Physics and India

I read with interest reviews of two books in *Current Science*[1]. These are, in reverse order, *Remembering Sir J. C. Bose* and *India in the World of Physics: Then and Now*.

Acharya Jagadish Chandra Bose made remarkable contributions in the field of semiconductors which are only lightly touched upon in the chapter devoted to 'Millimetre wave researches of Bose'. His 1904 patent is mentioned now in many textbooks in physics[2] along with the fact that metal-semiconductor rectifiers were discovered way back in 1874 by Ferdinand Braun, who used mercury as the metal and galena (PbS) as the semiconductor. It is often forgotten that Marconi shared the 1909 Nobel Prize with Braun 'for their development of wireless telegraphy'. Braun also demonstrated the propagation of radio waves in his laboratory. However, Bose was the first to generate millimetre waves, whose importance was realized much later, and also to demonstrate their quasi-optical properties. These millimetre waves, which propagated in straight lines, obviously could not cross the Atlantic and make the sensation created by Marconi and his team.

Bose studied the behaviour of a variety of metals on different types of galena and thus discovered that the polarity of rectification depended on the type of metal and galena. He thus used the terms positive and negative coherers which were later understood to be n- and p-type galena. Shyamadas Chatterjee who worked at the Bose Institute in the early forties discussed these results with Neville Mott when he visited the Cavendish Laboratory in the mid-fifties. Mott was struck by these observations which led to him to make the oft-quoted remark that 'Bose was sixty years ahead of his time!' This incident was narrated to me by Chatterjee shortly after his visit and is a mark of recognition of Bose's research by one of the doyens of the field.

This brings me to the subject of the other book *India in the World of Physics: Then and Now*. It was while working at the Bose Institute that Chatterjee discovered in 1940 the spontaneous fission of uranium, which must rank as one of the major experimental findings in India. I wonder whether this has been mentioned in the above volume. Working almost single-handed with a simple neutron source, he set-up an experiment with completely indigenous apparatus to study the newly reported uranium fission when it was bombarded with neutrons. In the process, he found that distinct counts were recorded by the detector even without the presence of the neutron source. He was puzzled by this observation, because he had taken precautions to shield the uranium sample and the detector from cosmic rays. He reported the phenomenon to S. N. Bose, who quickly arrived at the conclusion that this must be due to spontaneous fission of uranium. The half-life was calculated with the help of N. R. Sen, Head of the Department of the Applied Mathematics, a friend and contemporary of Bose. This was found to be about 4.5×10^9 years, at least an order of magnitude less than the value calculated by Teller *et al.* I have narrated the incident in a brief article in the recently published biography of S. N. Bose[3] and also earlier in the obituary of Chatterjee[4].

The phenomenon was discovered simultaneously by Georgii Flerov and Konstantin Petrazhak in the Soviet Union who verified Chatterjee's value of the half-life[5]. Their paper titled 'Spontaneous fission of uranium' addressed isotopes U-238, U-235 and U-234 and the observation of the first occurrence of spontaneous fission. Chatterjee published his work later in an Indian journal and was recognized by the Russian authors, who presented him an inscribed copy of their book on the subject. He was also one of the first few in the country to set up a Wilson Cloud Chamber in 1938 and also pioneered radio-carbon dating.

1. Menon, M. G. K., *Curr. Sci.*, 2010, **98**, 703–704; Shepherd, V. A., *Curr. Sci.*, 2010, **98**, 705–706.
2. Sze, S. M., *Physics of Semiconductor Devices*, Wiley, 1980.
3. Kameshwar C. Wali (ed.), *Satyendra Nath Bose: His Life and Times*, World Scientific, Singapore, 2009.
4. Bose, D., *Phys. Today*, 1995, **12**, 88.
5. Flerov, G. and Petrazhak, K., *Phys. Rev.*, 1940, **58**, 89.

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