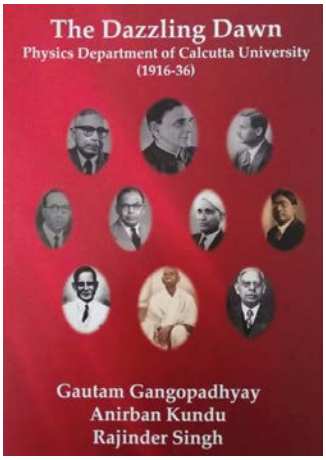


**The Dazzling Dawn: Physics Department of Calcutta University (1916–36).** Gautam Gangopadhyay, Anirban Kundu and Rajinder Singh. Shaker Verlag, Düren, Germany. 2021. 185 pages. Price: 21.90 Euro.

This book has 11 chapters with a focus on the teaching faculty of the Physics Department of Calcutta University (CU). It is a joint publication by three authors, two teachers of the Physics Department of CU, Gautam Gangopadhyay and Anirban Kundu and Rajinder Singh, Oldenburg University, Germany, who is a well-established historian of Indian Science. There is no mention in the Preface about the contribution of individual authors as we find in the research papers nowadays.

The Foreword is written by Amitava Raychaudhury (former Palit Professor of Physics, CU). Being an insider and a former student of the Physics Department, he has prepared this write-up drawing mostly from his personal experience. I agree with his remarks that the standards of teaching and research maintained by CU at that time (1916–36) reached heights that could well match those anywhere in the world. Raychaudhury has traced the root causes of downhill slide of the Physics Department after its golden era. He appreciates the efforts made by C. K. Majumdar to modernize the syllabus and encourage the faculty to engage in teaching and research with vigour. He also appreciates the quality of students in M.Sc. Physics, who could match with the best in the world.

The three authors of the book sum up the history of CU in the brief Introduction and reveal the sources on which their account is based. 'Calcutta University is among the top three universities of India established by the British Indian government during 1857 as a follow up of historical dispatch of Sir Charles Wood in 1854 to the Governor-General, Lord Dalhousie. It is the first modern university of India; the other two followed in the same year at Bombay and Madras. The Department of Physics started its journey in 1916 and had among its first faculty members, eminent Physicists like CV Raman, MN Saha, and SN Bose. There were half a dozen other unsung heroes of Indian Science, like DM Bose, SK Mitra, BB Ray, PN Ghosh, SK Acharya, and SC Sirkar.'

Chapter 1 traces the history of creation of the Physics Department. It sums up the contributions of Asutosh Mookerjee as the Vice-Chancellor of CU. The Physics Department was established for teaching at the postgraduate (PG) level. The teaching and research were promoted by two princely endowments, namely Sir Taraknath Palit (1912) and Sir Rashbehary Ghose (1913) endowments. Palit and Ghose Chairs were established for Indian Professors, and these were occupied by eminent physicists like Raman and D. M. Bose respectively. The salary of a Palit Professor was double (Rs 1000) compared to the salary of a Ghose Professor (Rs 500). Raman was the first Head of the Physics Department by virtue of being an occupant of the Palit Chair. This was later on occupied by D. M. Bose and Saha after Raman left. PG teaching in physics was shared jointly by the faculty of Presidency College and CU.

Chapter 2 gives us an idea on the PG teaching and research at CU. Teachers were encouraged to teach latest researches in physics using research papers. Raman took a lot of interest in building a workshop where instruments for laboratory experiments were made. Success rate in M.Sc. Physics was as low as 50%. Research scholars were paid a scholarship amount of Rs 75/month. K. Banerjee and Mitra were the first two research scholars to join the Physics Department. High-quality research papers in experimental physics were published by Raman's group, while theoretical physics research papers were published by Saha and S. N. Bose, and their students. Fifty-one scholars got their Doctorate in Physics between 1914 and 1936.

Chapter 3 is devoted to Raman and discovery of the Raman effect. Mookerjee had appointed Raman as a Professor with special privileges like higher salary and no obligation to teach. Thus Raman was able to focus on research full time, which led to the discovery of the Raman effect. Most of his work on the Raman effect was carried out in the Indian Association for Cultivation of Science (IACS) laboratories. Raman remained Palit Professor and Head of the Department of Physics till he left CU in 1933. He won the Nobel Prize for discovery of the Raman effect and won laurels for the university. After winning the Nobel Prize, Raman visited several foreign countries to deliver lectures. All his visits were funded by CU.

Chapter 4 describes the tale of D. M. Bose, who was the first appointee to the newly established Department of Physics which he joined in 1919. He was overshadowed by his uncle, J. C. Bose and other stalwarts like Raman, S. N. Bose and Saha. He made sterling contributions in diverse fields of radioactivity and nuclear disintegration, X-rays, cosmic-ray physics and magnetic properties of materials. D. M. Bose worked on the passage of $\alpha$- and $\beta$-particles in gases in Germany and Max Planck was one of his Ph.D. examiners. In 1923, he constructed the first cloud chamber in India and carried out $\alpha$-scattering experiments which were appreciated by Ernest Rutherford. He discovered the photo-magnetic effect, known as the Bose effect. He was appointed Palit Professor after Raman resigned from the post. He left CU in 1938 to become the Director of Bose Institute. In 1941, he started working on cosmic-ray particles using Ilford emulsions and missed the Nobel Prize by a whisker for the discovery of pi-mesons.

The next three chapters (5–7) discuss the contributions of S. N. Bose, Saha and Mitra, who were the pioneers of Bose–Einstein statistics, thermal ionization equation and ionospheric research in India respectively. I agree with the authors' remark that S. N. Bose can be considered, without any doubt, as the cult hero of Bengal science, who motivated generations of Bengal students towards science. All Indians lament that he missed the Nobel Prize. He was one of the founders of the old quantum theory along with Planck, Einstein and Niels Bohr. His work has been immortalized by naming particles obeying Bose–Einstein statistics as bosons.

S. N. Bose and Saha, both started as Palit research scholars in 1916. They were also teaching physics and applied mathematics in CU as assistants to the then Palit Professor Raman. Saha's paper, 'Ionisation in the solar chromosphere' is considered as the foundation of modern astrophysics, as it combined physics with astronomy. He went to Germany to work in the high-temperature laboratory of Walther Nernst to test his theory of ionization. Saha had cordial relations with

Albert Einstein, who recommended his case for grants to set up his laboratory in India. He was offered professorship in Allahabad University, where he started his own School of Astrophysics and Spectroscopy.

Mitra started as a research student of Raman and wrote a thesis: 'Investigation of interference and diffraction of light' to earn a D.Sc. degree. In 1920, he went to France and earned his second D.Sc. degree in the area of microwaves. On returning to India, he started teaching wireless technology after setting up a radio transmitting station in 1925. In 1935, he carried out studies on the properties of ionosphere at the Institute of Radio Physics and Electronics, Calcutta, now a Department of CU.

Chapter 8 describes the pioneering work of B. B. Ray in X-ray spectroscopy. Ray was also a student of Raman and did work on 'Optical analogue of whispering gallery effect'. Later on, he changed from acoustics to optics as Raman did. Ray went to Sweden under a travelling fellowship and started working under M. Siegbahn on X-ray spectroscopy. He spent two years in Copenhagen working with Bohr. In 1926, he returned to India and made strenuous efforts to set up the X-ray crystallographic laboratory in CU. He published 25 papers of high quality in this area.

Chapter 9 gives an overview of the activities of other teachers of the Physics department, namely J. C. Mukherjee, P. N. Ghosh, S. K. Acharya, B. N. Chakrabarty, D. Banerjee, H. Rakshit and S. C. Sirkar. The authors have given a brief resume of all these teachers who served the Physics Department in its formative years. Mukherjee was a topper of the Presidency College in 1907 and a classmate of Rajendra Prasad, the first President of India. He did not join research, but was among the first two lecturers of physics in 1916. He was rated among the best teachers of the Physics Department.

Ghosh was also a topper of MA in physics from Presidency College in 1908. He started research under Raman and got his Ph.D. after writing his thesis entitled 'The colours of the striae in mica and other optical investigations'. He joined as Ghose Professor of Applied Physics in 1920. Not much is known about the research career of Acharya, but he was associated with the Heat and Thermodynamics Laboratory of the Physics Department and teaching of theoretical courses. Chakrabarty joined Raman's group and got a D.Sc. degree for his thesis, 'On the colours of tempered steel and other tarnished surfaces'. He was appointed Assistant Professor on the recommendation of Raman.

Banerjee started his career as a laboratory. Assistant in Physics Department in 1917, then promoted as a Demonstrator, and finally as a lecturer in 1922. He submitted his D.Sc. thesis under Raman in 1923 on the basis of four papers published in the proceedings of the IACS. Rakshit did his D.Sc. working under the supervision of Mitra. He played an important role in radiophysics and ionospheric research. He is well known for the first radio map of Calcutta. Sirkar joined Raman's group in 1926 and his investigations led to the discovery of resonance Raman scattering, which played an important role in conformational analysis of biomolecules in later years.

Chapter 10 gives a brief introduction to the contributions of A. C. Saha, K. Banerjee, S. K. Banerjee, L. A. Ramdas, N. K. Sethi and S. N. Ghosh to the Department of Physics at CU. A. C. Saha taught electricity and magnetism. K. Banerjee got his D.Sc. in 1930 and is known as the founder of crystallographic studies in India. S. K. Banerjee got his D.Sc. under Raman and became Ghose Professor in the Department of Applied Mathematics. Ramdas got his Ph.D. under Raman and became a pioneer in agricultural meteorology in India. Sethi joined Raman's group in IACS and got his D.Sc. from CU for his work on 'Optics and relativity'. He was associated with Raman for testing the predictions of the special theory of relativity. S. N. Ghose was neither a teacher nor a researcher, but was handpicked by the Vice-Chancellor Mukherjee to develop laboratories of the Physics Department. He was a freedom fighter who went to USA to wage struggle for the freedom of India.

Chapter 11 is of special interest as it justifies the title of this book. The authors have provided glimpses how the 'dazzling dawn' occurred. There are three main reasons. First, CU had a visionary Vice-Chancellor, who recruited the best available faculty for the Physics Department. Second, he motivated rich nationalists of Bengal to create endowments for Science Chairs. As a result of his efforts, three Chairs, namely Palit, Ghose and Khaira Professorships were established in physics. These Chairs became the fulcrum for promoting teaching and research in physics. During this early phase, Indian scientists established close contacts with their counterparts in Europe. This provided a great fillip to their research. The third reason is more of a societal nature. Indian scientists wanted to prove to the British that they are not inferior in the field of science.

The authors attribute the eclipse of the 'dazzling dawn' again to three reasons as follows: (i) After independence, India followed a model where research was shifted from universities to central institutions set up for this purpose. As a consequence, talented faculty of universities moved to these institutions. (ii) Universities suffered due to lack of funds and loss of talent. Bureaucratic control and lack of vision continues to plague university education. (iii) Raman guided 80 students for research and attracted talent from all over India. We lack role-models like Raman, J. C. Bose, P. C. Ray, S. N. Bose and M. N. Saha to motivate students in scientific research.

The authors must be appreciated for bringing out this book with a focus on the golden era of Indian physics. We need more such books motivate Indian students of science and to inculcate a spirit of excellence and pride in the Indian heritage of science.

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**Techniques in Molecular Biology and Plant Biotechnology: A Compendium on Laboratory Experiments in Molecular Biology, Immuno-Diagnostics, Tissue Culture and Genetic Engineering in Plants.** M. R. Shylaja, Deepu Mathew and K. V. Peter (eds). NIPA, a division of NIPA Genx Electronic Resources & Solutions P. Ltd., 101, 103, Vikas Surya Plaza, CU Block, L.S.C. Market, Pitam Pura, New Delhi 110 034. xxiv + 191 pages. Price: Rs 2995. ISBN: 9789390591022.

Biotechnology has emerged as a promising career option demanding skilled biotechnologists in various fields of agriculture, horticulture, animal sciences, fisheries science, natural resource management, medicine, pharmaceutical and food-processing industries. For addressing the challenges of climate change and outbreaks of global epidemics and pandemics, biotechnology offers effective and efficient tools and techniques. Thorough hands-on knowledge of biotechnological tools is essential to develop protocols and procedures in the field.