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EDITORIAL

Science and Technology Proficience: China and India

'A vicious cycle is at work whereby the developing nations (especially the S&T lagging countries) fall farther and farther behind the industrialized nations that have the resources – in financial as well as human-development terms – to apply scientific advances and new technologies ever more intensively and creatively. The current disparity is likely to grow even wider as the industrialized nations continue to master the tools of science and invention, vastly outspend the developing nations in research and development (R&D) and even capture some of the developing nations' most precious human resources for their own use.'

Inventing a Better Future
InterAcademy Council, 2004

'China has over many years sustained its efforts to turn itself into a world class scientific power... . Despite such continuous development and despite major expenditure on science by the Chinese government, China is not yet fulfilling its scientific potential... . This results not only in a low scientific profile on the world stage but also in lost opportunities to make the most of what the rest of the world can offer, both scientifically and technologically. This also leads to missed opportunities for China to improve its economy and the quality of life for its citizens.'

P. Campbell
Nature, 2004, **428**, 203

An elegantly produced report entitled 'Inventing a better future' has been released a few weeks ago by the InterAcademy Council (IAC). The subtitle, 'A strategy for building worldwide capacities in science and technology' suggests that science and the technologies derived from science may be used to build a better future for the billions of deprived people across the world. The IAC is a body that 'brings together the collective advisory expertise and experience of a truly worldwide group of academies'. The body has its headquarters in Amsterdam, with the Royal Netherlands Academy of Arts and Sciences playing the host. Its governing board consists of the Presidents of 15 'national academies of science and equivalent organizations' and the Third World Academy of Sciences. The countries represented are Brazil, China, France, Germany, India, Israel, Japan, Malaysia, Mexico, Russia, South Africa, Sweden, Britain and the United States. India, with its bewildering range of Academies, is represented by the Indian National Science Academy (INSA), Delhi. The IAC considers itself a non-governmental organization (NGO) and can 'mobilize the world's best scientists for providing expert knowledge and advice to international bodies such as the United Nations and the World Bank, on 'critical issues – such as economic transformation and globalization; reduction of poverty, hunger and disease; and the sustainable use of natural resources'. The intent of the IAC report is to emphasize that the 'knowledge-based economies of the 21st century' require 'capacity building in science and technology everywhere'. The report states clearly that 'the need is greatest for developing nations' and calls for a 'global movement to address this need, which has been insufficiently addressed when not neglected altogether'.

The IAC report, put together by a blue ribbon panel, whetted by diverse experts, is a long wish-list of actions that must be performed by governments and agencies worldwide, particularly in the developing world. The report is largely devoid of statistics and avoids analysis of problems that may be country or continent-specific. Instead, in carefully measured language, the report advances the need for the poorest countries to invest in S&T and higher education and calls for international cooperation to bridge the growing gulf, in the capacity to absorb new and enabling technologies, between the advanced and developing countries. In attempting to read a document of 144 pages (and I did skip it in parts), I was struck by the boundless optimism of the IAC in hoping that governments across Asia, Latin America and Africa would take the proffered advice seriously. Might this not be another coffee table document which would one day be reissued with minor revisions, since most of its recommendations would remain unimplemented? Governments generally ignore even the reports that they commission and generate internally. Why then would the IAC report command more than a passing commendation, for a job well done? Even as I pondered the fate of the IAC report, I was drawn to some of its sections. This report divides the world in an intriguing fashion into four groups: S&T-advanced countries, S&T-proficient countries, S&T-developing countries and S&T-lagging countries. The advanced countries (although a classification is

not provided) are undoubtedly the developed 'First World' nations. The lagging countries must be the poorest nations, with little or no S&T infrastructure. Many countries in Africa would probably fall into this category; others which are always in the news like Iraq and Afghanistan would undoubtedly qualify, despite the former's much-touted ability to produce weapons of mass destruction. The two middle groups provide an interesting distinction. S&T-proficient countries appear to have a distinct edge over the S&T-developing countries, but the IAC report does not explicitly classify the 90 countries whose national academies are represented on the Inter-Academy Panel on International Issues. In diplomatically understated fashion the IAC seems to define the Second, Third and Fourth Worlds which, in the area of science, are represented by the Third World Academy of Sciences (TWAS).

The world's two most populous countries, China and India, are presumably S&T proficient; a term precisely defined by the IAC as applicable to countries 'with scientific and technological strength in several research areas and a growing S&T capacity in all aspects, including personnel, infrastructure, investment, institutions, and regulatory framework'. Coincidentally, even as the IAC report became available, *Nature* (11 March 2004) produced a supplement; a collection of seven articles by scientists of Chinese descent working in the West, who offer advice to their compatriots in China. Indeed, a characteristic of 'S&T proficience' is the ability to export legions of trained researchers to the West, creating a large expatriate community which then has the ability to compare policies and practices in the West, with those in the countries of their origin. China and India, of course, lead the rest of the world in producing human resource for the S&T enterprises in the 'advanced countries'. The articles on China in *Nature* may appear curiously familiar to many Indian readers. Chinese-American venture capitalists and entrepreneurs conclude that 'exceptional synergies between the Chinese and US economies are evolving'. As a result of increasing involvement of US companies, the authors suggest that China will 'lead the world' in nanotechnology and biotechnology (Hsia, J. C. and Fong, K., *Nature*, 2004, **428**, 218). Some of us may have heard similar expressions of faith from US-based venture capitalists of Indian origin. In an assessment of basic research in China in the area of biological sciences the judgements are less favourable: 'Despite a recent improvement the number of high quality research papers published by scientists from mainland China has remained low'. The author, Ray Wu, suggests that 'this is because there are few productive scientists in China and the level of financial support for basic research is inadequate. The system for evaluating research proposals and distributing funds is far from ideal, and does not promote innovative research. In addition, the education system in most universities does not encourage students to think critically and creatively'. In a commentary on publication practices Wu notes that 'the vast majority of papers are published in Chinese journals which are usually not read by scientists of other countries and thus are seldom cited'. Many of Wu's comments will appear familiar to Indian readers; China and India share many problems as they attempt to move up the ladder of S&T advancement. The popular saying in China's scientific circles, 'Small grants, big review; medium grants, small review; big grants, no review', succinctly summarizes the situation in India too. In analysing cultural traditions which inhibit the growth of science in China, Mu-Ming Poo notes that 'Chinese institutes have two important tasks: reform of the administrative structure, and establishment of a merit based system for staff evaluation and resource allocation... . Scientific administrators at all levels have enormous responsibility – and power. These administrators often control resources and give instructions rather than provide services'. Poo quotes Joseph Needham who concluded that 'bureaucratic feudalism' inhibited the rise of modern science in China (Poo, M.-M., *Nature*, 2004, **428**, 205). Indian readers may recall that the Prime Minister called for the 'debureaucratization' of science, at the Indian Science Congress in January 2003, while releasing the government's Science and Technology Policy. Over a year later, it is business as usual and there are indications that the mechanisms for administering science will remain complex and opaque. Reading *Nature*'s review of science in China, I must conclude that both countries face very similar problems as they struggle towards the IAC label of 'S&T advanced country'.

In returning to the IAC report, it is worth noting that a 'box' describes 'Indian research centres', featuring the Indian Institute of Science and the Indian Institute of Technology system. These institutions are highlighted in a section on 'S&T capacity building', an activity which is termed a 'shared regional and global responsibility'. Ironically, it is these very institutions which have been targeted for 'sanctions' by the governments of some S&T advanced countries, notably Japan and Germany which appear to have intensified restrictions on sales of scientific equipment over the last couple of years. In an interesting sidelight, the American Type Culture Collection (ATCC) does not ship, DNA segments ('clones') generated during the genome analysis programs, to some of these institutions. Presumably, the academies of both the 'S&T-advanced' and 'S&T-proficient' countries are unaware of these difficulties or unwilling and unable to address them. The many wonderful recommendations of the IAC panel would undoubtedly be implemented, by governments and scientific communities in different nations, in an ideal world. No one can quarrel with the need 'to ensure that science and technology are harnessed to address the needs of all, rather than add to the luxury of a few'. Sadly, we live in a far from ideal world.

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