Asoke Nath Mitra

N. Panchapakesan

Asoke Nath Mitra has been associated with Delhi University since 1944, when he joined Ramjas College. His father, D. Jatindra Nath Mitra was a distinguished teacher of mathematics in the College. Mitra joined the physics department in 1949 as a Ph D student of R. C. Majumdar after completing his M A in mathematics with flying colours. He was also involved in teaching (part-time) undergraduate classes. That was when he taught my class a course in mathematical physics, which included differential equations. He also taught a senior class having P. K. Kabir, Lalit Pandit and others, who later on became well-known physicists. Mitra's association with the physics department is now more than 60 years old. He is a professor emeritus in the department now.

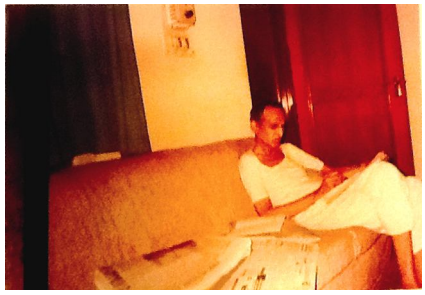
Mitra obtained his Ph D from Delhi University in 1953 and went to Cornell University in Ithaca, USA to complete a second Ph D in 1955. He worked with Hans Bethe and Freeman J. Dyson. Bethe is a Nobel laureate, while Dyson narrowly missed being one. Mitra worked in the area of renormalization theory of quantum electrodynamics and elementary particles. On his return he joined Aligarh Muslim University as Reader in 1955. He moved to Delhi University in 1963 as a professor of physics at a relatively young age of 34 years. Delhi University has the dubious distinction of not selecting for appointment Abdus Salam in the physics department and Hargobind Khorana in the chemistry department during the 1950s. Both of them returned abroad and obtained Nobel Prizes for their later works. The appointment of Mitra, along with L. S. Kothari and a year later S. N. Biswas, at a relatively young age was due to the efforts of R. C. Majumdar with the cooperation of D. S. Kothari. Majumdar also ensured that these eminent theorists were not burdened with practical classes and administrative work, and could devote their time to setting up viable groups in their fields.

Delhi University is 91 years old now and its physics department is 71 years old. Started by D. S. Kothari in 1942, it has played a major role in the development of physics in the country in the second half of the 20th century. It has had its ups and downs but has managed to keep its head above water level. Delhi University was in a bad shape at the time Mitra joined the faculty in 1963. From 1942, D. S. Kothari and Majumdar (who were friends and contemporaries of S. Chandrasekhar at Cambridge) had given a special status to Delhi University. Quantum mechanics was taught in M Sc courses. The B Sc (Hons) course which was taught in the department and not in colleges had modern and contemporary courses. Maurice Gwyer was a far-sighted Vice-Chancellor of the University then. Kitchlu, the well-known experimentalist had joined later. They had also attracted relatively bright young faculty members. All this had changed by the end of 1950s.

After the Second World War ended in 1945, many scientists working for war effort returned to research in pure sciences in both Europe and USA. They were empowered by the remarkable technological progress achieved during the War. W. Lamb observed a shift between two spectral lines of hydrogen atom, which was predicted by Dirac theory to be degenerate. This indicated that the theory needed revision. Higher-order corrections in quantum electrodynamics, which were turning out to be infinite, had to be made to yield a finite result. This led to the renormalization theory which was able to extract finite corrections from divergent or infinite expressions. This was a revolutionary development and a few senior scientists like Paul Dirac refused to go along with the mainstream efforts. Later, Richard Feynman and Julian Schwinger (USA) and S. Tomonaga (Japan) got the Nobel Prize for these insights in 1965. Many others had also made significant contributions, one of the most prominent being Dyson. He had shown how the seemingly different approaches of Feynman and Schwniger were related to each other. He also showed how the diagrammatic method invented by Feynman could be used to do calculations in quantum electrodynamics (QED) to evaluate spectral line shifts and scattering cross-sections. One such correction, the Lamb shift, had been calculated in a brilliant intuitive way by Hans Bethe, who was also an adviser to Mitra later. Bethe died a few years ago, but Dyson is still active and has become a father figure and high priest whose opinion is still highly valued by science and society.

The calculations of Feynman diagrams were laborious and time-consuming, but they were far simpler than what had to be done earlier. When I started my research career in 1955, one had to use α and β matrices of Dirac and combine various processes with and without electron–positron pairs. I came to know that Homi Bhabha and D. Chakraborty had missed out one such process in their calculation. This was pointed out by Majumdar who spent some time at the Tata Institute of Fundamental Research, Mumbai. The Feynman diagrams combined various processes with and without electron–positron pairs by thinking of the positron as an electron moving backward in time.

Such progress in QED had bypassed Delhi University and several other institutions in India. Both Kothari and Majumdar were aware of this. Bringing Mitra to Delhi was the first step that led to Delhi University recapturing some of its past glory in the 1960s and 1970s. Mitra had worked with Dyson on these new methods of QED called renormalization theory. He had continued such work with his students at Aligarh. His coming to Delhi marked a significant change to the physics department, which by then had been renamed as Department of Physics and Astrophysics. Changes continued with the department becoming a Centre for Advanced Study in 1964. A fair number of bright young persons were appointed to the faculty. At the same time the experimental side was strengthened by getting a liquid helium



Asoke Nath Mitra at work

plant from Russia, the first in the country. Luckily, unlike most other expensive experimental equipment, it was set up and put to good use for some time by K. D. Chaudhry, trained at Oxford, England. A new electronics wing was started with young experimental persons, which later became the Department of Electronics.

At the world level, field theory and particle physics continued to make rapid progress but led to a new paradigm. The problems and trends were identified by a few persons like Murray Gell-Mann. Geoffery Chew and other workers applied their ideas to various processes between particles. It was not easy to break away and suggest independent ideas. Mitra tried to break away from this trend and build up an identity of his own. He was able to do this by entering the area of 'few body problems'.

In classical non-relativistic physics, the two-body problem can be solved by separating the relative motion of the two particles from the motion of the centre of mass. The three-body problem is not solvable in classical physics. Quantum mechanics adds to the difficulties. Mitra succeeded in solving the problem, during 1960s, for the special case of a potential which is separable in momentum space. This gave special insight into the structure of the three-body wave function. This was the beginning of the area of 'Few nucleon studies'. One of the successful applications was to tritium, composed of one proton and two neutrons. This work with one of his students (V. K. Gupta) was published in the *Physical Review Letters* in 1965. In the 1960s while working on a model of the proton based on fermion quarks, Mitra found that a node occurred in the proton electromagnetic form factor. To avoid that an extra degree of freedom was needed, which was the forerunner of what was later called 'colour'. Working with Marc Ross he also discovered the quark recoil effect to explain the enhanced heavy meson modes of decay. Over the years Mitra 'developed a comprehensive dynamical framework leading to an integrated view of the dynamics of 2- and 3-body systems at successively deeper levels of compositeness, from nuclear to subhadronic. This attempts to bridge the traditional gap between theoretical sophistication and empirical fits to data'. Recent work includes a new formulation of a direct 3-quark force generated by a 3-gluon vertex in the QCD Lagrangian. This has interesting support from recent proton spin anomaly data. One of Mitra's finest hours was when he hosted successfully an international conference on few body problems at Delhi University in December 1975. In the 1980s, Mitra lectured on these ideas at Caltech and got the appreciative attention of Richard Feynman. Mitra often claims that whatever he learnt in mathematics, he owes to his father, Jatindra Nath Mitra.

Mitra married Anjali Ghosh in 1956, and they have two daughters. In 1969, Mitra received the Shanti Swarup Bhatnagar award. He was probably the first theoretical physicist to get the award. It was a proud day for the department, when the Vice-Chancellor Sarup Singh and pro-Vice-Chancellor V. P. Dutt came to the department to congratulate (Prof. Mitra on the award). The citation of the award mentioned his work on few nucleon problems and his work indicating the need for a new degree of freedom – colour. In 1975, he received the Meghnad Saha Award and in 1986 the S. N. Bose Medal of INSA (Box 1).

Delhi University, like many other institutions at that time had departmental heads continuing in the post till their retirement. In 1969, when K. N. Raj became the Vice-Chancellor he set up a committee to reform the system. The committee suggested many steps for democratization of the administration. Raj resigned in a year as he had trouble with the politics associated with the post of Vice-Chancellor. His successor Sarup Singh, who had earlier been principal of a college, managed to convert the recommendations into ordinances and rules which led to a fair amount of participation by teachers in decision-making. This resulted in both good and bad consequences. The good consequence was the reduction in the misuse of authority by heads, who, had no fear of censure or removal earlier. The bad consequences were the long delays in decision-making. A number of teachers, due to lack of confidence and/or insecurity or some other reason resisted necessary changes. Even the highly qualified teachers sometimes showed poor judgment and stooped to petty acts. This required heads to have a lot of patience, tact and political acumen.

Mitra became head of the physics department in 1973, when both D. S. Kothari and Majumdar had retired. He started by consulting teachers, both senior and junior, and tried to bring the much needed change in the courses offered and in administration. He succeeded to some extent, but soon found it difficult to persuade others to go along. Midway through the term of three years, he gave up the headship. This happened also with two of his contemporaries. Both Lakshman Kothari and Biswas resigned half way through their terms. Probably some scientists committed to their research do not like to be administrators. During his headship, one particular issue on which Mitra had a long correspondence with the higher authorities was the freedom of the department and the University to invite experts from abroad to visit, lecture and spend time at the University, interacting with students and teachers.

The physics department at Delhi University, during the 1950s and 1960s hosted a large number of foreign and resident as well as non-resident Indian scientists, visiting and inspiring students and teachers. This was partially due to the fact that scientists visiting India for the Science Congress and other conferences around New Year, usually passed through Delhi. I have heard lectures by Linus Pauling, Donald Glaser, P. M. S. Blackett. H. Shapley, Harish Chandra, S. Chandrasekhar, Hans Bethe, R. Dalitz and several others. Around 1972, a US scientist, a well-known particle physicist, was invited to spend a few weeks and give lectures in the department. Unfortunately, the invitee was also a member of a committee advising the US Government on science related to warfare. Some leftist organizations in the University became aware of this and organized a protest to prevent him lecturing. They succeeded after some scuffles and disturbances at the lecture hall. Besides media coverage there was also political fallout. Questions were asked in Parliament. Mitra, the head at that time or a little later, had to answer a large number of queries and give clarifications to higher bodies like University Grants Commission, Ministry of Education and others. I had an occasion to see the bulky file later. Mitra's pleading for academic autonomy was evident in every letter that he wrote; but unfortunately, many constraints like getting permissions and clearances from higher bodies were imposed. Academic freedom was and is curtailed in many ways, subtle and blatant even now. What amazed me was the fact that Mitra never mentioned or took credit for all his efforts in minimizing

Box 1.

Asoke Nath Mitra got his early education in mathematics from Ramjas College, Delhi University. He obtained his Ph D (1953) in physics from Delhi University under the guidance of R. C. Majumdar. Subsequently, he went to Cornell University, USA and worked under Freeman Dyson and Hans Bethe to obtain a second doctorate (1955). His areas of specialization are theoretical physics, quantum field theory, hadron and quark dynamics. On returning to India, he joined Aligarh Muslim University (AMU) as a Reader (1955). He was Visiting Professor of Physics, Indiana University (1962–63); Professor of Physics (1963–69), Senior Professor of Physics (1969–89), University of Delhi; Associate, Senior Associate and Honorary Associate of International Centre for Theoretical Physics, Trieste (1967–83); Visiting Professor of Physics, University of Illinois at Chicago (1986–87) and INSA-Albert Einstein Research Professor (1989–94) at University of Delhi.

Mitra has made original contributions in a sustained fashion. His principal contributions are: (i) exact solution of the nuclear 3-body problem with separable potentials which offered a new insight into the structure of the 3-body wave function, leading to 'few-nucleon studies' as a new branch of physics; (ii) a node in the proton e.m. form factor unless fermion quarks have an extra d.o.f. a forerunner for the discovery of 'colour' and (iii) the 'quark-recoil effect' (in association with Marc Ross), for the understanding of enhanced heavy meson modes of decay. He has developed a comprehensive dynamical framework leading to an integrated view of the dynamics of 2- and 3-body systems at successively deeper levels of compositeness, from nuclear to sub-hadronic with a formulational style designed to bridge the traditional gap between theoretical sophistication and empirical fits to data. He has published about 220 research papers, including reviews.

Mitra has been taking increasing interest in the structure of scientific ideas through articles of a general nature in *Pramana*, *Current Science*, etc. as well as through invited talks. He was a Member, Board of Editors of Few-body System. He edited several books such as *Few-Body Dynamics* (North Holland 1976); *Niels Bohr: A Profile* (INSA, 1985); *Quantum Field Theory; India in the World of Physics: Then and Now* (Pearson Education, New Delhi, 2008); and a monograph *Basic Building Blocks* (INSA, 1984).

Mitra is a recipient of the S. S. Bhatnagar Prize (1969), UGC National Lecturer (1973), UGC National Fellow (1975–78), Meghnad Saha Award (1975), S. N. Bose Medal of INSA (1986), and S. K. Mitra Medal of ISCA. He is a Fellow of Indian Academy of Sciences, Bangalore; Indian National Science Academy, Delhi; National Academy of Sciences (India), Allahabad; American Physical Society; and Academy of Sciences for the Developing World (TWAS), Trieste; and Member of New York Academy of Sciences. Mitra has also been Secretary (1975–78) and Editor of INSA Publications (1983–86).

the constraints. Probably, it was the most natural thing for an academic to do and that was that as far as he was concerned!

Mitra has been interested, to some extent, in questions that go beyond science. Persuaded by E. C. G. Sudarshan, he attended a few conferences on consciousness, spirituality and science in the 1970s. More recently, Mitra has been collaborating with his daughter Gargi Delmotte in studying the origin of consciousness and life. They also study the role of magnetic fields in giving rise to coherent structures in the early universe.

During the period 2005–2010, Mitra was editing a book on the *Work done in Physics in India since Independence*, for the Centre for Study of Civilisations. It was a mammoth task; it took even Mitra all of five years. The time taken indicates the difficulties associated with such a task. His stature persuaded eminent and not-so-eminent scientists to find time for writing the articles. Unfortunately, the price of such books or reviews makes them inaccessible to most scholars, especially students. Hopefully the book will be of use to historians of science and other motivated persons. Mitra's descriptive English writing has always been a source of admiration. He brings out the nuances and subtleties in the themes and the intellectual level of his articles is high.

Mitra has a way of underplaying himself and trying not to take centre stage, which sometimes leads to amusing situations as the following anecdote describes. N. Mukunda was once giving a lecture at Delhi, when Mitra came in a little late and tried to sneak in quietly and take a back seat. Mukunda paused and asked him to come forward. Mitra said apologetically 'I am only an observer, please ignore me.' Mukunda said 'When the observer comes the wave function collapses. We cannot ignore you'. In quantum mechanics, the wave function describing a state can be a superposition of two mutually exclusive states; like a dead cat and a cat that is alive. When a measurement is performed by the observer, the wave function changes (usually called collapse) to a definite physical state, either a dead cat or a live cat. Only a probability can be given for the occurrence of one or the other state.

Mitra has rarely spent any time without teaching students. Most of it has been at Delhi University. He is an excellent teacher, with a distinctive style, though in the early years, he had to face some problems. Soon after joining Delhi University, some students found his detailed arguments and derivations difficult to follow in the class and complained to Majumdar, who spoke to Mitra about it. Mitra promptly submitted his resignation and Majumdar had to make more than one trip to Mitra's house to persuade him to withdraw his resignation.

The way the departmental teachers treat their colleagues after retirement is always a complex one. Thanks to democratization, emeritus positions require majority support. For years no one, however eminent, has become emeritus professor in the physics department at Delhi University. In Mitra's case, he was made an emeritus professor only two years ago. Thankfully, he is finally helping the department as an emeritus professor now.

Mitra, unlike some other scientists, keeps himself up to date with events and

trends in India and the world, in politics as well as in science, but his first and last love is research in science. George Sudarshan in his Nehru Memorial Lecture in the 1970s said that scientists are the modern rishis (sages). Looking at some of the eminent teachers at Delhi, this is easy to believe. Their simplicity and lack of worldliness is so striking. The commitment and devotion of these teachers to the study and teaching of science is so intense, that they forego many other interests and economic advantages in life. While spending time at the International Centre of Theoretical Physics (ICTP) at Trieste, Mitra would often stay overnight in the Centre, even sleeping there on a couch. This drew comments from Abdus Salam, the Director of ICTP and a well-known scientist. Salam knew Mitra well and had a high regard for him.

Asoke Mitra has not only been a role model himself, but has had a great influence on the nature of research work done in Delhi University. This has been due to a large number of his students who occupied and still occupy teaching positions in the department and its constituent colleges. Mitra has constantly tried to identify, propose and support possible candidates for election as Fellows to the three Science Academies in India. He succeeded in some cases, but was unsuccessful in some others. In one particular case of a bright scientist, he failed because of disunity among the teachers of the department and their supporters in the Academy. Senior professors often disagree. Sometimes they discuss among themselves and agree on a common approach. This is what happened when D. S. Kothari and Majumdar were senior professors. With professors who came later this process did not quite work out. This caused difficulties in running the department from time to time. Asoke Mitra will be 85 years old in April this year. Let us wish him and Anjali Mitra all the best.

N. PANCHAPAKESAN

K-110, Hauz Khas,
New Delhi 110 016, India
e-mail: nargispanchu@gmail.com

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