With extraordinary explosion of knowledge, speedy travel and evolution in information technology, increasing awareness of global concerns, the world community of scientists has felt the need and has realized the value of establishing closer ties by removing barriers. This chapter briefly reports the progress made by India through government departments, autonomous societies and academies in fostering international relationship.
Science and technology (S&T) was accorded the pivotal role in the national development of India on emergence from colonial rule. Along with the material infrastructure that the country began to place on the ground, special attention was paid to the two dynamic aspects that would carry the country forward into the contemporary modern era: the expansion of education and training in scientific and engineering disciplines, on the one hand, and the promotion of research, both in the pure sciences and in S&T as well, so as to give full scope to the aptitudes and talents in Indian culture to attain their best potential. Indian science aimed to make meaningful contribution to and take its rightful place in the world scientific endeavours. Comprehensive structures and processes evolved over the years and these comprised academic institutions, laboratories, R&D organizations along with programmes of collaboration and interaction with other countries and international organizations.

The linkages established by Indian science are based on three major considerations: the scope for fruitful interaction in areas of common interest; opportunity to render assistance through joint activities; and the possibility for participation in newer domains of study and research. From time to time other considerations too are included.

A programme for cooperation in science and technology is adopted after due assessment of its scientific level, the nature of the proposed interaction, the availability of resources, both technical and financial and the relevant administrative aspects. The interactions generally cover such areas as conducting joint experiments, sharing equipment and material, exchange of information, exchange of visits by scientists, holding joint workshops and seminars, training of technical personnel and award of research fellowships.

In addition to these bilateral arrangements, India also has programmes of cooperation with several countries on a regional basis. The Indo-EC relations cover India’s cooperation with a number of European nations within the European Economic Community (EEC). With countries like Germany and the Netherlands, India has, thus, a dual relationship, one directly on a bilateral basis and the other as the members of the EC. Under the South

India’s Partners in Science

India has arrangements for cooperation with more than 50 countries round the world, ranging from the most scientifically advanced to those yet in transition: Australia, Belarus, Brazil, China, Cuba, Democratic People’s Republic of Korea, Egypt, France, Germany, Hungary, Indonesia, Iran, Israel, Italy, Japan, Kazakhstan, Kyrgyzstan, Mauritius, Mongolia, the Netherlands, Pakistan, Poland, the Republic of Korea, Russia, South Africa, Sri Lanka, Sweden, Tajikistan, Turkey, Ukraine, United Kingdom, United States of America, Uzbekistan, and Vietnam.
Asian Association for Regional Cooperation (SAARC) arrangement, India interacts with the other members of SAARC on a regional basis. The third regional arrangement, with the Association of South East Asian Countries, provides India with a forum for interaction with ASEAN members.

Besides these inter-governmental arrangements, India also has well defined channels of interaction with the various UN agencies, such as FAO, UNESCO, UNDP, WHO and WMO. It also participates in the programmes of the international bodies like the Third World Academy of Sciences (TWAS), and the Centre for Non-Aligned and Other Developing Countries. The Department of Science and Technology (DST) is the nodal agency of the Government of India designated to deal with the country’s international affairs, in coordination with the other concerned departments and organizations.

**Bilateral Cooperation**

For the purpose of an overview of India’s bilateral dealings with other countries, we shall consider the instances with China, France, Germany, Japan, Mauritius, Russia, USA, and Vietnam. The aim is twofold: to highlight the unique nature of India’s interaction with each country, and also to indicate the broad spectrum of activities under the various programmes of cooperation.

**China:** Initial bilateral contacts in S&T between India and China began with exchange of visits by scientific delegations, which followed the Official Level Talks that were periodically held between the two Governments, to review the status of diplomatic relations between them. Views on possible interaction in S&T were also exchanged at these meetings. Exchange of visits of scientific teams took place in a number of areas, including Seismology and Earthquake Engineering, Chemistry of Natural Products, Laser Technology and Plasma Physics, Astronomy, and Biotechnology, and these continued until 1988.

In December 1988, a formal Agreement on Cooperation in Science and Technology was signed in Beijing and eight priority areas were identified for future cooperation: Lasers; Materials and Earth Sciences; Chemical Engineering; Medicine; Biotechnology; Agriculture and Fisheries; Electronics; and Space and Remote Sensing. Some additional programmes were also identified in the protocols signed between some Indian and Chinese organizations, under the provisions of the S&T Agreement such as, joint workshops in the areas of Aerodynamics and Propulsion and Composite Materials.

**France:** An inter-governmental agreement on Cultural, Scientific and Technical Cooperation between India and France, signed in June 1966, made a specific provision for facilitating interactions between the scientists of the two countries, in particular those working in their academic institutions. A more comprehensive treaty for strengthening bilateral relations in S&T was concluded twelve years later, in July 1978, in the form of an Agreement for Cooperation in science and technology.

The implementation of this Agreement took place in accordance with the recommendations of a joint committee, consisting of representatives of the two countries, which deliberated on areas of mutual interest, scope and mechanisms of cooperation, and the funding of joint activities. Collaborative programmes were developed in Computer Science, Automation, Aeronautical Engineering, Immunology of Reproduction Control, Oncology, Oil Seeds and Soil Microbiology, and implemented through exchange visits of scientists, participation in training programmes and advanced courses, and joint workshops. In addition, a number of Protocols were signed, which included those in Renewable Energies; Ocean Science and Technology; Medical Research; and Biotechnology. In 1990, a special agreement on cooperation was also concluded between the CSIR and the Centre National de la
An important advance in bilateral scientific relations was made with the establishment of the Indo-French Centre for the Promotion of Advanced Research (IFCPAR) in New Delhi. Envisaged as a nodal office for piloting and financing of research programmes carried out jointly by the Indian and French teams, it was registered as an autonomous society under the jurisdiction of Indian law, and started functioning in 1987, under the purview of the DST of the Government of India and the Ministry of External Relations of the Government of France. Since its inception, IFCPAR has funded over 180 collaborative projects, organized several joint workshops and seminars, and sponsored the preparation of some state-of-the-art reports. The areas of priority interest have been Pure and Applied Mathematics, Computer and Information Sciences, Life and Health Sciences, Pure and Applied Physics, Pure and Applied Chemistry, Instrumentation, Geosciences, Material Sciences, and Environmental Sciences and Water. A large number of joint scientific papers have resulted from these collaborations.

Germany: Historically, when West Germany (Federal Republic of Germany) and East Germany (German Democratic Republic) existed as separate nations, each of them had independent S&T relations with India. Following their unification in October 1990, the diplomatic protocols between India and Germany were revised, and these included a renewed arrangement for cooperation in S&T. The pattern of this cooperation retained the basic features that had evolved after the signing of the Agreement on Cooperation Regarding the Peaceful Uses of Atomic Energy and Space Research and the 1974 Agreement on Cooperation in the Field of Scientific Research and Technological Development signed between India and West Germany.

The Special Agreements for implementing programmes were signed in the fields of Nuclear Research and Development (1974), Space Research and Space Technology (1974), Scientific Research and Technological Development (1974, 1986, 1993), Medicine and Biology (1976), and Aeronautical Science (1982). Collaborative interaction between institutions of the two countries took place in a wide range of areas, resulting in joint studies and research publications.

Though the above inter-governmental agreements were signed only in 1971 and later, other bilateral arrangements had existed since the 1950s providing for the visits of scientists and engineers, in the form of Exchange Programmes between (i) UGC and German Academic Exchange Service (DAAD), (ii) CSIR and DAAD, (iii) UGC and Alexander von Humboldt Foundation.
Humboldt Foundation, and (iv) Indian National Science Academy and German Research Foundation. The establishment of the IIT at Chennai, and the building and equipping of the research vessel *Sagar Kanya*, are two notable examples of the Indo-German Technical Cooperation Programme.

Against the backdrop of these wide-ranging linkages between the scientific communities of the two countries, the Indian Prime Minister and the German Chancellor decided in early 1994 that for further promotion of S&T cooperation between India and Germany, a German-India Committee on Science and Technology should be set up. This Committee met for the first time in Bonn during October 1994, when it adopted its mandate and reviewed some of the other issues relevant to the future. Reference should be made to two novel initiatives that emerged from the deliberations of this Committee: the first, improving the availability and diffusion of information on activities within S&T cooperation, and the second, developing measures to promote an enhanced involvement of industry.

**Japan:** The establishment of scientific relations with Japan may be divided into three phases. The first phase commenced with the posting of a Science Attache in the Embassy of India in Tokyo in the mid-seventies, with the aim of keeping abreast with the scientific and technological developments taking place in Japan. The Science Attache was also be in a position to assist Japanese agencies and individuals with information about the S&T scene in India. A symposium on Japan-India Cooperation in S&T took place in Tokyo in April 1975, followed by some exchange visits between the two countries.

The second phase started about a decade later, with the signing of an Agreement on S&T Cooperation in November 1985. However, The level of interaction in the various areas identified for collaboration remained at a low key. In 1992, fillip was provided by a meeting held in Tokyo between the Japan Society for the Promotion of Science (JSPS) and an Indian S&T delegation specially nominated for this purpose. The implementation of the recommendations of this meeting resulted in what could well be regarded as the third and the most active phase of S&T interaction between Japan and India.

Joint projects were implemented in the areas of Molecular Structure, Spectroscopy and Dynamics; New Materials; Modern Biology and Biotechnology; Manufacturing Science; and in Astronomy and Astrophysics. A large number of exchange visits by the scientists have taken place, and several joint workshops have been organized, both in India and Japan. In addition, postdoctoral and predotoral fellowships have been awarded to a number of Indian scientists. Several other initiatives from both the sides have further contributed to raising the level and scope of interactions.

**Mauritius:** The range and scope of scientific interaction with this nation of islands off the east coast of Africa has been more limited. It began with a programme on Radio Observations of the Centre of our Galaxy from Mauritius, shared by the Indian Institute of Science, the Raman Research Institute in Bangalore and the University of Mauritius in 1986-87. Supported under the Programme for Technical Cooperation with Developing Countries (TCDC), the project was to establish a Radio-Telescopic Observatory in Mauritius, a country whose geographic location was ideal for making astronomical observations on the Centre of the Galaxy. The Government of India spent over Rs. 15 millions towards the fabrication of equipment, its transportation and installation, training of S&T
personnel from Mauritius in India, and other technical inputs.

The scientific and technical contacts between the two countries developed beyond the scope of the Radio Telescope project and an inter-governmental Agreement was signed in January 1990. It provided for exchange of scientific information, exchange visits of scientists and training of Mauritian scientists in a number of areas, including Agricultural and Horticultural Research, Building Research, Environment, Geology, Health and Medical Science, and Renewable Energy.

**Russia:** Following the break up of the erstwhile USSR in December 1991, the Government of India embarked on wide-ranging negotiations with the Governments of the Russian Federation and the other newly formed States to establish diplomatic relations with them as independent nations. Exploring possible linkages in science and technology was a part of these negotiations. An Agreement on S&T Cooperation with Russia was signed in June 1994.

The arrangement with Russia was cast into a framework similar to the one that had existed earlier with the Soviet Union, after incorporating the relevant organizational changes and financial terms. The two main components of this cooperation were (i) the Integrated Long Term Programme of Cooperation (ILTP), and (ii) Other Activities of bilateral interest. ILTP focused attention on thrust areas, such as Biotechnology and Immunology; Materials Science and Technology; Materials and Technology for Electronics; Laser S&T; Catalysis; Space S&T; Accelerators, Water Technology; and Computers and Electronics; and, in the second part, on Basic Research in Mathematics; Theoretical and Applied Mechanics; Earth Sciences; Radiophysics and Astrophysics; Ecology and Environment; Chemical Sciences; and Biology. Besides these, interactions have also taken place in the areas of Agriculture, Standardization and Metrology, Non-conventional Sources of Energy, Building Materials, and Meteorology.

ILTP Fellowships have been awarded to eminent Russian scientists in the age group of 35 to 45 years, from the areas of Engineering, Physical and Life Sciences, to work in Indian laboratories for a period of six months to one year. Another initiative was the institution of the SN Bose-MV Lomonosov Lectures in Engineering, Physical and Life Sciences, which are delivered once a year in India and in Russia.

**USA:** The earliest linkages in S&T between India and the United States date back to the 1950s and 1960s, in the form of interaction between their agricultural scientists, joint projects in health, and establishment of several institutions of learning in India, including a number of agricultural universities in the various states and the IIT at Kanpur. These programmes were supported with the assistance of USAID and grants from PL-480 Rupee funds. Bilateral cooperation was further strengthened by the Exchange Programme between CSIR and National Science Foundation (1967), which provided 800 man-days of visit to each country. Besides the scientists from CSIR laboratories, this programme was also open to senior faculty of Indian universities and the IITs. Exchange of visits took place in the areas of Electronics, Earth Sciences, Instrumentation, Metallurgy, Natural Products, Toxicology and later, Biotechnology. Many of the visits led to formulation of collaborative research proposals, which were submitted for funding from PL-480 rupees. These Exchange Programmes were discontinued in 1991.

The bilateral relations in science and technology were cast into a broader framework when an intergovernmental Agreement (October 1974) decided to constitute an Indo-US Joint Commission, for exploring “the possibilities of fostering mutually advantageous cooperation” in economic, commercial, scientific, technological, educational, and cultural fields. In the fields of science and technology, the Commission was empowered (i) “to review and recommend plans for co-operation between the two countries and
measures for their implementation and co-
modation, which may include *inter alia* the
exchange of specialists and information and the
organization of bilateral seminars on problems of
common interest”, and (ii) “to identify common
scientific and technological problems and to
formulate and recommend joint research pro-
grames which lead to application of results in
industry, agriculture, health and other fields.”

Following this Agreement, the two Govern-
ments constituted the Indo-US Subcommission on
Science and Technology, for dealing with S&T
cooperation in 1975. The identified areas of
interaction were: (a) Health, Medical and Life
Sciences; (b) Physical Sciences: Materials, Modern
Optics, Electronics, Metrology; (c) Earth Sciences;
d) Atmospheric and Marine Sciences; (e) Environ-
ment and Ecology; (f) Energy; and (g) Informa-
tion Sciences. The implementation of joint
projects and holding of joint workshops were the
principal modes of cooperation between the
research groups of the two nations.

During the years 1982 and 1983, an additional
channel of interaction, known as the Science and
Technology Initiative (STI), was negotiated between
the two Governments. It was restricted to the areas
of Health, Agriculture, Biomass, Monsoon Research,
Photo-Voltaic Materials and Mineral Engineering. It
functioned independently of the S&T Subcommission, and had a different funding
mechanism. In contrast to the Subcommission related
projects, which were supported with the US held
Rupees in India, the STI programme was funded
separately by the two Governments: the Government
of India financing the Indian component of co-
operation and the US Government taking care of
expenditure on the American side. The third and the
last phase of STI Programme was concluded in 1991.

During the second half of 1980s, two principal
issues surfaced with regard to scientific and
 technological relations between India and the
United States: the future mechanisms of funding
when the US held Rupees in India were exhausted,
and a lack of agreement on the protection of
intellectual property rights (IPR) with respect to the
results of jointly executed projects. The latter
problem arose from the differing provisions of the
American and the Indian national patent laws. As
a result, the S&T interaction was, at the instance of
the US Government, restricted to themes of basic
research only. No proposals having any IPR
implication were entertained.

During the years 1992 to 1995, the Indo-US
Science and Technology Fellowship Programme
provided Indian scientists and technologists with
opportunities to get acquainted with advancements
in some of the frontier areas, by working for a year
in host American institutions. These included the
areas of Computer Science, Advanced Materials,
Robotics, Turbo-machinery, Instrumentation, Space
Technology and Biotechnology.

A more recent development has been the
establishment in June 2000, of the Indo-US Science
and Technology Forum. The Forum aims to *facilitate
and promote the interaction in India and the United States,
of government, academia, and industry in science and
technology and focus on issues of common concern and
activities of mutual benefit while exploring trends in S&T.*

**Vietnam:** The S&T cooperation between Vietnam and
India, which started in the early 1980s, is a good
example of collaboration between two countries,
neither of which was scientifically very advanced.
India was itself an economically developing nation,
which had a long way to go in fulfilling its own
scientific and technological goals. But, as a result of
the foresight and determined policies of the
Government, it had despite all odds, taken resolute
steps in building up a sizeable base for education and
training of its scientific and technical manpower, for
launching research and development programmes,
and for setting up industrial units in some of the core
sectors of importance to the country.

With the availability of its infrastructure and
experience, India was in a position to assist Vietnam,
by training some of its technical personnel in areas
that were relevant to that country’s needs. The interests of the Vietnamese trainees were mostly in disciplines of an applied nature, related to the needs of building infrastructure and related facilities in their own country. To provide an indication of the kinds of training they received in India, we mention the following areas: Fabrication of Railway Carriage, Irrigation Techniques, Tissue and Cell Cultures for Propagating and Improving Medicinal Plants, Low Cost Building Materials, Environment Management, Fruit Conservation, Remote Sensing, New Energy Sources, Informatics and Computers, Library Science, and Chemistry of Natural Products.

Utmost cooperation on the part of the various host institutions in India contributed to the success of these training programmes.

**REGIONAL COOPERATION.**

The special features of the Indo-EEC and the SAARC programmes in S&T are briefly described here.

**European Economic Community (EEC):** The shaping of relations between India and the EEC was a novel experience for both sides. Though the Government of India had bilateral relations with some of the individual members of the European Community, what the Indo-EC forum sought to develop was a framework of cooperation which would reflect the Indian interests on the one hand and the collective interests of the members of the EC, on the other. The Government of India was to transact business with the European Economic Commission in Brussels, rather than with the Governments of the individual countries. This implied that, in principle, a collaborative project could be developed between an Indian research group with two or more research teams in separate member nations of the Community, or, that a joint programme could be formulated with a research group within a laboratory of the EC, which was otherwise outside the purview of a bilateral arrangement with any of the member countries of the Community. The European Commission had, on its part, to look after the interests of its member countries in whatever programmes were agreed upon with the Indian side.

The Indo-EEC co-operation in S&T began to take place under two separate programmes of the Commission, viz., 1. International Scientific cooperation (ISC), and 2. Science and Technology for Development (STD). ISC was a purely bilateral arrangement which EEC had with the various non-EEC countries, while STD was a multi-partner mechanism in which a country like India was one of the collaborating partners. There were three sub-classifications under the STD Programme, and India was a partner country only in STD-II and STD-III, which dealt with cooperation in the areas of...
Agriculture, Life and Medical Sciences. Both these Programmes were closed down by the EC in 1994. From 1985 to 1994, ISC approved 39 projects; during 1987-1991, in all 11 projects were supported under STD-II, and during 1991-1994, in all 19 projects took place under STD-III, with India as one of the partner countries. Three joint workshops were also organized in India during this period.

Another important segment was the award of the EEC-Postdoctoral Fellowships to Indian scientists, for working in laboratories in EEC member countries. Of the 40 fellowships funded annually, 20 were awarded to young scientists for a period of one year and 20 to more senior scientists for a period of six months. About 130 fellowships were availed by the Indian scientists between 1991 and 1994, in the areas of Agricultural Sciences, Biotechnology, Chemical Sciences, Engineering Sciences, Earth-Atmospheric-Marine Sciences, Life Sciences, Physical and Material Sciences, Mathematics, Computer Sciences, and New and Renewable Sources of Energy.

In more recent years, India became partner in a number of projects in the Framework IV Programme, with 100 per cent grants provided by the EC. It was mandatory for these projects to involve two partners from the EC and two from the Developing Countries. From the Indian subcontinent, the latter two could in some cases be both from India.

**South Asian Association for Regional Cooperation (SAARC):** The idea of strengthening cooperation among the seven South Asian countries, of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka, was first discussed at the meeting of their Foreign Secretaries in Colombo in April 1981. It was agreed to set up Study Groups consisting of national representatives in respective areas of regional interest, to exchange views on issues of common concern, and to recommend possible measures for dealing with them through a suitably constituted forum. The concept of South Asian Regional Cooperation was thus born.

The field of science and technology was considered to be of regional importance with 14 areas of interest identified. Cooperation was to take place through exchange of information, exchange of experts, training programmes, scholarships, seminars and workshops, and joint projects of regional nature. To facilitate such interactions, Pakistan, in its capacity as the first Coordinator country, brought out a well prepared and informative document, entitled South Asian Regional Cooperation Directory of Scientific and Technological Activities, prepared on the basis of the inputs received from the seven countries.

The first Summit of the seven nations took place in Dhaka in December 1985. This meeting marked the birth of the South Asian Association for Regional Cooperation (SAARC), with the adoption of a Charter establishing this Association. The Charter enunciated the Objectives of the Association, and its Principles and General provisions.

At its annual meetings, the SAARC Technical Committee on S&T cooperation review the activities of the previous year, considers the proposals in different areas from the member countries, and recommends a Calendar of Activities for the following year. Its recommendations are considered, for approval, by the Standing Committee of the Foreign Secretaries. The meetings of the Technical Committee take place in the capitals of the member countries by rotation, with each country serving as host for two years in succession. The salient features of the SAARC programmes have been: 1. the organization of seminars and workshops; 2. the training of S&T personnel; 3. the preparation of state-of-the-art reports; and 4. joint projects.

Science and Technology is one of the 12 areas of cooperation comprising the SAARC Integrated Programme of Action, with each of the other areas having its own Technical Committee. These activities are looked after by the SAARC Secretariat which was established in Kathmandu in January 1987. The Secretariat coordinates and monitors the implementation of SAARC activities, services the
meetings of the Association, and serves as the channel of communication between SAARC and other international organisations. The Secretariat is headed by a Secretary General, who is nominated by one member country in turn.

**MULTILATERAL COOPERATION:**

**UN Agencies**: India has interacted with several Agencies of the United Nations, through participation in their respective programmes. These have included, among others, Development Assistance Scheme of the Food and Agriculture Organization (FAO); International Oceanographic Commission, and the Man and Biosphere Programme of UNESCO; projects supported by the United Nations Development Programme (UNDP) in a number of areas in agriculture, environment, science and technology, and health and family welfare; programmes relating to control and eradication of a number of diseases with the assistance of World Health Organization (WHO); hosting the regional meteorological training centres of the World Meteorological Organization (WMO), and serving as one of the Regional Meteorological Centres of WMO’s Global Data Processing System.

**Third World Academy of Sciences (TWAS)**: The Indian scientific community has an active relationship with the TWAS. Launched by the Secretary General of the UN in Trieste, Italy, in 1985, the responsibility for administering its staff and funds was taken up by UNESCO in 1991. The objectives of the Academy are: (i) to promote excellence of scientific research in the South; (ii) to provide promising scientists from the South with research facilities for advancement of their work; (iii) to facilitate contacts between scientists and institutions of the South; and (iv) to encourage South-North cooperation between individuals and centres of scholarship.

Two important achievements of TWAS have been 1. the establishment of the Third World Network of Scientific Organizations (TWNSO) in 1988, and 2. the establishment of the Third World Organization for Women in Science (TWOWS) in 1993. The TWAS South-South Fellowship Scheme is aimed at promoting contacts between research scientists in the South and to further relations between their scientific institutions and has been well utilized generally.

The members of TWNSO in India include: Indian National Science Academy, National Academy of Sciences, Council of Scientific and Industrial Research, National Academy of Medical Sciences, and National Academy of Agricultural Sciences.

TWAS has supported a large number of research projects in Biology, Physics, Chemistry and Mathematics in India, supported Scientific Meetings in the country and awarded several South-South Fellowships to scientists.

The revolution in the field of information technology has made the world a smaller place to live in. At the same time, the economic and strategic interests of individual countries have given rise to newer and changing norms of relationship amongst them. It is inevitable that these considerations should also apply to their dealings in the fields of scientific research and application. The future years should witness newer forms of cooperative linkage emerging between nations. India, with its diverse and valuable experience of the past few decades, is ready to play an active part in this future enterprise.