ASHESH PROSAD MITRA

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ASHESH PROSAD MITRA

(1927-2007)

Elected Fellow 1961

EARLY LIFE AND EDUCATION

ASHESH PROSAD MITRA was born in Calcutta (now known as Kolkata), West Bengal, as the eighth child to Sh. Ambika Charan and Smt. Subarna Prova on Feb. 21, 1927 and therefore was nicknamed as Gopal (one of the names of Lord Krishna – the eighth child of mythological legends Devki and Vasudeva). Ambika Charan was a mathematics teacher in Town School, Calcutta while Subarna Prova was a homemaker. Being a son of school teacher, Mitra inculcated from his father the high standards of honesty, integrity, modesty, discipline and benevolence. Mitra had his primary, middle and high school education from 1932 to 1942 at Town School. Being a brilliant student, he was always at the top of the class and was greatly influenced and inspired by his geography teacher whose practical demonstrations excited him a lot.

Mitra passed the Matriculation examination of Calcutta University in 1942 and stood first-class-first with record marks and secured Distinctions in Bengali, Mathematics, Additional Mathematics, Geography, History and Sanskrit. He was honoured with a gold medal by the Calcutta University for standing first and was at the top in the scholarship list also. Noting Mitra's exceptionally brilliant performance in the Matriculation examination, the Principal of Bangabasi College, Calcutta approached Ambika Charan (Mitra's father) with a request that Mitra joins Bangabasi College for Intermediate classes (10+2). Being an obedient son, Mitra joined the Bangabasi College without any hesitation. At Bangabasi, he was greatly influenced and inspired by teachers like Ladli Mohan Mitra (Chemistry Lecturer), Pramod Kumar Sen (Physics Lecturer), and Jagdish Bhattacharya, teacher of Bengali Literature. The teachers at the Bangabasi College were so fond of Mitra that many a times they would wait for him before starting their lectures.

Mitra passed his ISc examination in 1944 and secured Distinctions in Physics, Chemistry, Mathematics, Botany and Bengali. He stood first in Bengali and was awarded Dwindra Lal scholarship and Bankim Chandra gold medal. He completed his BSc in Physics honours in 1946 in first class from the famous Presidency College, Calcutta. He did MSc in Pure Physics in 1948 and was first-class-first of Calcutta University. For this brilliant performance, he was awarded a gold medal and the Prem Chand Roy Chand studentship. Sisir Kumar Mitra, Meg Nad Saha and

Satyendra Nath Bose, were his teachers during his MSc studies in the Calcutta University and Mitra was immensely influenced and inspired by all these brilliant scientists.

DOCTORAL AND POST-DOCTORAL WORK

After completing his MSc in Pure Physics, Mitra joined as a Research Assistant under Professor SK Mitra, in the CSIR sponsored scheme "Ionospheric Investigations" which was being operated at the Wireless Section of Physics Department of the Calcutta University. He was Research Assistant from 1949 to 1951 and during this period he worked for his PhD degree and completed his thesis entitled "Ionospheric Physics". He generated one of the first exhaustive studies of the ionospheric D- region, then an emerging area of unusual scientific interest. At the same time he also worked on the effects of solar tides in the ionosphere and did pioneering work in this field. He immensely contributed in the revision SK Mitra's famous book, "The Upper Atmosphere" (Asiatic Society), which was first published in 1947 and was being revised then for its second edition.

Mitra had written up his PhD thesis in 1951 and was waiting to complete the minimum post registration period required for submission of the thesis. Meanwhile, he was offered a Colombo Plan Fellowship at the CSIRO, Sydney, Australia in the Division of Radio Physics under the famous radio astronomer JL Pawsey. He left for Australia in 1951 and could complete the various formalities required to qualify for the PhD degree much later. As a result, he obtained the PhD degree from Calcutta University as late as 1955. At the CSIRO Mitra, in collaboration with the famous radio astronomer Alex Shain, discovered cosmic radio noise absorption as a new technique for studying the D- and F-regions of the ionosphere. The technique was applicable to the topside ionosphere also—a region then inaccessible to available methods. The cosmic radio noise technique later called 'Riometer', came into continuous use at several stations in the world, for detection of solar flares as well as of atmospheric nuclear explosions, and provided a powerful tool for monitoring flare proton bursts. This technique worked on a very simple idea. The galaxy emits radio noise all the time. This noise suffers absorption when it passes through the earth's ionosphere and measurement of this noise provides information on ionospheric conditions.

It was a matter of great coincidence that the URSI (International Union on Radio Science) General Assembly was held in 1951 at Sydney when Mitra was working there. Dr. KS Krishnan, the then Director of National Physical Laboratory, New Delhi, was also a participant. Krishnan was looking for a young scientist who could start radio science related research at the NPL. He had heard about Mitra's brilliant work from SK Mitra who too was attending the URSI-GA Krishnan met Mitra during the URSI-GA and offered him the position of Secretary, Radio Research

Committee at NPL, New Delhi. Mitra accepted the offer but explained that there were a few foreign assignments which he was committed to complete before returning to India. Krishnan kept the offer open and asked Mitra to join NPL at his convenience.

Before the expiry of the Colombo plan fellowship, Mitra had been offered the position of a Consultant by the Defence Research Telecommunication Establishment, Ottawa, Canada which he took up for a very brief period. Soon there was another important offer on the way. Impressed by Mitra's outstanding work in the ionospheric D-region as well as on the discovery of cosmic radio noise technique, AH Waynick, the then Director Ionospheric Research Laboratory, Pennsylvania State University, appointed Mitra as a Visiting Assistant Professor in the Department of Engineering Research (1952-53). This position was soon upgraded to Visiting Associate Professor for the period 1953-54. Other Visiting Professors at that time were: M Nicolet of Belgium, O Rydbeck of Sweden and VA Bailey of Australia. The concept of ionospheric chemistry was introduced during that period by Nicolet and Mitra. Some of Mitra's major work on the Physics of the lower ionosphere, its photochemistry and early reference models of D-region recombination coefficient were published in leading ionospheric/atmospheric Journals during that time.

PROFESSIONAL CAREER AND EARLY SCIENTIFIC CONTRIBUTIONS

Mitra returned to India to take up the position of Secretary, Radio Research Committee, (RRC) at the National Physical Laboratory, New Delhi, in 1954. Krishnan was then the Chairman of RRC. This committee had often expressed the need for a national level organization that could co-ordinate the ionospheric data recorded at the various ionospheric stations in India and also forecast radio wave propagation conditions well in advance on regular basis. At that time, planning of radio communication by the various agencies depended on the basic predictions obtained from the UK and Australia. The RRC had also recommended that this reliance on external sources in this critical area should be discontinued. Therefore soon after joining NPL, Mitra initiated an Ionospheric Prediction Service based on a new method of predicting solar activity. This service provided over a period of more than 50 years by NPL is now of international repute. The first co-ordinated bulletin, which contained data from six ionospheric stations was issued in January, 1955, only a few months after Mitra had joined NPL, thereby fulfilling the requirement expressed by the RRC.

Realising the need for extending radio systems beyond the very narrow region of MF and HF then in use in India, Mitra introduced research activities in the VLF and VHF, thus extending frequency usage at both ends. For this, some very novel methods were exploited. In both of these activities natural radio emissions were used—in one radio noise from atmospherics and in the other radio noise from

galaxy. And in 1957, when the IGY began, a national committee was formed with Krishnan as Chairman and Mitra as Secretary. This committee co-ordinated national programmes, under a system of controlled inter-comparison—a concept which was perhaps introduced for the first time. Much of the coherence in the nationally co-ordinated programmes that became possible in the area of radio and atmospheric sciences was a consequence of this effort. Some outstanding examples which followed were the International Quiet Sun Year, IQSY (1964-65), Middle Atmosphere Programme MAP, (1981-83), International Geosphere Biosphere Programme IGBP, (1991 onwards), and the Indian Ocean Experiment INDOEX (1997-99).

Mitra's group was officially designated as Radio Propagation Unit and soon integrated with the NPL staff in 1960. A number of positions at the level of Junior Scientific Assistant/Senior Scientific Assistant were created to undertake the new IGY programmes and as many as nine younger people, all fresh post-graduates, joined Mitra's group during the late fifties.

With the launch of Sputnik-I, the new area of Space Research came into vogue. Mitra immediately initiated four major programmes in this area, namely: (1) radio patrol of solar flares, (2) the use of satellite drag observation to generate atmospheric density models (3) the reception of satellite radio beacon transmissions, to measure ionospheric electron content and (4) ion chemistry with rocket borne experiments for D-region studies. Some important pieces of research works which came out of these programmes were: (a) early results on solar flare effects in the ionosphere, (b) daytime ionospheric loss processes including a recombination coefficient model from 60 to 600 km and (c) atmospheric density and temperature models from 130 to 1000 km from satellite drag data. Some of these works were widely reported by the national newspapers. Because of this exemplary research output, Mitra was promoted to the position of Assistant Director in 1957 - a position which then had a pay scale better than a Deputy Secretary to Government of India. He was the youngest Assistant Director and there were less than a dozen scientists of this rank in NPL then!

In February, 1960, Krishnan proposed Mitra's name for election to the Fellowship of Indian National Science Academy (then known as National Institute of Sciences). Mitra was elected the same year, with the fellowship effective from 01 January, 1961. He was less than 34 years then and was one of the youngest fellows of INSA. It needs to be mentioned that he was perhaps, the first scientist to be elected to this prestigious fellowship based upon work done in NPL. At about the same time, he was elected as a member of commission V of URSI on "Frequency Allocation for Radio Astronomy" He had by then established himself as a scientist of international repute in the field of Radio Science.

By early sixties, Mitra had got associated with several international organizations like URSI, COSPAR and thus represented India in several

international meetings. The most important international assignments at that time happened to be his Chairmanship of the COSPAR working group on "Data and Publications". Professor Van de Hulst, (the then President of COSPAR), Dr. R Porter (the then President, US Space Science Board) and Prof. Federov (USSR Academy of Sciences) invited him to undertake a trip to the USA and USSR in connection with space data and its publication. In this trip he met the most prominent people who were to decide and evolve a generally agreed set of principles concerning collection, publication and exchange of scientific data on space research. As a result of this meeting, procedures acceptable to both these countries for mutual exchange of space data and dissemination of such data to other countries were formulated. These guidelines went a long way for international co-operation in the area of space science, especially during the years of cold war.

From the early sixties, Mitra started supervising students for PhD degree. Some of those who registered under his guidance at various universities then were KA Sarada, KK Mahajan, BCN Rao, VP Bhatnagar, TR Tyagi and NR Mitra (a visiting lecturer from Bhagalpur University). In the years to come, dozens of students got registered under his supervision, mostly at the Delhi University and successfully obtained their PhD degrees. By this time the Radio Propagation Unit of NPL had established itself as one of the foremost group in the area of ionosphere and space research. Other important groups were at Andhra University, Waltair (headed by BR Rao); PRL, Ahmedabad (headed by KR Ramanathan) and Calcultta University (headed by JN Bhar).

In 1963, Professor PMS Blackett, was invited by Govt. of India to review the performance of the all the laboratories of CSIR. He reviewed NPL also and rated the achievements of Mitra's group as first class. He was very appreciative of Mitra's programme on Space Research. As a result, Radio Propagation Unit saw a lot of expansion in terms of new positions at senior levels and well known radio scientists YU Somayajulu, AK Saha and BM Reddy, joined Mitra's group. Additionally, Mitra was given a merit promotion, effective from 1964 and he was then the youngest Deputy Director in NPL.

LEADERSHIP IN NATIONAL PROGRAMMES IN ATMOSPHERIC SCIENCES

Mitra played a pivotal role in visualizing and planning national space science programme in the area of atmospheric sciences. In fact he was a Member of the very first Indian National Committee on Space Research, constituted in the early sixties. Although it was a committee of the Indian National Science Academy, the chairman of this committee always was from the Department of Space and more often it used to be Chairman, ISRO. Consequently almost all the space science programmes were discussed and formulated by this committee. A few years later, this role was given to ISRO's. Advisory Committee on Space Science (ADCOS). To start with, Mitra was a

Member of this Committee. Later on he chaired this committee for several years and thus shaped and supervised the various space science programmes for the department of space. Most of the early programmes dealt with the rocket exploration of equatorial ionosphere and some of these programmes were in collaboration with other advanced countries like the USA, USSR and France. Mitra was keen that Indian Universities take up space related programmes and as a start he gave a one-month course on Space Research at BHU way back in 1964. This was the first such training course in this upcoming area.

Mitra was awarded the prestigious Bhatnagar prize for physical science for the year 1968 in 1972. This prize was then being announced with considerable delays. At about the same time, CSIR introduced a new merit promotion scheme for recognizing and honoring talented scientists in its laboratories. Under this scheme, scientists of the rank of Deputy Directors could be promoted to the salary scale of a Director, with nearly the same benefits and facilities as drawn by the Director of a laboratory. Mitra was one of the first beneficiaries of this scheme and was promoted under this scheme in 1974.

In the early seventies, Ministry of Defense, on advice from DS Kothari the then, Advisor to MoD, approached Mitra to take up research in Tropospheric Radio Communication at the NPL. A centre on tropospheric research, CENTROP, funded by the Ministry of Defense was setup at the NPL, with Mitra as its Head. Tropospheric communication needed information on water vapour, rain, thermal and refractivity gradients. Thus new and sophisticated techniques were introduced by him to add and improve upon the information available from India Meteorological Department Mitra, with the help of SP Singal of Acoustic Section of NPL, set up the first SODAR facility in India, an acoustic monitoring system for the lower atmosphere. This SODAR was designed and produced by NPL. This facility proved very useful for monitoring of boundary layer, since SODAR could locate and measure the intensity of thermal as well as velocity anomalies. Several SODARs were then setup at various institutes in India, with NPL's collaboration.

Another new technique introduced was the monitoring of water vapour, rain and cloud attenuation with microwave radiometers which were the first of its kind. An outstanding work of CENTROP, under the leadership of Mitra, and SC Majumdar who was earlier with the Department of Aviation was the preparation of an Atlas of tropospheric radio refractivity over the Indian subcontinent. The Atlas contained information on pressure, temperature and humidity recorded at various meteorological stations—parameters required while designing systems for tropospheric communication at microwaves. In addition a new formulation of tropospheric radio environment, that replaced the universally used US methodology, was introduced.

By introducing tropospheric radio research, Mitra contributed in an important way in improvement of tropospheric communication in India. He had developed a scientific base for troposcatter design and performance analysis and for estimation of radar target errors. He helped the Indian Air Force in their radar communication systems, which gave them superior detection capability in difficult terrain.

Dr. Mitra soon got into another new area in atmospheric chemistry, which was just emerging often due to the works of Nobel Laureate Paul Crutzen and HS Johnston, who drew world's attention to the potential hazards of supper sonic transport. They argued that the super sonic aircrafts, through their large scale injection of nitric oxide in the atmosphere, could destroy ozone in the stratosphere. Mitra wanted to devote full time to this new area but with the expansion of several scientific programmes in the Division and because of other administrative responsibilities, it was getting difficult for him to find enough time. He therefore took up Jawahar Lal Nehru Fellowship for a two year period, from 1978 to 1980. During this fellowship he produced a detailed work on "Human Influences on the Atmospheric Environment", which included problems like (1) ozone destruction, and (2) inadvertent (or planned) modification of the higher regions of the atmosphere either through injection of active materials or through high power HF radio heating.

While SST debate on ozone resulted in the cancellation of SST development in the USA, the discovery of ozone hole in the Antarctica highlighted the destruction of stratospheric ozone as a major international issue. Mitra, through the Indian Middle Atmosphere Programme, IMAP identified ozone measurements and ozone chemistry as the major theme of the programme. On Mitra's initiative several high altitude balloons were launched in Dakshin Gangotri during the 6th Antarctic expedition to study the ozone hole. He was also instrumental in the establishment of new techniques like Laser Heterodyne System built by SL Jain and the 96 GHz radiometer built by RS Arora for accurate measurements of ozone profiles.

Mitra organized and supervised IMAP which was taken up as a part of the International Programme to study the region between 15 to 85 km. This region is specifically vunerable to humane activities and serves as a long-term reservoir of manmade emissions. It probably also holds the key for the long-term changes in weather and climate. Therefore during IMAP a variety of optical, radio, acoustic techniques with sensors located at the ground, in balloons and in rockets were employed. The programme originally was to end up on Dec. 31, 1985 but was extended to March 1989 and was the most extensive since the IGY. Mitra introduced the concept of "Campaigns" with specific objectives during this programme. Several campaigns like the "stratospheric ionization", "aerosols", "atmospheric dynamics" and "solar radiation" were undertaken. The organization practices used during the

IGY and IQSY went a long way in making the IMAP one of the most successful programmes in the area of atmospheric sciences.

AS DIRECTOR NPL AND DG-CSIR

Mitra was appointed Director of NPL in April 1982. As a Director, he introduced new concepts of management. He created several committees for the smooth working of the various laboratory programmes as well as for administrative transparency. The committees were not only for decision making, but for implementation of the decisions as well. Chairmen of committees were given the powers of the Director in their respective areas. This was a kind of a very bold step because most Directors would not like to delegate their powers to juniors as this could make them appear powerless. But, Mitra this way, cut off a lot of his administrative load and found more time for his research. The chairmen of committees were directly answerable to some searching questions by "Workers Union" and "Scientists Association". All scientists and other staff members nostalgically remember those good days when most things were done without much administrative delay.

In view of his significant and long lasting contributions to the field of Radio Science, Mitra was elected President of URSI in 1984. Mitra was the first Indian and the second Asian to be elected to this position. During his tenure as URSI President, Mitra introduced the young Scientist Programme. Under this programme, scientists below the age of 35 were provided travel and living expenses by URSI to attend the General Assemblies, which are held once every three years. This programme has since been continuing.

Mitra's reputation as a very mature and successful Director, as well as an outstanding scientist had been noted by the PM's office. Late Sh. Rajiv Gandhi, the then Prime Minister of India asked Mitra in Feb. 1986 to take up the position of Director General of CSIR. During his five years term as DG, Mitra introduced several schemes for the welfare of scientists and other staff. The assessment promotion scheme was modified so that a scientist could be promoted to the level of a Director. In additions quotas and percentages used earlier in promotions, were removed. All scientists were provided funds to become members of professional societies. They could also buy Journals. Mitra also introduced a new position called "Shanti Swarup Bhatnagar Fellow", which had all the benefits and facilities, as provided to a Secretary, Government of India. These positions were offered by CSIR only to some brilliant scientists and there was no upper age limit. Mitra also introduced the young scientist awards for the CSIR scientists. As DG-CSIR, Dr. Mitra had a very cordial relationship with all the Directors of the 42 CSIR Laboratories.

AS AN ENVIRONMENTAL SCIENTIST

During his tenure as DG-CSIR, Mitra was elected to the fellowship of Royal Society in 1988 for his outstanding contributions in the field of physical sciences. Soon after, he was awarded the Padam Bhushan by the President of India in 1989. During this period Mitra played a leading role in the initiation of International Geosphere Biosphere Programme (IGBP) on Global Change—a very broad programme aimed at understanding the interactive physical, chemical and biological processes that regulate the total earth system; changes occurring in this system, and the manner in which these changes are influenced by human activities. It is known that in geological times major global changes have taken place. But these changes were due to natural processes and forcings that were generally slow thus involving tens of thousand of years for the change. However, the last century has shown that the rapid industrialization can bring global changes much faster.

During the very early years of the Indian global change programme, there were two important achievements by Mitra. One was the preparation of the national inventory of greenhouse gases and the other was an extensive campaign, with the help of Analytical Chemistry Section of NIL for the measurements of methane emissions from paddy fields. This campaign was carried out in 1991 through a very carefully organized network and was continued as part of the ALGAS (Asian Low Cost Greenhouse Gas Abatement Strategy) Programme and MAC-98 (Methane Asian Campaign). These measurements lead to downward revision of the Indian methane flux from 40 Tg/yr to 4.0 Tg/yr by the Inter government Panel on Climate Change. Mitra gave the name "Home Grown Science" to this effort, which he thought was essential to counter the climate change politics. He expressed on many occasions that in the absence of data, the developing countries might face the threat of limiting industrial growth, energy production and agriculture yield. This could retard their struggle towards better quality of life. He therefore felt that the developing countries must equip themselves with a sound scientific database. In view of his important contributions in the area of greenhouse gases, Mitra was inducted as a member of the high level Advisory Committee on Climate Change in the Ministry of Environment and Forests (MoEF) and he remained in that position for several years. He played a leading role in the creation of an exhaustive and authentic database for "Climate Change Negotiations" by this ministry. Mitra was also the Chairman of the South Asia START (SysTem for Analysis, Research and Training) Committee (SASCOM) during 1944-1998. During his tenure, as chairman SASCOM, he established the South Asian START Regional Centre at NPL and continued to direct the activities of the centre until his death.

A major international event which substantially modified the perspective of climate change at regional and sub-regional levels was the INDOEX (Indian Ocean Experiment) of 1999 in which Mitra led the Indian Scientific Team. This international

programme involved several hundred scientists from the USA, Europe, India and Island countries of Maldives and Mauritius. The results of this experiment revealed the existence of an extensive brownish layer of pollutants and particles resulting from biomass burning and emissions. This brownish layer has now been identified by satellites at other parts of the world also. This discovery led to an important international programme, called the "Atmospheric Brown Layer" (ABL). A major consequence of INDOEX has been that it is now recognized that greenhouse gas warming, urban pollution and atmospheric ozone are indeed inter- related problems.

During the last few years, Mitra concentrated his efforts on problems relating to emission of trace gases including greenhouse gases and particulate matter emanating from mega-cities. This study was initiated to find out viability of various mitigation options which could be undertaken to reduce these emissions. It is well known that mega-cities contribute significantly to the national inventory on emissions of most of the gases. At the same time, these cities also provide the right platform to explore methods for mitigating these emissions. A range of options suggested by Mitra were from as simple as: change in the attitude, like sharing cars, efficient and justified use of electricity etc., to as complex as: technological options, like use of energy efficient construction materials, energy saving structures and designs use of roof tops for production of electricity by solar photo voltaic and integrating that in grids etc.

Mitra played a key role in setting up some large international level facilities and centres such as the MST radar at Gadanki, near Tirupati, the Free Air Carbon Dioxide Enrichment (FACE) facility at the Indian Agriculture research Institute, New Delhi, the Bose Institute of High Altitude centre for Astro-particle Physics and Space Sciences at Darjeeling and Regional Facility on Radio Science (RFRS) at NPL, New Delhi. Just a week before his death, a MoU of co-operation with URSI was signed by him as chair of RFRS.

AS A CONFERENCE ORGANIZER

Mitra was instrumental in introducing the culture of symposia and workshops in India in the area of radio and space sciences. During his lifetime, he was associated with the organization of several national and international conferences. The beginning was made in 1961 when he organized a national symposium on results obtained by the Indian scientists during the IGY. This was followed by the IQSY symposium in 1966. Then from 1971, under Mitra's leadership, NPL started organizing biannual symposia on radio and space sciences. In fact that was the origin of the current biannual space science symposia, now being organized by the Department of Space. Additionally, Mitra organized several symposia and workshops on topical subjects like Stratospheric Ozone, Green House Gases, Global

Change, Middle Atmosphere, INDOEX. Mitra played a key role in the organization of the IAU conference in 1986 and the URSI General Assembly in 2005, both held in Vigyan Bhawan, New Delhi. The foreign delegates had a very pleasant and memorable experience of these two conferences because of the excellent hospitality and decent local arrangements provided by the organizing committee.

Mitra never missed any opportunity in attending international conferences related to URSI, COSPAR, SCOSTEP, Middle Atmosphere, Green House Gases and Global Change and as a consequence he was often on travel. Because of his frequent foreign visits, some of his colleagues and friends nicknamed him "Air Port Mitra". But it must be appreciated that after attending these conferences, he used to implement the new ideas and directions gathered by him during these visits. Some of the experimental techniques introduced by him in the Radio Science Division of NPL were an outcome of these visits.

HONOURS AND AWARDS

Because of his outstanding researches, Mitra earned several honours and awards. He was: (1) Elected Fellow of the Royal Society (1988), (2) Awarded the "Padma Bhushan" – a civilian honour, by the President of India (1989), (3) Elected President, International Union of Radio Sciences – URSI (1984-1987), (4) Served as Member, General Committee of International Council of Scientific Unions (1984-1988), (5) Elected Fellow – Indian National Science Academy (1961), (6) Elected Fellow, Indian Academy Sciences (1974), (7) Elected Fellow of the Third World Academy of Sciences (1988), (8) President, National Academy of Sciences (1992-1993), (9) Elected Honary President, URSI (2002) – Lifetime, (10) Awarded Jawahar Lal Nehru Fellowship (1978-1980), (11) Awarded Shanti Swarup Bhatnagar Fellowship (1991-1996), (12) Awarded Senior Homi Bhabha Fellowship (1996-1998), (13) Bestowed Shanti Swarup Bhatnagar Memorial Award for Physical Sciences (1968), (14) Bestowed CV Raman Award of University Grants Commission (1982), (15) Bestowed Om Prakash Bhasin Award for Physical Physical Sciences (1987), (16) Bestowed FICCI Award for Physical Sciences (1982), (17) Bestowed Meghnad Saha Golden Jubilee Award of Indian Association of Science (1991), (18) Bestowed Modi Science Award (1992), (19) Bestowed Vasuic Award on Environmental Science and Technology (2002), (20) Awarded Meghnad Saha Medal by Asiatic Society (1994), (21) Awarded SK Mitra Centenary Medal by Indian Science Congress Association (1995) and (22) Awarded DSc (Honors Causa) from Universities of Manipur, Kolkata, Jadavpur, Burdwan, North Bangal, Vidhyasagar.

ROLE IN POLICY MAKING BODIES

Mitra served COSPAR in various capacities, played a major role in IGY was formerly: (1) Chairman, National Committee for International Union of Geosphere-Biosphere Programme (1991-1994); (2) Chairman of START – SASCOM and Director,

SASCOM-RRC; (3) Chairman, Indian Advisory Committee on Space Sciences; (4) Chairman, Governing Council of National Council of Science Museums; (5) Chairman, SAC–NMRF; (6) Member ICSU Executive Board and Chairman, ICSU Finance Committee, (7) Bureau Member in ICSU Scientific Committee on Solar-Terrestrial Physics; (8) Member, Council of United Nations University; (9) Member, Scientific Planning Group, Asia Pacific Network, (10) Adviser, Ministry of Environmental and Forests on Global Environment and (11) Member, Advisory Committee on Climate Change, Ministry of environmental and Forests.

HUMANE AND ARTISTIC QUALITIES

Mitra was very friendly with his students and colleagues. He would invite them for parties at his residence and at social functions. Some of these colleagues became his life time friends. During his early years at NPL, Mitra used to take his students and colleagues to his residence, and get engaged in playing bridge for long hours. Also he was a very kind hearted person. The great quality in him and admired by all, was that he never talked ill of any body. Another great asset he had, was his a very photogenic memory. He could store a large amount of scientific and literary information in his brain and recall it at the right hour. As result he could take correct and quick decisions. Mitra supervised dozens of students for the PhD degree, and thus was instrumental in developing a large reservoir of human resources in the area of radio and atmospheric science.

Mitra played an important role in popularizing science. He wrote several articles on topics like radio science, atmospheric environment, global warming, in English as well as in Bengali. He used to give public lectures on these topics at schools, colleges, universities and at other places like Rama Krishna Mission. As Chairman of National Council of Science Museums, he played a very important role in the creation of Science City at Calcutta.

Mitra had artistic qualities too. He was a voracious reader and used to buy latest fiction and non-fiction books in English as well as in Bengali literature. He used to write poems during his younger days. He was fond of music and had a vast of collection of tapes, videos and DVDs which he used to play in the background while working.

A FAMILY MAN

Mitra married Sunanda Mitra (Née Ghosh) on 12 Aug. 1956 and had two daughters, Anasua, an architect and Patralekha (Mila Mitra), an astrophysicist. Sunanda is a talented dancer, a very friendly person and a great hostess. The daughters too are excellent classical dancers and have excelled in their professional work.

Mitra was a family man. He rarely attended a social gathering without his wife. Due to his professional involvements in several national and international

committees, he was on travel quite often. In his absence Sunanda used to handle all issues and problems of running a house very diligently. She was the strength behind this great man and she provided all the support which he needed to achieve his professional goals.

Mitra never sent his children to private tutors. He used to spend most of the evenings at home coaching his children. He encouraged them to take lessons on classical dances and read books on art and literature. Tushu and Mila, along with their mother, gave several stage performances of classical dances during cultural programmes organized by NPL for delegates attending national and international symposia.

LAST DAYS

Mitra expired in the early hours of 3rd September 2007 due to kidney failure. Prior to that he had been coming daily to the National Physical Laboratory (even on weekends) as "Honorary Scientist of Eminence". In fact he came to work in the laboratory a day before his death. Although, he had problems in climbing stairs at home and in the laboratory (when the lift was not operating), he used to climb up and down with brief halts. On the fateful day, he enquired with the doctor at AIIMS, if he could attend a meeting scheduled for 3rd September at the Ministry of Environment and Forests. That was the kind of zeal he had for work.

Sunanda, Anasua and Patralekha were with him at AIIMS when Mitra breathed his last.

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