

Bidhu Bhushan Ray – A Pioneer of X-Ray Spectroscopy. Rajinder Singh. Shaker Verlag GmbH, P.O. Box 101818, D-52018 Aachen, Germany. 2017. x + 158 pp. Price: 21.90 Euro.

Rajinder Singh is a prolific writer on the history of science, dealing with contributions of Indian scientists. This monograph is the 17th volume in the series. In the preface, author writes: ‘From the Niels Bohr Archive in Copenhagen, I found that B. B. Ray was the first Indian to work under the Dane, Niels Bohr. Ray’s correspondence with physicists like N. Bohr, Samuel Goudsmit and Y. Nishina is not only about the exchange of scientific ideas, but also about the private and political situations. This aroused my interest and I searched for his biography but without success.’

S. C. Roy, Editor-in-Chief, *Science and Culture*, writes in his foreword: ‘Rajinder has the capability of digging up water out of a hard rock. ... In my opinion, Rajinder is an investigative historian who is always on the run to discover new things, new materials, etc. In the process, he has written biographies of some Indian scientists like S. K. Mitra, D. M. Bose and U. N. Brahmachari, who were eminent in their own field of research. A biography of B. B. Ray was long overdue. Our kudos to Rajinder for filling this void.’

In the introduction, the author states that the book intends to explore: (i) general aspects of Ray’s life, (ii) his contacts with Rabindranath Tagore and Subash Chandra Bose, (iii) research in meteorology, (iv) contribution to atomic physics through X-ray spectroscopy, (v) reception of his scientific work in India and internationally, and (vi) Ray’s contact with international and national scientific

community. Despite the fact that the author has taken pains to collect and collate information extracted from Niels Bohr Archive in Copenhagen; Philosophical Archive, University of Konstanz, Germany; Archive of University of Calcutta, and from family and friends of Ray, he is not fully satisfied with his present work due to lack of some original documents in support of Ray’s forays outside the domain of his academic work.

Ray was born on 1 July 1894 in the village of Khadarpara in East Bengal, now Bangladesh. He was a brilliant product of the Calcutta School of Physics. Ray started his research career under C. V. Raman. He was awarded D Sc of the University of Calcutta for his thesis on meteorological optics. On the recommendation of Raman, he was awarded the T. N. Palit Foreign Scholarship to work on X-ray scattering in Niels Bohr Institute at Copenhagen. Probably due to advice from Niels Bohr, Ray decided to travel to Sweden and work with M. Siegbahn, who was an authority on X-ray spectroscopy.

After arriving at Uppsala, Ray started his observations on K_{α} lines in pure metallic powders in Siegbahn’s laboratory. By applying Sommerfeld’s theory of fine structure, they calculated the frequency difference of K_{α} doublets. Their experimental results were in support of Bohr’s atomic theory. Ray also proved the validity of Bohr’s model in the case of L_{α} values for different elements. When Bohr came to know about Ray’s work in Uppsala, he invited him to Copenhagen. Ray published two papers from Copenhagen which were communicated by Bohr.

Bohr was so impressed by Ray’s research work carried out in Uppsala that he recommended six months extension of his stay in Copenhagen for theoretical interpretation of his experimental results. Bohr wrote three letters to authorities of University of Calcutta with hardly any response to his pleas. Ray’s application for the post of Senior Lecturer at the University of Calcutta was also recommended by Bohr on 31 October 1925.

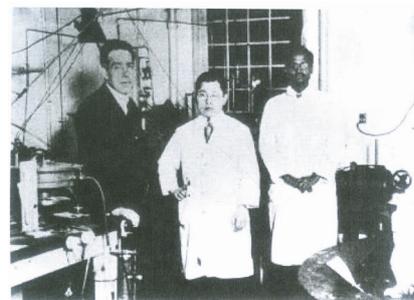
On his return to Calcutta, Ray had to face both private and official problems. His health deteriorated and on the academic front, he felt almost humiliated as neither space nor funds were made available by the University of Calcutta for setting up a research laboratory in X-ray spectroscopy. In October 1927, Ray was offered the post of a Reader in Physics at

Dacca University at double his salary at the University of Calcutta, but he was not allowed to join due to the bond he had executed with the University of Calcutta prior to leaving on the Travel Fellowship. Raman pleaded with University authorities to retain Ray by offering higher salary, but in vain. In 1934, Ray received the Ghosh Travel Fellowship for his second visit to Europe. He met his old colleagues in Europe and travelled to Germany and Italy before returning to India. During this trip, Siegbahn communicated his paper on L-series of barium and cesium.

Ray’s theory of glory and controversy over the Ray effect

The notion that the brightness of the daytime sky is due to the reflection of sunlight by suspended particles in the air was formulated by Alhazen, an Arabic scholar in the 11th century. Rayleigh’s theory of scattering of light was modified by Ray, who found that the intensity of scattered light depends on the polarized character of the light. For light waves, Ray numerically calculated the values of amplitude and phase for larger particles. His theory was verified experimentally in case of gold particles suspended in water as the colour of transmitted light turns from red to yellow and finally to blue. Ray’s 1923 paper in the *Proceedings of the Indian Association for the Cultivation of Science* on scattering of light by liquid droplets, and the theory of coronas, glories and iridescent clouds is considered a classic till today.

In 1930, Ray observed some spectral lines in X-ray spectra, an analogue of the Raman effect using X-ray scattering; but scientists of Europe and USA were unable to reproduce his results, which led



Niels Bohr, Yoshio Nishina and B. B. Ray (Credit: Niel Bohr Archive, Copenhagen).

to controversy. Ray observed that a part of monochromatic X-rays while passing through carbon, nitrogen and oxygen undergo a change in frequency and appear on the longer wavelength side of the primary radiation. He was of the opinion that this effect was a similar to the Raman effect, which was theoretically predicted by Kramers and Heisenberg.

M. Boetzkes in Germany and J. M. Cork in USA repeated Ray's experiment and both got negative results. However, M. N. Saha came out in support of Ray. The experiments were carried out by research students of Saha – S. Bhargava, R. C. Majumdar and J. B. Mukerjee – in Allahabad University, in support of Ray's effect. Even Sommerfeld wrote a letter to A. H. Compton, which appeared in *Physical Review*, suggesting to re-interpret Ray's experimental results. Despite all this support, controversy over the 'Ray effect' failed to die down.

Ray's social and political activities

According to Rajinder, Ray did not belong to the Bengali intellectual elite by birth, but was well connected with Bose, Saha, Raman and other scientists of the Calcutta School. After his marriage, Ray came in contact with Rabindranath Tagore, the first Indian Nobel laureate. During his second trip to Europe, Ray went to Germany and met W. Heisenberg. There is reference to a meeting between Ray and Subash Chandra Bose, the great Indian revolutionary, in this monograph. According to evidence gathered by the Rajinder from D. Ray (Member of Ray Family): 'Netaji Subash Chandra Bose met Dr B. B. Ray before his great escape to Germany to have an introduction letter addressed to Prof. Heisenberg to meet Hitler.'

In his correspondence with Bohr, Goudsmit and Nishina, there are oblique references to the political situation in India, but Ray had poor opinion about Indian politicians. In one of his letters to Nishina, Ray wrote: 'You know I was once interested in politics, and I did a little bit when I came back here, but I have found out that the politicians are as a rule scoundrels, and I have given it up as hopeless, and returned to my laboratory, only to find also a horrible mess.'

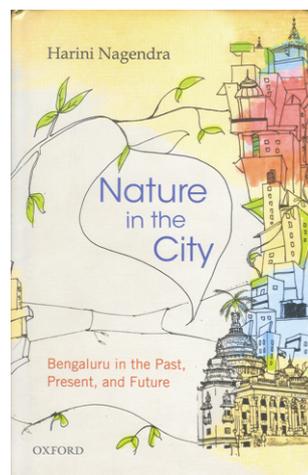
The most intriguing part of Ray's biography is his relationship with Raman and Saha. It is a well-known fact in aca-

demical circles that both Indian giants had no love lost between them. Ray was a research student of Raman, who always supported him in his academic pursuits, namely, visits abroad and entry into the University of Calcutta as a physics faculty. However, later on Ray was won over by Saha and he turned against his mentor, Raman. Does it have to do with the Bengali versus non-Bengali trait which was being hammered into Ray's mind by Saha? It is a predicament which needs better explanation.

On the whole, the monograph is a valuable resource material on Ray's life and his scientific achievements, as the unsung hero of the Calcutta School. I swam through this volume of 150 pages in just one sitting. It reads like a fiction story inter-woven with scientific facts, social and ethical values of pre-colonial Indian society, and predicaments of a young Bengali scientist who had lost his moorings. The author deserves appreciation for bringing out this biography as a volume under the 'History of Science' series.

HARDEV SINGH VIRK

*SGGS World University,
Fatehgarh Sahib 140 426, India
e-mail: hardevsingh.virk@gmail.com*



Nature in the City: Bengaluru in the Past, Present and Future. Harini Nagendra. Oxford University Press, New Delhi. 2016. xvii + 224 pp. Price: Rs 750. ISBN 9780199465927.

As a scholarly work on the ecological history of Bengaluru, the capital of Karnataka in southern India, this book

breaks new ground and makes for a refreshing read. It is interdisciplinary in scope, bringing insights from fields as diverse as ecology, urban planning, history and sociology.

Nature in the City is distinctive in several ways. First, as a book written by an ecologist, it is refreshing and unusual in that it addresses nature in cities, rather than in forests or wilderness areas considered a more typical domain of all things natural. With over half of the world's population today residing in cities, or increasingly living in rapidly urbanizing spaces, the focus of this book is timely and relevant to contemporary concerns over how to integrate nature and sustainability with urban development. Second, the book delves into archival and historical material from the 6th century CE to recent times without relying solely on these sources. Instead, Nagendra blends into the work findings of primary field research conducted by her students, co-workers and herself in the present-day city, which traces nature in the city's parks, wetlands, slums, streets and sacred spaces. Further, the voices of different groups of citizens presented as quotes and findings of interview surveys add a significant dimension to the work, illustrating how perspectives vary among the different segments of society ranging from the underprivileged and marginalized poor, the middle-class apartment dwellers, other interest groups and members of civil society, to the wealthy elite. Finally, Nagendra writes in an easy, clear and flowing style, almost free of jargon, with each chapter winding down with a summary of the main conclusions. The book makes for an intelligible and illuminating read by non-specialists and non-academic readers, without compromising on the scholarship. This makes for a reading experience marked by ease and clarity which is rare among scholarly works in ecology, sociology and environmental history.

The book opens with a chapter that sets the wider context of urbanization and changing perception of nature in cities from being a productive commons to a more constrained and privatized space that provides regulatory 'services' or recreation for urban citizens. The second chapter takes a closer look at the ecological history of Bengaluru itself. The landscape where the city is embedded even today is marked by thousands of years of human presence, going back