Third World Academy of Sciences at Trieste, Italy.

Inter-Academy Council

Following informal discussions initiated at Budapest, and later continued at Cairo and Davos, it was proposed to create a formal arm of IAP to be called Inter-Academy Council (IAC) as a legal entity to provide scientific advice to international organizations on request. This was based on the realization that decision-makers, in both international organizations and national governments are faced with the fact that major issues and concerns are regional and global, and increasingly intertangled with significant scientific and technological questions. It is therefore, an urgent need for international decision-makers to rely on scientifically credible, cross-disciplinary advice for addressing the complex challenges and opportunities. The existing mechanisms are unable to meet these demands expeditiously. An urgent-task for the worldwide scientific community is therefore to develop effective mechanisms for delivering timely advice that utilizes the best scientific expertise, while being clearly so multinational that it cannot be dismissed as reflecting the interests of one nation or particular block of nations. The opinion of all members of IAP was sought through a questionnaire. Finally at the meeting of the IAP steering committee on 14 May 2000 (along with representatives all other member academies present in Tokyo), it was resolved to establish IAC. A draft constitution prepared by a committee consisting of Yves Quèrè (Chair), Eduardo Krieger, E. Winnacker and P. N. Tandon was deliberated upon. It was decided that the Council will consist of 15 Presidents of the IAP member academies (or equivalent national organizations). Bruce Alberts (USA) and Goverdhan Mehta (India) were elected Co-Chairs. The other members of the Council will be Brazil, China, France, Germany, Israel, Japan, Malaysia, Mexico, South Africa, Sweden, Third World Academy of Science, UK, USA. In addition, President of ICSU, one of the Co-Chairs of IAP and the host academy of the Council will be ex-officio observers. The Royal Dutch Academy, The Netherlands was voted to host the IAC secretariat.

It may be mentioned that IAC, on being requested to provide scientific opinion on a subject of global interest, would constitute an expert group, based on the suggestions received from members of the IAP and then provide assistance through its secretariat, monitor the progress of the operation and get the final report vetted by independent reviewers. The report will be issued in the name of the experts who prepared it and not in the name of IAC. This mechanism is on the line of the established practice already followed by the US National Academy, which produces a large number of such reports primarily for its national use.

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Plant genome initiatives in India

With international competition in plant genomics becoming fierce, foresight led to the setting up of a National Centre of Plant Genome Research (NCPGR) in India as far back as April 1998. NCPGR is an autonomous institute funded by the Department of Biotechnology. Asis Datta, Vice-Chancellor, Jawaharlal Nehru University (JNU), New Delhi, a pioneer of plant genome research in India and an expert in plant molecular biology and genetics, said 'this centre is expected to evolve and develop into a premier research institute on plant genomics'.

Plant genomics in India will receive a big boost, as activities of the NCPGR include a core-research programme with structural, functional and application genomics as components. With its linkage research programme, the centre would provide networking within India between various plant genome research groups. The centre would also actively train manpower required for such research.

The foundation stone of the centre was laid on 30 November 1999 by the Minister for Human Resource Development, Science and Technology and Ocean Development, Murali Manohar Joshi. In the meantime, working from interim premises in JNU, several research initiatives have begun. They include mapping and sequencing of expressed sequence tags (ESTs) and gene prospecting, i.e. identification and isolation of important genes and promoters from various sources, in the area of structural genomics. The functional genomics programme has ongoing research in genes involved in plant–pathogen interaction, nutrition and nutritional quality and value-added transgenic plants. International and Indian patents have been obtained by the research group led by Datta.

Indian efforts towards genome studies at NCPGR will be strengthened with crops such as chickpea and rice, as well as medicinal plants. Chickpea (*Cicer arietinum*) is the third most important seed legume in the world, with India accounting for 75% of world production. It is a major source of protein in human and animal diet, with a protein content of 25 to 28% of its total dry weight.

As recently as June 2000, India injected a new excitement and challenge into plant genome efforts by joining hands with ten other countries for the International Rice Genome Sequencing Project (IRGSP). Spurred on by government support and commitment, the Indian initiative has been jointly funded by Department of Biotechnology (DBT) and the Indian Council for Agricultural Research (ICAR).

The project has taken off. Responsibility for sequencing a part of rice chromosome-11, a 10 million base pairs (Mb) segment over the next five years, will rest on the shoulders of two centres at a total cost of Rs 48.83 crores. These are, the Department of Plant Molecular Biology, University of Delhi South Campus (UDSC) with Akhilesh Tyagi as overall Coordinator and J. P. Khurana as Principal Investigator, and the National Research Centre for Plant Biotechnology (NRCPB), Indian Agricultural Research Institute

(IARI) headed by N. K. Singh, both at New Delhi. Table 1 provides details of allocated funds.

Speed is the key issue, along with quality. Both centres are targeting to provide sequence information of about 1 Mb in the first year and 2 to 3 Mb per year subsequently. Progress will be monitored by a Committee headed by the well-known plant breeder, G. S. Khush of International Rice Research Institute (IRRI), Manila.

Japan led the IRGSP initiative in 1997. Keeping in view the high costs involved they created a consortium of ten countries. Each country selected segments of the rice chromosome for sequencing. The ten countries taking part in the IRGSP and the selected chromosomes are shown in Figure 1. Interestingly, India came into the fray at a time when rice chromosomes 7, 8 and 11 were available. After consultations with experienced hands at rice genetics and breeding, chromosome-11 from 56.9 cM to 109.3 cM was India's chosen segment for sequencing. The rest of the chromosome was then taken up by USA. Chromosome-11 has several genes of interest such as disease-resistant genes for blast and blight diseases. Chromosomes 7 and 8 still remain unclaimed.

Rice, a good candidate for DNA sequencing is of particular relevance to India and a model species. Among the major cereals, rice has the smallest genome size of 400 to 430 Mb. Rice molecular map already exists with over 6000 markers, useful in aligning physical chromosome maps. Over 40,000 ESTs have been reported and mapped. Previously, physical maps were assembled using yeast artificial chromosomes (YACs). YACs have several disadvantages as templates for DNA sequencing. These include chimerism, and the difficulty in separating them from other yeast chromosomes. In the IRGSP, bacterial artificial chromosome (BAC)/P1-derived artificial chromosome (PAC) vectors would be used to construct the new rice genomic libraries from the *Oryza sativa* japonica variety of rice. Common standards have been set for sequence quality, annotation and sequence release, and adopted by the members of the IRGSP. In the case of sequence quality and release, a standard of less than one base-pair (bp) error in 10,000 bp has been set.

Until now India has been sequencing individual genes. However, with the induction of high throughput DNA sequencers, gene sequencing will be accelerated. In fact, two researchers have just been trained in high throughput technology and to develop the infrastructure support for the programme. Others are soon to follow. According to Tyagi, the future ramifications would include 'well distributed physical markers of the whole rice genome, for plant breeders to do precision breeding'. The new genes uncovered would be utilized in functional genomics wherein patents could be obtained.

Sequencing in this project uses a map-based, clone-by-clone shotgun strategy. End-sequencing, fingerprinting and marker-aided screening are being used to make sequence-ready contigs. Annotated sequences, available for public use will be released with supplemental information at each IRGSP member's website. Updated information on IRGSP exists at the website http://www.staff.or.jp/Seqcollab.html. Ultimately, networking within the country will provide information freely to interested researchers.

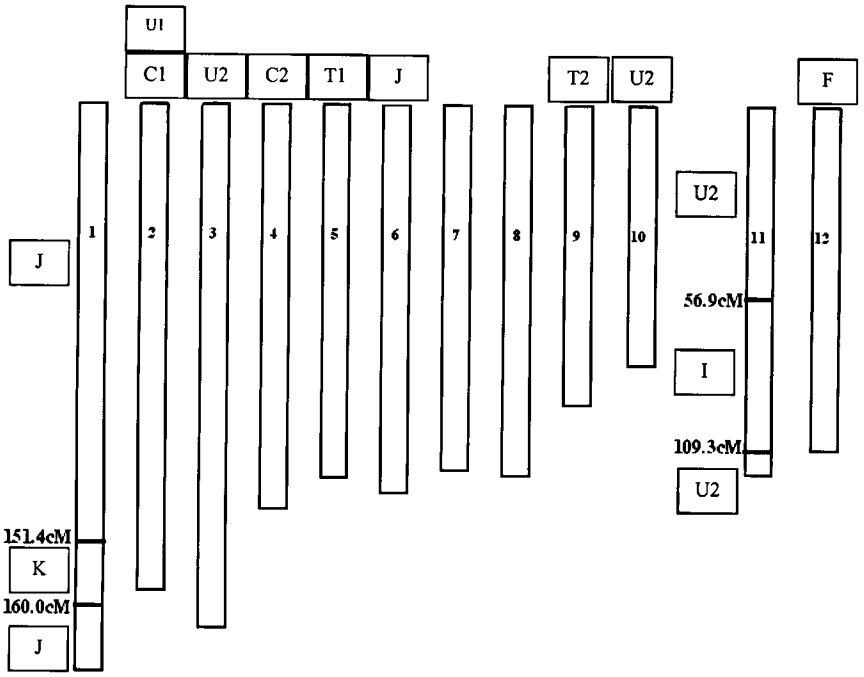
With the start of the 'first major genome sequencing programme' in India, spin-offs are expected in functional genomics as well as in bioinformatics. The Human Genome Project (HGP) passed India by, since India was not a collaborating country. However, sources from the Ministry of Science and Technology feel that 'the more challenging task is to decipher useful information from these data in the area of bioinformatics'. Also, 'India's traditional leadership in information technology is going to be relevant in this context', the sources add. The DBT, Government of India, has already spearheaded a network of laboratories (Bioinformatics Network) across the country, to help decipher information arising out of sequencing and to utilize it for future applications, as in functional genomics.

Alok Bhattacharya, School of Life Sciences, JNU, New Delhi, an experimentalist in the molecular biology and genomics of protozoa, is also actively involved with the Bioinformatics Centre at JNU. Bhattacharya is of the opinion

Table 1. Budget summary of the Indian component of IRGSP

Project head	NRCPB	UDSC
Non-recurring	11.38	10.55
Recurring	13.48	13.42
Total	24.86	23.97

Project costs in crores of rupees.



C1, Canada; C2, China; F, France; I, India; J, Japan; K, Korea; T1, Taiwan; T2, Thailand; U1, United Kingdom; U2, United States of America

Figure 1. Selected rice chromosomes to be sequenced by member countries of the IRGSP.

that the limiting factor to development of bioinformatics is the lack of trained professionals. To overcome this, JNU has recently started a new diploma programme in the field of bioinformatics. There exists tremendous scope for people with varied backgrounds such as mathematics, physics, chemistry and biology to come together. Under the umbrella of bioinformatics they can help India with new approaches to find meaning out of sequence data, analysis, location, with functional and computational studies, including molecular modelling.

With the tools obtained in the area of genomics and bioinformatics, especially in plant genome research in India, the country is moving towards being fully involved in applications of post-genome research in genetics, plant biotechnology and agriculture. Lacking this, India may find itself technologically incapable of taking the next step in the genomic revolution.

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MEETING REPORT

Indian Geological Congress*

At the 12th Indian Geological Congress (IGC), B. C. Bora, President IGC delivered an address on the 'Role of fossil fuels as future energy sources in India'. The keynote address by D. K. Chadha (Central Groundwater Board) was on 'Groundwater management in arid zones in India'. The depletion of mineral resources is a matter of great concern to earth scientists as indicated by the invited lecture on 'Volcanogenic massive sulphides (VMS) on the mid-oceanic ridges – Resources for the future?' by G. S. Roonwal (University of Delhi). The technical sessions of the IGC and the seminar on groundwater resources were held concurrently. *Profile of Presentations* (the abstract volume) with 175 titles was distributed to the registrants.

The Sixth IGC Foundation Lecture by P. N. Agrawal (University of Roorkee) on 'Seismological aspect of earthquake damage reduction', was followed by the invited lecture by R. S. Sharma (University of Rajasthan) on 'P-T-t evolution of orogenic belts: A case study of the Aravalli Mobile Belt'.

Papers at the technical sessions of IGC were presented on five broad themes. The presentation on petrology, mineralogy and geochemistry (23 titles) covered a wide spectrum, including petrogenesis, migmatization of granulitic anorthosite complex and granites, petrology of carbon phyllite and limestone, and computer programs.

A large number of papers (32 titles) were to be presented in the session on mineral resources, minerals exploration, fossil fuels and mineral industries, but only a few could be orally presented, covering various types of mineral resources, strategies for exploration and entrepreneurship, and geotechnical studies. The scope of foreign investment and opening the gates to multinationals were debated at length.

The session on Precambrian geology and tectonics (16 titles) witnessed presentation on tectonic modelling of several areas. Stratigraphic position of ultramafic rocks in the Aravalli and the shear zone characters in Delhi and Aravalli rocks, the Asia–India collision using thermochronology, and papers on neotectonics and microtectonics were also discussed.

The session on Phanerozoic stratigraphy and palaeontology (7 titles) was essentially an 'oil-men show'. Papers on petroleum exploration, erection of basin stratigraphy of Bombay High and Assam regions and the stratigraphy, using megafossils and new species of Ostracode, were presented. The invited lecture on 'Petroleum systems in the Indian sedimentary basins: Stratigraphic and geochemical perspectives' by Kuldeep Chandra (KDMIPE–ONGC) was presented *in absentia* by Anil Bhandari (ONGC).

In the session on environmental geology and remote sensing (23 titles), effects of mining, afforestation, watershed development using GIS techniques and assessment of groundwater pollution by remote sensing were presented.

The National seminar on groundwater resources was covered under four sessions having 71 titles. The presentations laid stress on the study of groundwater, its recharge techniques, improvement in quality and management of available groundwater resources in India. The modelling of fractures, fissures in hard rock areas for fruitful targeting of the sites for tube-wells and the electrical resistivity techniques in semi-arid and arid regions were discussed. The chemical quality and fluoride content in groundwater are of great concern. Techniques for defluoridation were discussed. Stress was laid on artificial recharges and management of groundwater in semi-arid and arid terrains.

A group discussion on the focal theme 'Emerging opportunities and geological curricula of the 21st century' anchored by V. K. S. Dave (Roorkee) was held, where a drastic change in the earth science education was discussed in light of the contemporary needs and developments, specially in applied geology and entrepreneurship. Introduction of geology as one of the optional subjects at the senior secondary school level was stressed by most of the participants.

Two excursions were also organized. One across Udaipur–Haldighati–Rajnagar section to familiarize the participants with Aravalli rocks and mechanized marble mining. The other was along Udaipur–Ranakpur section to know about the

*A report on the 12th Convention of Indian Geological Congress and National Seminar on Groundwater Resources, held at Mohanlal Sukhadia University, Udaipur, during 8–12 February 2000.
The keynote address, invited lectures, and profiles of presentations are available on: http://www.mlsu.ac.in