, ICSU and UNESCO for "a Massive Attack on Scientific Illiteracy", the case of chemistry

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At the beginning of the sixties, UNESCO project to develop scientific education in developing countries encountered a huge agreement from the international Unions of mathematics, physics and chemistry represented in the International Council of Scientific Unions (ICSU). In this frame, the International Union of Pure and Applied Chemistry (IUPAC) appointed an ad hoc committee on the teaching of chemistry in 1962. This last launched a series of enquiries to know the situation of chemical education in developed and developing countries. Several international symposia followed and were held particularly in Asia during the sixties and the seventies. Several international books were published, some under the auspices of UNESCO, some under the auspices of IUPAC. If the Journal of Chemical Education or Education in Science edited some papers on this projects, but a proper periodical appeared in 1974: International Newsletter on Chemical Education, until 1994. This international project has to be put in parallel with the Nuffield project, the Harvard Physics Project, and some others, as in France, the Lagarrigue Reform: A large universal movement for a great change in teaching, after the shock of the sputnik in the mind of cold war, to fight the scientific illiteracy, for peace!

V.A.Koptyug and the collaboration between IUPAC and Scientific Committee on Problems of the Environment (SCOPE) in the field of environmental protection

Elena Zaitseva (Baum)
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1987-1989 years of the Koptyug presidency at IUPAC was the most innovative period of his work in this Union. At the end of the 1980s the problems of the environment arose sharply before mankind and all the scientifically organizational activity of the scientist was associated with the search for ways to solve them. In February 1989, Kotyug offered the first specialized interdisciplinary program, “Chemistry and Environment”, of which the development necessitated the participation of different divisions and commissions of IUPAC. For Koptyug, the solution of global environmental problems is only possible with the consolidation of the efforts of the entire concerned chemical community. His analysis of the activities of various international organizations in the environmental protection allowed to propose the participation of IUPAC to the similar projects as SCOPE and to find the ways of collaboration.

In this paper, based on the materials from Koptyug’s Archives in the Library of the Siberian Branch of Russian Academy of Science, I examine the scientist’s correspondence concerning the organization of cooperation between IUPAC and SCOPE in the early 1990s (for example in SCOPE projects “Water Contamination”, “Biogeochemical Pathways of Artificial Radionuclides”, etc.).

Comments

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Tuesday, 30 July, 15:50-17:50, Session A3 [A]

Analyses in Context

J.A. Rob van Veen (chair)

Negotiating chemical standards: the moral economy of mineral waters in eighteenth-century France

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The trade of mineral waters gained unprecedented pace in eighteenth-century France, thanks in parts to the expertise of chemistry. Although the discipline was still fragile in its institutional roots, the present paper sets out to show that through standards imposed onto the market of mineral waters, chemistry gained considerable clout and credibility. The late 1770s saw the rise of a new institution dedicated to the administration of remedies in the French kingdom, named the Société de Médecine. Staffed with physicians and chemists, it took to heart the intendancy over the sprawling market of mineral waters by attempting to inject ideals of scientific accuracy, economic efficiency and moral conduct into this trade, generating both public approval and conflict with the many interested parties. The aim of this paper is to use this little-known institution and its unique scrutiny of French waters to uncover the importance of water analysis and its uses. By recovering the process of standard negotiation at the Société, the entanglement of scientific discourse in society at large becomes apparent. Chemical practice and vocabulary entered the market and discourse surrounding mineral waters, and in turn served the ideal of establishing a moral and reliable mineral water trade.

The reinvention of the nitrous gas eudiometrical test in the context of Dalton's law on the multiple proportions of combination

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Dalton's chemical atomism was inspired by his physical fascination with gases and developed through his chemical investigation. In regard to the latter, Dalton's very first chemical experiments on nitrogen oxides enabled him to identify the first verifiable case of integral multiple proportions of combination, as well as playing a significant role in the process of establishing the basis for the reinvention of the nitrous gas eudiometer. Dalton gave a published account of the first clear instance of multiple proportions of combination in the first section of his 1805 paper Experimental Enquiry into the Proportions of the Several Gases or Elastic Fluids Constituting the Atmosphere. Nevertheless, the eudiometrical context of his early experiments on the oxides of nitrogen remains unclear. Dalton's interest in the nitrous gas test was in principle concerned with the justification of his statement on the multiple combining proportions, rather than with the improvement of the test as a eudiometrical method for verifying the oxygen content in common air. All in all, the nitrous gas test after passing through

the hands of Dalton was returned to eudiometrists in a simpler and more trustworthy version of the eudiometrical test than those performed with the latest nitrous air eudiometers.

Early Research on Chemical Ingredients in Hot Springs in Japan and Other Countries

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Volcanic eruptions in Japan have led to the formation of hot springs. The presence of one thousand springs has developed into social custom of bathing in the hot springs and searching for their therapeutic benefits. Visits to spa resorts became a Japanese cultural habbit. The first research on the chemical content of hot springs was carried out by the 19th century physician and Dutch translator Udagawa Youan (1798-1846). In his vast book on chemistry, seimi kaiso, Introduction to Chemistry, analysis of the chemical constituents of water of hot springs is reported. He mentioned qualitative properties of the water: color, smell, taste and relative density. The chemicals mentioned include alkali and ammonium compounds, metals and non-metals.

Following a Dutch encyclopedia of 1825 Youan described the constituents of chemicals in hot springs in foreign countries; those include iodine spa, copper spa that contains also silver, zinc ores and other metals. Japanese terminolgy formed by Youan to describe chemical ingredients in hot springs and their assumed therapeutic benefits will be presented.

The Introduction of Western Analytical Chemistry in 19th Century China

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Under the influence of the “Rich Nation, Strong Army” policy, Western analytical chemistry was one of the Western technologies that the Manchu Government wanted to introduce, because chemical analysis technology exploits Chinese minerals to supply the raw materials needed by the defense industry. Therefore, the Manchu government also hired the French chemistry teacher Anatole Billequin to teach at Tong Wen College. He not only analyzed the content of iron ore in China but also translated Fresenius's book on quantitative analysis chemistry. At about the same time, John Fryer and Xu Shou also translated Fresenius' two books on analytical chemistry. These two translation can be said to be the best Chinese scientific works in the late Qing Dynasty. This is not only related to their long-term translation of Western scientific works but Xu Shou was a key figure who was not only rich in Western scientific knowledge but who also purchased chemical instruments to conduct experiments. Compared with other sciences, the introduction of analytical chemistry should have been the most successful one. However, the process of introducing Western analytical chemistry to 19th century China, also saw some of the most basic problems in studying Western science during the late Qing Dynasty.

An epistemological- scientometric study of hormonal steroids research in Mexico

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The study focuses on the steroid research from 1946 to 1965 that led to the discovery and industrial production of the contraceptive pill and cortisone. Complemented by traditional historical reconstruction, scientometrics searches indicate that Syntex, a new laboratory at that time just established in Mexico, with the collaboration of many students from different public universities, produced more than half of relevant papers published in mainstream journals, which in turn generated the majority of industrial patents in the field. This course of events which was unprecedented at that time in a developing country was interrupted when Syntex, under the political pressure of US moved its research division to California leaving Mexico with a small but productive research group in the chemistry of natural products. Pickstone´s epistemological approach of Ways of Knowing is used to characterize the scientific literature produced. From this epistemological position,“Synthesis” identifies 74% of published papers, meaning that in the participation of Mexican institutions on steroid research, the main interest lean on the novelty, more than in the recognition and study of the parts (“Analysis”) or the study and identification of the vegetable natural resources (“Natural History”). Syntex becomes in this study as an example of technoscience.

A historical analysis of the coal liquefaction technology development in China

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Historically the coal liquefaction technology was developed before and during WW II by Germany and Japan. Pre-war Japan constructed a coal liquefaction plant in Fushun of Manchuria by the direct liquefaction. The hydrogen adding technology, which is the key process of the direct liquefaction, was inherited to New China because the major oil, Daqing oil, is very heavy and quite similar to coal. Fushun became the technical center of China’s hydrogen adding technology contributing to process Daqing oil.

In 1978 China adopted Economic Reform and Open Door policy and dispatched a delegation to Japan, requesting the technical cooperation for the modernization program of China. Japan proposed to develop the direct coal liquefaction plant using the hydrogen adding technology. New Energy Development Organization of Japan gave assistances to China, including donation of pilot plants and invitation of engineers to Japan for 20 years.

During 10th 5-year plan (2001-05) China constructed 1 million t/y plant in Ordos. This is the first commercial large-scale coal liquefaction plant using the hydrogen adding technology in the world. Due to the successful operation of the new plant, China constructed a lot of coal liquefaction plants during 11th and 12th 5-year plans, giving a great impact on the current world chemical indsustry.

Tuesday, 30 July, 15:50-17:50, Session B3 [B]

Communication and Education

Annette Lykknes (chair)

Printing Lines and Letters: The Role of Communication Practices in the Making of the Modern Chemical Notation

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Structural formulae function not only as heuristic tools in research and education, but also as a means for communicating and debating chemical knowledge outside the laboratory. Yet the gradual development of the formulae's distinct visual appearance is still poorly understood. Aiming to provide a detailed account of the iconographic evolution of the modern chemical notation, I combine perspectives from history of chemistry with history of print culture to examine the practical challenges of printing and circulating different forms of chemical diagrams in the nineteenth century.

I argue that, as a result of being printed by means of letterpress, structural formulae acquired several practical and economic advantages over competing diagrams that were proposed in the 1860s. I demonstrate that typeset formulae were faster to print and easier to reproduce than diagrams rendered by means of wood and copperplate engravings. I conclude that these advantages made structural formulae the most convenient representation of chemical structure with regard to the highly competitive market for chemical literature. In so doing, I show that the iconography and lasting success of structural formulae did not derive from theoretical reasons alone, but were to a very large degree based on economic and practical aspects of print communication.

Creating Fundaments of Organic Chemistry in Europe: Contribution of Vilnius University

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Vilnius University (established 1579) sought to ensure that science and studies were international, in line with the cultural and economic needs of the country's society. In first part of 19th ct Vilnius University attracted a number of scholarly elite from Europe, and became not only the oldest, but also the largest University in Russian empire. It operated according to the programme, created by an Educational Commission (established 1773), one of the oldest ministries of education in the world. Earth and life sciences were in exclusive position at the University, especially thanks to the efforts of Jędrzej Śniadecki (1768-1838), a chemist, physician and writer. After studies in Italy and Scotland, professor of chemistry strived to create a fundamental study on living bodies. His tractate "Theory of Organic Beings" became one of the first attempts to describe chemical processes in living bodies. He worked on the manuscript more than thirty years, including the insights on latest scholarly achievements in chemistry, biology and medicine. The paper will present bibliographical context of the organic chemistry in Europe, also will illustrate the track of scientific ideas of the field in Europe in first part of 19th ct. in a context of political and cultural circumstances.

Revolutionising Teaching − Lessons from a Century Ago

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In 1918 the Republic of Estonia was first declared after the collapse of the Russian empire. This coincides roughly with the publication of first chemistry textbooks in Estonian. Based on close reading and critical analysis of the forewords and content of these textbooks this paper seeks to determine how revolutionary is the way of teaching and learning chemistry currently promoted. In the forewords of the first Estonian language chemistry textbooks authors emphasise many key elements of what is considered outstanding teaching today. Teacher Julius Kalkun argues in "Handbook of Mineralogy" (1918) that the most important principle in teaching science is making one's pupils interested in the subject and the best way of doing that is to capture their attention with varied natural phenomena from the very beginning. Several authors point out the importance of experimenting, making models, and highlighting practical applications; they call for teachers to rely on analogies to assist pupils. A number of authors assert the autonomy and responsibility of the teacher and promote independent pupil research. The central thesis of this paper is that many aspects of contemporary excellent teaching have been on the forefront of pedagogical innovation from the birth of the Estonian Republic.

Some reflections on the (apparent) decline of the use of the history of chemistry in textbooks and teaching in Portugal and other countries

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The analysis of a representative set of textbooks and syllabus of the last century in Portugal and some other countries reveals a clear diminishing of the references to the history of chemistry (as well to other sciences) and to biographical material about scientists. This is a general trend that seems paradoxical, as the History of Chemistry had attained in the same period the importance of an autonomous science, and most of the authors consider that the history of science facilitates the process of learning. Explanations based on the lack of time and extensive syllabus, as well of more logical organization of the matters, can be part of the answer, but also the contemporaneous myth of impersonal science, based in collective work, and the known aversion of most of the scientists to the public exposure, and the opposition of historians and sociologists of science to legendary and anecdotal material can also contribute for this result. Some selected examples will be analyzed and discussed in this communication.

Getting schoolteachers and their students into the "scientific habit": Practices and material culture of chemistry teaching in the early 20th-century Spain

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History of science education has expanded enormously during the past two decades. Even many recent publications show the growth and diversification of protagonists, some of them are far less known, such as science teacher educators. The biographies of these neglected protagonists could be helpful to deepen in the creative nature of science teaching. Hence, it is a major aim of this paper to focus on the changes of the pedagogical practices and the material culture of chemistry teaching in the first decades of the 20th century in Spain by using the biography of Modesto Bargalló (1894-1981). Bargalló had a major role in the process of emergence and circulation of a new methodology for science teaching in Spain from 1915 to 1939. Bargalló was also the only Spanish historian of chemistry who has obtained the Dexter Award of the American Chemical Society. He published several science textbooks and authored many studies in science education in order to get schoolteachers in training and primary education students into the "scientific habit". Overall, this paper aims to explore the emergence of the idea of "scientific habit" in Bargalló's work, connecting it with the pedagogical renewal movements in Europe and North America.

History of chemistry as a part of pedagogical content knowledge of pre-service chemistry teachers

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The content knowledge of pre-service chemistry teachers which includes, among others domains of chemistry, the knowledge about the history of chemistry, represents the basis for the formation of pedagogical content knowledge of teachers. Pedagogical content knowledge is a part of chemistry teachers' competences that can be defined as a combination of pedagogy and the content of chemistry, including the history of chemistry as well. According to that we created the workshops within the framework of course of the history of chemistry for the pre-service chemistry teachers with the aim to enable them to gain insight into development of chemistry through different historical periods and, in the same time, to offer them the models for their future work with school students on elaboration of chemistry concepts from historical point of view. The workshops comprised different pre-service chemistry teachers' activities, for example: work with different sources of historical facts, creating a timeline, performing different roles in quizzes (competitors, items creators, moderator, and supervisors of the accuracy of the answers). The work within the workshops has potential to improve the pre-service chemistry teachers understanding on development of chemistry knowledge. The workshops could be also adapted for students of different ages and level of education.

Wednesday, 31 July, 10:45-12:45, Session A4 [A]

Panel: European Alumina (18th-21st Centuries): from a Chemical Invention to a Globalised Industry – Innovations, Sites, Societies and Environment”

Philippe Mioche,Thierry Renaux (organisers)
Danielle Fauque (chair)

Aluminium is the most abundant metal of the earth’s crust. However, it is not a native metal. Two operations are required to obtain this young metal (1854) pure. The first step consists in processing the ore – bauxite – into aluminium oxide or alumina; the second stage aims at produce the metal from its oxide. Theretofore, historians have mostly focused their research on this last operation and alumina is mainly considered as a transitional product. The fact remains that alumina production is a main and fundamental element of the global aluminium industry. From the invention of this chemical product on the scientists lab benches to the contemporary environmental and societal issues, by way of its uses and the choices of establishment of factories, alumina is a major part of the European chemical industry of the 19th, 20th and 21st Centuries.

[The panel is supported by the Institute for the History of Aluminium (IHA, www.histalu.org), a French non-governmental organization which provides ressources and expertise on aluminium and issues the semestral journal *Cahiers d’histoire de l’aluminium* **/** *Journal for the History of Aluminium*.]

The Invention of a Chemical Material and of an Industry (18th-19th Centuries)

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Pure aluminium was obtained for the first time by the French chemist Henri Sainte-Claire Deville in 1854. This discovery was the completion of European scientists’ theoretical and practical works aiming for the extraction of aluminium from its oxide, alumina. The scientific context of these researches was the decomposition of the earths and the salts; to be precise, the “earth” of aluminium is also a salt, alum, known and used since Antiquity. In the frame (and on historiographical background) of the setting up of the aluminium industry, then a rare and semi-precious metal, a new ore – bauxite – is discovered and alumina is “invented” as a chemical, commercial and strategic product. In fact, when the aluminium production had started in the soda manufacture of Henry Merle in Salindres, in the south of France, the main interest of this engineer was alumina. This oxide replaced alum and offered many outlets: chemical uses, abrasives, refractories and aluminium. Consequently, an industry to produce it was set up in France, Germany and United Kingdom (Ulster). Our intention is to study the scientific, economic and industrial conditions of the invention of alumina, a chemical raw and intermediate material in the long-term (18th-19th Centuries).

An inventor. Karl J. Bayer and the Early Aluminium Industry

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In 1887 and 1892, the Austro-Hungarian chemist Karl Joseph Bayer (1847-1904) developed the process for extracting pure alumina from bauxite ore which was to become one of the technological foundations of the modern aluminium industry. Drawing on extensive research in European archives and on family recollections (Karl Bayer was an uncle of my grandfather), the paper outlines the inventor's life and seeks to reconstruct the many international initiatives undertaken by him with regard to alumina: St. Petersburg, Yelabuga, Ludwigshafen, Woburn, Gardanne, Larne, Rietzdorf – the very first steps of the Bayer process. Attention is given to the relevant knowledge networks connecting scientists and industrialists around 1900. Intended at the outset for the rapidly growing aluminous chemicals industry, the Bayer process soon attracted the interest of the emerging aluminium industry. Faced with the fierce opposition of German aluminous products makers, the cartelisation of the aluminium sector and the extraordinary evolutionary dynamics of his process, Bayer lost control over its industrialisation at the end of his life. It was not until 1905 to 1909 that the pioneer plants in Gardanne and Larne were followed by important scale-ups in St. Louis-les-Aygalades near Marseille and St. Louis, Missouri. – Closing remarks about Bayer's view of his process as a (potentially closed) cycle.

The European Alumina Industry in Global History (1887 to Present)

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The industrial manufacture of alumina, since the Bayer patent in 1887, developed mainly in Europe and North America until the interwar period. The growth of metallurgical alumina, mostly intended for electrolysis to make aluminium, was proportional to that of the "light metal". The overall ratio was two tons of alumina per one ton of aluminium. This manufacturing relied essentially on the Bayer process that has prevailed in the world to the detriment of other processes. This industry is now globalized. The manufacture of alumina progressively disconnected from that of aluminium. On the one hand, it is transported to the world by different firms, on the other hand, about 10% of the alumina - said chemical - found other outlets than aluminium. Alumina has been manufactured and is still manufactured in Europe. The communication traces the extension of this industry in the European territory (excluding USSR and Russia), using long-term statistical and cartographic materials; it measures the relative weight of alumina manufactured in Europe in the world production. It is a contribution to the industrial history of chemistry and the environmental history of the continent because each ton of alumina produced generates two tons of residues (red muds).

The European Alumina Industry and its Environment in the 20th Century, from Acceptance to Suspicion? The Cases of Alumina Plants in France, Greece, Ireland

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The chemical manufacture of alumina is the application of the Bayer process, which generates high quantity of waste ("red mud"). The production of one ton of alumina creates about one ton of residue. A general environmental turn has occurred during the 1970's and red mud conflicts have multiplied. Citizens, neighbourhoods, NGOs, local authorities, fishermen (concerned with the discharge in seawater) have developed actions and have criticized the impacts of this industry on the environment (air, rivers and seas, soils) and on people (health, quality of life). Long-time considered as non-toxic, unavoidable and seen as a matter of space (where to store it), the "red mud problem" has turned into a major environmental and societal concern. How has local communities perception on alumina industry and its pollution changed during the 20th century? How have the companies reacted to the recurrent demonstrations, proceedings, media exposures or new legislation? The "historical" bauxite residue management, notably the storage near factories, in former mines, into dammed valleys, the discharge in rivers and seas, etc., is not accepted anymore. This paper will analyse this evolution through the situation of three different alumina plants: Gardanne, France (started in 1893); Agios Nikolaos, Greece (1966) and Aughinish, Ireland, (1983).

Wednesday, 31 July, 10:45-12:45, Session B4 [B]

Instruments, Collections, Materials

Marco Beretta (chair)

Governing Fluids: Hydrometers, Salpeter and Empire in the Early Nineteenth Century World

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The history of hydrometers is an ideal vehicle to shed fresh light on the historical relationship between chemistry and empire in the early nineteenth century world. While manufacturers of chemical substances and drugs relied on the instrument to guarantee their businesses' productivity, chemists and administrators promoted the instrument as tool to improve colonial administrations all over the world. In order to study some aspects of the instrument's global career, this paper examines the history of hydrometers as they were used in the early nineteenth century Dutch empire in Europe and Southeast Asia. Special attention is given to hydrometers which were introduced in a salpeter manufacture in Gresik, in the eastern part of Java, and in pharmaceutical context. Taken together this paper makes two interconnected

points: First, the paper gives insight in material aspects of colonial administrations, an aspect which historians usually neglect. Second, the paper argues that hydrometers used in Dutch colonial context formed part of a much broader ‘gravimetric culture’ which can best be studied by a careful contextualization of different types of instruments (with a special focus on their design, calibration, and use) not only in Asia but also in other parts of the world.

The biochemical roots of the pH value and the glass electrode

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The purpose of the present contribution is to provide a discussion of the following issues:

- Both the pH and the glass electrode are bioanalytical achievements.
- The physiologist Max Cremer (1906) started the research on the measurement of acidity with a glass electrode during his attempts to mimic biological membranes.
- The biochemist Sören Sörensen (1909) invented the pH as an algebraic redraft of already well-known empirical facts, namely the correlation and concentrations of the hydroxide- and the hydrogen-ions in water.
- The extraordinary success of both bioanalytical achievements can be traced back primarily to applications in nutritional, biomedical and ecological fields.
- The pH electrode evolved parallel to and independently of the “instrumental revolution”.

Historical cryogenic instruments in the collection of the Jagiellonian University Museum

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In April 1883, Zygmunt Wróblewski, a professor of physics at the Jagiellonian University in Krakow (Poland), sent a note to the French Academy of Science to inform the Academy about the liquefaction of oxygen in a static state. This fact caused a discussion about the priority, because Wróblewski used the apparatus of Louis-Paul Cailettet which has been modified in Krakow by Karol Olszewski – professor of chemistry at the Jagiellonian University. This apparatus has preserved at the University Museum, like other gas liquefaction apparatuses made in Krakow and used by Karol Olszewski in his later research. There are also at the University collection other instruments that were crucial for the low-temperature workshop equipment from c.1888 to about 1915. Presentation of this collection and discussion of its meaning will be the subject of the paper. Regardless of how the success of Krakow scientists in 1883 is assessed from the current perspective, the preserved collection of cryogenic instruments is undoubtedly one of the most important in Europe. It illustrates the instrumentation for low temperature research from the turn of the 19th / 20th century - an important stage in the development of this new branch of science.

A look into historical collections of chemicals: Glass containers' deterioration and the development of conservation guidelines

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The collection of historical chemicals from the National Museum of Natural History and Science of the University of Lisbon is composed with circa of 1500 chemicals, from the 19th and 20th centuries, mostly preserved inside glass containers. These chemicals represent a material evidence of the history of education, as they had an important role mainly in the teaching of chemistry and its practices across these two centuries, particularly at high schools and at the university. For this study, the macro and micro visual characterization and the compositional analysis of corrosion patterns and products found in the glass containers are demonstrated. Considering these containers as real time models for glass corrosion mechanisms, both the chemical nature and effect of the stored substances, among with the glass composition and its quality, can be assessed as factors for the observed patterns. Together with the information gathered from the analytical study and the results of an international survey that addresses conservation practices in similar collections, in this paper, and as a result of this study, we will present a conservation scale and guidelines, outlining internal and external factors contributing to glass deterioration, as well as preventive measures to be applied for these collections.

Wednesday, 31 July, 14:00-15:20, Session A5 [A]

Panel: Making, Knowing, and Performing Outside the Laboratory: Different Sites of Chemical Knowledge Production

Christopher Halm (organiser)

Elena Serrano (chair)

Chemists do not just work in laboratories. As recent studies have shown, the production and presentation of chemical knowledge encompass a huge variety of different sites and practices. This panel will examine the observatory, the courtroom, arable fields, and the surface of Mars.

By entering these non-laboratory spaces, chemists confront new problems and have to adapt to new requirements. Unstable working conditions and sometimes annoying interventions by non-chemists or nature itself are just some of the challenges they face. So, what do chemists do to handle their new environment? And what new opportunities and cooperations are opening up for them?

By carefully studying the conditions of those other spaces, we seek to identify and understand typical ways that chemists pursue to potentially succeed at different sites.

Chemists in Agriculture: The Implementation of «Field-Laboratories»

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In the mid-18th century, chemists started to explore and describe agricultural processes in terms of chemical methods and principles. The utilitarianism of Enlightenment thought in Europe and North America incited these chemists to package their knowledge as both useful and practical. Engaging with other like-minded philosophers, big landowners, and farmers, chemists had different types of plants and soil samples sent to them. However, in order to successfully avoid being labelled as mere theorists, chemists had to leave their laboratory buildings and examine the farmer's field right on the spot. Thus, chemists not only brought their view of nature to bear on agriculture, they also brought chemical instruments and reagents from the laboratory to the field. There they undertook individual experiments and performed medium-sized cultivation trials. Overall, this paper explores how chemists transformed the conception of the field as a space of nature and toil to a site of precise and practical chemical inquiry. I argue, that chemists implemented a new space, that was neither a field nor a laboratory, but a hybrid of these two. This new space, which I call «fieldlaboratory », will be proposed as a new category in the history of science.

Chemical Knowledge in the Courtroom: Forensic Toxicology in 19th-century Germany

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The courtroom was one site outside the laboratory or the industry where chemical knowledge was put into practice. More specifically, in alleged poisoning cases, analytical chemistry was useful if not necessary to determine the cause of death. In the courtroom, chemists and pharmacists were facing laymen who had to decide whether to rely on the chemists' expert testimonies for their judgment. In my talk, I will focus on how this situation affected the method selection of the chemical experts. Which methods were deemed more suitable for a testimony in court and why? Which strategies were employed by the experts to convince the laymen in court and to strengthen their authority? Concentrating on 19th-century Germany, I will also ask how this process was influenced by the wideranging mid-century reforms of the legal procedure.

The Observatory as Chemical Laboratory: Spectral Analysis at the Mount Wilson Observatory

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This paper will discuss the seminal changes in astronomical research practices made at the Mount Wilson Observatory in the early twentieth century by George Ellery Hale and his staff. Hale's desire to set the agenda for solar and stellar astronomical research is often described in terms of his new telescopes, primarily the solar tower observatories and the 1.5- and 2.5-meter telescopes on Mount Wilson in Southern California. This paper will focus more on the ancillary but no less critical parts of Hale's research mission: the establishment of associated laboratories as part of the observatory complex where observational spectral data could be quickly compared with spectra obtained using specialized laboratory equipment. Hale built a spectroscopic laboratory on the mountain and a more elaborate laboratory in Pasadena and staffed it with highly trained chemists and physicists, not classically trained astronomers. The success of Hale's vision for an astronomical observatory quickly made the Carnegie Institution's Mount Wilson Observatory one of the most important astrophysical research centers in the world.

Chemistry on another World: The Chemical Exploration of Mars' Surface

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Since the Viking Landers set down on Mars in 1976, chemists and chemical methods have been contributing to the exploration of the martian surface. This work has required the miniaturization and automation of established chemical apparatus, as well as the development of new methods, techniques, and tools. This talk examines the evolution of chemical methods as they have developed on Mars from the Viking Lander's Gas Chromatograph Mass Spectrometer to the most recent Curiosity Rover's Chemistry and Mineralogy X-Ray Diffraction Instrument. These instruments and the spacecraft that carried them have perhaps defined a new era in human-robotic field chemistry. Nonetheless, the work done on Mars is still closely connected to chemical work that continues on Earth, as well as the industries that support it. This paper attempts to contextualize the "heroic" history of cosmochemistry in the larger framework of the history of applied chemistry.

Comments

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Material and Visual Cultures of Chemistry

Frank James (chair)

Material and Visual Culture of Chemistry: Guyton de Morveau's laboratories

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Louis-Bernard Guyton de Morveau (1737-1816) is mainly known as a chemist who authored with Lavoisier, Berthollet and Fourcroy the Méthode de nomenclature chimique with (1787), the French translation-refutation of Kirwan's Essay on Phlogiston (1788), and the Annales de chimie (1789). At that time, he was also recognized as a skilled experimenter who especially replicated foreign experiments he had (or had had) translated from Latin, English, German, Swedish and Italian, for his public chemical lectures and his Dictionnaire de Chymie of the Encyclopédie méthodique. Besides occasional experiments in other chemists' laboratories, such as Lavoisier's, Guyton de Morveau worked in his own laboratories as well as the public ones he also set up, mainly at the Academy of Dijon and the Ecole polytechnique. The archives of those institutions, the travelogues of foreign visitors and his correspondence, notebooks and printed works provide much information about the equipment of the laboratories. The paper will present a survey of Guyton de Morveau's instruments, apparatuses and other artefacts, with a special emphasis on the use of visual supports, in the laboratory itself, and in the publications.

The rise of a chemical instruments market in the Netherlands, 1850-1914

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This paper explores the market of chemical instruments in the Netherlands between 1850 and 1914. Early nineteenth century chemists often had to invent, make or adjusted the needed equipment. In general the demand for chemical equipment was limited till the 1850s. This changed as new methods and technologies made progress. As part of the industrialisation, applied chemistry gave rise to business activities unknown before. The use of chemical equipment and instruments widely spread as emerging industries, like the food and agricultural, needed instruments to analyse their raw materials and products as well as to control their production processes. Food safety regulations and fiscal policy also contributed to the demand for lab instruments. This increasing demand could not met by local craftsmen and small domestic manufactures. Specialized manufactures and trading houses entered the Dutch market in the 1880s. German, French and British manufactures were able to produce a wide range of high quality chemical and other instruments for reasonable prices. Their catalogues and price lists and products reflect this development.

Picturing Chemists in the 19th Century

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When portrait photography came into fashion in the middle of the 19th century, chemists took on the new medium enthusiastically. Even important figures in the field, such as Robert Wilhelm Bunsen, who were hitherto reluctant to have their portraits painted due to the lengthy sittings, were fascinated by the new technique and allowed their photographs to be taken. But how did chemists set themselves and their discipline into scene? What do we know about the contexts and the circumstances within which the pictures were being produced and circulated? I argue that chemists were keen to present themselves as men of learning and to cast off the image of the “laboratory worker.” In fact, their individual portraits were in perfect accordance with typical bourgeois studio photographs. This talk will further explore why the setting differed considerably in workgroup pictures, where it soon became the fashion to pose with the insignia of the discipline. Special consideration will be given to the questions which ideals and implicit images of chemistry as a discipline were being transmitted by these photographs – and how photography helped shaping the discipline.

Materials and instruments of the contemporary chemistry

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Since 2003, a program, entrusted to the Museum of Arts and Crafts in Paris by the Ministry of Research, stimulate local initiatives and develop tools for the preserving of both materials and memories of public and private research establishment. The program create a network that is composed of 22 partners at date. As a sign of the production of science research and teachning methods, it appears necessary to replace this objects in the cycle of innovation that saw it born. And with the rapid evolution of science and technology and the retirement of people (researchers, technicians, engineers) something has to be done from a heritage point of view. As we can see, the actual physical difficulties of conservation encountered does not prevent to keep at least numerically the data. This data constitute an heritage under construction. The program has created a database adapted to the constraints of this heritage. Collection officers are in charge of cataloguing artefacts in it. We can now consult more than 1800 technical data sheets representing the heritage of contemporary chemistry laboratories. We can present you some example that is a rich information source for researchers in history of chemistry.

Wednesday, 31 July, 16:00-18:00, Session A6 [A]

Panel: Women, Gender, and Chemistry

Joris Mercelis (organiser)
Jeffrey A. Johnson (chair)

This panel offers comparative perspectives on the experiences of women who pursued their interests in chemistry and experiments with materials in male-dominated scientific institutions, ranging from the Enlightenment-era economic society to the early to mid-twentieth-century academic institute and industrial research laboratory. The papers examine the motives and identities of women who were early to join these institutions, and highlight not just the barriers that they encountered, but also their strategies for circumventing or managing these obstacles. In addition, this panel reflects on why the activities of these women and their contributions to the development of chemistry—and of related fields such as medicine and chemical engineering—have long remained relatively invisible. In this respect, the papers consider short- as well as longer-term consequences that result from the gendered nature of the sources on which we depend as historians, as well as challenges that we face in addressing this kind of bias.

Gender and Representation in Chemistry: Two Cases from the 18th Century

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This paper brings together the themes of gender and artistic representation with respect to the period of the 18th century Chemical Revolution by examining the work of two women, the English poet Anna Letitia Barbauld (née Aikin) and the French artist-illustrator Marie Lavoisier, wife of Antoine Lavoisier. Anna Barbauld was a close friend of the Priestley family, and Joseph Priestley features in seven of her poems. These poems are often domestically set and humorous in tone, but with an underlying critical irony. My analysis concentrates on 'An Inventory of the Furniture in Dr. Priestley's Study' (1771?), and its surprising, quasi-chemical ending. Marie Lavoisier was herself represented in the best- known portrait of any chemist, Jacques-Louis David's portrait of Antoine and Mme. Lavoisier (1788). My analysis builds on Marco Beretta's work by attending to the painting's gendered compositional features and reflexive elements, before advancing the claim that one of Mme. Lavoisier's well-known sketches of experiments in the Salpetrière laboratories (1791-2) can be seen to be in explicit visual conversation with David's portrait. The paper concludes by bringing together the strikingly performative features of the work of these female artists under one unifying description and interpretation.

Madame Lavoisier's Changing Role in Laboratory Practice (1771-1836)

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In late eighteenth-century France few women became known for their work in chemical laboratories. Marie-Anne Paulze-Lavoisier (1758-1836), wife of the French chemist Lavoisier, was one of them. In fact, shortly after her marriage in 1771, she began to assist her husband in his experiments and, by the end of the following decade, her role as a laboratory assistant was mentioned and praised by Lavoisier's colleagues and friends. In some cases, her skills were recognized also by Parisian press and by the Académie Royale des Sciences. But what did she effectively do? How her laboratory work was represented to the public by the Lavoisiers? To what extent these representations challenged the gender norms of the time? On the basis of Madame Lavoisier's textual and visual sources, in my presentation I shall provide some tentative answers to these questions. I shall also briefly examine what happened after Lavoisier's death in 1794 and explore how this event influenced Mme Lavoisier's later approach to chemistry and to laboratory practice.

Gendering readings: the case of food tests in the Madrid Foundling House in the late eighteenth century

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In 1799, the feminine branch of the Madrid Economic Society, the Junta de damas, took over the administration of the Foundling House. The House received c.100 babies each month, a quarter of the total births in Madrid, of which 70-90% would die. This enormous mortality was caused in part because of the lack of enough wet nurses. This paper analyses the trials done in the House for testing alternatives to breast-feeding during the Junta's care. The historiography has presented these trials as a consequence of the progressive control of the House by doctors, their masculine way of understanding science, and the submission of the Junta to their will. However, this paper argues that the Junta took an active and important role in the tests. Furthermore, it shows that the tests were not alien to their 'feminine' identity, but in tune with their identity of 'female improvers'. Finding new ways of feeding the poor, profiting from remains, and developing novel edible substances was at the center of the research agendas of economic societies. Ultimately, the paper reflects on how political agendas and ideas about gender roles shape our interpretation of sources.

Shaping identities as women engineers in early twentieth-century Norway: Women chemists at the Norwegian Institute of Technology in Trondheim

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Expectations were high when the Norwegian Institute of Technology (NTH) was established in Trondheim in 1910. Modelled on the German Technische Hochschule, NTH was an academic institution with modern teaching and research facilities. It was the first polytechnical institute in Norway (and remains the only one today) and had to be developed from scratch, and adjusted to the budding Norwegian industry. Amongst c. 100 students who were enrolled at the NTH in 1910 there was only one woman. However, she gave up her chemistry studies, and the first female (chemical) engineers graduated in 1919. Throughout the history of NTH, chemistry attracted more women than other fields. What happened to the women chemists after their graduation? This paper is a follow-up on a book project on 100 years of chemistry education at NTH, where I, among other things, looked at how the first chemistry professors shaped their identities between industry and academy at a technical institute. I have mapped the family backgrounds and careers of the first generations of female engineers. In this paper, I will use this to discuss how the female students formed identities as the first generation of Norwegian-trained engineers, and Norwegian women engineers in particular. I will particularly look at the women who took jobs, and stayed, in the chemical industry: what roles did they take and what motivated them for their work?

Gender discrimination in industrial research: historical perspectives from the photochemical industry

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This paper addresses the history of gender discrimination in the chemical industry by comparing and contrasting the careers of Frances Hamer (1894-1980) and Leslie Brooker (1902-1972), two leading authorities on the synthesis of cyanine dyes and their use for photosensitizing purposes. Hamer entered this field at the University of Cambridge in the context of World War I, before joining Ilford Limited as a research chemist in 1924. Her seminal studies helped give Ilford a competitive edge in the development of panchromatic emulsions, but also prompted other photographic firms to dedicate more manpower to sensitizing dye research. Eastman Kodak primarily turned to Brooker, whose memoirs document in illuminating detail how his employer took advantage of Hamer's work in both conventional and rather shady ways. Together with related sources, these memoirs also offer new insights into Hamer's resignation from Ilford and subsequent career at Kodak, where she stayed until her retirement in 1955. Throughout the paper, I demonstrate that, while the photographic industry was relatively welcoming to women scientists, Hamer frequently encountered gender-related stereotypes and obstacles. As a result, she ended up working in relative isolation, whereas Brooker developed many productive research partnerships with male colleagues within and outside of Kodak.

Wednesday, 31 July, 16:00-18:00, Session B6 [B]

Transitions in Twentieth-Century Chemical Industries

Asbjørn Petersen (chair)

On the role of theory on the development of heterogeneous catalysts for the conversion of coal to oil, 1900-1985

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In the first quarter of the 20th century, in response to the rising importance of mineral oil (especially in the transportation sector), two processes were invented in Germany, that could convert coal, abundant in that country, into oil: a direct “liquefaction” process, Bergius-Pier, and an indirect one, Fischer-Tropsch. From the start there was an interest in these processes outside Germany as well, but especially in the wake of WW II, and again in the days of the oil crises in the 1970s. Both processes are catalytic, and the question addressed here is how heterogeneous (solid) catalysts were developed for them and how they were further improved, both in Germany and outside it, with an emphasis on the role of theory, i.e. the fundamental knowledge of what makes a catalyst tick. Before WW II there was little theory to go on, but after it, the advent of new analytical and catalyst-characterization tools, and the blossoming of fundamental mechanistic studies, mostly done in academia, increased the knowledge base enormously: nevertheless, its impact remained limited. The reasons for this will be discussed, as well as the principles that guided catalyst development over time instead.

DDT and the making of the Spanish pesticide industry during the early years of the Francoist dictatorship (1944-1950)

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The paper reviews the first uses of DDT in Spain during the 1940s. We discuss how fascist policies, political repression, autarky, pest alarms along with several agricultural engineering projects encouraged the emergence of the Spanish pesticide industry. Our focus is on the first important regulation on pesticides: the National Register created in 1942. We start with a brief review of the use of pesticides in early 20th-century Spain and the challenges created by the arrival of the Colorado beetle in the late 1930s. Then, we offer a collective portray of the community of agricultural engineers and their role in the first years of the Francoist regime. We discuss how the politics of autarky offered new opportunities for developing agronomic

programs and chemical industry. We also discuss the consequences of these regulations in invisibilizing the risks of pesticides for farmers and food consumers. Pesticides became sources of slow poisoning and tools for social control and reinforced the alliance between agricultural engineers and fascist politicians in autarkic, authoritarian and technological dreams. In this context, we review the role of DDT in these developments by discussing its early uses in agriculture and public health in Spain.

The history of cholesterol: An example of inter-relations between science and technology

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Cholesterol is a well known word that designates a chemical substance socially associated with serious threats to human health. However most people have no idea of what cholesterol really is and of how difficult it was to know its chemical structure. In this communication we intend to present an overview of the fascinating history of the discovery and isolation of this substance as well as of the challenges chemists had to face to establish its structural formula, to make its total synthesis, and finally to understand the related biochemical mechanisms involved. In the long process that led to the establishment of the complex structural formula of cholesterol and corresponding confirmation by chemical synthesis, and later by biosynthesis, several outstanding chemists (and teams) were involved, contributing step by step to the final result. Many contributions were actually recognized, leading to the award of Nobel Prizes to the more relevant partial results, eventually not always correct. All this process, that lasted about two centuries, is a paradigmatic example of the inter-relations between the evolution of the conceptual frameworks in chemistry and the development of technology, in particular associated with the introduction and subsequent evolution of instrumental methods of analysis, progressively more sophisticated.

Intermediary work. Producing knowledge and commercial value in natural product chemistry

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A case study based on ethnographic fieldwork in a European company serves to analyse practices of producing knowledge and commercial value in present-day natural product chemistry. The company I investigated isolates compounds from plant and microbial sources to assemble a massive library of pure natural products. In order to speed up the production of knowledge and substances, only a limited amount of information is gathered: Molecular structures and other basic properties of compounds are elucidated whereas their biological activities remain unknown as they are being sold, in contrast to traditional ways of using natural products in drug discovery since the 19th century. Accumulating resources with unknown

effects but in formats adapted to industry's needs – compatible with high-throughput-screening – amounts to trading in potential value. From industry's point of view, natural products are expensive to acquire and cumbersome to deal with but increase the diversity of molecular structures in compound collections; an uncertain yet potentially vital advantage in drug discovery. Hence, the company provides compounds in a way that minimizes most issues typically associated with natural products: Constituents of living beings are purified and made available in standardized formats. Its services constitute a kind of intermediary work: For this purpose, to mobilize a vast array of biological materials is as crucial as being able to assure compliance with the regulation foreseen by the Convention on Biological Diversity; detailed knowledge in analytical chemistry intermingles with experience in botany, microbiology and drug discovery.

The force of operational research: Bayer AG and the transition to the life sciences

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The merger of Bayer and Monsanto finally settled Bayer's more than hundred-year history as a diversified chemical company. In retrospect, the focus on a core business seems to be the consequence of a rational strategy that many chemical companies followed since the 1980s. As Bayer as a chemical firm depends strongly on its R&D capabilities, I plead to take a closer look at the development of operational research to explain the transformation of the once highly diversified company. Based on the discovery of the polyurethanes and of polycarbonate, the company's biggest business sector during the period of the post-war boom became plastics. Pharmaceutical research on the contrary had its difficulties to catch up to international standards defined by the US companies. Only at the end of the 1960s, the catch-up process was accomplished. But how, considering the situation of the late 1960s, did it happen that the life sciences came to be the core business of the corporation only three decades later? By looking at the internal research, I will argue that this development started significantly earlier than generally assumed and, that the management did not follow a distinct strategy during this process, but was guided by its self-introduced management tools.

Modification of edible oils as a pivotal point in the food supply: Historical lessons for renewable food?

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It's now one and a half century ago since margarine was invented. Margarine has been an important source of nutrition for edible oils and fats and vitamins. However, in the 21st century margarine depicts the 'Frankenstein' of industrially prepared food rather than the panacea for an impending food shortage. This paper highlights the chemical innovations that have been implemented in the raw materials for margarine.

Indeed, margarines were a model of advances in chemistry such as modern analysis and separation techniques, the hardening of liquid oils and, furthermore, conversions with catalysts. Certain types of oils—such as the poly-unsaturated fatty acids—appeared to have beneficial physiological effects. Metal catalysis was rejected by consumers to be replaced by enzymic conversions.

In the sixties there were important shifts in the world production of oils and fats. Soybean oil overrun the market, while the processing of palm oil also showed an increase. Chemical operations made it possible to adapt to this dynamic supply of raw materials. A whole range of vegetable feedstock of varying make-up could be converted into products of constant quality. Catalysis—chemical or biological—will be necessary in the 21st century to make edible oils renewable.

Panel: Materials Research and its Toolkits

Joseph D. Martin, Cyrus Mody (organisers)
Benjamin Gross (chair)

Materials research contributes to pervasive yet largely invisible changes to society, including the sciences. From computers to nuclear reactors, technologies – including research technologies – require advanced materials. Yet no systematic history of materials research exists, despite groundbreaking work by Klaus Hentschel and Bernadette Bensaude-Vincent. This panel explores two ways forward. First, we can follow the trajectories of materials themselves. Second, historians have shown that tools can nucleate materials research communities, and that institutions of materials research foster innovation in tools. We are editing a volume on the history of tools in materials research, which this panel samples. We define “tools” expansively, including obvious candidates (sputterers, spectrometers, microscopes), less obvious infrastructural tools (standards, safety practices, laboratory buildings), tools so ancient and ubiquitous they are taken for granted by policymakers and practitioners of materials research (glassware, recipes, balances). Taking these categories together highlights the mutual evolution of tools, materials, and research communities.

Too Many Cook(books) Spoil the Broth: Handbooks as Objects of Disciplinary Division

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Handbooks and manuals are where the knowledge and practices of a discipline accumulate. In their use, professional standards can be disseminated and enforced. But, even in their rejection, handbooks can be used to construct disciplinary boundaries. This paper offers a historical example documenting the tenuousness of a manual’s authority and role as an instrument of professionalization. In the early twentieth century, disciplinary boundaries were being created within the larger field of industrial chemistry. Denouncing the use of manuals, pejoratively termed “cook books,” helped to solidify professional prestige among individual or groups of industrial chemists through the exclusion of chemical technicians, in part along gendered lines. The rejection of “cook books” for use in research or industry soon extended into a rejection of their use for education. Although handbooks are no longer an object of common contention among scientists, the term “cook book laboratory” has lasted to the present day among science education reformers.

Infrastructural Tools: Safety, Standards, Fume Hoods, Vacuum Chambers

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Materials researchers make and study materials, and thus they require fabrication and characterization tools. Yet they also need to make and study those materials within highly regimented environments. Even field-based materials research – e.g., studies of weathering – is done under controlled conditions only indirectly in contact with "nature." Most materials research takes place in special buildings; in fact, mostly in special spaces within those buildings where researchers seek precise control over air, water, dust, and the other inanimate and animate (including human) occupants of the built environment. They do so both for the rigor of their experiments and the safety of the experimenters (and surrounding communities). In this paper I survey what historians have said about the development of infrastructural tools such as safety regulations, materials standards, filtration systems, and fume hoods. I then offer a case study of the development of vacuum chambers, a fairly extreme environmental control technology necessary both for fabrication and characterization of many advanced materials. Vacuum is in one sense a very old technology; but "ultra-high vacuum" was invented almost simultaneously with the field of materials science in the 1950s. Its development is therefore a useful probe of the evolution of materials research more generally.

Tracing the Careers of Geraniol

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Geraniol is a naturally-occurring terpene with important applications as a pesticide and fragrance. It has also been suggested as a credible antitumor agent and regulated as an allergen, with recent consequences for French lavender farmers; and it is a useful intermediate in many chemical syntheses. As such, it is a modern material which recalls what Ursula Klein and Wolfgang Lefèvre have called, in the context of eighteenth century chemistry, "multidimensional objects of inquiry". From this arises the question: how to tell the history of such a multifarious material? This paper introduces the use of techniques from corpus linguistics and text analysis to the study of material biographies, exploring how following a material through multiple texts can allow us to link sites of use and production, and the constructions of expectations around the future uses of materials, in novel ways and through multiple contexts.

A revival of material innovation: The pioneering of atomic layer deposition and high-k metal gate in semiconductor manufacturing, 1997-2007

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In 2007, Intel introduced a computer chip containing a revolutionary – but easily overlooked - innovation. The new chip consisted of transistors in which its gate dielectric and electrode had been replaced for new materials. Silicon oxide was replaced for a so-called high-k dielectric (hafnium oxide), and the polysilicon gate was changed for a metal gate. The introduction of the new materials was accompanied by the integration of a novel deposition technique: atomic layer deposition. Through this technology, a thin film was grown in sequence, atomic layer per atomic layer. These new materials had a huge impact even as they were just a few nanometers thick. They formed billions of transistors integrated on a single computer chip, which successively were produced in millions in Intel's factories. Even more, the introduction of the high-k and metal gate materials constituted the first major change in the chip industry's transistor in 40 year! The innovation heralded a new period in semiconductor manufacturing, during which transistor structures and new materials followed each other rapidly. The innovation of the high-k and metal gate materials involved complex material challenges and international industrial collaboration between chip manufacturers, research institutes, and equipment suppliers. In this presentation, I will look into the collaboration between Intel and its equipment supplier ASM International.

New Tools for Characterizing New Materials

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"If you can spray them then they are real" is Ian Hacking's rule for when we should believe in entities we cannot see. Much history and philosophy of science has concerned the second half of Hacking's slogan. Historians have investigated how scientists came to believe in electrons, neutrons, photons, etc. Philosophers have wondered what it means to build science around unobservables. But the first half invites other stories. When we spray electrons, neutrons, or photons, how do we spray them? At what? To what end? History and philosophy of science have said much about things we spray, but less about how and why we spray them. This talk discusses 20th-century tools that provided insights into characteristics of materials, and redefined what scientists mean when they talk about materials. Materials are often distinguished from other matter because they can be turned to human purposes. Nothing about that definition requires a scientific understanding of materials. The proliferation of tools for characterizing materials brought that knowledge within grasp. These tools helped fuse the traditions of materials research into interdisciplinary materials science. They made knowledge of matter essential to the concept of materials as the substances humans use to achieve their aims and desires.

Thursday, 1 August, 10:45-11:25, Session B7a [B]

Chemists and Politics

Ernst Homburg (chair)

J.H. van 't Hoff and the offers from Germany

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Towards the end of the nineteenth century, a tension arises between an internationally developing science on the one hand and an increasing national assertiveness on the other. In the Netherlands the scientific community craved for international recognition, but simultaneously frowned upon those who acted upon such recognition by accepting foreign offers. This is illustrated by two episodes in the career of the later Nobel Prize winner J.H. van 't Hoff, who received offers from renowned German institutes in 1887 and in 1895. Whereas he decided to turn down the first offer (from the University of Leipzig), eight years later apparently all doubts had vanished, and he moved to Berlin. What drove him to act like he did? How did his colleagues and the Dutch Academy of Sciences react, and what actions did the government and municipal authorities take? Based on previously unknown documents from various archives I will try to answer these questions and show the consequences of the double-edged sword of scientific nationalism.

The Racial Laws of 1938 in Italy and their Consequences on Chemical Community

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Between September and November 1938, a series of key decrees - the Racial Laws - against the Italian Jews, were adopted by the Fascist government. This stripped the Italian Jews of their rights as citizens and eventually caused the loss of many remarkable persons through the whole Italian society, excluding them from their jobs and professions. The devastating changes that occurred at the Universities concerned professors and students, both affected by the application of racial theories. Several dismissed jewish professors were absorbed by academic institutions in other countries, while others, hoping for better times, remained in Italy and were arrested and ultimately exterminated in death camps. Not to forget what the racial persecutions have represented also in the field of Italian chemistry, we have chosen to remember the stories of some professors or university students such as for example Mario Giacomo Levi, Maurizio Padoa, and Ciro Ravenna and one Jewish student at the University of Turin, the chemist and writer Primo Levi.

Thursday, 1 August, 11:25-12:45, Session B7b [B]

Methodological Approaches

Ernst Homburg (chair)

The chemical space and its three statistical regimes

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We can view the history of chemistry as an exploration of the chemical space, the space spanned by all chemical species, connected by chemical reactions. Despite its importance, very little is known about this exploration throughout history and about the driving forces affecting it. This history is documented in 200 years of chemical literature, and this literature, containing millions of reactions, is stored in the Reaxys® database. By analyzing these data, we have found that the history of this exploration can be rather statistically divided into three sharply distinct regimes, shaped by social and scientific factors. The first regime was dominated by volatile inorganic production and ended about 1860, when structural theory gave place to a century of guided production, the organic regime. After 1980, the least volatile regime began, the current organometallic one. We found an exponential growth of new compounds with a general 4.4% annual growth rate. The growth shows relatively swift recoveries after the World Wars, and has not been systematically affected by the introduction of new theories. Moreover, we found that chemists have been conservative in the selection of their starting materials, but nevertheless could enter novel corners of the space.

From Well-Defined Small Molecules to Molecular Weight Dispersity: The Emergence of Polymer Statistics

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In 1888 Bernhard Tollens indicated using probability calculus ("Wahrscheinlichkeitsrechnung") to describe dispersity of molecular species in a polysaccharide sample. At this time the notion of a statistical distribution of molecular weights for a chemical substance was quite alien to organic chemists obsessed with well-defined, crystallizable compounds. Particle size dispersity was, however, at the time an easily observable property of minerals in the mining industry and of raw materials used in the production of cement. It was also a parameter in the study of colloids. I will argue for a link from statistics in the social sciences of the early 19th century via the probability calculus of the kinetic gas theory to the modern polymer chemistry of the early 1930s. There is less evidence that Tollens' reflections on probability calculus had any impact on the development of polymer statistics. This will be discussed in view of prematurity in science.

Chemical Law vs. Biological Law in the Biological Clock Controversy

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Examples of biological rhythmicity mounted in the first half of the twentieth century, but the nature of biological rhythms – whether they were direct responses to rhythmic environmental stimuli or, rather, generated internally by biological clocks or oscillators – remained sharply disputed. When Frank A. Brown, Jr. observed precise 24-hour rhythms in the color changes of fiddler crabs that were isolated from changes in environmental lighting that could synchronize them with the daily cycle, he rejected the internal clock as an explanation, owing to his belief that such a biological mechanism must operate chemically and consequently run faster at higher temperatures (Van ’t Hoff’s rule), which was not borne out by his experiments. Colin Pittendrigh was committed to the idea that the rhythms were generated by unknown, temperature-compensated mechanisms, without offering any explanation for how this might be accomplished. At the core of their dispute, which was aired publicly from 1954 until Brown’s death in 1983, was a difference in belief: Brown’s fundamental reductionism, which required biological processes to conform to the laws of chemistry, vs. Pittendrigh’s trust in the power of evolution to select for temperature compensation, for which no plausible chemical model then existed.

The Hofmeister series. A tantalizing yet unsolved problem in Physical Chemistry

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Researchers are still puzzling around specific ion or Hofmeister effects. They refer to the specific role of cations or anions in modifying a particular phenomenon depending on their nature. These effects were discovered and reported by Franz Hofmeister at the University of Prague between 1880 and 1890. Since then their interpretation is still challenging and a general consensus on the mechanisms involved at the molecular level has not been reached yet. Hofmeister phenomena occur in a plethora of systems: from bulk aqueous and non-aqueous solutions to interfaces and soft matter self-assembled systems. Usually they emerge from moderate salt concentrations (typically above 10 mM). In fact, electrostatics dominates the behavior of very dilute systems, that can be described in terms of non-specific interactions, as in the Debye-Hückel theory: all salts with the same stoichiometry behave in the same manner. However, at higher concentrations Coulombic interactions vanish and leave room to non-electrostatic specific interactions. Generally speaking, the effect of cations and anions is illustrated by the “Hofmeister series” that ranks the ions according to their cosmotropic and chaotropic nature and therefore to their interactions with the solvent molecules. Implications with the greatly disputed water structure issue will be discussed.

Panel: From the Lower Rhine Area into the World: Applied Sciences, Synthetic Dyes and Entrepreneurship in Germany around the turn of the 19th Century

Jürgen Schram, Marc Holly, Stefanie van de Kerkhof (organisers)
Jürgen Schram (chair)

This session will focus on the innovation and knowledge that were implemented around the turn of the 19th century in the Lower Rhine area with Krefeld and Mönchengladbach. In a relatively small area close to the Dutch boarder, the German chemical industry grew rapidly in the second half of the 19th century. The area is well linked to Köln, Wuppertal, the newly founded Leverkusen and the uprising Ruhrgebiet. Until today this region is one of the most important for the German (chemical) industry.

The papers examine the linkage of textile and chemical industries and the talks will open insights into the development of institutional knowledge, applied sciences and entrepreneurship. In addition, the establishment of trade names and exemplary chemical products like synthetic dyes and textile additives will be presented. We will approach this topic from a commercial, chemical-analytic and historic point of view giving several case studies.

Applied Chemistry at the Royal School for Dyeing and Finishing in Krefeld, Germany

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The school for dyeing and finishing established 1883 was a unique institution at the time. Originally founded for the education of local based practical dyers it soon attracted international students and chemists who had already finished their academic studies and were working in the dyestuff or textile industry. With its founding the school broke with the established system of craftsmanship and established its own institutional but also practical orientated way of education for dyers and colourists. The level of natural sciences, especially chemistry, in the courses was cutting-edge and nearly at the same level as at the universities these days. The education system is already comparable to the universities of applied sciences which were founded in Germany more than a hundred years later. With Heinrich Lange, a dye chemist from BASF and a well-established researcher of these days became director of the school. In this talk the knowledge transfer between university and industry will be examined and discussed taking the school in Krefeld as example. The different ways of education for practical dyers but also for academic dyestuff chemists around the year 1900 will be compared. This exchange has not exclusively taken place in the laboratories of the chemical companies.

Historical Dyes shows their True Colours: Looking into a Dyestuff Collection with Infrared Spectroscopy

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Subject of the research is the Historical Dye Collection at the Niederrhein University of Applied Sciences which is one of the biggest and oldest collections of this type. It was established already since the 1860s and comprises about 10,600 colourants. It represents nearly all dyes invented by the (German) chemical industry until middle of the 20th century and thus, broadly documents the development of this industry and the synthetic dyes. Comprehending this development is part of the presented research. The aim is to investigate the correlations between inventions in the chemical industry and changes in fashion and everyday life. The instrumental-analytic focus is on the history of the chemical industry by analysing the dye powders with infrared spectroscopy. The differentiability of dyes with identical names, but from different producers is of special interest. The evaluation of the IR spectra reveals the answer to the question if products are indeed also chemically identical. Thereby, information about raw material, production processes and possible contaminations can be gathered, too. Inversely, the data also helps to identify colourants which have been marketed under different trade names but are chemically identical. This could be a hint for the patent and product exchange in these days.

The “Rhenish Manchester” and the chemical industry – From regional business to global players

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The textile region of the lower Rhineland has developed to a high degree of regional and transnational interdependencies which is reflected in the naming as “Rhenish Manchester”. Small Rhenish towns like Krefeld and Mönchengladbach grew during the second industrial revolution to large cities with high industrial capacities. At the end of the 19th century, the silk producers of the region created spin-offs in the dyestuff, soap and brightening industry. Located at the river Rhine they developed to international renowned big business like Bayer or IG Farben as joint stock corporations, Stockhausen or Weiler-ter Meer as family-owned enterprises. Through the application of scientific knowledge to the demand of the textile industry they produced innovative dyestuffs like aniline colours or textile additives like “Monopol soap“, “Monopol oil” or “Stokopol” for a mass market. Monopol soap and Monopol oil were solicited by Stockhausen as being the “first real textile additives” of the time. The paper discusses how the former producers of additives for the textile industry grew to global players in the chemical business. Case study method is utilised to contribute to a history of the chemical industry during the second globalization (19th/20th centuries) from a business and science history perspective.

Panel: Creating and Regulating New Technologies for Sanitary Fumigation in the 19th and 20th Centuries

Ximo Guillem Llobat (organiser)
Anders Lundgren (chair)

Infectious diseases mobilized a huge number of initiatives and sources during the nineteenth and early twentieth century. The fumigation of sites, objects and people with a number of chemical substances was one of the initiatives increasingly undertaken by sanitary institutions throughout this period. This session will analyse the discussions on the acceptable uses, the efficiency and the risks of fumigations. It will do so by focusing on three types of substances (mineral acids, sulphur dioxide and sulphuric acid, and hydrogen cyanide), which had a significant impact in fighting infectious diseases in three consecutive periods. In our analysis we shall also deal with the experts involved in the implementation of these fumigations and the factors fostering or avoiding technological innovation and circulation. We expect to conclude with an interesting comparative approach in a final general discussion following the presentation of the three papers of the panel.

Fumigating Spain. Consensus and silence on the medical uses of mineral acids for the treatment and preventions of epidemics in Spain, 1770-1850

Pedro Giovanni Medina Alfonso, Antonio Garcia Belmar
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The work of Guyton de Morveau, devoted to the notion of the purifying power of mineral acids, was systematically translated in Spain, beginning in the 1790s. His work decisively contributed to the construction of an imperfect consensus in Spanish society at the end of the eighteenth century over the use of the fumigation of mineral acids in the treatment and prevention of epidemics. Our paper examines the persons, the interests, and the strategies that helped to construct this imperfect consensus, as well as how it was maintained during the first ten years of the nineteenth century, at a time when yellow fever spread in the towns and villages in the south and the east of the Iberian Peninsula, and how it lasted until the middle of the 19th century.

Sulphuric Utopias: The Clayton Machine in the History of Maritime Sanitation

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Our paper tells the story of a technology that transformed global practices of maritime quarantine through the combination of chemical and engineering innovation. Fumigation applied gases like sulphur dioxide (SO_2) and sulphuric acid (H_2SO4) to the task of eliminating pathogens, insects, and rats while leaving goods and the structure of the vessel itself unharmed. Its purpose was to shorten detention times of ships and cargo in quarantine stations, to minimise the risk of importing infectious diseases, such as yellow fever and plague, and to establish universally applicable standards of hygiene in maritime trade. Our paper explores this overlooked but historically crucial practice at the intersection of epidemiology, hygiene, applied chemistry and engineering. The paper will unpack this story around a machine, developed and patented in the disease-ridden swamps of 1890s New Orleans: the Clayton apparatus. Initially emerging as a response to the threat of yellow fever in the American South, the Clayton was a simple furnace, attached to a ventilator, which could exchange the air of enclosed compartments with SO_2. By 1905, the apparatus would be installed in ports across the globe, pioneering the emerging paradigm of complete maritime deratisation and disinfection: a sulphuric utopia.

Innovation and risk regulation in cyanide fumigation in València in the early twentieth century

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In the 1920s the fumigation with hydrogen cyanide of boats and trains, among others, became widely applied worldwide as a method to prevent the spread of infectious diseases. Since the late nineteenth century quarantines had increasingly been criticized and to some extent reduced or even substituted by alternative procedures such as sanitary fumigations. And from the 1910s the fumigation with hydrogen cyanide, which had initially been applied in order to fight several pests affecting citrus fields in California, was introduced in seaport sanitary fumigations in America. One decade later the city of Valencia, in the Mediterranean basin, became a major centre for innovation in cyanide fumigation. Valencian physicians and agricultural engineers from local public services as well as local private companies were very successful in this endeavor. The Casa Grima Company invented the Cianogeneratriz applier, which was internationally employed. This method was part of the so-called “Spanish procedure” developed by the company and the maritime health services in Valencia, and was soon adopted as the official procedure by more than forty countries. The circulation of these procedures occurred despite the high toxicity of hydrogen cyanide. In this paper we shall focus on the Valencian case in order to evaluate the continuities and discontinuities in the implementation and evaluation of these fumigations by sanitary and agricultural services. And in this analysis we will consider risk regulation and the public/private divide as our main analytical categories.

Thursday, 1 August, 16:00-17:30, Closing Session A9 [A]

Round Table: Writing the History of Chemistry
Part I: A New Cultural History of Chemistry

Alan Rocke (organiser and chair)

With the collaboration of dozens of historians of the chemical sciences, Bloomsbury Press is currently sponsoring the writing of a six-volume history of chemistry from antiquity to the present, a future entry in the press's richly illustrated and highly regarded "Cultural History" series. This panel discussion will explore the strengths, weaknesses, challenges, and potential rewards of writing and producing, at this point in the history of our field, what promises to be a milestone in the historiography of our discipline. Discussants include a general editor, volume editors, chapter authors, and non-involved critics of the project. This proposed panel has applied for sponsorship by the Forum for the History of the Chemical Sciences of the History of Science Society. The discussion will be chaired by the organizer of the panel and co-general editor of the project.

Participants: Ernst Homburg, Maastricht University; Peter Ramberg, Truman State University; Marco Beretta, University of Bologna; Marcus Carrier, Bielefeld University.

Round Table: Writing the History of Chemistry
Part II: A New Cultural History of Chemistry

Peter Morris (organiser)
Brigitte Van Tiggelen (chair)

The writing and editing of volume six of the Bloomsbury Cultural History of Chemistry which covers the period between 1914 and 2018 illustrates the value and the problems of writing the history of recent chemistry. This panel will discuss the editing and writing of chapters in this volume, covering topics such as the chemical industry, the instrumental revolution and the internationalisation of chemistry in this period. Two eminent discussants will critique the chapters and share their views on the writing of recent chemistry before the issue is opened to the floor.

Participants: Jeffrey Johnson, Villanova University; Cyrus Mody, Maastricht University; Annette Lykknes, Norwegian University of Science and Technology; John Christie, Oxford; Peter Morris, Science Museum London.

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