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AJIT KUMAR SAHA

(1922-1991)

Elected Fellow 1959

AJIT KUMAR SAHA was a distinguished physicist of the country, who was widely recognised not only for his scientific contribution but also for his affectionate and encouraging patronage to the scientific pursuit of many younger scientists. He was largely instrumental in the growth and development of many front line areas of research in Saha Institute of Nuclear Physics. He was a man of versatility and vision.

FAMILY BACKGROUND AND EARLY EDUCATION

Ajit Kumar Saha was born on 31st August 1922 in Calcutta. His illustrious father, Meghnad Saha, needs no introduction. It is needless to mention that Ajit inherited many of his qualities from his father. His mother, Sm Radha Rani Saha, was a very devoted and kind housewife. In fact, her kindness and genuine simplicity of character had won for her the affection and respect of generations of students and admirers of his father and colleagues of Ajit. Ajit was the eldest among the three brothers and four sisters.

His father, Meghnad Saha, joined the Allahabad University and hence Ajit spent his early years at Allahabad. He received his school education at the Anglo Bengali Intermediate College, Allahabad and passed the Matriculation Examination of the UP Board in 1935 at the age of 12 years. Subsequently he accompanied his father in a tour of the middle east and visited many famous places of antiquity. This travel left a deep impression on his mind. At the end of the tour, he studied for some time at the School of Paul Gehebe in Switzerland. On his return, he joined the Ewing Christian College at Allahabad and from there received the Intermediate Science degree of the UP Board in 1938. Thereafter Ajit joined the Presidency College, Calcutta and did his BSc degree with honours in Mathematics. He did his MSc degree in Pure Physics at the University College of Science, Calcutta University in 1942. His was the first batch of MSc students who were offered by the University a course in Nuclear Physics. His MSc thesis was on the Libby counter. His research career started in the Palit Laboratory of Physics of the University of Calcutta and under the guidance of his father, Prof Meghnad Saha. In 1945 he was awarded the Premchand Roychand Studentship (PRS) by the University of Cal-



cutta. On the basis of his thesis on a topic of nuclear spectroscopy, he was awarded the DSc degree by the University of Calcutta in 1946. In 1951 he was married to Sm Biswabani Saha.

PROFESSIONAL CAREER AND SCIENTIFIC CONTRIBUTIONS

Ajit Kumar Saha worked for some time as assistant to the Palit Professor of Physics at the Pure Physics Department of the Calcutta University and subsequently in 1946 received a Junior Research Fellowship of the National Institute of Science (now Indian National Science Academy). He then left for England, was awarded the 1951 Exhibition Scholarship and worked at the University of Edinburgh from 1947 till 1950 in the laboratory of Professor N Feather. During his stay abroad, he visited the laboratories of Professor Scherrer at ETH Zurich, Professor K Siegbahn at Nobel Institute, Stockholm and Professor Madame Irene Curie-Joliot in Paris. After his return to India, he was awarded the Mowat Medal of the University of Calcutta. He received offers of service both from the Tata Institute of Fundamental Research, Bombay and the Institute of Nuclear Physics, Calcutta. He joined the latter Institute in Calcutta as Reader. Subsequently in 1956 he became a Professor and then in 1968 a Senior Professor of this Institute. He served the Institute (which was later named as Saha Institute of Nuclear Physics in commemoration of the name of Meghnad Saha, his father, who founded the institute) till his date of superannuation. Ajit Kumar Saha played a significant role in the development of this Institute and worked as Director of the Institute for a short period around 1980. After his superannuation, he was appointed Emeritus Professor by the Institute for the rest of his life.

Prof AK Saha and the School he built up in Saha Institute of Nuclear Physics made many pioneering contributions in India in many areas of Physics. Nuclear Spectroscopy and Nuclear Magnetic Resonance (NMR) researches were initiated under his leadership. He laid almost equal emphasis on the theoretical and experimental aspects of research in physics. Prof Saha further emphasised the need for design and construction of new instruments in accordance with the research requirements. Around 1956-57, two major NMR equipments, one being of the continuous wave kind (both Block and Purcell types) and the other of a pulsed variety (Hahn type) were built. The groups led by him utilised these instruments in the study of the phenomenology of NMR, which stimulated variety of theoretical analysis in molecular quantum mechanics and statistical mechanics. This group also investigated in detail the problem of interpreting the complex high resolution NMR spectra by using the properties of crystal and magnetic symmetry groups. A book entitled 'Nuclear Induction' was published by the Institute under the authorship of AK Saha and TP Das, one of his students. After the initial developments were achieved, one commercial wideline (2-16 MHz) and one high resolution NMR spectrometer (100 MHz for proton) with suitable electromagnets were installed. The wide line spectrometer



enabled the group to undertake many interesting studies including i) charge-transfer mechanisms in molecules, ii) transferred hyperfine interactions in a series of rare-earth phosphates and vanadates, iii) elucidation of nature of ion-solvent interaction etc... Further to these works, a pure nuclear quadrupole resonance spectrometer (NQR) (30 MHz) and an electron paramagnetic resonance (EPR) spectrometer (X-band) were built in the laboratory under his supervision and encouragement. Mapping the details of nuclear quadrupole couplings and asymmetry parameters in several single crystals, delineation of the magnetic interactions in several copper complexes, theoretical calculations of EPR relaxation times etc. were some of the interesting lines of research that resulted thereafter. Researches on nuclear spin-phonon interactions in metals and acoustic NMR were initiated. A pulse-echo apparatus (10 MHz) and a continuous wave acoustic spectrometer (10 MHz) were built in the laboratory. Prof Saha had given a method of determining the orientation parameters of the electric field gradient tensor from a rotation study of the nuclear quadrupole resonance (NQR) spectrum.

After 1956, the group led by Prof Saha continuously expanded and newer areas of research were undertaken. A team of investigators emerged who developed the expertise on radio frequency and microwave techniques. He provided the necessary impetus and guidance in the building of a Stark-modulated microwave spectrometer (8-50 GHz). Subsequently a K-band gaseous microwave spectrometer with 100 KHz square wave modulation was set up. The microwave group made subsequently many interesting studies on several halogen substituted benzene and pyridine compounds. Prof Saha also initiated researches involving Mössbauer Spectroscopy, cryogenic research including study of acoustic resonance at liquid helium temperature, crystal growth and X-ray crystallography.

In the area of Experimental Nuclear Physics, the institute witnessed many significant developments and achievements under Prof Saha's leadership. The beta-gamma spectroscopy laboratory was born around 1952 where initially theoretical and experimental investigations in beta and gamma ray spectroscopy and in nuclear structure were undertaken. A short lens beta spectrometer with a continuous baffle was designed and constructed with a view to making precision measurement of beta spectrum and internal conversion coefficients. Being encouraged by the initial success and also for making scope for more advanced research, a high transmission Siegbahn-Slatis beta ray spectrometer was acquired for this group in 1957.

Experimental arrangement for the measurement of gamma-gamma directional correlation was set up. Initially scintillation counters containing organic phosphors were used. The need for using inorganic phosphors like NaI (Tl), CdWO₄, CaWO₄ etc for having better response was felt and a project for building a Verneuil furnace was undertaken under his guidance to prepare these phosphors. The development of scintillation counting, coincidence spectroscopy and life time measurement had since then been pursued by the group with increasing degree of sophistication and many successful and pioneering contributions were recorded. Measurements of life time of nuclear isomeric levels as low as 10^{-11} second and of gamma-gamma angular correlation



were achieved. The beta-gamma spectroscopy laboratory developed under his guidance has made a distinct contribution to the development of nuclear instrumentation in the institute.

Under his guidance the beta-gamma ray group developed a tradition of theoretical work on structural models relevant to their own experiments and also of broader interests. Theoretical shell structure calculations were continued. Also in the solid state physics area, students were trained and engaged in theoretical calculations of line widths, crystalline fields and other aspects of solid state theory. Another group was engaged in calculating accurate electron wave functions in light atoms not only in ground state but also in their excited states.

Prof Saha provided all through his scientific career a very fruitful, active and distinctive leadership toward the initiation and development of research, teaching and developmental activities in diverse areas in Saha Institute of Nuclear Physics. It may be mentioned that some of the instruments that were designed and fabricated by his group, viz, short magnetic lens beta spectrometer, spin-echo magnetic resonance spectrometer, NQR spectrometer with a special goniometer for rotation studies with crystals etc, were the first of their kinds made in India. Two separate divisions, Theoretical Nuclear Physics and Crystallography and Molecular Biology, emerged out of the expanding activities of his group. Besides, the investigators in his group formed the core of two other divisions, Solid State and Molecular Physics and the Experimental Nuclear Physics divisions of the Institute. A large number of students obtained the PhD degree under his guidance. Some of his students are now in the forefront of researches in their respective fields. The post MSc teaching course offered by the institute to bridge the gap between university education and research level was originally planned and organised by him. Prof Saha's advice and guidance were freely available to research workers of many different areas. The interest and well being of the institute was so dear to him that he sacrificed his personal career to a great extent. In fact he did not accept many coveted offers that came his way for the simple reason that he wanted to serve the Saha Institute as much and as best as possible. Indeed he had no hankering for top administrative position, the Directorship, of the institute. Had he wished he could have been the Director of the Institute long ago. The academic and scientific interests prevailed over any choice for administrative position.

ORGANISATIONAL AND EXTRA CURRICULAR ACTIVITIES

During the later part of his life Prof Saha devoted himself to a thorough and analytical study of the energy problems that mankind in general is likely to face and in particular the energy problems of developing countries including India. How the energy problems would affect India was the subject for the focal theme of the 67th session (1980) of the Indian Science Congress of which he was the General President. As General President,



he recorded extensive observations, recommendations and comments on the energy strategies for India in the days to come. Moreover, as a Member of the Indian delegation to the Sri Lanka Science Congress held in 1968 he extensively dealt with, in his address, the problems and prospects for development and utilization of nuclear energy in developing countries. He rightly pointed out that the energy crisis cannot be met if India's population is allowed to increase unchecked. He made a quantitative study of the present status of energy resources including i) fossil fuels, ii) oil, iii) natural gas, iv) hydroenergy, v) nuclear fuels, vi) biomass, and vii) solar energy and analysed the status, including the production capacity and efficiency, of energy from various sources. Some of the important recommendations that he put forward included that i) energy planning should occupy the position of highest importance when planning the national economy, ii) there should be a central data bank for storage of energy data of the country as well as of other countries, iii) it will be necessary to conduct vigorous prospecting for new sources of energy, iv) production of ethanol from biomass for transport fuel is assuming importance all over the world and should be actively considered by the energy policy framers, v) in the matter of production of electricity, installation of oil based thermal generation stations must taper off with time and more and more dependance on coal has to be envisaged, vi) a major role in the production of electricity in the coming years will have to be played by hydel systems, vii) vigorous prospecting for uranium is required for further development of India's nuclear energy programme etc. While considering the prospects of new energy sources, he pointed out that solar energy being a continuous source of energy but of very low quality, conversion technology has to be improved significantly to convert it to a form of high quality like electricity. He anticipated that hydrogen will possibly be the most widely used fuel in future. He further recommended that fuel cells having many desirable features *viz.* absence of moving parts, high efficiencies, usability on the modular principle etc, should demand significant attention of energy planners. While considering the energy problems of future, Prof Saha was equally aware of the environmental pollution problems and social aspects of energy production. In short, Prof Saha had exhibited through his addresses and writings profound depth of knowledge of the problems and prospects of energy production.

Professor Saha acted as Chairman of the Cyclone Review Committee set up by the Department of Science and Technology, Government of India in 1979 and submitted a comprehensive report in May 1984. This report reviewed the Cyclone Monitoring and Cyclone Warning systems as they were being pursued in India and presented valuable suggestions for a National Cyclone Code, a Cyclone Emergency Action Plan and a Community Preparedness plan against cyclones for the coastal states of the country. The 480-page voluminous report presented many important recommendations for consideration of i) the Indian Meteorological Department in respect of cyclone monitoring and warning systems, ii) the Government of India and coastal State Governments in respect of the National Cyclone Code, the Cyclone Emergency Action plan and the Community Preparedness plan against cyclones and iii) various research organizations in respect of research and training areas connected to cyclones. The other important



members of the committee included Dr SK Das, Director-General of Meteorology, Govt of India, Prof PK Das, Ex-Director-General of Meteorology and Dr AP Mitra, the then Director, National Physical Laboratory, New Delhi. This report was a significant contribution by Indian scientists toward a national cause.

Professor Saha had wide interest and significant knowledge in many areas of arts and science besides his own scientific researches. Part of this versatility he imbibed from his illustrious father and part he developed himself. He was a prolific reader of English literature and was conversant with the history of world and particularly the Greek History. Phonetics was one of his very favourite subject. Not only he was very fond of but also he could explain the intricacies and grammar of western music and also Indian classical music. His interest in Astronomy originated partly from the contributions of his father. In his Inaugural Address to the Seminar of Astronomy and Mathematics, organised jointly by the Indian Council for Philosophical Research and the Asiatic Society, he pointed out that Astronomy was perhaps the first science to be studied in a systematic way and that today there seems to be no ends to the surprises that the astronomical discoveries are bringing in. He appealed that we should open our mind beyond Surya-Siddhanta and the other Siddhantas, which recorded the early Indian Astronomical findings, to the ever expanding horizon of modern astronomy.

HONOURS AND ASSOCIATION WITH SOCIETIES, NATIONAL COMMITTEES AND ORGANISATION

Professor Saha had been the recipient of many distinctions and honours since his school days. He was awarded a gold medal for standing first in Bengali Examination at the Matriculation Examination of the UP Board in 1935. He stood third in order of merit at the Intermediate Science Examination in 1938. Also he stood third in order of merit at the MSc Pure Physics Examination of the Calcutta University in 1942. He received the Premchand Roychand Studentship (PRS) of the University of Calcutta in 1945. In 1951, he became the recipient of Exhibition Scholarship of the University of Edinburgh. He was elected Fellow of the Indian National Science Academy in 1959 and was the Honorary Fellow of the National Academy of Sciences, India.

Prof Saha was associated with many learned societies and organizations in various capacities. He served as i) member of the Council of the National Physical Laboratory, ii) Member of the Board and Governing Body of the Council of Scientific and Industrial Research (CSIR), iii) Member of the Council of the Indian Association for the Cultivation of Science, Calcutta, iv) Member of the Council, Bose Institute, Calcutta, v) Member of the Council for Meteorological and Atmospheric Sciences, vi) Member of the National Committee of Science and Technology set up by the Government of India, vii) Member of the Committee formed by the Government of India for investigating the nuclear device



placed on the Nanda Devi, viii) Chairman of the Cyclone Review Committee set up by the Government of India, ix) Member of a Scientific Delegation sent by the Government of India to USSR in 1958, x) Member of the State Almanac Committee set up by the Government of West Bengal in 1963, etc. In 1968, Prof Saha represented the Indian Science Congress Association at the Annual Meeting of the British Association for the Advancement of Science at Dundee and also the Annual Meeting of the Sri Lanka Association for the Advancement of Science. He served the Indian Science Congress Association for long time in various capacities, as General Secretary from 1966-1970, as Treasurer from 1971-1974 and again in 1976-1977 and as General President in 1980. He was a Founder Member of the Indian Biophysical Society and served the Society as Treasurer for many years. Prof Saha acted as Director of the Bose Institute in 1977 and subsequently of Saha Institute of Nuclear Physics in 1980.

FAMILY AND PERSONAL LIFE

His family life was a happy and responsible one. By nature he was very calm, quiet and systematic and as such his father depended most on him. He took all pains right from his younger days to give appropriate relief to his father in respect of financial and other family matters. He was equally dutiful toward his younger brothers and sisters and did his best to spare them as much as possible from any sort of hardship. Meghnad Saha was indeed very proud of his eldest son, Ajit and often expressed to others about Ajit's proficiency in mathematics and other subjects. His mother was equally if not more confident about his ability and sense of responsibility. Although his wife, Sm. Biswabani Saha, came from a very rich family, she did not aspire for wealth and comfort, rather felt proud for the intellectual attainments and scientific contributions of her father-in-law and husband, and played the role of a devoted and efficient housewife.

Professor Saha is survived by his wife, a son, two daughters, two sons-in-law and a number of grand children. His son, Prabal, has been engaged in Pharmaceutical Machineries Marketing affairs. His daughter, Anamita, is married to Sri Aniya Baran Saha, who is an engineer and has been holding the post of Joint Director of the Department of Electronics, Government of India. His second daughter, Nandini, is married to Sri Prabir Mukherjee who is a Chartered Accountant and is holding the post of Manager of the Bank of Baroda. This well-knit family has lost a simple, loving and responsible husband and father.

LAST DAYS

Prof Saha had been keeping a good health all through his life except for the last one year or so. He was suffering during this period from rectal cancer. Initially he was under the treatment and care of Dr Dipak Banerjee, a surgeon and urologist, who could not diagnose the disease properly. Dr Banerjee suggested surgical removal of the rectum



particularly since the disease was till then localised and felt confident of his recovery thereby. Since the very name cancer is a dreaded one, the family sought other expert's views. Unfortunately the suggestion of Dr Banerjee was not accepted and Prof Saha was subjected to radiation therapy in a Cancer hospital in Calcutta. After going through a number of courses of radiation therapy, it appeared that the cancerous cells were killed and the patient had recovered. The Chief of the cancer hospital felt very confident about his recovery. Indeed, the patient, Prof Saha, himself felt very fit and so much so that he resumed his normal activities, attended meetings, visited places etc. Many of us who visited him during this time also had a glimpse of his recovery. He himself expressed to some of us that he was feeling confident that he would see the end of twentieth century. But alas ! that was not to be and this recovery was a very temporary one. He again fell seriously ill and had to be transferred to a nursing home. The illness, this time, was not due to cancer but because of massive damage of kidney and all surrounding tissues. The kidney did not function at all. This was totally unexpected and it was felt by the attending physicians and others that such an extensive damage resulted from a massive and non-localised dose of radiation to which his rectal part was exposed. The end came soon through a heart attack. It is no use now arguing about the cause of the extensive damage leading to death, but certainly the unanimous feeling was that his life could have been prolonged by many years by a careful and appropriate medical treatment. On 1st March 1991, he left for his heavenly abode.

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SN CHATTERJEE
Biophysics Division
Saha Inst. of Nuclear Physics
37, Belgachia Rd.
Calcutta 700 037



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