Science as a symbol of new nationhood: India and the International Geophysical Year 1957–58

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The International Geophysical Year 1957–58 (IGY) enabled India to join the world club of science as an equal, modernize its existing institutions, support basic sciences unapologetically, and prepare ground for new initiatives directed towards nation-building and national prestige. More specifically, India's space programme emerged from the IGY exposure. At the same time, it accentuated the dependence of Indian science on the West for assessment and encouragement.

The International Geophysical Year 1957–58 (IGY) was the largest international field research programme ever undertaken. Although the programme was funded by various national governments, the management and organization was left to the scientists. IGY was overseen by the International Council of Scientific Unions (ICSU), a non-governmental organization representing both national scientific bodies and international scientific unions. To act as the governing body for all IGY activities, a Special Committee for the IGY (known by its French acronym, CSAGI) was formed in October 1952, under the chairmanship of Sydney Chapman. It was enlarged in March 1953 to include representatives from the constituent unions. IGY proper lasted for 18 months from 1 July 1957 to 31 December 1958. Its activities were continued till 31 December 1959, under the heading International Geophysical Cooperation. Eventually 64 countries participated in the IGY.

India with its vast size, extant institutions and scientific manpower turned out to be an important and enthusiastic participant. IGY has been called 'a poor man's programme'[1], in the sense that its scientific and technological requirements were quite modest and easily met by the industrial and educational India of the 1950s. (Subsequently as world technologies developed at a fast pace and basic sciences became more a child of high technology, India fell behind sharply.)

Historical background

The British could not have built and maintained an empire in India without the help of modern science and the natives. This brought Indians into contact with modern science. The empire-supported science in India was utilitarian and primarily field science. It was thus latitude-driven (unlike the IT-facilitated Western interest in India today, which is longitude-driven).

European men of science employed in the 19th century India were the highest paid anywhere in the world. In the course of time, Indians were trained and employed at lower levels. Inherent in the British rule over India was the slow and increasingly reluctant training of the Indians to eventually overthrow that rule. Indo-European linguistic commonality, then interpreted in racial terms, 'placed in the hands of the British Government a powerful instrument of connexion and conciliation' with the (upper-caste) Hindus, who in the course of time began turning Indo-Europeanism to their advantage. From 1870s onwards, the Indian leadership started demanding that it was the bounden duty of their English brethren to impart them (Indians) science education and raise them in the scale of nations[2–4].

Clamour for basic science education was the strongest in Bengal. The science laboratories of the government-run Presidency College, Calcutta, were among the best equipped in the world in their time[5]. Its two professors, the physicist Jagadis Chunder Bose (1858–1937) and the chemist Prafulla Chandra Ray (1861–1944), who began their work in the 1890s, were the world's first non-White mainstream modern scientists. Similarly, Chandrasekhara Venkata Raman's (1888–1970) 1930 Nobel Physics Prize was the first one to go outside the Western world.

At the time of the outbreak of the Second World War, there were two mutually exclusive streams in Indian science: routine science under the government, and nationalism-inspired research activity by Indians in the universities. The twain met during the war. 'It was a foregone conclusion that the British would leave India after the war. (India became free on 15 August 1947.) Indians were already in important positions in government as well as in industry and science. Though still working under British auspices, the Indians sought to dovetail their country's post-independence interests into the British exigencies of war'[6].

Since the government needed Indian help in its war efforts, a purely advisory Board of Scientific and Industrial Research was set up in 1940. It was a landmark, 'because it was the first time official funding was systematically forthcoming for research being carried out by individuals and organizations outside the government system'[6]. The Council of Scientific and Industrial Research (CSIR) established in 1942 'was seen merely as a clearing house'. It is noteworthy that Norah Richards' authorized 1947 biography of Shanti Swarup Bhatnagar (1894–1955) who headed both the Board and the Council, does not mention CSIR at all.

Indian science at the time of IGY

Throughout the world, all available scientific expertise was mobilized by the governments for their war efforts. But as soon as the war needs were over, the universities were re-energized. Not so in India. Unfortunately what was an outgoing foreign government's temporary compulsion became the abiding philosophy of a new nation. Independent India opted for government science laboratories at the cost of universities. CSIR was given a high profile and priority by Jawaharlal Nehru, who made the Prime Minister the ex-officio president of the CSIR.

The foundation stones of five national laboratories were laid between December 1945 and April 1947. National Physical

Laboratory (NPL), New Delhi was opened in 1950, with an internationally respected physicist K. S. Krishnan (1898–1961) as its director. Krishnan was the Vice-President of International Union of Pure and Applied Physics during 1951–57 and of ICSU during 1955–58. (Chapman is wrong in stating that Krishnan was the ICSU Vice-President for six years[1].)

A radio propagation unit was established at NPL in 1954 by Ashesh Prasad Mitra (1927–2007). A doctoral student of the pioneering atmospheric scientist, Sisir Kumar Mitra (1889–1963) at Calcutta University, A. P. Mitra went for a year to CSIRO, Sydney in 1951 and thence to Pennsylvania State University, USA, where he spent two years as an assistant Visiting Professor and Associate Professor in the ionospheric lab. His unit at NPL became the hub for ionospheric research under the IGY.

In 1945 (or 1944) the Indian Government appointed a committee under Meghnad Saha (1893–1956) for the [post-war] 'planning of Astronomy and Astrophysics in India'[7]. Though nothing substantial came out of its efforts, it does show the national concern for scientific upgradation in the newly independent nation. The Solar Physics Observatory at Kodaikanal, set up in 1899, which lay just half a degree north of the magnetic equator, was provided with a new magnetic observatory in 1948 (the earlier one set up in 1923 had long been dysfunctional). In 1951, an ionospheric division was added[8]. In 1954, the Uttar Pradesh State Observatory was established, and moved the following year to Naini Tal[9]. This came up on the initiative of Sampurnanand, then a Cabinet Minister and later Chief Minister.

In the meantime, two private laboratories had made a modest beginning. Homi Bhabha (1906–66) established the Tata Institute of Fundamental Research at Bombay in 1945 while Vikram Sarabhai (1919–71) set up the Physical Research Laboratory (PRL) at Ahmedabad in 1947. It was headed by K. R. Ramanathan (1893–1984) who had just retired from the India Meteorological Department (IMD). He served as the President of International Union of Geodesy and Geophysics from 1954 to 1957. Though privately owned in a legal sense, these laboratories were generously supported by the Government. While Bhabha or his institute had no role in the IGY, Sarabhai and PRL were actively involved.

Among the Government science organizations IMD, established in 1875, and All India Radio (AIR), founded 1930, had, and still have, a vast network of field stations. They were particularly useful and active during the IGY.

Preparations

India was thus ready for the IGY. It is not that India had not participated in international science before. Bose and Ray as well as others had been deputed to attend many conferences abroad, but there was an understandable defensiveness and consciousness about their country's slave status in their participation. S. K. Mitra was a participant in the International Polar Year 1932–33, but in a strictly individual capacity. But here was the new nation country with its whole apparatus ready to help its band of scientists to become an equal partner in the new world of science.

Indian association with the IGY began early enough. Two Indians, T. V. Ramamurthy (NPL) and Sarabhai were among the 12 observers drawn from nine countries who attended the first meeting of the enlarged CSAGI in Brussels in June–July 1953 to plan the IGY programmes. Similarly, Ramanathan participated in some of the later meetings of the CSAGI. The Indian national committee for IGY was formed in 1955 with Krishnan as the President and Mitra as the Secretary. S. K. Mitra, Ramanathan and Sarabhai were members of the Committee. There were others drawn from various Government scientific departments. The Committee formed 14 sub-committees to look after specific disciplines, ranging from aurora to world days.

IGY's prime mover, the American science administrator Lloyd Berkner, met the Prime Minister Jawaharlal Nehru in January 1957 and was assured all help. On 12 June 1957, a fortnight before the formal inauguration of the IGY, Krishnan gave a talk titled 'The International Geophysical Year and its significance' on AIR. The type-written text with corrections in Krishnan's hand is in the custody of his grandson, V. R. Thiruvady (Bangalore). (I thank D. C. V. Mallik, Indian Institute of Astrophysics, Bangalore, for making the text available to me.) It represents an effort to educate the initiated. A typical product of the historiography of the times, it begins with Columbus and then moves on to discuss Halley and Gauss, before delivering a class-room lecture on the science underlying IGY, 'undoubtedly the most extensive programme that has ever been undertaken by an international organization'. Krishnan went on to point out that 'All the various scientific organizations in the country, the observatories, the Universities, the Council of Scientific and Industrial Research, the scientific departments in the Ministry of Education and Scientific Research, Information and Broadcasting, Communications and Defence are participating in the programme'. He concluded thus: 'We are looking forward to a period of intense scientific activity, and we hope it will help us to solve at least some of the outstanding problems in Geophysics'.

Source material

Regrettably, the extant source material is extremely limited. No minutes of any committee are available nor any old correspondence or photographs. A film on the IGY was made by AIR but it is not traceable. Mitra wrote a popular account for *The Statesman*, Calcutta, but it is not readily accessible. Whatever is available in print deals with the scientific output rather than the history. On the occasion of Krishnan's 60th birthday in 1958, a special issue of the JSIR[10] was brought out on 'work carried out under the auspices of the Indian National Committee for the IGY 1957–1958'. A small 1985 monograph, *Indian IGY Programme: Achievements* by A. P. Mitra, provides useful but mostly technical information.

On 18 July 2007 Mitra kindly recorded in an interview with me his impressions of those days, which give us some feel for the times. (Mitra passed away on 3 September 2007.) I will draw attention to some of the scientific highlights and lowlights, but try to place the scientific outcome in a wider perspective.

Scientific activity

In the 19th century, India's geographical vastness was put to good use by measuring a great meridional arc. India's size, coupled with the fact that the magnetic equator passes through its southern tip, made the country an asset for the IGY. India already had good facilities for ionospheric, geomagnetic and meteorological studies. They could now be upgraded and expanded.

The whole of the 75°E longitude zone was monitored for ionospheric studies by India from 11 field stations, spread over 20° of latitude (8°29′–28°38′N). A new observatory was set up at Thiruvananthapuram, which lay as much south of the magnetic equator as Kodaikanal was north (half a degree). IMD took up the task of developing an ozone sonde with great enthusiasm and excitement[11]. In retrospect, the pleasure of making one's own instruments was a passing phase. Since India could not keep pace with the technological and industrial developments elsewhere, its laboratories soon became dependent on non-cutting-edge purchases from abroad.

During IGY, the Kodaikanal Observatory 'intensified and extended' its 'normal routine programme'. Along with the Nizamiah Observatory it observed solar flares, prominences, etc. and dutifully sent data to the world data centres as well as All India Meteorological Broadcasting Centre[10]. The IGY provided an opportunity for the much-needed modernization of the Kodaikanal Observatory, which at the time stood where John Evershed had left it half a century ago. Three new instruments were commissioned[1], but with mixed results.

A large solar tunnel telescope with an object glass of 38 cm aperture and 36 m focus was ordered from the well-known English firm, Sir Howard Grubb Parsons. The installation was done by the observatory astronomers and technicians themselves, without any help from the manufacturer. The telescope has been the mainstay of Kodaikanal ever since. For the Lyot coronagraph and the Lyot heliograph, it was decided to import only the essential parts and rig the other parts in the observatory itself. In retrospect, it would have been better to buy the instrument in its entirety, because the observatory failed to make these two facilities operational.

In those days, the best coronagraph objectives were those made by the associates of the late Bernard Lyot, who were 'busy astronomers and optical experts, not commercial instrument-makers'. To get the 20 cm aperture, 3 m focus objective made from Paris, 'personal influences and contacts' had to be used. Only the telescope was ordered. As the then Director of the observatory has recorded, the equatorial mount 'has been improvised by adapting components of disused old instruments and the optical accessories have been designed and built in the observatory's machine-shop and laboratories with the help of optical components already available in the observatory'[8].

Similarly, a hydrogen-alpha Lyot filter, along with a 15 cm aperture telescope objective and 'one or two small optical components', were purchased from Paris, while the 'whole design and the construction of all mechanical parts for the complete heliograph' were carried out at the observatory[8]. The coronagraph and the heliograph were never really used. Soon thereafter, with the arrival of M. K. V. Bappu as Director in 1960, the focus shifted to night-time astronomy from the new facility at Kavalur, Tamil Nadu.

Non-successes

Before proceeding further, let us briefly take note of non-successes. On the express suggestion of Chapman, a programme was launched to visually look for the rather low-latitude aurorae. But none was sighted. More seriously, longitude and latitude determination under the Survey of India remained more or less a non-starter, because the Survey was used to keeping confidential the results of its work, although this itself was not public. Although Antarctica was a part of the IGY programme, it did not interest India then. It was only in 1981 that India, under the Prime Minister Indira Gandhi, began its Antarctica programme[12].

Mitra[11] lists a total of 265 publications as IGY publications. The entries are of uneven quality. Even publications as late as 1966 are mentioned. Some of them must be repetitive, being conference papers. It is for scientometric experts to analyse the available publication data. But, even taking the lists at face value, some interesting conclusions can be drawn. Ionospheric studies rank first output-wise with 62% of the listed publications, cosmic rays a distant second (11%) followed by geomagnetism (8%) and meteorology (7%).

Space programme

While most of the success that attended Indian efforts was incremental, an entirely new vista was opened by the IGY. India was introduced to the new field of satellites. Naini Tal Observatory was one of the 12 world stations equipped with a Baker-Nunn camera by the Smithsonian Astrophysical Observatory (SAO), to optically track artificial earth satellites. This part of the IGY programme was overseen by the director of Naini Tal Observatory, Bappu (1927–1982), who was educated at Hyderabad and sent to Harvard Observatory on a Government scholarship for his Ph D[13]. Bappu's Harvard connection was a great help because the SAO's new dynamic director, Fred Whipple was also from Harvard[14]. Unlike the other satellite-tracking stations that were under SAO's control, the Indian station would be 'under the complete jurisdiction of local astronomers'.

The non-scientific dimension of the project was lost on none. Krishnan rather indelicately and to the embarrassment of the Soviet representatives remarked publicly that 'it was wonderful that the US was taking the world into confidence on the satellite program so that all nations could cooperate'. He said further that it was a shame that the satellite program of the USSR was so secret and he hoped they might follow the example of the US. On its part, USA was sensitive that the project should be viewed as international and not American. Whipple wrote that 'the scientific advantages would be marked for both of our great countries'[14]. The importance that the US attached to satellite tracking programme under the IGY can be gauged from the fact that *New York Times* carried a news item datelined Naini Tal, where the reporter made it a point to mention that both Soviet and American satellites would be tracked and the information 'will become part of the treasury of scientific data' of the IGY[15].

The Baker-Nunn camera was shipped to India in March 1958, and the first track recorded in September 1958. For the first few years an observer from SAO worked with the Naini Tal staff. The project continued well beyond the IGY, i.e. till 1976. Thanks to the project, the geographical location of the camera was recorded to an accuracy of better than 10 m, so much so that 'the Survey of India tied its triangulation network to this benchmark'[16].

It will be no exaggeration to say that the IGY experience paved the way for the Indian space programme under Sarabhai. He had already been interested in observational studies of the impact of solar activity on cosmic rays. The IGY exposure helped Sarabhai expand his horizons. In 1962, an Indian National Committee for Space Research was set up. The very next year there came up the Equatorial Rocket Launching Station at Thumba near

Thiruvananthapuram. The Indian Space Research Organization was established in 1969, and India's first satellite, *Aryabhata*, named after the 6th century Indian astronomer, was launched in 1975, and tracked at Naini Tal from the facility set up during the IGY.

Arnold Frutkin, who was the director of NASA's Office of International Programmes from 1959 onwards, has an interesting story to tell (www.jsc.nasa.gov/history/oral_histories/). USA was planning the Satellite Instructional Television Experiment (SITE), which could broadcast into home-receivers, provided the host country set up some simple equipment. NASA wished to have a big country like India participate. The India desk in the state department however declined to approach India, because India had earlier refused permission to Voice of America to set up its broadcasting stations. The fact that SITE was not propaganda but science cut no ice with the officials. Frutkin then decided to take matters into his own hand. Frutkin knew Sarabhai well as he had been dealing with Sarabhai on sounding rocket programmes. He persuaded Sarabhai not only to arrange for India's participation, but also to write as if the initiative was coming from India itself. The programme was such a great success from the Indian point of view that the country unsuccessfully tried to get the availability of the US satellite extended for another year. India then decided to make use of commercial satellites and eventually developed its own satellite network as part of the INSAT programme.

General remarks

Mitra, in his recorded conversation made some interesting points. Enthusiasm for the IGY was not confined to the scientists alone. It permeated the officialdom also and that too at all levels. It is not that instructions had to be obtained from higher authorities for obedience down the line. A postcard containing scientific data from Taiwan was intercepted and destroyed by the Bombay Customs in accordance with the prevailing rules. The Customs was however decent enough to inform the IGY secretariat. The matter was taken up with the Ministry of External Affairs and scientific correspondence exempted from censor. An American scientist set out from Hawaii for India, only to discover in New York that he needed an Indian visa. It was an easy matter for Mitra to persuade the Indian embassy in the US to immediately issue a visa.

The IGY also had a rather negative influence. Although India's tryst with modern scientific research began more than a century ago, it has never been self-assessing. It has depended on the West for encouragement and recognition. This may have been understandable during the Colonial period, but the internationality of the IGY gave a new lease of life to this attitude. Indian choice of research problems has often been dictated by the availability of post-doctoral positions in the West, especially in USA, and the possibilities of an invitation for a conference or a visiting position. At least in the years immediately after independence, the role of science in nation-building was recognized. Now, 60% of Indian GDP comes from the services sector, which is science less. As the Indian economy becomes more and more derivative, so does Indian science. India does not seem to need science anymore.

The greatest asset India had at the time was a band of young energetic scientists ready to work hard and make the programme a success for the sake of science and their own career. As Mitra recalled: 'That was a good time to be a young scientist in India'. IGY provided an opportunity to Indian scientists not only to build international contacts, but also to come to know one another. Also, the image of science and scientists got enhanced in the eyes of the administration and the nation in general.

At the time of the IGY, the Indian nation was young and so were its science and scientists; in the sense that its technological and engineering requirements were rather modest. Fifty years later, things are not quite the same for the International Heliophysical Year (IHY). There are hardly any young scientists in the country. Also, science is now a child of high technology. If India is to make even a partial success of the IHY, some of the spirit of the bygone days will have to be revived.

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