tainable use of nitrogen inputs in the predominantly nitrogen-deficient soils of Africa, and parts of Latin America and Asia.

- Fossil fuel and biomass combustion are currently necessary to meet demands for electricity, transportation and energy. Reactive nitrogen by-products from these sources are a serious cause for concern. However, business-as-usual scenario of inefficient production and use of reactive nitrogen will multiply in the coming years, as the demand for food, especially animal proteins, and biofuels, fossil fuel and biomass burning increases, and growing urban populations produce more waste. It is important to recognize that the anthropogenic releases of reactive nitrogen vary widely between countries of the world, between regions within countries and between different economic sectors, and that the responsibility to mitigate the damage varies proportionately.
- There is a need for the UN bodies, regional organizations, national governments, scientific communities, including Consultative Group on International Agriculture Research (CGIAR), industries, policy makers, INI and the civil society to address nutrient deficiencies move towards increased efficiencies in each segment of nitrogen cycle management. Approaches should consider the use of incentives, make full use of recycling and ensure the treatment of discharges.
- There is a need to encourage coordination for interdisciplinary research, capacity building and policy within and between countries, inter-governmental bodies, the INI and civil society to ensure adequate nitrogen availability for food and nutrition security in different regions, and to understand, and mitigate the adverse impacts of accumulation of excess reactive nitrogen. Policies need to be 'nitrogen proofed' to maximize benefits and minimize negative effects of reactive nitrogen. There is a pressing need for national governments to develop more integrated, rigorous and multidisciplinary approaches for the management of sources, sinks, flows and effects of nitrogen and other nutrients at the local and national level. These approaches must be based on consolidation and synthesis of existing data, identification of gaps to undertake necessary research, and the use of information to promote appropriate practices and technologies, with the accompanying policies encouraging adoption of 'nitrogen proofed' best practice.

Regional assessments are required to frame issues of nitrogen deficiency and excess, and mitigation options in policy-relevant contexts based on expert judgement of scientific knowledge and uncertainties. These regional assessments should lead to a similar framing of issues and options in a comprehensive global assessment for policy makers. Identification, communication and promotion of best practices require collaboration among many stakeholders, including governments, scientists, practitioners and policy makers at global, regional and national levels. The formation of GPNM facilitated by UNEP is a welcome development in this regard. Nitrogen is one of the most important nutrients already identified by GPNM. In close partnership with INI and its regional centres, GPNM offers scope for further expansion of partnerships to address the issues of managing reactive nitrogen as a part of comprehensive plans for sustainable development. The Conference reaffirmed the Nanjing Declaration on Nitrogen Management (2004) that reactive nitrogen is a critical nutrient for food, feed and fibre security. Organization of international conferences on nitrogen reiterate the commitment of scientists and their concerns related to nitrogen cycle in India.

N. Raghuram, Sunita Sangar and Yash P. Abrol*, Indian Nitrogen Group, Society for Conservation of Nature, F4, A Block, NASC Complex, DPS Marg, New Delhi 110 012, India.
*e-mail: ypabrol@gmail.com

MEETING REPORT

History of S&T in 20th century India*

In the 20th century science progressed at a rapid pace. India witnessed the works of C. V. Raman, S. N. Bose, M. N. Saha, G. N. Ramachandran, among others. Raman also received the Nobel Prize in Physics in 1930. India celebrates his Nobel-winning discovery of the 'Raman effect' as National Science Day every year on 28 February. But not all the scientific contributions of our forefathers were well-recognized. Even now, while reading habits are plummeting, particularly among the young, they are even more untouched by the rich history of science.

Some historians of science hail from a science background, while others do not. Those who have a science background are often accused for being biased and narrow in their approach, and those who do not are warned they lack the understanding of science to look into its past. One can still find historians who have successfully researched science history despite their science/non-science background. A one-day seminar drew a few historians and other experts to review the history of science and technology in India during the 20th century.

Historian Deepak Kumar (Jawaharlal Nehru University (JNU), New Delhi) presented a critical analysis of science and society in the 1900s. He noted that at the turn of the century, though there was some diffidence because India was under the colonial rule, good debates were still being held in the society, the sort not seen anymore. P. C. Ray who displayed extraordinary historical sense is largely forgotten; there are no celebrations in the country outside West Bengal to mark his

*A report on the seminar 'The History of Science and Technology in 20th Century India', held at the Centre for Contemporary Studies, Indian Institute of Science, Bangalore, on 15 October 2011, and sponsored by the Indian National Science Academy, New Delhi.

150th birth anniversary which falls this year, of the kind that mark Rabindranath Tagore's anniversary. Kumar said that after the establishment of the Indian Institute of Science, Saha Institute of Nuclear Physics and the Indian Science Congress, a new phase of 'individual competitiveness' began, when individuals were financially supported to build institutions. The Tata Institute of Fundamental Research (TIFR) was founded by Homi Bhabha with help from J. R. D. Tata. Journals such as *Science and Culture*, and *Current Science* were established during the 20th century. Kumar also urged that an oral history archive of the late 20th century scientists be made.

Another historian Indira Chowdhury (Centre for Public History, Bangalore), author of *A Masterful Spirit: Homi J. Bhabha (1909–1966)*, discussed the role of scientific 'internationalism' in the building of TIFR by Bhabha. He wanted to create an institution like the University of Cambridge to be able to do that kind of science in India. Since the foundation of TIFR, Bhabha believed in keeping the doors of his institute open for researchers of any nationality to come and work in the institute. He also made attempts to bring S. Chandrasekhar, who was working at the University of Cambridge, to be a part of TIFR. A question was raised during the discussion following Indira's talk about the two seemingly contradictory positions that Bhabha held, one as a physicist at TIFR and the other at the Atomic Energy Establishment (later renamed as the Bhabha Atomic Research Centre (BARC)). Obaid Siddiqi (National Centre for Biological Sciences, Bangalore) replied: 'Bhabha kept them separate; what he was doing at TIFR was intellectually different from his activities at BARC and he was not secretive'.

M. S. Valiathan (Manipal University, Manipal) traced the growth of clinical medicine and medical research in India. Clinical medicine existed in India for thousands of years when plant extracts were given to the diseased; it was also known what combination of plant extracts should not be administered. But that was not medical research, mentioned Valiathan. Medical research started in the 19th century and by the beginning of the 20th century (1912) there were 2700 hospitals in British India, treating 27 lakh people as out-patients and 4.5 lakh as in-patients. About ten lakh surgical procedures were carried out in these hospitals. Modern (Western) medicine became the mainstream medicine in the 20th century and traditional systems got marginalized with import of 90% of the drugs and equipments. Epidemics were still not under control. The Indian Research Fund Association (later rechristened as the Indian Council of Medical Research) was started in 1942. A number of research laboratories such as Pasteur Institute, and the School of Tropical Medicine and Hygiene were also established. Research institutes took up public health issues and focused on problem-oriented research. Valiathan ended his talk by saying that the present 'anaemic status of medical research' in India has roots going back to the entry of modern medicine in the 19th century.

Though biotechnology was being pursued for many years, the excitement surrounding it is quite recent. S. Natesh (Department of Biotechnology (DBT), New Delhi) gave an overview of the activities of DBT and how it has put biotechnology at the centre stage. It evolved as an isolated activity due to government efforts; there was little private industry participation in the investment. The National Biotechnology Board was started in 1982, spearheaded by M. S. Swaminathan. DBT was established in 1986. It has initiated a number of human resource development programmes and built infrastructure facilities. It has also built two extramural research centres for collaborative research. The Biotechnology Regulatory Authority of India Bill (which has been opposed lately) is yet to be tabled in the Parliament.

Rohan D'Souza (JNU) narrated how the perception that humans can use technology to control nature and overcome natural disasters (such as floods) changed in the late 20th century. He believes that the history of Hirakud Dam, Orissa, should be written keeping in view flood vulnerability, rather than flood dependence for livelihood. According to him, the history must not celebrate the triumph of technology over nature. One must also grasp the findings of river ecology, that rivers are not the volume of water they are made of, but complex geomorphological, chemical and biological processes in motion.

S. N. Bose and J. C. Bose are well known for their contributions to science. Anup Dhar (Ambedkar University, Delhi) brought to light the 'other Bose', Girindra Sekhar Bose. He was a doctor by training and drifted into psychoanalysis. Bose also set up a mental hospital in Mumbai and wrote a couple of books on topics ranging from fiction to psychology. Dhar said that because of his correspondence with Sigmund Freud over several years one needs to trace the history of Bose in the field of psychoanalysis. The contact between Freud and Bose also led to the establishment of the Indian Psychoanalytic Society.

This seminar was part of the efforts made by the Indian National Science Academy (INSA), New Delhi, for promoting the history of science. The second part of the seminar will be held on 29 December 2011 during the annual meeting of INSA, at the University of Tezpur.

Richa Malhotra
e-mail: rchmalhotra@gmail.com