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CHMC

Globalisation and Diversity: Modern Chemistry and Chemical Technology

ICHS Symposium SC16

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The theme of the symposium relates to the general theme of the XXII. ICHS „Globalisation and Diversity: Diffusion of Science and Technology throughout History" and is aimed at discussing a variety of topics relating to the general theme, including the transmission of chemical knowledge and chemical technologies; the globalisation of modern chemistry and chemical industry and its problems; and chemistry and chemical technologies in the colonial and the postcolonial context. The time period to be focused on is the 20th century. In particular, the conference will attempt to answer the following questions:

- How were chemical knowledge and chemical technologies transferred from one area to other countries? Did any models serve in this process?
- How were chemistry and chemical technologies developed in the context of colonial linkages?
- How were they transformed into the postcolonial world?
- What was the nature and outcome of globalisation of chemistry and chemical technology?

Focussing on globalisation as well as knowledge and technology transfer, the symposium will nicely supplement the CHMC symposium "Emerging Peripheries and Shifting Centres" held during the XXI. International Congress of History of Science in Mexico City in 2001.

CHMC was established in 1998 as a subdivision of the International Union of the History and Philosophy of Science, Division of History of Science (IUHPS/DHS), and is related to UNESCO through the International Council for Science (ICSU). The Beijing symposium is the seventh in a series of international conferences organised by CHMC.

Organizing Committee

Prof. Yasu Furukawa; History of Science, College of Bioresource Sciences, Nihon University, 1866 Kameino, Fujisawa 252-8510, Japan
phone & fax: +81 466 84 3717
<yfuru@brs.nihon-u.ac.jp>

Prof. Ernst Homburg, Dept of History, Faculty of Arts and Culture, Maastricht University, P.O. Box 616, NL-6200 Maastricht, The Netherlands
phone: +31 43 388 3314/3495, fax: +31 43 388 4816
<e.homburg@history.unimaas.nl>

Prof. Zhang Li, China Institute for the History of Natural Science, Chinese Academy of Sciences, 137 Chaonei Street, Beijing 100010, China
phone: +86 10 84027627, fax: +86 10 6401 7637
<lilyzhang@ihns.ac.cn>

Prof. Nasir Tyabji, Centre for Studies in Science Policy, School of Social Sciences, Jawaharlal Nehru University, New Delhi 110 067, India
phone +91 11 2619 1308, fax +91 11 2619 5777
<ntyabji@vsnl.com>

Prof. Christoph Meinel (President of CHMC) History of Science, University of Regensburg, D-93040 Regensburg, Germany
phone: +49 941 943 3659, fax: +49 941 943 1985
<christoph.meinel@psk.uni-regensburg.de>

Session 1:
Chemistry and Chemical Technologies in the Context of Colonial Linkages

Chair: Prof. **Ernst Homburg** (University of Maastricht, Netherlands)

1. **Naoki Yamaguchi**
University of Beijing, Center for Social Studies of Science,
100871 Beijing, China; phone 010-6276-2199
<ngodzilla21@yahoo.co.jp>

"Transmission of Chemical Technologies from Japan-occupied Manchuria to Post-war China"

Recently, Japanese historians of science and technology have shown an interest in areas under Japanese colonial control before World War II. In this report, I am going to argue for an institutional continuity and transfer from the Central Research Institution of the South Manchurian Railway Company to China. This institution was established by Shinpei Gotou, since 1907 the first president of the South Manchurian Railway Company in the Northeast part of China. During the colonial period, this institution played an important role in the industrialisation of that part of the country.

In 1945, after the end of World War II, Russia occupied Manchuria and the Russian army took over the institution. Tuneya Marusawa was its last director. He had graduated from Tokyo University in 1907 and became director of the Central Research Institution of the South Manchurian Railway Company in 1936. Later, he stayed in China until 1955.

Tuneya Marusawa made sure that both Russia and China could share the results of research carried out at the institution, because he believed in the universality of science and technology, beyond national states. As a matter of fact, many Japanese scientist and technicians cooperated with the Chinese authorities. In my talk, this cooperation will be presented as an interesting example of scientific and technological exchange across national boundaries.

2. Dr. **Harro Maat**
Wageningen University, Netherlands, Technology & Agrarian Development (TAO), Hollandseweg 1, NL-6706 KN Wageningen, The Netherlands;
temporary visiting address: Mansholtlaan 10-12, Building 127, Room B514, NL-6708 PA Wageningen, The Netherlands
phone: +31 317 484828, fax +31 317 485616
<harro.maat@wur.nl> <http://www.sls.wau.nl/tad>

"Agricultural Sciences in Colonial and Post-colonial Indonesia"

A general perception in colonial history is that science and technology were primarily ‘tools of empire’ (cf. Headrick), instruments to maintain and expand political control in overseas territories. Underlying this historical interpretation is the view that science and technology are a modern enterprise that belongs to the developed Western world and in some (mostly reduced and simplified) form were (and still are) transferred to the less developed areas of colonies and former colonies. The development of agricultural science in the former Dutch East Indies during the first half of the twentieth century make clear that this historical perception requires significant adjustment. Ecological en socio-economical conditions in the Indonesian archipelago were entirely different from circumstances in the Netherlands and, consequently, a scientific understanding of crops and growth processes as well as the development of technological innovations was build up from scratch and in close interaction with local knowledge and practices. Together with differences in scale and profitability these factors resulted in a scientific and technological activity that was bigger in size and in many cases more advanced than agricultural science in the mother country. Using various examples, a.o. research in soil fertility and fertilizer application, it is argued that the history of colonial agricultural science is an interesting and fruitful domain for historians of chemistry.

3. Prof. **Nathan M. Brooks**
Department of History, MSC 3H, New Mexico State University,
P.O. Box 30001, Las Cruces, NM 88003, USA
fax: +1 505 646 8148
<nbrooks@nmsu.edu>

"Chemistry and the Chemical Industry in the Soviet Union, 1917–1940"

This paper will examine the development of chemistry in the Soviet Union from the time of the Bolshevik Revolution in 1917 until the beginning of World War II in 1939. During these years, the state authorities pressed chemists to link their activities ever more closely to the needs of the chemical industry. In addition, many chemists moved from the universities to specialized research institutes, most of which were closely connected with the practical needs of industry and agriculture. The main focus of this paper will center on the chemists' involvement with the beginnings of rapid industrialization during the First Five Year Plan (1929-1932). Chemists took an active part in the events of these years, in particular with the "chemization" project, first proposed by a group of prominent chemists in 1928.

Session 2:
Globalisation and Transfer of Modern Chemistry

Chair: Prof. **Yasu Furukawa** (Fujisawa, Japan)

4. Dr. **Yoshiyuki Kikuchi**
The Open University, Department of the History of Science, Technology and Medicine, Walton Hall, Milton Keynes, MK7 6AA, England
phone: +44 1908 659 164, fax +44 1908 653 750
<y.kikuchi@open.ac.uk>

"The English Model of Chemical Education in Meiji Japan: Transfer and Acculturation"

The impact of English chemical education on Japan is an example of intercultural relations between the East and the West in history of science. This topic fascinated historians of science in Japan as well as science in other non-European countries like China and India where Western impact was significant. They have commonly asked the following question: do these relations comprise transfer or spread of Western science in the literal sense or a process of interaction between Western science and indigenous cultures and societies? Adopting a similar approach, I aim to elucidate how and in what extent English models of chemical education was transferred to Japan in the Meiji period (1868-1912) and underwent a process of acculturation, using 'transculturation' in 'contact zones' (Pratt, 1991) and 'translatability of culture' (Ōhashi, 1993) as key historiographical concepts.

My presentation will cover the following four phases of Anglo-Japanese scholarly relations in chemistry: 1) the pre-Meiji samurai students from Chōshū and Satsuma at University College London (UCL) in the 1860s; 2) the implementation of chemical education in Tokyo by English chemists Edward Divers (1837-1912) and Robert William Atkinson (1850-1929) in the 1870s; 3) the chemical studies of Atkinson's students, Sakurai Jōji (1858-1939) and Takamatsu Toyokichi (1852-1937) at UCL and Owens College Manchester, respectively, in the late 1870s and the early 1880s; 4) the differentiation between higher 'scientific' and 'technical' education of chemistry in Japan under Sakurai and Takamatsu, respectively, at the Imperial University, Tokyo (est. 1886) in the 1880s and their developments until the 1910s.

I will first show how the Chōshū and Satsuma students in the 1860s, with little experience in Western-style schooling and motivated by xenophobic jōi sentiment and interests in naval and military technology, encountered UCL chemists such as Alexander W. Williamson (1824-1904), Charles Graham (1836-1909) and Frederick S. Barff (1823-1887) and developed their own views on science and technology, which was markedly different from Williamson's 'liberal science model' (Roberts, 1998) and had long-term implications for the institutionalisation of chemical education in early Meiji Japan. Secondly, I will make a comparison between Sakurai's learning experience with Williamson at UCL and that of Takamatsu with Henry E. Roscoe (1833-1915) and Watson Smith (1845-1920) at Manchester to show regional differences of English chemical education and to elucidate how the social origins of Japanese students and the different power relationships between Japanese and Westerners in Japanese and English educational institutions had influenced the way in which English models of chemical education were perceived and modified by Japanese students. Thirdly, I will analyse how Sakurai and Takamatsu materialised their visions of the teaching style of chemistry, the management of chemical teaching/research laboratories, and the social relevance of their chemical expertise by translating them into institutional and rhetorical forms to fit them for Japanese indigenous situations.

5. Dr. **He Juan**
Institute for the History of Natural Science, Chinese Academy of Science, 137 Chaonei Street, Beijing 100010, China
phone: +86 10 8401 7720,or +86 10 6400 3430
<hejuanpku@163.com>

"An Analysis of the Disputes about the Chinese Terms of Chemical Elements"

Since the year of 1901 when Chemical Terms and Nomenclature was established, five organizations have attempted the standardization of the Chinese terms for chemical elements. And the standardization at last came to an end in 1932 when The Nomenclature of Chemistry was approved. The long history of this standardization is conspicuously unusual, yet few studies deal with the reasons. After a comparative analyse of the final systems of chemical element terms established by the five organizations, at the same time in connection with the state of the uses of element terms in contemporary chemistry textbooks and some controversies among scholars, the author argues that, at the first glimpse the uses of the element terms seem intolerably chaotic, but these are only the disguise of different transliteration terms and liberal translation terms, and there are less essential conflicts among these terms. Main conflicts are focused on those Chinese terms for these elements such as N, O, Cl, C, P, Hg, As, Si, B and etc. After an examination of the discussion records about the element terms in 1917 by the Scientific Term Committee and in 1932 by Nanjing Chemical Assembly, the author finds that the same reason can be used for or against a term, and that the final decision of the terms is contingent and flexible. Therefore, the author excludes the academic reason for the explanation of the long history of the standardization. The author thus advances it is the slow pace of the institutionalization of chemistry subject that should be responsible for it.

6. Dr. **Zhang Li**
Institute for the History of Natural Science, Chinese Academy of Sciences, 137 Chaonei Street, Beijing 100010, China
phone: +86 10 8402 7627, fax: +86 10 6401 7637
<lilyzhang@ihns.ac.cn>

"From the Soviet Union to the U.S.: International Exchange in China's Polymer Science"

In China, the institutionalization of polymer science started with the founding of the People's Republic in 1949. The creation of the specialization or program (zhuan men hua) for polymer chemistry in Peking University in 1953 marked the beginning of the incorporation of this field into China's higher educational system; in 1963, the Commission for Polymer Science was founded under the Chinese Chemical Society which signalled the establishment of the study as a scientific field in China. Thus polymer science was institutionalized in China during a period of about ten years. From then on, it has been, and still is developing rapidly as an independent and organized discipline contributing to the building up of economy and of national defence in China and to scientific developments in the world.

Undoubtedly, polymer science in China was developing under the disciplinary tendency in the world. Keeping in close, manifold exchange and collaboration with other countries, even including private communication and friendship among scientists, ensure that modern science could be progressing continually and international scientific community, one of whose missions is seeking science and technology to serve the whole human society, could take form. However, due to the influence from the ideology, social system, economic

status in the world stage during the PRC's founding in 1949 to opening windows to the world in 1978, an effective exchange and collaboration system with international scientific community had not been established. At this period of time, class character appeared in Chinese science.

As a case study, this paper gives an account of how international exchange and collaboration in Chinese polymer science were underway with changing or adjusting in the state's ideology and political benefits. In 1950's, the polymer science in the Soviet Union, which was call as "the eldest brother" in the socialist camp countries at that time, set an fine example for the Chinese polymer scientists to learn. But after worsening relationship between the two countries, China began accepting visits and understands of polymer scientists from neighbouring or political neutralist countries. In the early of 1970's, marking with the scientists interchanging between China and the U.S., the formerly "capitalist" nation, Chinese polymer science gradually launched pluralistic exchanges and collaborations and eventually opened its door to the world. And it is pointed out that in China, a scientific system was established for meeting the needs of a centralized, socialist political and economic system. Thus the orientation and mechanism of Chinese science were determined in this way. Only when reforms in the political and economical system bring plurality to scientific organizations and management in the future would it be possible to reconcile the conflicts that arise in the development of Chinese science as a result of the statization of science.

7. Prof. **Nasir Tyabji**
Centre for Studies in Science Policy, School of Social Sciences,
Jawaharlal Nehru University, New Delhi 110 067, India
phone +91 11 2619 1308, fax +91 11 2619 5777
<ntyabji@vsnl.com>

"Globalization and Chemistry within the Council for Scientific and Industrial Research, 1945-2005"

The Council of Scientific and Industrial Research (CSIR) was established in 1942, five years before Indian independence, as the main coordinating institution through which industrially oriented research would be undertaken. After independence, CSIR was transformed into a network of laboratories engaging in research. This research had a marked predominance in favour of those technologies that had a chemical basis. The history of the changing overall thrust of the CSIR thus provides a basis for the examination of the changing character of industrial chemical research in India.

The sixty odd years since independence cover roughly three phases of India's relationship with the world economy. The first period, from 1947 to 1980 or so forms the high noon of the phase of import substitution, with the establishment of the public sector as the main pillar of the attempt to create self reliance in industrial technology. This was also the period when the demand for technology , though largely met by the process of foreign collaboration between Indian firms, both in the public and private sectors, was also sought to be obtained by the efforts of the CSIR laboratories. Although these efforts were not very successful, most of the larger private firms preferring the path of foreign collaboration, CSIR laboratories did succeed in creating the knowledge base of several simpler and smaller scale technologies.

With the 1980s, there were the first signs of a new paradigm of industrial development becoming apparent. This was signified by a much greater degree of leeway which was provided to individual entrepreneurs in terms of decisions involving technology choice, and scale of operation while there was a new emphasis on the export market, and the simultaneous deregulation of the import control system. On the one hand now, with the growth of the petrochemicals industry, a large arena in the plastics processing industry was opened to small scale units. Simultaneously, with this development imports which competed with the products of the small scale sector reduced the space for the operation of this sector and thus the derived demand for CSIR created technologies.

The third phase of Indian economic development, starting from 1991 and continuing till today, marks a complete break with the past with an abandonment of the import substituting industrialization effort, deregulation of the internal and external linkages of the economy and privatization of public assets. This phase is also characterized by a shift in the engine of industrial growth, from public investment to private initiative.

The paper examines the overall directions set for the CSIR under each of the policy phases. The directions for research in industrial chemistry were obviously set by this overall direction, which reflects increasing degrees of globalization. Connected to this process is the rise in importance of biotechnology, for instance, which is marked by the fact that the growth in this technology has been largely in the private sector though fundamental advances have been made in laboratories associated with the CSIR. With the help of Reports of Committees which laid out the perspective for CSIR, the paper delineates the contours of this changing focus.

8. Prof. **E. Haribabu**
Department of Sociology, University of Hyderabad,
500 046 Hyderabad, India
phone: +91 040 3010 500 (extn. 3250), fax +91 040 3011 088
<ehbss@uohyd.ernet.in> <hari_ejna@yahoo.com>

"Chemical Science and Biotechnology Interface: Antecedents and Consequences in the Era of Globalization"

Historical sociology of science places science in its historical context to understand the formation of scientific communities and the dynamic interface between the internal world of science and the external world of science. New paradigms are formed on the basis of transfers of knowledge from one discipline/sub-discipline to the other. The discovery of the double helical structure of the DNA, that eventually has become the dominant paradigm, may be seen as a result of transfer of theoretical, and experimental knowledge and instrumentation techniques form chemistry, physics, and biology to understand structures and processes of life at molecular level. Focus on the structure and properties of chemicals in the living organisms and understanding of the structure of protein molecules, such as the amino acids and the pattern of bonding via biochemistry laid foundations of molecular biology. Today protein engineering may be carried out either by chemical method or genetic method. Knowledge of structures and functions of proteins created the possibilities of protein engineering that enables one to intervene in the life processes at molecular level. Transfer of discrete genetic material across an organisms that was made possible in the mid-1970s created genetic engineering. This marks a new stage of industrialization of biology in contrast to the earlier stages in which fermentation technologies on the basis of microbial processes dominated. Recognition of the application potential of chemistry in the 19th century paved the way for industrialization chemical science. Research and Development in life sciences based on based on understanding life processes at molecular level is increasingly getting concentrated in private industrial corporations, some of which are transnational corporations that have global operations. Many chemical companies have transformed themselves into biotechnology companies. Instrumentation and communication, aided by Information and Communication Technologies (ICT), one of the hallmarks of the current phase of globalization, have enabled the industry to achieve vertical integration of R&D and commercial production through establishment of subsidiaries and through outsourcing, the latest strategy in R&D. The WTO provisions on the IPRs in today’s context have the potential to influence the basic research in chemical science and biology. Science has been undergoing a cultural revolution from a disinterested academic science to a post-academic science that is influenced by social interests and social values of efficacy, profitability, and safety.