

S. K. Mitra



SISIR KUMAR MITRA

1890-1963

SISIR KUMAR MITRA was born in Calcutta on October 24, 1890

Parentage and Early Life

His father Joykrishna Mitra belonged to an orthodox Hindu family of Konnagar, a township near Calcutta in the district of Hooghly in West Bengal. His mother, Sarat Kumari, came from a Brahmo family of Midnapur, well-known for its liberal outlook and progressive ideas.

Though brought up in a family of conservatives, Joykrishna was attracted from his boyhood to the liberal doctrines of the Brahmosamaj. Against the wishes of his father, Joykrishna married Sarat Kumari in 1878 according to Brahmosamaj rites and, as was to be expected in those days, had to sever social connections with his paternal family. He left Konnagar and shifted to Midnapore where he lived for about a decade and begot three children—two sons and one daughter. In 1889, Joykrishna moved with his whole family to Calcutta and took up the profession of a school teacher.

By all means, female education was not the order of the day, for the orthodox Hindus did not like sending their womenfolk to schools and colleges. Further, Joykrishna's income was too small to enable him to maintain his family. Notwithstanding all these, he got his wife admitted to the Campbell Medical School for medical education. This bold step bears testimony to his great strength of mind and progressive outlook, which he might have gathered by his close association with eminent persons like Pandit Iswar Chandra Vidyasagar, Pandit Shiv Nath Shastry and Babu Bipin Chandra Pal.

Sisir Kumar was born when his mother Sarat Kumari was still a student in the Campbell Medical School. She passed the final examination in 1892 and got an appointment in Lady Dufferin Hospital at Bhagalpore in Behar. To enable his wife to accept this appointment, Joykrishna gave up his teaching profession in Calcutta and shifted the whole family to Bhagalpore. Here he himself secured an appointment as a clerk in the local Municipal Office. At Bhagalpore another son was born in this family—Sukumar Mitra, the youngest brother of Sisir Kumar.

In due time Sisir Kumar was admitted to the Bhagalpore Zilla School for receiving his first education. Soon after he joined school, his two elder brothers, Satish Kumar and Santosh Kumar died within a span of five



years. This was too rude a shock to his struggling father Joykrishna, who developed nervous exhaustion and was eventually struck with paralysis.

The family was now in dire distress. The whole burden of the family fell on his mother whose income as a physician in the Lady Dufferin Hospital was hardly adequate for making both ends meet, particularly because of the rising educational expenses of her two surviving sons, Sisir Kumar and Sukumar. Passing the Entrance Examination from the Zilla School, Sisir Kumar got himself admitted as an F.A. student in the T. N. J. College, Bhagalpore and about this time his father died. Had it not been for his mother, Sisir Kumar would have had to cut short his educational career at this stage. But his mother did not allow this to happen. A lady of unusual strength of character and sense of duty, she managed the family single handed till Sisir Kumar could finish his University education. In fact, when he came out successful in the F.A. examination and expressed his desire to study for the B.Sc. of the Calcutta University at Presidency College, Calcutta, the premier college of India during those days, his mother readily agreed in spite of the heavy financial strain this would mean to her.

School and University Education

At the Bhagalpore Zilla School Sisir Kumar was a serious type of student from the very beginning and could be easily distinguished from his class-mates. About 1889-90, a Bengali youth named Ram Chandra Chatterjee was trying to ascend in a balloon. His first attempts ended in failure but he eventually succeeded in ascending to a height of a few hundred feet and covered a horizontal distance of about 15 miles from the Calcutta maidan to Basirhat. This created great sensation at the time so much so that it gave rise to a popular Bengali verse:

“Uthlo balloon Garer Mathe
Namlo giay Basir Hate”

(The balloon rose from the fort grounds and descended at Basirhat). This attracted the attention of young Sisir Kumar when he was only six or seven. How could a balloon rise up when everything else falls to the ground—was a question that troubled the little lad’s mind and he put this question to his elder brother Satish Kumar. Not an expert himself, Satish Kumar explained to the best of his ability the scientific principle underlying the ascent of a balloon. As far as he could recollect in later years this was perhaps the first occasion that young Sisir Kumar felt within himself an urge for scientific education.

Young Sisir Kumar’s interest in science grew with years as he came across popular scientific articles published in Bengali journals. These articles were mostly written by Jagadish Chandra Bose, Upendra Kishore Raichaudhuri and Jagadanando Ray who became very popular as writers



of scientific literature in Bengali. Recalling the early years of his life, Sisir Kumar often used to say amongst his colleagues and friends that he developed almost a fascination for reading these scientific articles even though, as a school boy, he could not understand all the details. These articles, he used to remark, were a source of great inspiration to him and his young mind saw visions of a scientific career.

Passing the F.A. Examination from the T. N. J. College, Bhagalpore, Sisir Kumar got himself admitted in Presidency College, Calcutta, in 1908 in the B.Sc. Class. Here he met Sir J. C. Bose and Sir P. C. Ray, the two illustrious sons of Bengal and pioneers of modern scientific research in India. The names of Jagadishchandra and Prafullachandra were almost worshipped by all students of science in Bengal in those days. Naturally Sisir Kumar felt glorified when he came in contact with these scholars and got the opportunity to learn at their feet. His curiosity about the subjects of their researches and their findings was more than usual for a fresher in the undergraduate class. Whenever there was an opportunity, he would trespass into the research laboratories and have a look at Sir J. C. Bose's apparatus for recording the response of plants and his equipment for the generation and detection of Hertzian waves. In the early days of college life, he had no idea of the implications of scientific research. Yet the sight of these equipment filled his receptive mind with admiration. As years rolled on, knowledge of the methods and difficulties of original research gradually dawned on him and he often wondered how Bose could have devised such sensitive and delicate apparatus at a time when there was no industry worth its name and when the new techniques of scientific research were unknown in this country. Bose's microwave equipment with which the reflection, refraction and polarization of electro-magnetic waves were so strikingly demonstrated fascinated him. In fact the environments at the Presidency College so strongly inspired him that he decided to dedicate himself to scientific research if ever he could manage to earn just enough to make two ends meet. In 1912, he passed out of Presidency College taking his M.Sc. degree in Physics and topping the list of successful candidates.

Period of Uncertainty

Because of severe financial hardship Mitra, despite his yearning for doing research, had to seek employment after finishing University education. His mother, who had been so long bearing the burden of the family single handed and with exemplary patience, badly needed relief. Thus although he got the opportunity of working as a research student under Sir J. C. Bose in the Presidency College immediately after his M.Sc. results were out, he could not stick to it for more than a few months. On getting an appointment as Lecturer in the T. N. J. College, Bhagalpore where he himself was an F.A. student only five years before, he left Calcutta



and his much coveted opportunity for doing research, though for a brief period.

From Bhagalpore he transferred himself to Bankura on being appointed a Lecturer in the well-known Christian College. Naturally in these moffusil colleges there were no research facilities and Mitra had to spend four years of his life in an atmosphere of near frustration, the hope of a research career languishing in his mind. He, however, found some solace in devising ingenious demonstration experiments in his leisure hours with what little material and accessory he could collect in the laboratories and illustrating his class lectures with these experiments. While staying in these colleges he also developed the habit of writing popular scientific articles in his own language, Bengali. These activities were the outcome of a strong desire in him to explain scientific principles to others with clarity and precision, an art in which he became an indisputable master in the following years.

About this time the Calcutta University was undergoing extensive development under the able stewardship of Sir Asutosh Mookerjee, the then Vice-Chancellor, whose vision was to organise his University along Western lines for advanced teaching and research in science and technology. The University College of Science was founded in 1916 for the newly formed post-graduate departments of science. Mitra was invited to join the Department of Physics and he lost no time in accepting the offer. This marked the beginning of his scientific career. He was then 26.

With unusual foresight Sir Asutosh had already gathered in the University College of Science a number of young and promising scientists for post-graduate work in Physics, Chemistry and Applied Mathematics. In Physics there were C. V. Raman, D. M. Bose, M. N. Saha and S. N. Bose. When Mitra joined this group in 1916 Prof. D. M. Bose was away in Germany.

Mitra began researches on the diffraction and interference of light in the laboratory of Sir C. V. Raman. An ardent worker as he was, he completed the work for his doctorate thesis in less than three years and got the D.Sc. degree of the Calcutta University in 1919.

In 1920, Mitra left for Paris to work under Prof. Charles Fabry in the University of Sorbonne. Here he worked on the determination of wave-length standards in the region 2000-2300 Å of the copper spectrum and got his doctorate in 1923.

The award of the highest research degree by two renowned Universities in quick succession signalled the beginning of a successful research career. Yet, a feeling of uncertainty worked in his mind. Maybe, he had been so deeply impressed in his college days by Bose's experiments on wireless waves that a desire for doing research in this line lay hidden in his subconscious mind. Thus despite his initial success in spectroscopic research, he drifted away from this line and on leaving Sorbonne, joined the Institute of Radium to work under Madame Curie.



Since when he arrived in France Mitra had been coming across reports about radio valves and their successful application to radio communication during World War I. Many laboratories of the West had started investigation on radio valves and their possible application in various fields. These reports had been agitating his mind all the while. Soon after joining the Institute of Radium, he made the final decision. He had the information that in the Institute of Physics, University of Nancy, Prof. Gutton was working on radio valve circuits. Although it was only a few months before he was due to return to India, he left the Institute of Radium and joined Prof. Gutton's laboratory to work on radio valves. Here he found what he was missing so long and his career in radio research was settled.

Wireless Laboratory in Calcutta

Mitra's decision to change over to radio research was undoubtedly a bold one. Radio was then a new born science still in its teething stage. It had not found place in the curriculum of any of the Indian Universities, not to speak of research facilities in the subject. Mitra recognized this difficulty but was not deterred. Immediately after joining Prof. Gutton's laboratory he wrote to Sir Asutosh Mookerjee about his decision stressing the need for including the new subject 'Wireless' in the post-graduate Physics curriculum of his University. Anxious as he was for the furtherance of scientific research in his own University Sir Asutosh wrote in reply:

10th May, 1923

My dear Dr. Sisir,

I am glad to receive your letter dated 18th April and to hear that you have been so successful in your work. The course of investigation you suggest as to signals by wireless telegraphy is very attractive. Do please draw up a scheme and make it as inexpensive as possible. I shall see what we can do. But you may rest assured that there will be plenty of opposition. That need not frighten us; we shall have to fight our way through. I am looking forward to your return in November.

Yours affectionately,

ASUTOSH MOOKERJEE

On his return to India late in 1923, he was appointed Khaira Professor of Physics in the Calcutta University and joined hands with Sir C. V. Raman, Prof. D. M. Bose and others in reorganizing post-graduate teaching in Physics in the University College of Science.

He himself took charge of organizing the 'Wireless Section' for teaching and research in the new subject. With the whole-hearted support of



of work. Dr. H. Rakshit made the most valuable contribution in this undertaking by developing the first indigenous equipment for ionospheric studies by the angle of incidence method. The Calcutta Station of the Indian State Broadcasting Service lent active co-operation in these investigations by making available its medium wave transmissions, often specially broadcast outside regular programme periods. Utilising these transmissions, experimental evidence of the E layer of the ionosphere was obtained for the first time in India in 1930 with the receiving equipment installed at a distance of 75 miles from Calcutta. Soon after, a pulse equipment was built for recording radio wave reflections from the ionospheric layers near the transmitter and their heights were successfully measured. This equipment also enabled the laboratory to participate in the Second International Polar Year (1932-33) programme of ionospheric observations and thus won for it international recognition.

The stage was now set for extending the scope of ionosphere research in the laboratory. Prof. Mitra became deeply interested in the subject and he turned his whole attention to it. As a result, with the help of a steadily swelling team of enthusiastic workers, the Ionosphere Laboratory grew up and a good amount of work was done before the end of 1935. The results of these investigations formed the subject matter of a lecture which Prof. Mitra delivered before the Maxwell Society at King's College, London in January, 1936.

By the end of the 1930's the number of research workers in the Ionosphere Laboratory had increased considerably and its activities increased further. The old equipment had been converted into a manual multifrequency ionosphere recorder—an early version of the modern ionosonde. With this equipment hourly observations of the critical frequency and height of the ionospheric layers were started. On the other hand, theoretical problems on the physics of the ionosphere were also taken in hand.

These investigations contributed a good deal to the then existing knowledge of the ionosphere. Besides giving the first general picture of the ionospheric conditions in a sub-tropical region of low latitude like Calcutta, the experimental results threw considerable light on the effect of thunderstorms, magnetic storms and meteoric showers on upper atmospheric ionisation. Theories were also advanced to explain the formation of the ionospheric layers as observed experimentally. In particular, the first successful explanation of the formation of the E layer at a height of 100 km by solar ultraviolet radiation, a problem which baffled all previous attempts at a solution, received wide recognition.

Campaign for a National Radio Research Board

Not long after the Ionosphere Laboratory had taken root Prof. Mitra began to feel that in a vast country like India the observations made at



only one research station—that of his own in Calcutta—were not adequate to gain useful information about the ionosphere over this part of the globe. True, by 1935, Prof. M. N. Saha, who left Calcutta in 1923 to join the Allahabad University, had also started some researches on the ionosphere, but such sporadic activities were far from adequate for a synoptic study. It was necessary to establish in a planned way a number of research centres in suitable latitudes and longitudes spread over the country. For this the primary requirement was to set up a national Radio Research Board. But it was impossible to fulfil this need without government support, which was lacking at the time. Prof. Mitra thought that the apathy of the Government of India might perhaps be shaken if he could win the support of leading British scientists to this noble cause. In his 1936 lecture before the Maxwell Society, he not only laid stress on the importance of close co-operation between ionosphere workers in different countries but also emphasised the need of a co-ordinating body in India like the Radio Research Board of England. On May 5, 1936 he invited a number of top ranking British scientists to a dinner to discuss the desirability of creating a Radio Research Board in India on the same lines as the one in England. The guests, amongst whom were Sir E. V. Appleton, Prof. S. Chapman, Sir R. A. Watson Watt, Dr. R. L. Smith Rose, Prof. E. N. da C. Andrade, Prof. F. W. G. White and many others, unanimously favoured Prof. Mitra's proposal. Dr. R. A. Gregory, the distinguished editor of *Nature*, who was also one of the guests in the dinner, devoted a thoughtful editorial in his journal on the organisation of radio research in India. He wrote: 'The time would now appear to be very opportune for considering the establishment of a similar Radio Research Board in India, where fundamental research in radio communication has so far been limited to the activities of quite small bands of workers in different universities, notably those under Prof. S. K. Mitra at Calcutta and under Prof. M. N. Saha at Allahabad. He concluded thus: 'It is surely time that India was able to take its place in such a world-wide scheme (of radio research), and it is to be hoped that those in a position to do so will foster the inauguration of a suitable Radio Research Board and provide the necessary funds to initiate its work. The research already carried out in India indicates that the universities are ready to provide a programme of problems of a fundamental nature, and even the nucleus of a staff of trained personnel, keen and enthusiastic to continue their investigations, which are at present being limited through lack of resources'.

Armed with the support of the British scientists, Prof. Mitra returned to India and launched a strong campaign for his cause. In these efforts he received invaluable support from Prof. M. N. Saha, who was still at Allahabad. Yet all these efforts evoked little response in the men in authority. In 1938, Prof. Saha came back to Calcutta as Palit Professor of Physics and the two professors now jointly renewed their efforts for the formation of a national Radio Research Board. Meanwhile the political



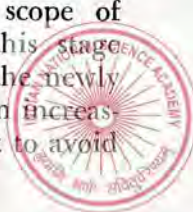
situation in the country had undergone considerable change. The Viceroy's Executive Council consisted of a number of Indian nationals who cherished in their hearts the longterm well-being and development of the country. On the other hand, with war clouds gathering over the West, the British War Cabinet was extremely eager to win the hearts of the Indian people. It was under these circumstances that the Board of Scientific and Industrial Research was formed under the Department of Commerce of the Government of India.

The proposal for the establishment of a Radio Research Board was submitted before the newly formed Board of Scientific and Industrial Research. This was immediately accepted and the Radio Research Committee was formed in 1942. This opened a new chapter in the history of radio research in India. Prof. Mitra was appointed the first Chairman of the Radio Research Committee and continued in this chair till 1948, when he was succeeded by Prof. M. N. Saha.

Haringhata Ionosphere Field Station

Prof. Mitra firmly believed that for the advancement of knowledge, teaching and research should go side by side. However, even up to the late 1940's, the scope of teaching 'Wireless' in the University was very limited. It continued to be treated as a branch of Physics and was allotted only about one-fifth of the whole syllabus in Physics. The students doing post-graduate work under this arrangement were steadily falling behind the latest advances in the subject and their value for employment in radio research was adversely affected. The shortcoming was to a great extent compensated when Prof. Mitra launched upon preparing his treatise on 'The Upper Atmosphere'. This required all the research workers in his laboratory to delve deep into one or other aspects of upper atmospheric phenomena, keeping them engaged in this work for years on end. The net result was highly beneficial to all concerned. The interest of the workers was fully awakened to the latest advances in the knowledge of the upper atmosphere and radio wave propagation and new lines of investigation were opened up. In fact, during the period of preparation of the manuscript the laboratory was transformed into a veritable training ground for ionosphere research. As a result, the handful of research workers with whom Prof. Mitra started the ionosphere laboratory in the late twenties grew into a strong school of ionosphere research by the middle forties.

With the strengthening of the research school, need was felt for the expansion of facilities for intensifying and extending the scope of ionosphere and allied investigations in the laboratory. At this time, the sanction of grants by the C.S.I.R. on the recommendations of the newly created Radio Research Committee largely assisted Prof. Mitra in increasing the activities of his research school. It was soon realized that

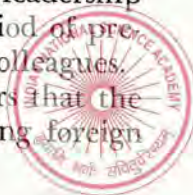


man-made static which was badly interfering with the observations particularly during daytime it was necessary to shift the ionosphere work to a field station in the countryside where static interference would be less disturbing. Prof. Mitra submitted before the Radio Research Committee a plan for the establishment of a radio research station outside Calcutta. The proposal was favourably received by the Committee and, on its recommendation, the C.S.I.R. sanctioned in 1949 suitable capital and recurring grants for the construction and running of the proposed station. The University spared a plot of farm land at Haringhata, a village about 50 km from Calcutta, for this purpose. The same year, in recognition of the work done by it, the laboratory received an automatic ionosonde as free gift from the Commonwealth Scientific and Industrial Research Organisation of Australia. This ionosonde was installed in the field station when it was completed and regular round-the-clock observations of the ionosphere were started there in 1955. This was the first Ionosphere Field Station of its kind in India .

The Upper Atmosphere

The investigations on the ionosphere carried out in different parts of the world since its discovery in 1925 resulted in rapid widening of our knowledge about the ionosphere. Indeed, within a decade, a surprisingly large amount of information had been collected by the many research centres and published in different journals and research reports. In order to obtain a world-picture of the ionosphere one would, however, have to look into these scattered records, which meant considerable time and labour. This difficulty of ionosphere workers was early recognised by Prof. Mitra. In 1935, the National Institute of Sciences of India organized a symposium on the ionosphere and invited him to open it. Prof. Mitra took this opportunity to write a connected account of the ionosphere including all the details then known about it. Under the title 'Report on the Present State of our Knowledge of the Ionosphere' he presented it as his opening address at the symposium which was held in August, 1935. Encouraged by the favourable reception accorded to this Report by ionosphere workers all over the world, Prof. Mitra began to think of writing a treatise on the upper atmosphere—of which the ionosphere is only a part. During his stay in the U.K. and France in 1935-36, he visited different ionosphere research laboratories and came back with the idea reinforced in his mind. He discussed his plan with his colleagues who by this time had made some reputation in ionosphere research. It took nearly ten years of continued effort by a united team of workers under the able leadership of Prof. Mitra to finalise the manuscript. During this long period of preparation his patience and capacity for hard work surprised his colleagues.

It was originally desired by Prof. Mitra and his collaborators that the publication of the treatise should be entrusted to some leading foreign



concern. Quite some time before the manuscript reached the final stage, Prof. Mitra wrote to two or three firms, giving them the list of contents of the book. But the response was depressing. To quote in full the reply received from one of the leading publishers of the West:

“Dear Sir,

We have given very careful consideration to your letter of May 16th. Your name, of course, is well-known to us, and we naturally are assured that your treatise on the Upper Atmosphere is an admirable work. We are sorry to say, however, that for various reasons we do not think it would be a practicable proposition for us to undertake its publication.

In the first place, from what you say, it is a very large book and would be extremely expensive to produce even in India. Of course, it would be better to have it printed in this country, but that would be even more expensive. From previous experience of books of this nature we feel very doubtful whether it would have a large enough sale to cover the expense of publication; in fact we anticipate that it would involve us in a considerable financial loss.

Books of this kind really ought to be published by the University Presses who exist largely in order to publish learned works whose appeal is limited. A further consideration is that even in the small field covered by your book it would have to compete with Chapman & Bartel's GEOMAGNETISM and works by Sir Napier Shaw.

On the whole, therefore, we are very sorry to say that we can only thank you and regret that we feel unable to publish the work. We return the list of contents which you kindly sent us.

We are,

Yours faithfully,

.....”

After the hard labour put in the preparation of the book such a cold reply from a respectable firm disappointed all concerned. Prof. M. N. Saha was at that time the President of the Asiatic Society of Bengal. He knew all about the book and recommended that the Asiatic Society publish the book as one of its Memoirs, however costly the venture might be. Finally in 1947 the first edition of ‘The Upper Atmosphere’ was published by the Asiatic Society.

The reception accorded to ‘The Upper Atmosphere’ was beyond all expectations. The 2000 copies of the first edition were sold out within three years. The Asiatic Society's venture was amply rewarded. In 1950, the Society offered to publish a second revised edition of the book, then out of print, to meet the ever-increasing demand from all over the world. The offer was accepted by the Professor and the second revised edition was published in 1952. This edition is also out of print now. It is not worthy that this edition of the book was translated into Russian in full



and was published by the Foreign Languages Publishing House, Moscow, in 1955.

Theory of Active Nitrogen

By and large, Prof. Mitra's greatest contribution to scientific knowledge was in the field of the ionosphere. His ideas and guidance were at the root of most of the contributions made by the Ionosphere Laboratory of Calcutta. Indeed, whenever any new idea or problem occurred to him, he would pick up one or other of his research workers and discuss it with him, laying bare the essential points involved and focussing attention to the core of the problem to be tackled. This type of discussion inevitably culminated in the selected worker being inspired to take up the investigation himself. Of course the Professor was always there to show the way out in case of difficulty. It was this inspiration that worked behind the building up of the ionosphere research school of Calcutta which produced a number of distinguished scientists who now hold high positions in India and abroad.

A problem which Prof. Mitra took upon himself to work out in the early 1940's was that of active nitrogen. While investigating upper atmosphere ionization his attention was drawn to the problem of the night sky luminescence. He suggested that the faint glow in the night sky should be related to the ionization in the high atmosphere in much the same way as the glow in a discharge tube is related to the ionization in it. In 1943 he offered a theory of night sky luminescence in which he sought to identify region F of the ionosphere as the luminescent layer and suggested that the ions and electrons, in course of their mutual neutralisation, emitted the observed lines and bands of O and N₂ respectively. He ascribed the nitrogen afterglow in a discharge tube to the N₂⁺ ions and the electrons produced by the discharge and proposed that these N₂⁺ ions should be identified as active nitrogen. According to this theory the afterglow is emitted in the act of neutralisation of the N₂⁺ ions by recombination with electrons which is a three body collision process. In the high atmosphere, the third body is absent or at least rare and therefore the recombination process of the ions and electrons is delayed resulting in the persistence of the glow and the ionisation for a long time. In the case of the ordinary glow discharge the ions and electrons disappear largely by recombination on the walls of the tube which act as the third body and the glow disappears quickly. In the case of discharge in nitrogen, however, the afterglow persists because the walls of the tube are somehow conditioned in such a way that recombination on the walls is retarded. The problem was studied by him with characteristic thoroughness and the theory was developed in elaborate detail. This, together with an excellent review of earlier work on the subject, was published as a book under the title "Active Nitrogen—A New Theory" in 1945.



It should be noted that the ionic theory of active nitrogen, as presented in this book, was criticised on the ground that the presence of N_2^+ ions in the glowing gas could not be detected by experiments carried out with this specific purpose. To meet this criticism, Prof. Mitra subsequently modified his theory and suggested that active nitrogen is a mixture of nitrogen atoms in the ground state and the metastable states which is the product of dissociative recombination of N_2^+ ions and electrons. These latter are therefore the parent bodies of the active substance instead of being the active substance themselves as proposed by him originally.

Industrial Research

Although Prof. Mitra's main interest was in fundamental research, he was fully conscious of the importance of industrial research also. He often expressed the view that the progress of fundamental research in a country depended largely on industrial development; indeed the two formed a vicious circle.

Soon after he became Chairman of the Radio Research Committee he directed his attention to researches on the applied side. Being deeply interested in the development of a radio industry in India, his first step was to explore the possibility of manufacturing radio receivers in the country. The writer, who was then the Secretary of the Radio Research Committee, was deputed to visit different institutions and firms in the country where activities, however little, on the production of radio components and the assembly of radio receivers were known to exist. A comprehensive report was prepared on the "Possibility of Radio Set Manufacture in India" and was presented before the Board of Scientific and Industrial Research in 1943. In this report the complete range of components and raw materials needed for the production of a domestic radio receiver was first indicated with necessary details. Against this background was detailed what little facilities then existed in the country for the production of receiver components, including hardware, and what raw materials were indigenously available. Based on these informations the possibility of the manufacture of complete radio receivers in the country was discussed. Soon after this the Radio Research Committee began to sponsor schemes on applied research. In his laboratory Prof. Mitra undertook two schemes—one on the laboratory production of microphones and loudspeakers and the other on the production of electron tubes. The first scheme resulted in the development of a single button type carbon microphone and an energized type loudspeaker, with raw materials available indigenously. The prototypes of these components together with complete design details and necessary information regarding the processing of the different raw materials required for their production were submitted to the C.S.I.R. for commercial exploitation. Work under the scheme on electron tubes resulted in 1950 in the construction, first, of a rectifier

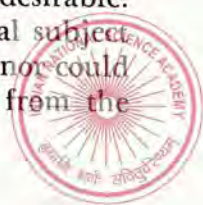


tube—the type 80 diode, and, later, a type 6C₅ triode. As far as is known, these were the first radio valves fabricated in India. The technical know-how's involved in the various phases of vacuum tube production technique were developed in the laboratory. Certain raw materials had of course to be obtained from abroad. The scheme as such was terminated in 1954 but the experience gained and the equipment assembled served as the nucleus out of which has grown the present Electron Tube Laboratory of the Institute of Radio Physics and Electronics in Calcutta.

The Institute of Radio Physics and Electronics, Calcutta

A strong advocate of scientific research and progress, Prof. Mitra hailed the creation of the Council of Scientific and Industrial Research by the Government of India with great delight. His attitude towards this organization found expression in the following remarks which he made in his Presidential Address at the Silver Jubilee of the National Institute of Sciences of India: "Much of this increased scientific activity has been due to the support which scientific research began to receive from the Government with the establishment in 1940, of the Board of Scientific and Industrial Research, which later became one of the component units of the wider organization, the Council of Scientific and Industrial Research (C.S.I.R.). Indeed, the adoption of the policy of sponsoring and encouraging scientific research at the government level—though at the time it was actuated more by the urgent considerations of possible Axis aggression than to any national development—was the greatest single event in the history of the progress of science in the country in the last quarter of a century".

For the advancement of radio research, the Radio Research Committee was formed under the C.S.I.R. and, as stated earlier, with grants received through this Committee, a number of radio research centres grew up in the country. However, there still remained another drawback. In order to carry on research on a truly advanced level, the availability of funds is not the only necessity. There should also be a steady flow of scholars with advanced training from the universities to feed the research staff. Provision of such advanced training in the science of radio did not exist at that time in any of the Indian universities. The most that was there in the early forties was in the Calcutta University where, as stated earlier, the subject under the name 'Wireless' was taught as an elective subject within the framework of the Physics syllabus. On all counts, this limitation in the scope of teaching electronics and radio physics was undesirable. For, the fresh M.Sc.'s of the University with 'Wireless' as special subject could neither take up research without considerable preparation nor could their training in the subject be of the desired level, judging from the contemporary needs.



In 1944, Prof. Mitra again went to England and U.S.A. as a member of a Scientific Mission appointed by the Government of India. The revolutionary applications of radio and electronics and the concomitant advancement of research in these countries convinced him that the subject must have the status of an independent discipline, if our students were expected to be anywhere near the front line in this field. He submitted a proposal to the University for creating an independent post-graduate Department of Radio Physics and Electronics. The proposal was readily accepted by the University but could not be implemented for want of funds. Two years later, in 1947, funds were made available by the Ministry of Education of the Government of India on the recommendation of the newly established All India Council for Technical Education. This enabled the University to create the Institute of Radio Physics and Electronics in 1949 incorporating the new Post-graduate Department of Radio Physics and Electronics and the existing Ionosphere Research Laboratory. The teaching and associated research activities were transferred to the new building of the Institute located within the campus of the University College of Science in Calcutta and the work of experimental observations on the ionosphere was transferred in 1955 to the Ionosphere Field Station at Haringhata. Prof. Mitra's long cherished desire of developing facilities for teaching and research in radio and electronics was thus fulfilled. These facilities have since developed considerably throughout the country and there are unmistakable signs of much further progress in the coming years. The pioneering contributions of Prof. Mitra to this cause will, however, be remembered for ever.

It may perhaps be interesting to note here that while laying the Foundation Stone of the Institute of Radio Physics and Electronics in 1949, Dr. B. C. Roy, the then Chief Minister of West Bengal, made the following remarks:

"Let me hope that in laying the foundation stone of the Institute of Radio Physics and Electronics today, I have planted a seed which will grow into a mighty tree, spreading its branches much beyond the borders of your present expectation. The Institute will become not only an all-India centre of study and research but will also attract earnest seekers after truth from beyond the boundaries of India".

Indeed, in recognition of the tradition of research created by Prof. Mitra and his school, the Institute was selected by the University Grants Commission as one of the first five Centres of Advanced Study under a scheme sponsored jointly with the Unesco.

As Administrator, Board of Secondary Education

Prof. Mitra retired from University service in November, 1955 and was thereafter appointed Professor Emeritus of the University of Calcutta. On his retirement he was requested by Dr. B. C. Roy, the then Chief



Minister of West Bengal to take charge of the Board of Secondary Education, which was then in a very unsatisfactory state of affairs. In spite of his reluctance, he had ultimately to yield to Dr. Roy's request and in September, 1956, accepted the Administratorship of the Board of Secondary Education.

On taking charge his first duty was to eliminate the many irregularities and shortcomings from which the working of the Board of Secondary Education in West Bengal had been suffering. He used to listen attentively to the grievances and complaints of students, guardians and school authorities alike and ensured that the same were looked into and remedied by his office with promptness and justice. In his office, Prof. Mitra was a symbol of punctuality and orderliness and this in no small way was responsible for the efficient running of the Board under his charge.

Perhaps the most important event of his regime as Administrator was the introduction of the Higher Secondary Syllabus in the schools of the State in 1957. The transition from the School Final to the Higher Secondary curriculum was inevitably beset with difficulties. Besides, the time at his disposal to effect the change-over was extremely short. In spite of all these, the first Higher Secondary Examination was held in time and without any untoward event, a sure proof of his administrative efficiency.

As Administrator of the Board, Prof. Mitra had to come in contact with the State Government, particularly in regard to the formulation of basic policies. He never hesitated to express his own views in such matters with firmness even though these were in conflict with those of the Government. Of particular importance was his stand on the language formula. The State Government was of the view that Sanskrit should be studied as a compulsory elective subject in the Humanities Course of the Higher Secondary Syllabus. Prof. Mitra was, however, of the opinion that it would be unfair to compel the students to study Sanskrit as this would be an unprofitable drain on the time and energy of the students. As Administrator he firmly stood by his decision and the opposition of the Government could not deter him from the course of action which he considered to be correct. However, the Government had eventually to issue an ordinance to nullify the Administrator's decision and to give effect to their own four-language formula.

As Lecturer and Writer

Eminence as a renowned scientist, fame as an excellent lecturer and distinction as a reputed author are not usually to be found in a single individual. Prof. Mitra, however, was an exception. His attainments as a scientist of world repute have already been referred to in this memoir. But perhaps not so widely known was his excellence as a lecturer and a writer. Whether delivering lectures in the post-graduate classes of the



University or in scientific conferences or outside, addressing a much less sophisticated audience on popular or semi-popular topics, Prof. Mitra, appeared to be equally at ease. What marked his talks as outstanding was his clarity of exposition. There was complete absence of superfluity in his talks, yet nothing was left unsaid. Every word seemed to have been chosen with care. Every sentence that he uttered was meaningful. The appeal of his talks, the popular ones in particular, was heightened by witty analogies, carefully chosen slides and properly accented delivery. One of his analogies, for example, describing the ionosphere as the 'radio roof' of the world stands out indeed as a fine example of fusion of scientific idea and literary conception.

The same qualities of precision, clarity and compactness which characterized Prof. Mitra's talks were also clearly evident in his writings. He would not mind devoting hours of concentrated effort in writing and rewriting portions of a manuscript until he was satisfied that his theme had been presented in elegant, precise and unambiguous language. His 'Upper Atmosphere' remains a glowing proof of his excellent presentation and style.

Private Life and Reminiscences

Prof. Mitra married Lilavati Biswas, daughter of Rai Bahadur Hara Kishore Biswas of Barisal in 1914. On his appointment as Lecturer in the University of Calcutta in 1916, the couple settled in Calcutta in a rented house near the University College of Science. About this time Lilavati gave birth to her first child, a son, who died in infancy. Thereafter two sons were born to them at an interval of one year, Asok Kumar and Kalyan Kumar.

On being appointed Khaira Professor of Physics, Prof. Mitra made up his mind to build a house of his own in Calcutta. He purchased a plot of land at Ballygunge and the house in which he passed the rest of his life was built there. Shortly after it was completed, a part of it was set aside for use of his research assistants for their ionospheric observations for the Second International Polar Year (1932-33). During this period, Prof. Mitra used to give all attention to the workers who had to stay in his residence day and night at regular intervals. In fact, the particular care that they received from Prof. Mitra might have been looked upon with envy by his two young sons, then only ten or twelve. Mrs. Mitra lent full support to her husband in all this and bore the brunt ungrudgingly. Unfortunately, about this time, she developed respiratory troubles which ultimately led to asthma. Prof. Mitra had to pass many sleepless nights sitting by her side and trying to alleviate her sufferings. But she never recovered from this ailment and passed away in 1939.

The untimely death of his wife was a great loss to Prof. Mitra but he bore it with fortitude. His sons were then young and the additional



burden of looking after them was borne by him with admirable calmness without any hindrance to his scientific activities.

Prof. Mitra's only pastime was chess. Every Sunday morning some of his friends living in the locality used to assemble in his house and sit round the chess board enjoying the game for hours together. Besides these Sunday chess sittings and the weekly Rotary Club Luncheon meetings he had no other activity by way of relaxation. Throughout the week he would remain completely engrossed in work and study both in office and at home. And in every sphere of his activity he always strove to attain perfection as far as is humanly possible. This almost uninterrupted strain was perhaps too heavy for him particularly in the later years of his life.

He possessed a good physique and even up to the age of fifty he was seldom heard to complain about any sort of indisposition. The first noticeable ailment that he suffered from was an enlarged prostate for which he was operated upon in early 1948. Symptoms of high blood pressure and cardiac insufficiency also began to show up, but by exercising exemplary restraint in diet and regularity in habits he never allowed these troubles to get the upper hand. The result was that for the last twenty-five years of his life he lived with these ailments pursuing his normal avocation with only slightly diminished vigour. But in January 1961 he received a cruel blow that completely upset him. His eldest son Ashok who was in service in Aden, suddenly died of a heart attack at the age of forty. This grievous shock was too hard for him to bear. With characteristic fortitude he struggled to forget the calamity and pursue his normal activities but never fully succeeded. Gradual deterioration of his heart for the next two years culminated in an acute attack of cardiac asthma which, after a brief spell of illness, dealt the final blow on August 13, 1963.

After the first signs of high blood pressure were detected, he felt the necessity of some relaxation after the day's hard toil. He confided his feelings to his close friends and together they found a club which they named "Chakra Baithak". In 1942 the club acquired a small house with an adjoining garden on the bank of Rabindra Sarobar (the former Dhakuria Lake) and Prof. Mitra acted as its President for a long time. He rarely failed to attend the daily evening sessions of the Chakra Baithak in which the members indulged freely in all sorts of discussions. As years rolled on he became deeply attached to the club so much so that he eventually resigned the membership of the Rotary Club.

Reserved in appearance, Prof. Mitra exercised unusual restraint on his speeches and movements. He impressed those around him with his high regard for discipline, exemplary devotion to duty, keen sense of responsibility and his concern for precision and perfection in any work done by himself or under his supervision. Punctuality was inherent in his nature so much so that his associates often wittily remarked that one could check time by noting his movements. Either at home or in office, his scrupulous



observance of rules and discipline surprised even his subordinates. In all spheres, his love of order, cleanliness and beauty was easily noticeable. In short, his attention to neatness in deeds and words, in manners and appearances and in his dealings with others was remarkable. Neatness was indeed his way of life.

The last few years of his life alternated with extremes of happiness and sorrow. He was delighted more than ever before when in 1955 he received the news that the second edition of 'The Upper Atmosphere' had been translated into Russian and published in the U.S.S.R. Early in 1957 he was requested by the Asiatic Society to consider preparing a revised third edition of the book as the second edition was fast nearing extinction. All this agitated the Professor. But the colossal nature of the task, shortage of man power, the Professor's lack of leisure—after discharging the heavy responsibilities as Administrator of the Board of Secondary Education, and, above all, his waning health—were factors that weighed heavily against undertaking the work. The idea had to be abandoned for the time being and he was visibly depressed. Fortunately, this state of his mind did not last long. His election as Fellow of the Royal Society in 1958 raised new hopes in him, but his heart showed no signs of improvement. At this stage, the premature death of his eldest son dealt him the hardest blow in his life. Everybody close to him apprehended that he would not be able to survive this shock but to the relief of all he endured it.

His appointment as National Research Professor in April, 1962 was again a source of great encouragement to him for he thought he could now relinquish the post of Administrator of the Board of Secondary Education and devote his time entirely to a revision of 'The Upper Atmosphere' for the third edition. He actually started laying the table in preparation for this job but Providence ordained otherwise. Although his outward appearance did not show it, trouble was all the time lurking in his heart. His doctors advised him to avoid physical exertion and mental stress as far as practicable. He obeyed this advice to the word except for the fact that he could never get rid of the thought of a revision of 'The Upper Atmosphere'. Prof. Mitra had a reputation for his capacity for dispassionate judgement. It was perhaps only in regard to this subject that he was found wanting in that dispassionate judgement. The desire to see the third revised edition of 'The Upper Atmosphere' was too strong for him to accept reality and he could not give up the idea till the end of his life.

Honours

Honours were showered on Prof. Mitra in large numbers. In 1958, he was elected to the Fellowship of the Royal Society, London, for his contribution to the study of upper atmospheric phenomena.



Prof. Mitra held many responsible positions of which the following are worth mentioning: Chairman, Radio Research Committee of the C.S.I.R. (1943-48); President, Asiatic Society of Bengal (1951-52); General President, Indian Science Congress (1955); President, National Institute of Sciences of India (1956-58). He was a member of the Indian National Committee for the International Geophysical Year and was in the Editorial Board of a number of Indian and foreign scientific journals.

Prof. Mitra was the recipient of the King George V Silver Jubilee Medal in 1935, Joy Kissen Mukherjee Gold Medal of the Indian Association for the Cultivation of Science in 1943, Science Congress (Calcutta) Medal of the Asiatic Society in 1956 and the Sir Devaprasad Sarbadhikary Gold Medal of the Calcutta University in 1961.

He received the Presidential Award, Padmabhushan in 1962 and the same year was appointed National Research Professor in Physics by the Government of India.

J. N. BHAR

BIBLIOGRAPHY

1918. On the asymmetry of the illumination curves in oblique diffraction. *Phil. Mag.*, **35**, 112.
 1919. On Sommerfeld's treatment of the problem of diffraction by a semi-infinite screen. *Phil. Mag.*, **37**, 50.
 1919. On the large-angle diffraction by apertures with curvilinear boundaries. *Phil. Mag.*, **38**, 289.
 1920. On a new geometrical theory of the diffraction figures observed in the Heliummeter. *Proc. Indian Ass. Cult. Sci.*, **6**, 1.
 1923. Détermination des états spectroscopique dans la région des petites longueurs d'onde. *Ann. Phys., Paris*, **19**, 316.
 1923. Sur la désaimantation des fer par des oscillations électriques. *C. R. Acad. Sci., Paris*, **176**, 1214.
 1928. (With D. BANERJEE) Beats by high frequency interruption of light. *Nature, Lond.*, **121**, 573.
 1928. (With H. RAKSHIT) Refraction of light by electrons. *Nature, Lond.*, **123**, 796.
 1931. On the periodic classification of the elements. *Phil. Mag.*, **11**, 1201.
 1931. (With B. C. SIL) On the variation of the resistance of thermionic valves at high frequencies. *Phil. Mag.*, **13**, 1081.
 1932. On the spontaneous generation of oscillation in low pressure discharge. *Phil. Mag.*, **14**, 616.
 1933. (With H. RAKSHIT) Recording wireless echoes at the transmitting station. *Nature, Lond.*, **131**, 657.
 1933. (With P. SYAM, H. RAKSHIT & B. N. GHOSE) Effect of the solar eclipse on the ionosphere. *Nature, Lond.*, **132**, 442.
 1933. (With H. RAKSHIT) On a study of the upper ionized atmosphere in Bengal by wireless echoes of short delay. *Phil. Mag.*, **15**, 20.
 1934. Earthquakes, *The Calcutta Rev.*
 1934. (With P. SYAM, & B. N. GHOSE) Effect of a meteoric shower on the ionosphere. *Nature, Lond.*, **133**, 533.
 1934. Transmission of radio waves round the earth. Presidential Address, Mathematics and Physics Section, *Indian Sci. Congr.*, 1934.
 1935. Report on the present state of our knowledge of the ionosphere. *Proc. natn. Inst. Sci. India*, **1**, 131.
 1935. (With S. S. BANERJEE) Dielectric constant of ionized air. *Nature, Lond.*, **136**, 512.
 1935. (With P. SYAM) Absorbing layer and the ionosphere at low heights. *Nature, Lond.*, **136**, 923.
 1936. (With A. C. GHOSH) Experimental investigation of the magnetic double refraction of ionized air. *Nature, Lond.*, **137**, 68.
 1936. Ionospheric studies in India. *Nature, Lond.*, **137**, 503.
 1936. Need of a Radio Research Board in India. *Sci. & Cult.*, **1**, 755.



1936. (With J. N. BHAR) Wireless echoes from low heights. *Sci. & Cult.*, **1**, 788.
1936. Return of radio waves from the middle atmosphere. *Nature, Lond.*, **137**, 867.
1936. Atmospherics. *Sci. & Cult.*, **2**, 430.
1938. (With H. RAKSHIT) Distribution of the constituent gases and their pressures in the upper atmosphere. *Indian J. Phys.*, **12**, 47.
1938. (With S. P. GHOSH & J. N. BHAR) The lower ionosphere. *Indian J. Phys.*, **12**, 455.
1938. Origin of the E layer of the ionosphere. *Nature, Lond.*, **142**, 914.
1938. The ozonosphere and the early morning increase of the E layer ionization of the ionosphere. *Sci. & Cult.*, **3**, 496.
1939. (With A. K. BANJERJEE) The fringe of the atmosphere and the ultra-violet light theory of aurora and magnetic disturbances. *Indian J. Phys.*, **13**, 107.
1940. (With B. B. RAY & S. P. GHOSH) Cross section of atomic oxygen elastic collision with electrons and region F absorption. *Nature, Lond.*, **145**, 1017.
1940. Magnetic storms. *Sci. & Cult.*, **6**, 70.
1940. Obituary of Late Sir Oliver Lodge. *Sci. & Cult.*, **6**, 217.
1940. Need for a planned development of broadcasting in India. *Sci. & Cult.*, **6**, 249.
1941. Radio in peace and war. *Sci. & Cult.*, **7**, 229.
1942. (With S. DAS SARMA) Zodiacal Light—A cosmic mystery-I. *Sci. & Cult.*, **8**, 8.
1942. (With S. DAS SARMA) Zodiacal Light—A cosmic mystery-II. *Sci. & Cult.*, **8**, 58.
1943. Light of the night sky. *Sci. & Cult.*, **9**, 46.
1943. Nature of active nitrogen. *Sci. & Cult.*, **9**, 49.
1944. Active nitrogen and $N_2^+(X')$ ions. *Nature, Lond.*, **154**, 212.
1944. Variations in the after-glow brightness of active nitrogen under varied experimental conditions. *Nature, Lond.*, **154**, 576.
1944. Scientific collaboration between India and Britain. *Nature, Lond.*, **154**, 756.
1944. Energy imparted by active nitrogen. *Nature, Lond.*, **154**, 831.
1944. Ionisation in active nitrogen. *Sci. & Cult.*, **10**, 133.
1945. Active nitrogen—A new theory. Joy Kissen Mookherjee Memorial Lecture, Indian Association for the Cultivation of Science, 1945.
1945. Night sky emission and region F ionization. *Nature, Lond.*, **155**, 786.
1945. (With J. N. BHAR) The Radar. *Sci. & Cult.*, **11**, 343.
1946. The auroral spectrum. *Nature, Lond.*, **157**, 692.
1946. Geomagnetic control of region F₂ of the ionosphere. *Nature, Lond.*, **158**, 668.
1946. Microwaves—pioneer work in India half a century ago—Sir J. C. Bose Memorial Lecture, November 30, 1946.
1947. The Upper Atmosphere. Royal Asiatic Society of Bengal, 1947.
1947. Some unsolved problems of the upper atmosphere. Extrait des colloques de Lyon, pp. 91-96, Sept. 1947.
1947. The atomic age. Lecture at the Rotary Club of Calcutta, Oct. 7, 1947.
1948. Active nitrogen. *Phys. Rev.*, **74**, 1637.
1951. Dissociative recombination of N_2^+ ions and some nitrogen afterglow phenomena. *Sci. & Cult.*, **16**, 488.
1951. Active nitrogen in auroras. *Nature, Lond.*, **167**, 897.
1951. General aspects of upper atmospheric Physics. pp. 245-261. Compendium of Meteorology, Edited by T. F. Malone, American Meteorological Society, Boston, Mass. U.S.A.
1952. Recent work on the ionosphere (Summaries of addresses) 39th Indian Sci. Congr. January, 1952.
1952. The Upper Atmosphere, 2nd Edition, The Asiatic Society Monograph Series. Vol. 5, 1952.
1953. Active nitrogen. *Phys. Rev.*, **90**, 516.
1954. (With M. R. KUNDU) Thunderstorms and sporadic E ionisation of the ionosphere. *Nature, Lond.*, **174**, 798.
1954. Atomic weapons and their logic. Lecture delivered at the Rotary Club of Calcutta, June 1, 1954.
1955. Science and Progress, The Story of Radio-electronics (Presidential Address—42nd Indian Sci. Congr.), *Sci. & Cult.*, **20**, Supplement, 7.
1956. Aeronautics and electronics, Address to the Annual General Meeting of the Indian Institute of Aeronautics and Electronics, 8th March 1956.
1957. Science and Culture. *Sci. & Cult.*, **23**, 171.
1958. Science service. *Sci. & Cult.*, **24**, 169.
1958. Birth Centenary of Sir J. C. Bose—an appreciation. *J. Brit. Instn. Radio Engrs.*, **18**, 661.
1959. Electronics in the service of medicine. *Calcutta Med. J.*, **56**, 45.
1960. Upper atmosphere and space exploration with artificial satellites. *Proc. natn. Inst. Sci. India*, **26A**, 215.
1960. Man and Nature. *Proc. natn. Inst. Sci. India*, Anniversary Address to the Silver Jubilee Session of the National Institute of Sciences of India, December 1960.
1963. Physics of the earth's outer space. *Sci. & Cult.*, **29**, 314.

