



Unsuccessful FRS nominations from colonial India

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Abstract

In the early decades of the twentieth century, several pioneers of modern science in India were nominated for the Fellowship of the Royal Society. Apart from those who got elected, the others who were not elected also had high reputation among their peers and were usually nominated by British scientists who were aware of their scientific contributions. This paper discusses six Indian scientists who were nominated for FRS during the era 1913–1939 but were not elected: P.C. Ray, D.N. Mallik, Raghavendra Row, N.R. Dhar, S.K. Banerjee, L.K. Ananthakrishna Iyer. In some of the cases, their nomination certificates (available at the Archives of the Royal Society) are the best compact statements of their scientific achievements, and it is not easy to find more information about some of them.

Keywords D.N. Mallik · Fellowship election process · J.C. Bose · L.K. Ananthakrishna Iyer · N.R. Dhar · Nominations of Indian scientists · P.C. Ray · Raghavendra Row · Royal Society · S.K. Banerji

1 Introduction

The Fellowship of the Royal Society was perhaps the most highly coveted honour for the pioneers of modern science in India in the early decades of the twentieth century (Choudhuri, 2018). It was clear that the Nobel Prize, which was the highest form of scientific recognition, could be expected only for works of extraordinary quality. Only two Indian scientists of that era—C.V. Raman and M.N. Saha—were seriously considered for the Nobel Prize, and Saha eventually did not succeed in winning it (Singh & Riess, 1999). On the other hand, several Indian scientists were elected FRS in that era. Apart from the prestige, an election to the Royal Society often brought other benefits as well. In a 1947 letter to H.H. Plaskett, M.N. Saha described the hardships he faced after joining Allahabad University and then wrote: “Things began to improve when... I was elected to the Royal Society in 1927. This was regarded in India as a rare distinction and I was congratulated by the Governor of the Province, Sir Wm Marris... Taking advantage of the favourable change in the atmosphere I approached the Governor for an annual research grant to enable me in my research work and through

his efforts, annually a sum of Rs. 5000 was granted to me” (Saha-Plaskett Correspondence, 2018).

Choudhuri (2018) has given a short account of the Indian scientists who were nominated for the Fellowship of the Royal Society during the colonial era. In order to be considered for this Fellowship, a person had to be nominated by at least six Fellows of the Society in writing. This nomination would remain valid for five years. For the sake of completeness, we reproduce here Table 1 from Choudhuri (2018), listing all the Indians who had been nominated for FRS during the era 1900–1947. For those who were elected, the year of election is indicated in bold. Curiously, S.N. Bose, who did his famous work in 1924, was nominated and elected much later in 1958, the same year in which S.K. Mitra was also elected. One surprising missing name is that of Jnan Chandra Ghosh, who does not seem to have ever been nominated to the Royal Society. The Royal Society would elect only 15 new Fellows per year in the early decades of the twentieth century, this number being increased to 17, 20 and 25 in the years 1931, 1938 and 1945 respectively (Andrade, 1960, pp. 12–13). It is clear that many persons who were nominated for FRS would not get elected.

In an era when very few Indians were Fellows of the Royal Society, an Indian could be nominated for FRS only if he (regrettably, all the persons we shall be discussing in this paper were men) had sufficiently high professional

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Table 1 Indian scientists nominated for FRS during the colonial era. For those who were elected, the year of election is indicated in bold.

Names	Nomination years
Prafulla Chandra Ray	1913–17, 1918–22, 1934–38
Jagadis Chandra Bose	1915–1919, 1920
Srinivasa Ramanujan	1918
Devendra Nath Mallik	1919–23
Chandrasekhar Venkata Raman	1922–1924
Meghnad Saha	1925–1927
Raghavendra Row	1926–30
Nil Ratan Dhar	1927–31, 1932–36
Birbal Sahni	1932–1936
Sudhansu Kumar Banerji	1933–37
L.K. Ananthakrishna Iyer	1935–38
Kariamanikkam Srivivasa Krishnan	1936–1940
Shanti Swarup Bhatnagar	1937–41, 1942– 1943
Homi Jehangir Bhabha	1941
Upendra Nath Brahmachari	1942–46
Subramanian Chandrasekhar	1942–1944
Prasanta Chandra Mahalanobis	1942–1945
Karm Narayan Bahl	1943–47
Daulat Singh Kothari	1944–48
Suri Bhagavantham	1945–49
Rappal Sangameswara Krishnan	1945–49
Sisir Kumar Mitra	1945–49 (elected later in 1958)
Jnanendra Nath Mukherjee	1945–49
Rames Chandra Ray	1945–49

reputation among his British peers who were already Fellows of the Royal Society and were willing to nominate him. It is clear that even those Indians whose FRS nominations were eventually not successful were important scientists of that era who had sufficiently high professional reputation outside India. Although they would unquestionably be key figures to a historian of science studying the emergence of modern science in India, many of them are almost completely forgotten now. For many of them, their FRS nomination certificates may be the most comprehensive brief summaries of their scientific accomplishments that we have today. All the Indians who were elected FRS in that era are rightly regarded as heroes of Indian science and many authors have written about them, there being even a book on the Indian Fellows of the Royal Society (Chaudhuri, 1992). However, to the best of our knowledge, there has been no previous study of the unsuccessful Indian FRS nominees. Presumably, the primary reason for the lack of such a study is that, unless one looks up the necessary documents at the Archives of the Royal Society in London, it is very difficult to get any information about the unsuccessful FRS nominations.

This paper is primarily based on the materials collected by the author during his visit to the Archives of the Royal Society during 24–25 July 2017. The aim of the present paper is to discuss the unsuccessful FRS nominations of

Indian scientists made in the first few decades of the twentieth century. Although no attempt at a detailed analysis has been made, we believe that the data provided in this paper will be of sufficient interest to historians of science studying the development of Indian science in that era. It should be emphasized that we are discussing scientists of an era for which scientometric information is not readily available. It is not easy to compile publications lists or citations records of these scientists from the internet. Even on the basis of the limited materials available in the Archives of the Royal Society, the unsuccessful Indian FRS nominees emerge as remarkable men whose scientific activities give us an idea of what was happening in Indian science in that era beyond the small circle of the giants of Indian science.

2 The Royal Society and the nature of the data available in the Society's Archives

For nearly two centuries after its establishment in 1660, the Royal Society of London was not too unlike a gentlemen's club. Since a newly inducted Fellow had to pay a fee and it meant an income for the Royal Society, the Society was initially quite eager to admit any foreign scholar who wanted to be a Fellow. According to Heilbron (1982, pp. 115–116), “Voltaire had the idea that anyone who declared his love of science, and deposited his fee, was immediately received a member, and d'Alembert is said to have boasted that he could arrange the election of any traveller bound for England, ‘should he think it an honor’.”

Only after the Royal Society adopted new Statutes in 1847 (available at the Royal Society Archives), clear guidelines for the election of Fellows were laid down and accomplishment in a branch of science became the primary consideration for election to the Royal Society. Although a provision was made for electing Foreign Members, a person had to be “one of Her Majesty’s subjects” in order to be considered for election as Ordinary Fellow. According to Statute III, “Every such Candidate shall be proposed and recommended by a certificate in writing signed by six or more Fellows, of whom three at least shall certify their recommendation from personal knowledge. The certificate shall specify the name, rank, profession, qualifications, and usual place of residence of the Candidate.” The names of all the proposed candidates would be compiled in a list, as stipulated by Statute VI: “In the first week in April, a list shall be printed, containing the names of all the Candidates..., arranged in alphabetical order..., together with the names of the Fellows by whom each Candidate is proposed and recommended; and a copy of such list shall immediately thereafter be sent to every



Ordinary Fellow.” Fig. 1 of Choudhuri (2018) shows a portion of a page from the list of 1922 in which the nomination certificates of C.V. Raman and P.C. Ray appear one after the other in the alphabetical order.

Statutes VII–XI thereafter laid down the detailed procedure by which “from such printed list of Candidates a number not exceeding fifteen” were to be elected as Fellows. First, the Council of the Society would select the fifteen candidates to be elected. Then there would be a voting process involving all the Fellows of the Society before this election was finalized. It is not difficult to guess that scientists within the British establishment who would be personally known to some members of the Council would have an advantage in this election process. A scientist working in a remote part of the British Empire like India would have a chance of successfully passing through this procedure only if his international scientific reputation was sufficiently high as to be known to the members of the Council.

Before the Statutes of 1847 were adopted, Ardasheer Cursetjee, a ship-builder from Bombay, elected FRS in 1841, was the first and the only ethnic Indian to be elected to the Royal Society in that era. His nomination certificate mentioned that he was “lately in England having undertaken the journey to this country at his own expense in order to perfect himself in the knowledge of the Steam”, indicating that it was expected at that time that a candidate would be able to present himself to the Society to be admitted into it. In later years, it was not necessary that a person would have to be in England at the time of his nomination and he would not have to present himself at the time of election. However, one ritual of the election process was that the elected Fellow had to sign the Charter Book of the Royal Society on some occasion when he was in London. Figure 2 of Choudhuri (2018) shows a page from the Charter Book in which the signatures of C.V. Raman and M.N. Saha appear.

After the adoption of the Statutes of 1847, no ethnic Indian was nominated for more than half a century, P.C. Ray being the first Indian to be nominated in 1913 in the new era. However, during the second half of the nineteenth century when no ethnic Indian was nominated, several British men who worked in India were elected FRS. A systematic study of British men who were elected FRS on the basis of their works done in the colonies has been carried out by Home (2003), who pointed out that some of these British men were elected “on the basis of the senior positions that they held in government scientific agencies rather than the originality or the intrinsic merit of their research”. Home (2003) prepared a very valuable Appendix listing the ‘Indian’ nominations. Data presented in Table I, which can be extracted from this

Appendix, have been independently checked by me at the Royal Society Archives.

At this point, it would be worthwhile to say a few words here about the nature of the materials available in the Archives of the Royal Society. An electronic catalogue of the rich collection of materials in these Archives is now available online. While the catalogue is still not complete in all respects, one can obtain brief descriptions of most of the materials in the Archives from the website of the Archives. Nomination certificates of most persons who have been elected FRS from the beginning of the nineteenth century are fully available online. However, in most cases, apart from the nomination certificate, no other materials connected with the nomination would be available. From 1941 onwards, lapsed nomination certificates of unsuccessful FRS nominees also have been preserved. In a few cases, the Royal Society Archives also have correspondence regarding such nominations. One such case was the nomination of Upendra Nath Brahmachari. Enquiries were made about his scientific reputation and whether he deserved to be elected FRS. This correspondence connected with Brahmachari (not available online) has been studied by Singh (2014), who believes that Brahmachari might have been elected if he lived longer. Unfortunately, full nomination certificates of unsuccessful FRS nominees which lapsed before 1941 have not been preserved. The only source of information about such nominations would be the lists prepared for distribution to all the Fellows, as stipulated by the Statute VI of 1847 quoted earlier. The Royal Society Archives have preserved these lists of nominations for most of the years from the beginning of the twentieth century, although there are a few missing years for which the lists are not available. However, since a nomination would be valid for five years, it is possible to prepare a full list of all the persons who were nominated in that era, even though the yearly lists are missing for a few years. These yearly lists are so far not available online. These lists, which have to be consulted in the Archives of the Royal Society, are the only source of information about the unsuccessful nominations before 1940. Figure 1 of Choudhuri (2018), showing an extract from the list of 1922, would give an idea of what can be seen in these lists.

In this paper, we present the materials about the unsuccessful Indian FRS nominees before 1940 which can be found only in the yearly lists at the Royal Society Archives. As can be seen in Table 1, there were six such persons (P.C. Ray, D.N. Mallik, Raghavendra Row, N.R. Dhar, S.K. Banerji, L.K. Ananthakrishna Iyer). Additionally, we present some discussion about J.C. Bose, since his first nomination during 1915–1919 was unsuccessful. Many Indians were



nominated in the decade of the 1940s. Since their nomination certificates have been preserved in the Royal Society Archives and some information is available online about these nominations, we do not discuss these nominations after 1940.

3 J.C. Bose and D.N. Mallik

As can be seen in Table 1, apart from the mathematical genius Srinivasa Ramanujan, only three other Indians were nominated during the era 1910–1920. It is rather remarkable that all three of them were professors at Presidency College, Calcutta, in three different departments—Chemistry (P.C. Ray), Physics (J.C. Bose) and Mathematics (D.N. Mallik). As we shall see below, although D.N. Mallik taught in the Mathematics Department, his research was primarily in the area of physics. So I shall discuss him together with J.C. Bose.

It is generally acknowledged that J.C. Bose and P.C. Ray were the first Indian scientists of the modern era to carry on original scientific research of high quality. However, it is often not realized how sudden their appearance was. Both of them received their initial training in Britain (Bose in Cambridge and Ray in Edinburgh) and then joined the faculty of Presidency College (in 1885 and 1889 respectively). Both of them took some time to settle down in India, before they began original investigations. Both of them published their first research papers from Presidency College in the *Journal of the Asiatic Society of Bengal* (Bose, 1895; Ray, 1894). Although this was a journal more known for publications on Indology and related subjects, scientific papers (especially related to geology, flora and fauna of the Indian subcontinent) continued to be published in it. During the era 1836–1885, as many as 866 scientific papers appeared in this journal, of which only 4 were written by ‘natives’ (Visvanathan, 2007, p. 311). It is unlikely that ‘natives’ were publishing their scientific papers elsewhere. Ethnic Indians were simply not writing scientific papers in that era. Then suddenly there were 14 scientific papers by ‘natives’ in the *Journal of the Asiatic Society of Bengal* during 1886–1905—some of which were from Ray and Bose. It should be clear from this that it was not the case that a few Indians were doing research on chemistry and physics, and Ray and Bose just surpassed the others. Rather, they appeared on the stage at a time when no scientific research on physics and chemistry of any quality whatsoever was undertaken by Indians. Ray and Bose burst upon the Indian science scene with the suddenness of a totally unexpected storm. It is no wonder that they were the first Indians of the modern era to be nominated for FRS.

As can be seen in Table 1, the first FRS nomination for J.C. Bose, which was valid for the years 1915–1919, was unsuccessful. When he was nominated again in 1920, he was elected in the very first year. His successful nomination certificate of 1920 can be seen online. Here we reproduce the earlier unsuccessful nomination certificate from 1915–1919:

Jagadis Chunder Bose, Presidency College, Calcutta

M.A. (Camb.), D.Sc. (Lond.). Professor of Physics. Has devoted himself to the study of electrical phenomena. Is the author of numerous papers and books giving the results of his researches, and describing the highly ingenious apparatus of his own design, by which they were carried out. He has investigated with success the behaviour of electric radiation of small wave-length. His experiments are given in a series of papers published in vols. lix. –lxx. of the Proceedings, Royal Society (1895–1902). Also the electrical changes accompanying the automatic movements, or induced by the stimulation of animal and vegetable tissues and organs, his experiments are given and discussed in the following:—“Electrical Response of Ordinary Plants to Mechanical Stimulus” (Journ. Linn. Soc., vol. xxxv., 1902); “Electrical Pulsation accompanying Automatic Movements of *Desmodium gyrans*” (*ibid.*, 1903); “An Automatic Method for the Investigation of the Velocity of Transmission of Excitation in Mimosa” (Phil. Trans., 1913); “Diurnal Variation of Moto-excitability in Mimosa” (Annals of Bot., vol. xxvii., 1913); “Response in the Living and Non-Living” (1902); “Plant Response as a Means of Physiological Investigation” (1906); “Comparative Electro-Physiology” (1907); “Researches on the Irritability of Plants” (1913).

[Dated Dec. 31, 1914.]

S.H. Vines. Rayleigh. Francis Darwin. J.A. Fleming. R.J. Strutt. F.W. Oliver. [S.P. Thosmosn.] E.A. Shipley.

The nomination certificate makes clear the well-known fact that J.C. Bose’s scientific career can be neatly divided into two parts. During 1895–1902, he primarily worked on radio waves. i.e. “electric radiation of small wave-length”. After 1902, his work mainly concentrated on responses of plants to various stimuli. It is curious to note that Bose’s works in these two distinct phases are described very differently in the nomination certificate.

After summarizing Bose's pathbreaking work of the first phase in one sentence ("He has investigated with success the behaviour of electric radiation of small wave-length."), it is mentioned merely that his results appeared in a series of papers in the *Proceedings, Royal Society*. On the other hand, several publications from the second phase are listed in full. We may wonder why the two phases of Bose's career are described so differently in the nomination certificate. Bose's investigations on radio waves were highly appreciated by some of the leading British physicists of that era, such as Lord Kelvin (who was no longer alive at the time of Bose's nomination) and Lord Rayleigh (the second signatory of the nomination certificate). On the other hand, several leading plant physiologists of Britain were very much opposed to Bose's works on the responses of plants to stimuli and it was even becoming difficult for Bose to publish his papers on this subject in leading British journals (Geddes, 1920, pp. 98–107; Dasgupta, 1999, pp. 183–192). One wonders whether the nominators did not write much about Bose's early phase because his research in that phase was well recognized, but they decided to list the important papers from Bose's second controversial phase to bring out the fact that some of these papers appeared in professional journals in the field like *Journal of the Linnean Society*, *Philosophical Transactions* and *Annals of Botany*. One might expect that the physicist Fellows of the Royal Society would have been supportive of Bose's nomination for Fellowship, but plant physiologist Fellows probably would have opposed it. It would have been of great interest to know of the discussions that might have taken place within the Council of the Royal Society in response to Bose's nomination. Unfortunately, no material on this is available in the Archives of the Royal Society. As already indicated in Table 1, Bose's first nomination (valid during 1915–1919) was not successful, but, when he was nominated again in 1920 immediately after the lapse of the first nomination, he was elected in the very first year. Bose's second nomination certificate of 1920, which was successful, is available at the website of the Royal Society. The text of this certificate is almost the same as the text of first certificate already quoted, except that the second certificate contained references to two papers published after the first certificate. One of these papers was published in Bose's own new journal *Transactions of the Bose Institute* and would have hardly carried much weight. So, the second certificate did not contain any significant new information to strengthen Bose's case. The most significant difference between the two certificates is that, whereas the first certificate had 8 signatories, the second certificate was signed by 13

Fellows—perhaps because of a conscious effort to show that Bose had support from a large number of Fellows of the Royal Society. Presumably, when the second nomination was put before the Royal Society, the Council felt more pressurized that they should not keep ignoring such a deserving candidate and Bose was elected.

Now we come to D.N. Mallik. His nomination certificate, which was valid during 1919–1923, was as follows:

Devendra Nath Mallik, 121, Lower Circular Road, Calcutta. Professor of Mathematics.

Senior Professor of Mathematics, Presidency College, Calcutta; sometime Reader in Physics, Calcutta University; formerly Junior Professor of Mathematics and Physics, Patna College. Author of numerous papers on mathematical and physical subjects, among them the following:—"Magnetic Induction in Spheroids" (*Phil. Mag.*, 1907); "Experimental Determination of Magnetic Induction in Elongated Spheroid" (*ibid*, 1908); "Mutual Induction" (*ibid*, 1908); "Magnetic Rotation of Electric Discharge" (*ibid*, 1908); "Lines of Force Due to Given Static Charges" (*ibid*, 1911); "Theory of Electric Discharge in De la Rive's Tube" (*ibid*, 1912); "Note on Secular Cooling of the Earth and a Problem in Conduction of Heat" (*Asiatic Society's Journ.*, 1912); "Fermat's law" (*Phil. Mag.*, 1913); "Dynamical Theory of Diffraction" (*ibid*, 1914); "Theory of Dispersion" (*ibid*, 1915); "Electric Discharge in a Transverse Magnetic Field" (*ibid*, 1916); "High Vacuum Spectra of Gases" (*ibid*, 1917). Author of a work on "Optical Theories" published by the Cambridge University Press, 1917.

G.C. Foster. H.C. Pocklington. A.W. Porter. Joseph Larmor. G.F.C. Searle, F.T. Trouton. —*Oliver Lodge. E.H. Burton. Ernest Rutherford.*

The names of the last three nominators are given in italics, as they appear in the printed list of nominations. From the titles of Mallik's papers mentioned in the nomination certificate, it is clear that he worked primarily on electricity, magnetism and optics—many of his papers appearing in *Philosophical Magazine*, the leading English-language journal for physics in that era. His nominators included such giants of physics as Larmor, Lodge and Rutherford. The title page and the interesting Preface of the book *Optical Theories* mentioned in the nomination certificate is shown in Fig. 1. It may be pointed out that Mallik later had another book published by Cambridge University Press in 1921—an elementary textbook *The Elements of Astronomy*.



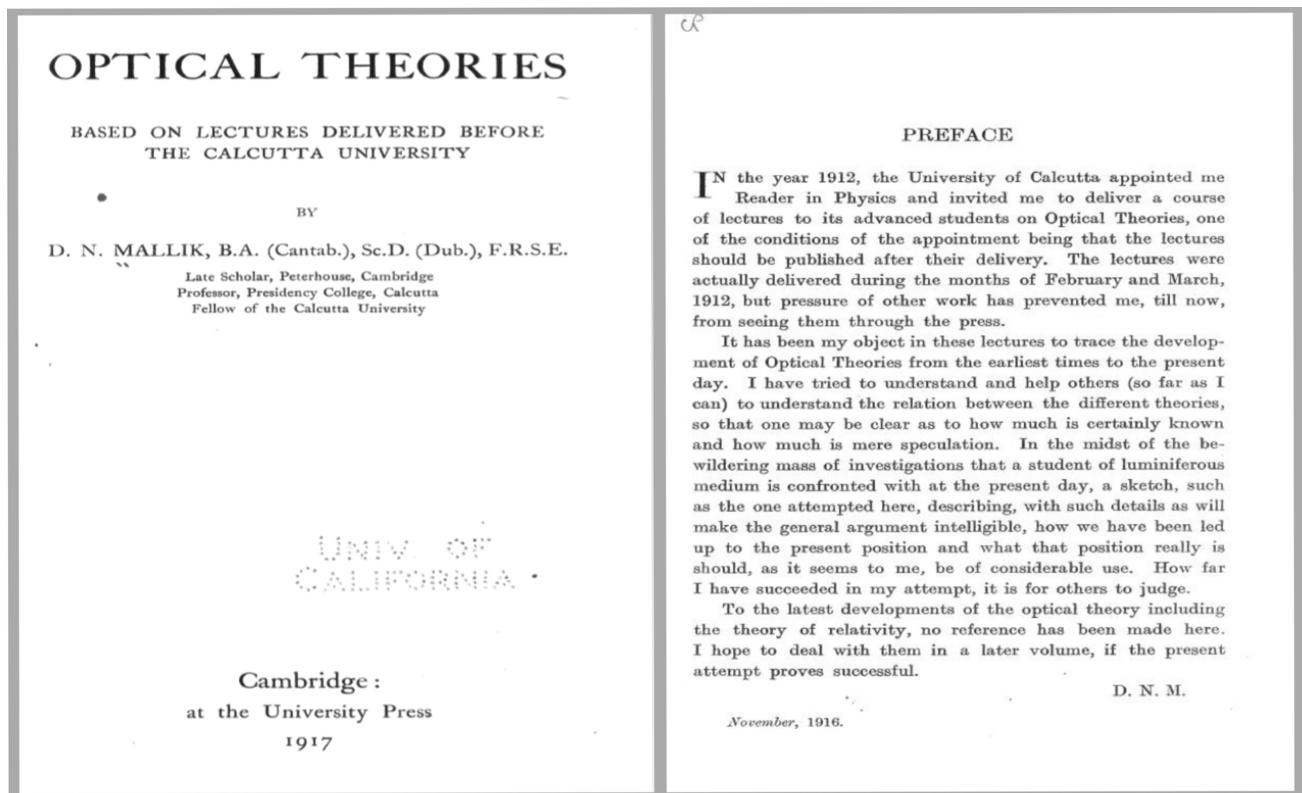


Fig. 1 The title page and the Preface of D.N. Mallik's book *Optical Theories*

I have been unable to come across any detailed account of D.N. Mallik's life. According to the records of Presidency College (175th Anniversary Commemoration Volume, Presidency College, Calcutta, 1992, p. 154), he served in Presidency College during 1908–1921, his qualifications being "B.A. (Cantab), Sc.D (Dublin), F.R.S.E.", the same as mentioned in the title page of his book. We come to know that Mallik had degrees from Cambridge and Dublin. Quite possibly, he was the first Indian to do a doctorate in physics from a university abroad (note that J.C. Bose did not work for a doctoral degree when he was a student in England and got an honorary DSc from London University much later). Mallik was elected Fellow of the Royal Society of Edinburg (R.S.E.), and the following online information about him is available in the website of R.S.E.:

DEVENDRA NATH MALLIK ?—08/12/1941
Date of Election: 18/05/1908
Profession: Mathematician
Notes: Born c1866.
Fellow Type: OF

Here we get the date of Mallik's death, but not the date of birth—the year of his birth being given circa 1866. If 1921,

the year in which Mallik's service ended in Presidency College is the year of his retirement and if he retired at the age of 55, then 1866 would indeed be the year of his birth. Mallik was, therefore, a few years younger than J.C. Bose and P.C. Ray (born in 1858 and 1861 respectively).

In the early decades of the twentieth century, most of the Indians serving in government colleges would be put in the 'Provincial Service'. Usually, only some of the British men serving in these colleges in India would be put in the 'Indian Education Service (IES)' with a higher salary. It is well known that J.C. Bose worked for three years without accepting his salary before he was placed in the IES grade (Geddes, 1920, pp. 36–39). D.N. Mallik was the only other Indian professor of that era at Presidency College in this grade. Ruchi Ram Sahni wrote in his autobiography (Sahni, 2017, p. 150–151):

It will be news to some that here even as late as the time of my retirement (April, 1918), there were only three Indians in the Imperial Education Service (IES) *in the whole of India*; namely Sir Jagdish Chandra Bose, DSc, FRS, Dr. D. N. Mullick, DSc, and a Christian gentleman who was Professor of English in Madras. Even Sir P.C. Ray, DSc, had to content him-

self with remaining all his life on the lower ranges of the educational ladder.

Mallik's being in the Mathematics Department of Presidency College in spite of his research in physics may not be so surprising when we note that this Department was offering BSc and MSc courses in Mixed Mathematics, which was later renamed Applied Mathematics in 1936 (175th Anniversary Commemoration Volume, Presidency College, Calcutta, 1992, p. 99). During the tenure of Mallik in this Department, S.N. Bose and M.N. Saha completed their BSc and MSc in Mixed Mathematics in 1913 and 1915 respectively. Mallik was their teacher. As a popular teacher, he was close to the students. S.N. Bose mentions that he applied for jobs after MSc with a recommendation letter from Mallik and would consult Mallik about his career (Bose, 1980, p.

226). While reminiscing about Saha, his college classmate N.R. Sen, who was also a student of Mixed Mathematics and must have been taught by Mallik, wrote: "Prof. D.N. Mallik, the Senior Professor of Mathematics in the Presidency College at that time, took immense pains for the top students of his class, and Saha read with him for two years in the Post-graduate classes" (Sen, 1954, p. 144). According to the reminiscences of a physics batchmate of Bose and Saha (Chakrabarti, 1976), Mallik carried on some research on the electrical discharge through gases in the laboratory of the Physics Department in Presidency College. Apart from mathematical physics, Mallik clearly had interest in experimental work as well. The results of the experimental work mentioned by Chakrabarti (1976) appeared in a paper listed in the FRS nomination certificate (Mallik & Das, 1916).

<p>PRAFULLA CHANDRA RAY, Calcutta.</p> 	<p>C.I.E., D.Sc. (Edin.); Hon. Ph.D. (Calcutta); Hon. D.Sc. (Durh.). Professor in the Presidency College, Calcutta. Author, as also joint author with his pupils, of close upon fifty-four memoirs:—"Mercurous Nitrite and its Derivatives"; "Isomorphism of Univalent Mercurous with Silver"; "Decomposition of Hyponitrous Acid"; "Preparation of Aliphatic Nitro-bodies by the Interaction of Mercurous Nitrite and Alkyliodides"; "Molecular Volumes of Nitrite of Silver, Mercury, Alkali, and Alkaline Earth Metals"; "Dimercurammonium Nitrite, Methyliammonium Nitrite, and Nitrites of the Alkylammonium Bases"; "Molecular Conductivity of Potassium Nitrite, Mercuric Nitrite, and Mercuripotassium Nitrite"; "Nitrites of the Mercuri-alkyl and Mercuri-alkyl-arylammonium Series"; "Sublimation of Ammonium Nitrite in a Vacuum and Determination of the Vapour Density of the Ammonium Nitrite." Published chiefly in the Journal of the Chemical Society, and in Liebig's Annalen, Zeit. Anorg. Chem., Journal of the Asiatic Soc. of Bengal, &c. Author of "History of Hindu Chemistry" (2 vols.).</p> <p>[Dated Dec. 16, 1912.]</p> <p>[Henry E. Roscoe.] A. C. Brown. J. Walker. W. H. Perkin. H. B. Dixon. Thomas H. Holland. H. B. Baker. M. O. Forster. P. F. Frankland. William A. Tilden. A. W. Crossley. Alexander Pedler. W. J. Pope. J. E. Reynolds. V. H. Veley. A. Scott. [H. Müller.]</p> <p><i>Supplementary Certificate.</i></p> <p>The following articles (out of about 40 papers) published in various journals during the past twelve months by Prof. Chandra Ray and his pupils have appeared in the Journ. Chem. Soc. "The Vapour Density of Ammonium Nitrate, Benzoate and Acetate" (Journ. Chem. Soc.); "Equivalent Conductivities of Hyponitrous Acid and Sodium and Calcium Hyponitrite" (<i>ibid.</i>); "Nitrites of the Alicyclic Ammonium Series.—Nitroso Piperazinium Nitrite" (<i>ibid.</i>).</p> <p>[Dated Nov. 19, 1913.]</p> <p>[Henry E. Roscoe.] A. W. Crossley. William A. Tilden. W. H. Perkin. H. B. Dixon. P. F. Frankland. W. J. Pope.</p>
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Fig. 2 P.C. Ray's nomination certificate, as it appeared in the 1914 list of nominations booklet. Apart from the original certificate dated Dec. 16, 1912, a later Supplementary Certificate dated Nov. 1, 1913, can be seen. (Courtesy of the Royal Society of London)



It is very likely that some obituaries were written about such a person who was held in such high regard in the contemporary scientific community. I have so far not been able to find any obituary or photograph of D.N. Mallik.

4 P.C. Ray and N.R. Dhar

We now come to the two pioneering chemists of modern India, who were unsuccessfully nominated for the Fellowship of the Royal Society. As we have already pointed out, Prafulla Chandra Ray was the first Indian to carry out internationally acclaimed research on chemistry. Apart from doing his own research, he succeeded in establishing a school of research in chemistry in India by inspiring several students through his own example. Nil Ratan Dhar was one of his favourite students in Presidency College and an ideal guru-shishya relationship always existed between the two. Dhar got his first training in research by working in Ray's laboratory as a student, before he went to London and Paris for higher studies.

P.C. Ray's nomination certificate of 1913 should be of considerable interest as being the first nomination certificate to the Royal Society of an ethnic Indian scientist in the modern era. We reproduce in Fig. 2 this certificate from the list of candidates sent to Fellows in 1914. While the requirement was that a certificate should be signed by at least six Fellows, we find that Ray's certificate was signed by as many as 17 Fellows. This was certainly very unusual. Browsing through the lists of candidates for the Royal Society, one rarely comes across a certificate signed by so many Fellows. Since the nominators were nominating an Indian for the first time in the modern era, perhaps they wanted to make the point that Ray had the support of a very large number of Fellows. Since the year following the first nomination turned out to be a very productive year for Ray, as can be seen in Fig. 2 of Choudhuri and Singh (2018), some of the nominators sent a Supplementary Certificate next year pointing this out (the Supplementary Certificate also can be seen in Fig. 2). After this first nomination elapsed in 1917, a second nomination was put to the Royal Society in the very next year. This nomination certificate can be seen in Fig. 1 of Choudhuri (2018). Unlike the case of J.C. Bose whose first and second nomination certificates were practically the

same, the second nomination certificate of P.C. Ray is very different from the first nomination certificate. The titles of Ray's papers are not listed in the second certificate, unlike the first one. However, Ray's monumental work *A History of Hindu Chemistry*, which is barely mentioned in the last sentence of the first certificate, is highlighted in the second certificate at the very beginning, describing it as "a unique work of great research and learning". Perhaps this was due to the growing reputation of this great work (of which the two volumes were published in 1902 and 1909) which was increasingly viewed as Ray's masterpiece—not any less important than his chemical research. When the second nomination also lapsed in 1922, there was a gap of more than a decade and Ray was again nominated for the third time in 1934. This nomination certificate is quoted below:

Ray, Sir Prafulla Chandra (Calcutta). C.I.E., D.Sc. (Edin.), Hon. D.Sc. (Dun.), Hon. Ph.D. (Calcutta). Professor of Chemistry, Presidency College, Calcutta. Distinguished as an investigator in chemistry and as the author of "A History of Hindu Chemistry", a unique work of great research and learning. He has been a pioneer of chemical research in India. Either alone or in collaboration with his pupils, he has published more than one hundred and forty papers, dealing with inorganic and organic nitrites and with complex salts of platinum and allied metals, in the Transactions of the Chemical Society; Liebig's Annalen; Journal of the Asiatic Society of Bengal; Journal of the Indian Chemical Society, and elsewhere. A veteran leader of scientific education in India.

G.T. Morgan. Henry E. Armstrong. W.J. Pope. W.P. Wynne. R.A. Gregory. James A. Philip. —*William A. Bone.*

The text of this third certificate is very similar to the text of the second certificate. We note one curious thing. P.C. Ray retired from Presidency College in 1916 and joined as Palit Professor of Calcutta University. Although both the second and third certificates were prepared after this, Ray continues to be described as "Professor of Chemistry, Presidency College, Calcutta" in both of these certificates. While his various accolades are listed, it is not mentioned that he held the prestigious Palit Professorship of Calcutta University.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

THURSDAY, MARCH 6, 1919.

THE LIFE-WORK OF A HINDU CHEMIST.

Essays and Discourses. By Sir Prafulla Chandra Rāy. With a Biographical Sketch and a Portrait. Pp. xxxii+349. (Madras : G. A. Natesan and Co., 1918.) Price 3 rupees.

SIR PRAFULLA CHANDRA RĀY, professor of chemistry in the Presidency College, Calcutta, is well known to chemists in this country as the author, either alone or in collaboration with his pupils, of more than a hundred papers, chiefly on the inorganic and organic nitrates, published in the Transactions of the Chemical Society, in Continental journals, or in the Journal of the Asiatic Society of Bengal. In his own country he is also known as the founder of a successful chemical industry, which, from small beginnings, now occupies factories spreading over an area of eight acres. It is one of the most successful concerns in India, and proved of considerable service to the Government during the war, when the supply of Western chemicals and drugs was seriously interfered with. It is entirely staffed with Bengali workers, and its research chemists are of its creator's training.

Chandra Rāy should, as he expressed it, sooner or later find himself "the property of anybody and everybody," and be called upon by various educational institutions, by conferences, and by the periodical Press and leading newspapers interested in the social reform and development of the industrial and political life of India to address his countrymen on subjects which so closely affect their national welfare and prosperity; and it was equally certain that a demand should arise that these essays and discourses should be collected and published in some permanent form.

The little book before us is the outcome of this demand. It contains a series of addresses and articles on scientific education in India; on the pursuit and progress of chemistry in Bengal; on science in the vernacular literature; on the antiquity of Hindu chemistry; on the Educational Service of India; on the Bengali brain and its misuse; on Government and Indian industries, together with a number of appreciations of men who have signalised themselves in the national evolution of India.

The collection is prefaced by a short biographical sketch of the author, and concludes with a list of original contributions from the Indian School of Chemistry.

Such a book, as a literary production, cannot be judged wholly from a Western point of view.

Fig. 3 The beginning of T.E. Thorpe's front-page article in *Nature* reviewing a book by P.C. Ray

Apart from Ray's detailed autobiography giving an account of his life (Ray, 1932), his life has also been documented by Dhar (1972). Since the basic facts of Ray's life are likely to be known to the readers of this paper, there is no need to discuss his biographical details here. Apart from being a pioneer of chemistry research and a historian of science, he was an important public figure in contemporary India—founder of a chemical industry, a political activist, a writer of incisive essays both in Bengali and English. While discussing why such an important scientist was not elected FRS, one question that comes up is whether his high fame was largely confined within India or whether his scientific works were sufficiently known also to his peers outside India. This question has been analyzed by Choudhuri and Singh (2018) in their study of the FRS nomination of Ray. N.R. Dhar was

studying in London and Paris during 1915–1919 when Ray's nomination for FRS was being considered seriously. Although a young student at that time, Dhar lobbied with several leading chemists of Britain to get Ray elected to the Royal Society and kept Ray informed in a series of fascinating letters written in Bengali. Choudhuri and Singh (2018) have presented translations of relevant portions from these letters, from which we know that several British chemists of that era very strongly felt that Ray should be an FRS. What is more, although the FRS election is a confidential process restricted to the Fellows of the Society, several British chemists were very willing to discuss Ray's nomination openly with Dhar. While Dhar was in Europe, Ray was knighted for his contributions to chemistry and Sir Thomas Thorpe, a leading British chemist, wrote a review of a book by Ray as a front-page



article in *Nature* titled “The life-work of a Hindu Chemist” (Thorpe, 1919). This article (see Fig. 3) begins with the assertion that Ray is “well known to chemists in this (Figs. 4, 5, 6) country”.

Since Ray’s letters to Dhar are not available, we do not know what his own attitude towards FRS election was. However, one existing letter dated 21.4.21 written jointly to Jnan Ghosh and Meghnad Saha comments on the election process in the Royal Society. I give translations of some relevant portions of this letter included in the book by Chakrabarti (2009, p. 270). In this letter, Ray first comments on the appreciation received by Jnan Ghosh’s theory of strong electrolytes (my translation from Bengali):

Einstein, Laue, Planck and Nernst are scientists of such calibre that merely describing them as Nobel Laureates would not add anything to their stature. I am delighted to know the opinions they expressed on Jnan’s ‘bahnbrechende Werke’. I have never experienced such pure joy in my life.

As already mentioned, Ghosh was surprisingly never nominated for FRS in spite of this important work which was highly appreciated by scientists of Continental Europe. Then Ray writes (my translation from Bengali):

What you have written about the Royal Society of England is literally true. On hearing about this year’s election, a very even-tempered person like Nilratan also exclaimed that these people are *haramzadas*.

(The word *haramzada* is intranslatable in English, the closest approximation being ‘son of a bitch’). We shall probably never know the real reason why Ray was never elected. Choudhuri and Singh (2018) guessed that Ray’s being an



Fig. 4 The only known photograph of P.C. Ray and N.R. Dhar—the master and the disciple—together, probably taken during a visit of Ray to Allahabad in the 1930s. (Courtesy of Professor Mahesh Chatopadhyay, Allahabad University)

outspoken critic of the British imperialism might have been a factor.

Coming to N.R. Dhar, we first reproduce his first nomination certificate (valid during 1927–1931):

DHAR, Nilratan (India). D.Sc. (Lond.), D. es Sc. (Paris). Professor of Chemistry and Dean of the Faculty of Science, Allahabad University, India. Distinguished as a very active and prolific worker in the field of physical chemistry. Has published about 140 scientific papers, either alone or in collaboration, on a very wide variety of topics, including—theory of solutions, colloid chemistry and adsorption phenomenon, catalysis, photochemistry, reaction-velocity, induced reactions, and bio-chemistry. Has done a great deal towards the promotion of scientific research in India, and has created an active centre of such work at Allahabad. Editor of the Indian Chemical Society’s Journal. Was President of the Chemical Section, Indian Science Congress, in 1922.

F.G. Donnan. James Walker. James C. Phillip. George Barger.—W.C. McC. Lewis. J.N. Collie.

After this nomination certificate lapsed in 1931, Dhar was again nominated next year. His second nomination certificate (valid during 1932–1936) was as follows:

DHAR, Nilratan (India). D.Sc. (Lond.), D. es Sc. (Paris). University Professor of Chemistry, Allahabad. Professor of Chemistry and Dean of the Faculty of Science, Allahabad University, India. Distinguished for researches in photochemistry and chemical kinetics, colloids and periodic precipitation, biological and biochemical oxidation processes. Has published, either alone or in collaboration with his students, a very large number of scientific papers on a very wide variety of topics. Has published a well-known book on the “Chemical Action of Light” (Blackie). Has done a great deal towards the promotion of scientific research in India, and has created an active centre of such work at Allahabad. Editor of the Indian Chemical Society’s Journal. Was President of the Chemical Section, Indian Science Congress, in 1922.

F.G. Donnan. James Walker. James Kendall. F.A. Freeth. James C. Phillip. E.C.C. Baly. Morris W. Travers.—J.N. Collie.

The main difference between the nomination certificates is that Dhar’s book *Chemical Action of Light*, which was published by Blackie & Sons, London, in 1930 (after the first nomination), could be mentioned in the certificate of the second nomination.

As pointed out already, Ray inspired several of his students to take up a career of research in chemistry. N.R. Dhar, J.C. Ghosh and J.N. Mukherjee among Ray's students turned out to be the internationally recognized Indian chemists of the next generation, the other outstanding chemist of that generation being S.S. Bhatnagar. Since Dhar was slightly older than Ghosh, Mukherjee and Bhatnagar, going by age he should be considered the second important chemist of India after Ray. A detailed obituary of Dhar was written by his student Mishra (1990), recording the dates of Dhar's birth and death (2 January 1892–5 December 1986) as well as listing his 150 students and the large number of research publications from his group. Readers interested in knowing about Dhar's life can turn to this obituary. Apart from stating the bare facts of Dhar's life, we mainly restrict our discussion to comments on his international standing in the community, to help readers to form their own opinion whether Dhar deserved to be elected to the Royal Society.

While an MSc student at Presidency College, Dhar started his research working in P.C. Ray's laboratory and managed to have several publications in international journals. He then obtained a Government of India Scholarship, which enabled him to carry on research in London and Paris, obtaining doctoral degrees from both the places. After this impressive start of his career, he got a job in Muir College, Allahabad, in the Indian Education Service (I.E.S.)—the Service in which his guru P.C. Ray was never placed. As Muir College, which had served as the seed for Allahabad University, became an integral part of the University, Dhar always remained associated with this University, living in Allahabad till the end of his life. Although Dhar began his career as a physical chemist, his research on the chemical action of tropical sunlight made him interested in photosynthesis in plants, ultimately leading to research on soil science—publishing an impressively large number of papers reputed in international journals.

Curiously, although Dhar was never elected to the Royal Society, he received an honour which was much rarer for Indians: he was elected to the Académie de Sciences of France in 1961. As far as the author knows, the only other Indian scientist of that generation to receive this exclusive honour was Raman, who was elected to this Academy in 1949. After them, C.N.R. Rao and T.V. Ramakrishnan, elected in 2000 and 2005 respectively, are probably the only other Indians who have so far been elected to this Academy. About this election, Dhar wrote: "Through the good will and support of Professors G. Bertrand, Jacques Duclaux, Paul Pascal, Marcel Delepine, J. Trefouel, J. Lecomte, G. Chaudron, R. Courrier, F. Perrin, P. Leping, A. Lacassagne, L. Leprince-Ringuet, M. Lemoigne, and other French Savants, I was elected to the French Academy of Sciences in 1961,

six years after my election to the French Academy of Agriculture" (Dhar, 1974). After spending a year in Paris in his youth, Dhar maintained his contacts with French scientists, which surely helped him to receive this truly rare honour for an Indian.

Dhar's international standing can also be gauged from the following fact mentioned by Choudhuri and Singh (2018): "It is well known that each year a few eminent scientists from around the world are invited to send nominations for the Nobel Prize. Dhar was invited to send nominations for the Chemistry Nobel Prize repeatedly—in 1939, 1947 and 1952. He was one of the only three chemists in pre-independence India who sent nominations for the Chemistry Nobel Prize, the other two being P.C. Ray himself (in 1935) and P.C. Mitter. One chemist whom Dhar nominated in 1939 was G. Urbain, who was Dhar's mentor in Paris." It is widely believed that Dhar himself was also nominated for the Nobel Prize. While reminiscing about Dhar, his student Chowdhury (2019) has given quotations from undated letters of V. Kovda of Moscow University, a leading soil scientist of USSR, and Eve Balfour, President of the Soil Association of UK, nominating Dhar for the Nobel Prize. We do not know whether Kovda and Balfour were responding to invitations for sending nominations for the Nobel Prize or if they wrote to the Nobel Committee on their own (in which case their nominations might not have been considered by the Nobel Committee). The online archive of the Nobel Prize, which has information about nominators and nominations till 1966, does not have any information about Dhar himself being nominated for the Nobel Prize (although there is online information about the nominations Dhar made).

As the Indian scientific community started growing in size, a need was felt by the late 1920s for a science academy in India along the lines of the Royal Society. For various complicated reasons, India eventually ended up having three science academies (Singh, 2020). Dhar was a Foundation Fellow of two of these academies: National Academy of Sciences (established in 1930) and Indian National Science Academy (established in 1935, initially called National Institute of Sciences of India). Following the model of the Royal Society, Indian National Science Academy started bringing out *Biographical Memoirs* of deceased Fellows. These *Biographical Memoirs* are often the source of the most detailed information about the Indian scientists who were elected Fellows of this Academy. Dhar was quite advanced in age when the Third World Academy of Sciences (TWAS, later renamed The World Academy of Sciences) was founded in Trieste, Italy, in 1983 to promote science in developing countries. According to the official website of TWAS, Dhar was one of the seven Indians among the 42 Founding Fellows which included nine Nobel Laureates.

During the 1920s, three physicists—J.C. Bose, C.V. Raman and M.N. Saha—were elected FRS. On the other



hand, two chemists with impressive publications record and high reputation within international peers—P.C. Ray and N.R. Dhar—were not elected. This raises the question whether there was more resistance to electing chemists to the Royal Society from outside Britain. It may be interesting to note that one British chemist, Alexander Pedler, working in India was elected FRS in 1892. He was an inspiring teacher of chemistry at Presidency College for many years (1873–1893). P.C. Ray greatly admired him and wrote about him: “Pedler was an expert in gas-analysis and he was almost unrivalled as an experimenter. His manipulative skill was the envy of us all” (Ray, 1932, p. 83). He was the Vice-Chancellor of Calcutta University during 1904–1906. Although Pedler was fondly remembered by his students as an outstanding teacher, it is not very clear whether his research was highly regarded by the international chemistry community. His FRS election certificate lists his important papers:

Author of papers on ‘An Isomeric Modification of Valeric Acid,’ ‘Calcutta Coal Gas,’ ‘The Use of the Radiometer as a Photometer,’ ‘Cobra Poison,’ ‘The Past and Present Water Supplies of Calcutta,’ ‘Technical Education for Bengal,’ ‘The Fall Point Cyclone of September 22nd, 1885,’ published in the Proc Roy Soc, the Journ Chem Soc, the Journ Asiat Soc Beng, and elsewhere.

Just from the titles of his most important papers, one is inclined to think that Pedler’s contributions to chemistry were not as fundamental as the contributions of Ray or Dhar. It should be remembered that Ray and Dhar were nominated for FRS in an era different from the era when Pedler was elected. Still, it is difficult not to conclude that the bars were much higher for a ‘native’ scientist compared to a British scientist working in India, who might belong to an ‘old boys’ network’ personally knowing many important persons in the Royal Society from his student days. S.S. Bhatnagar was the first Indian chemist to be elected FRS in 1943.

5 Raghavendra Row, S.K. Banerji and L.K. Ananthakrishna Iyer

In the last decades of the nineteenth century and the first decades of the twentieth century, physics and chemistry were two well-established branches of basic science with systematic course curricula in various universities around the world. It is no wonder that many young Indians of that era who aspired for an academic career in science would be attracted to physics and chemistry. After discussing the unsuccessful FRS nominations in physics and chemistry, we now turn to unsuccessful FRS nominations from colonial India in

three rather diverse areas—medical research (Raghavendra Row), geophysics (S.K. Banerji) and anthropology (L.K. Ananthakrishna Iyer). All three of them were Foundation Fellows of Indian National Science Academy, when this academy started in 1935 under the name National Institute of Sciences in India (NISI) in the premises of the Asiatic Society in Calcutta. The names of all three appear in the list of the Foundation Fellows provided by Sahni and Tandon (2017, pp. 243–244). We can get valuable information about Banerji and Iyer from their biographical memoirs bought out by that Academy. Unfortunately, a biographical memoir of Row does not seem to have been published.

We quote below the FRS nomination certificate of Raghavendra Row valid during 1926–1930:

ROW, Lt.-Colonel Raghavendra (Bombay).I.M.S. (Hon.), O.B.E. (Military: mentioned in despatches), M.D. (Lond.), D.Sc. (Lond.). First Physician and Professor of Medicine, J.J. Hospital and Grant Medical College, Bombay. Author of the following papers, among others:—“Parasite of Oriental sore in Cultures” (Quart. Journ. Micros. Sci., 1909); “Tubercle in Bombay” (B.M.J., 1909); “Leishmania donovani and tropica” (*ibid.*, 1912); “Experimental facts *re* Kala Azar” (B.M.J., 1912; J. Trop. Med. and Hygiene, 1912–13); “Glycerinated pest vaccine” (Trans. 17th Internat. Congr. Med. Lond., 1913); “Generalised Leishmaniasis . . . in Mouse” (Bull. Soc. Path. Exotique, Paris, 1915); “Experimental Leishmaniasis in monkey and mouse” (Indian J. Res., 1914); “Bass’ method of cultivation malarial parasite *in vitro*” (*ibid.*, 1917); “Spirochaete from case of rat-bite fever” (*ibid.*, 1911); “Reversion of the flagellate form of Leishmania donovani and L. tropica to resistant torpedo W.O. body in culture” (*ibid.*, 1922).

E. Sharpey-Schafer. C.J. Martin. J.C.G. Ledingham. W.B. Leishman. Ernest H. Starling. John Rose Bradford.

Row was the first Indian working in western India to be nominated for FRS. It may be noted that several of his papers dealt with Leishmaniasis (also known as Kala Azar in Indian languages), a disease caused by the bite of certain kinds of sandflies leading to ulcers and was often fatal. One of his nominators was W.B. Leishman, who served as an army medical officer in India and identified the micro-organism causing this disease in 1901. It may be mentioned that U.N. Brahmachari, who discovered urea stibamine to treat this disease in 1922, was also an unsuccessful FRS nominee during a later period (1942–1946).

Raghavendra Row was born on 16 November 1871 and died on 14 November 1953. Although he was a Foundation Fellow of the Indian National Science Academy, his

biographical memoir or photograph is not available from this Academy. However, a short unsigned obituary of him appeared in the *British Medical Journal*, in which Row published regularly including several papers mentioned in the nomination certificate (*British Medical Journal* 1954, 3 July issue, p. 54). We come to know from this obituary that Row went to London for his postgraduate studies, eventually obtaining his M.D. and D.Sc. degrees from there—becoming the first Indian to receive D.Sc. from the University of London. The obituary traces his career path after he returned to Bombay with the D.Sc. degree. He was a practicing physician and also a professor at Grant Medical College, Bombay, from 1921 till his retirement in 1931. As more and more Indians started turning to modern European medicine in preference over traditional medical systems, there was a rapidly growing demand for modern medicine in India. However, facilities for medical research were rather limited. According to the obituary:

Throughout his long life he possessed the inquiring mind of the perpetual student and in other circumstances might have become a research worker of the first rank. Though lacking the opportunity and the facilities to devote his whole time to research he was not prevented from gathering clinical material which, in the intervals between the work of his private practice, he studied in his own private laboratory . . . A prolific writer on a wide variety of subjects, including leishmaniasis, malaria, rat-bite fever, leprosy, plague, enteric fever, he had a number of communications published in this *Journal* between the years 1902 and 1924.



Fig. 5 Sudhansu Kumar Banerji. (Courtesy of Indian National Science Academy)

Row was two years older than U.N. Brahmachari and must have been one of the first Indians to publish medical research in reputed international journals. Looking at the author index of Brahmachari's classic monograph *A Treatise on Kala-Azar* (Brahmachari, 1928), we find that Row's work has been discussed in 13 different pages of the book, whereas Brahmachari's own work is discussed in 16 different pages. There is no other Indian researcher whose work has been referred by Brahmachari so many times. Clearly, Brahmachari must have had a high regard for Row as his most significant Indian predecessor.

The FRS nominations of all the Indian scientists we have discussed so far were initiated by their British peers. As a handful of Indian scientists started joining the ranks of FRS, it became possible for nomination processes of Indians to be initiated by Indian Fellows. The geophysicist S.K. Banerji, whose nomination was valid during 1933–1935, was the first Indian scientist for whom the first two nominators were Indians (C.V. Raman and M.N. Saha). The nomination certificate is as follows:

BANERJI, Sudhansu Kumar (Bombay). Director, Bombay and Alibag Observatories, and Honorary Professor of Applied Physics at the Royal Institute of Science, Bombay. Formerly Professor of Applied Mathematics in the Calcutta University. Is a mathematical and experimental physicist of distinction who has made important contributions to geophysics and meteorology, including especially on such topics as the electricity of thunderstorms, microseisms associated with disturbed weather at sea, and hydrodynamics of disturbed fluid motion. Has been responsible for the publication of the scientific reports of the Bombay and Alibag Observatories for the last fifteen years. Has rendered important service to science in India by developing a school of experimental research in physics at Bombay. His publications (over 50 in number, see list submitted) indicate great energy and versatility. C.V. Raman. M.N. Saha. Gilbert T. Walker. G.C. Simpson. Sydney Chapman. Napier Shaw. J. Proudman. Harold Jeffreys.

As mentioned already, Banerji was a Foundation Fellow of Indian National Science Academy and his Biographical Memoir brought out by that Academy (Rao, 1966) is the best source of information for him. Dates of his birth and death (27 April, 1893—10 August, 1966) and his publications list are available there. He completed MSc in mixed mathematics from Presidency College in 1914—just a year before S.N. Bose and M.N. Saha—securing the second position. D.N. Mallik must have been his teacher. Like Bose and Saha, he also opted for a career in physics, joining C.V. Raman's laboratory for initial training in research. After a doctoral thesis on

Some Problems in Diffraction, Wave Motion and Vibrations, he was appointed as Rashbehari Ghosh Professor of Applied Mathematics, Calcutta University, in 1918. He started being interested in some problems of seismology and had discussions with Sir Gilbert Walker, Director-General of Observatories (whose name appears as the third nominator for Banerji in the nomination certificate), during a meeting of the Indian Science Congress. Walker was eager that bright young Indians took up geophysics. According to Rao (1966), “He offered Dr Banerji the post of Director, Colaba Observatory, Bombay in the India Meteorological Department, which he accepted after some hesitation.” Thus, Banerji became a geophysicist coming through the route of physics and applied mathematics. During the next few years, Banerji published papers on a wide range of geophysical topics (as mentioned in his nomination certificate), which appeared in such leading journals as *Nature*, *Philosophical Magazine*, *Philosophical Transactions of the Royal Society*, etc.

Raman must have had a high opinion of Banerji, since he had so far not nominated any of his other students for FRS before nominating Banerji in 1933. According to K.S. Krishnan’s diary entry of the day on which the first indications of the Raman effect became available (Krishnan was the co-discoverer): “he [Raman] remarked that nothing was beyond my reach referring to the Fellowship of the Roy[al] Soc[iety] and that I might probably get the Fellowship before I got my Doctorate” (Mallik, 2000). While Raman might have said this on the spur of the moment, he presumably decided to wait for a few years for the reputation of Krishnan to build up. Krishnan was nominated for FRS in 1936, three years after Banerji (with Raman as the first nominator for Krishnan as well). Saha, the second nominator of Banerji, was one year junior to Banerji in college and must have known him well. Still, it is remarkable that Raman and Saha teamed up to nominate Banerji. It is well known that Raman and Saha were involved in a personal fight during 1932–1934. Even after accepting the Directorship of the Indian Institute of Science, Raman wanted to retain his control over the Indian Association for the Cultivation of Science, which was unacceptable to Saha (Venkataraman, 1988, p. 56–59; Chatterjee & Chatterjee, 1989; Mallik & Chatterjee, 2012, 149–152; Choudhuri, 2016). The nomination for Banerji must have been prepared towards the end of 1932, when this fight was picking up its initial momentum. It is certainly remarkable that Raman and Saha could both rise above this partisanship and could nominate Banerji together, even though the nomination was not successful.



Fig. 6 L.K. Ananthakrishna Iyer. (Courtesy of Indian National Science Academy)

At last, we come to L.K. Ananthakrishna Iyer. His nomination certificate (valid during 1935–1938) is reproduced now:

IYER, Rao Bahadur L.K. Ananthakrishna (Kalpathy Post, S. India). Distinguished as a student of the anthropology and ethnography of Southern India for a period of 35 years. Appointed Superintendent of Ethnography in Cochin State in 1901. In the early years of this century was instrumental in enlightening the Indian public in anthropology and ethnography and it is largely due to him that the Universities of Madras, Calcutta and Mysore have taken interest in these subjects. He organised the Department of Anthropology in Calcutta in 1920 and was Reader in Anthropology in the Universities of Madras and Calcutta. Was appointed Superintendent of Ethnography, Mysore, in 1924. Has been referred to by the Government of India as “the doyen of Indian anthropologists.” A list of some of his publications is attached.

A.C. Haddon. G. Elliot Smith. C.G. Seligman. Arthur Keith. R.B. Seymour Sewell. C.V. Raman.

Ananthakrishna Iyer was born in 1861 and died in 1937. So, he was at a fairly advanced age when he was nominated for FRS. He clearly belonged to the generation of J.C. Bose and P.C. Ray rather than to the generation of scientists who were being nominated around the time when he was nominated. He was a Foundation Fellow of Indian National Science Academy and his biographical memoir (Ramdas, 1937) is a good source of information for him. He seems to be a completely self-made man.

Anthropology was not yet a recognized academic discipline in India during his younger days. He had a basic degree in 'Natural Science'. When he was appointed the Superintendent of Ethnography, Cochin State, in 1901, he started anthropological investigations at his own initiative. His *Cochin Tribes and Castes* published in two volumes (in 1908 and 1912) established his international reputation. He was invited in 1921 by Asutosh Mookerjee, the visionary Vice-Chancellor of Calcutta University (during his last term in that position), to develop and head the Anthropology Department of Calcutta University. Raman was the Palit Professor at the University at that time and must have come to know Ananthakrishna Iyer well, both being Tamil Brahmins. In fact, Ananthakrishna Iyer's son L.A. Ramdas, who wrote the biographical memoir of his father (Ramdas, 1937), did his doctoral dissertation under the guidance of Raman. As we see, Raman was one of the signatories of the Ananthakrishna Iyer's FRS nomination certificate, although their research fields were widely different. In 1934, Ananthakrishna Iyer got an opportunity of travelling outside India for the first time. Although a strictly vegetarian orthodox Brahmin, he proceeded on a lecture tour of Italy, France and Germany on his way to England, where he attended the first International Congress of Anthropological and Ethnological Sciences at London and served as the Vice-President of a section. He was nominated to the Royal Society next year—presumably by his British peers who met him for the first time at this Congress and must have been impressed by his deep scholarship. This explains why he was nominated for FRS at such a late stage of his career.

6 Conclusion

There were about half a dozen scientists in colonial India (J.C. Bose, P.C. Ray, S. Ramanujan, C.V. Raman, M.N. Saha, S.N. Bose) whose achievements became a matter of national pride. Several books have been written about them, although sufficiently authoritative and critical biographies of some of them with proper historical documentation are yet to be written. However, a thorough historical understanding of such an unusual era of science is not possible if we focus our attention only on a few extraordinary achievers. There have been very few studies of the other important Indian scientists of that era whose achievements were somewhat less spectacular. Even members of the present-day scientific community often have very dim and vague idea of what kind of international standing other Indian scientists of that era had. It is in this historical context that a study of unsuccessful FRS nominations of Indian scientists from the colonial era is of utmost importance. Since the first few Indian scientists nominated to the Royal Society had to be nominated by

their British peers, only those scientists whose works were sufficiently known internationally had a chance of being nominated. Even those whose nominations were unsuccessful constitute a group of truly unusual individuals, some of whom are almost entirely forgotten today.

Out of the seven unsuccessful nominees discussed in this paper who were nominated before 1940, J.C. Bose got elected FRS when he was nominated for the second time. Of the remaining six, P.C. Ray was a towering figure of Indian science and his life has been documented to some extent. But that is not the case for the other five. Luckily, we can get some biographical information about N.R. Dhar, S.K. Banerji and L.K. Ananthakrishna Iyer from the memoirs about them published in the *Biographical Memoirs of Fellows of the Indian National Science Academy* (Mishra, 1990; Ramdas, 1937; Rao, 1966). However, in the cases of D.N. Mallik and Raghavendra Row, it is extremely difficult to find any detailed information about their lives and research. Although their nomination certificates and what little information we can gather about them make it amply clear that they were extraordinary pioneers in the early years of modern scientific research in India, they are virtually forgotten by the Indian scientific community today. Their nomination certificates, though brief, provide us the only reliable statements about their scientific achievements. Even for Dhar, Banerji and Ananthakrishna Iyer, their biographical memoirs were written by their admirers and are often full of uncritical adulation, without giving us a clear idea of their international reputation. The certificates for their nomination to the Royal Society provide perhaps the only documents showing us in a concise manner how their scientific achievements were viewed by their peers outside India. In some of the cases, the certificate provides a very useful list of the candidate's most important publications.

From the website of the Royal Society, one can get the lists of lapsed nominations from 1941 onwards (although access to this information is 'closed' after 1970). Here I give the numbers of lapsed certificates in the early years of 1940s to give an idea of how many nominations would typically be unsuccessful: 1941–27, 1942–15, 1943–26, 1944–23, 1945–6. Keeping in mind that 20 candidates used to be elected in those years, we find that the number of lapsed cases used to be comparable to the number of successful cases. In other words, about 50% of the nominations used to be successful in those years. Given this fact, the non-election of scientists of the stature of P.C. Ray and N.R. Dhar, who clearly had high international reputation, appears quite surprising. It should be mentioned that the number of lapsed certificates went up dramatically in the 1950s and the election to the Royal Society became much more competitive. However, the situation was not quite like that in the first half of the twentieth century. One can safely speculate that a British scientist with credentials comparable to the



credentials of some of the unsuccessful Indian scientists was highly likely to be elected. A randomly chosen group of seven British scientists who were unsuccessfully nominated to the Royal Society in the first half of the twentieth century would hardly be a group worthy of attention from a historian of science, unlike the quite remarkable group of unsuccessful Indian nominees. Even if we rule out the possibility of deliberate racial discrimination, the Indian candidates had the disadvantage of not belonging to the ‘old boys’ network’. Additionally, there was often scepticism about the reliability of scientific works coming from a community which did not have a previous tradition of producing high-quality research. When Raman was nominated for FRS, his certificate began with the statement: “Although trained entirely in India has made considerable additions to our knowledge of sound and light.”

It is not easy for a person belonging to a community without a previous scientific tradition to develop the right kind of outlook for doing scientific research (Choudhuri, 1985). The first pioneers of modern science in colonial India such as J.C. Bose and P.C. Ray received their initial training in Britain. However, as a scientific research tradition started building up in India, it is quite remarkable that a few younger Indians—both within the group of those who were elected FRS and within the group of those who were unsuccessfully nominated—were able to figure out how to carry on research in their chosen research fields completely on their own. Apart from the Fellowship of the Royal Society, a few other important recognitions also started coming to the nascent scientific community of India. We now know that a few Indian scientists in the early decades of the twentieth century were invited to send nominations for the Nobel Prize (Singh, 2007), although this information was supposed to be confidential at the time of these nominations and was not widely known in the community. A few Indian scientists were knighted for their important contributions to science—J.C. Bose, P.C. Ray, C.V. Raman, J.C. Ghosh, U.N. Brahmachari, S.S. Bhatnagar. It is curious to note that among these Indian scientists who received knighthood—the other important recognition of the British establishment—P.C. Ray and U.N. Brahmachari were not elected to the Royal Society and J.C. Ghosh was not even nominated. On knowing of P.C. Ray being conferred knighthood, N.R. Dhar wrote to him from Paris on 8 January 1919 (my translation from Bengali): “The Government has done a very wise thing by conferring knighthood on you. I was delighted to read about this in the ‘Times’. Now the Royal Society will find it very difficult not to elect you this year” (Choudhuri & Singh, 2018). However, the Royal Society did not elect Ray. Apparently, the election to knighthood and the election to the Royal Society were two completely independent processes—the outcome of one not dictating the outcome of the other—although a person’s standing in the scientific

community was presumably the primary criterion for both these elections.

The facts that J.C. Ghosh was never nominated to the Royal Society and S.N. Bose was nominated more than three decades after his famous work show that even the nomination of an Indian scientist to the Royal Society involved accidental factors, and not all Indians who did important scientific research in that era got nominated. Since the nominations of Indians in that era were made at the initiative of their British peers, scientists working on areas of science in which Britain was not strong were less likely to be nominated. In the quotation from P.C. Ray given in Sect. 4 on J.C. Ghosh’s work on electrolytes published in a series of papers during 1918, it may be noted that the four scientists whom Ray mentioned for appreciating Ghosh’s work were all German. Perhaps one possible explanation of Ghosh never being nominated to the Royal Society is that there were not any important British scientists working in that field who could have been interested in nominating Ghosh. One chemist important in the British scientific establishment, J.R. Partington, worked on a rival theory of electrolytes at the same time and got involved in a controversy with Ghosh (Mukherjee, 1959). Since both J.C. Ghosh and S.N. Bose were classmates and close friends of M.N. Saha, one wonders why Saha did not take the initiative of getting them nominated to the Royal Society after he himself was elected FRS. Since a nomination certificate had to be signed by at least six Fellows of the Royal Society, it was not easy for an Indian to arrange a nomination. If a British Fellow of the Royal Society wanted to nominate an Indian, he merely had to request some of his FRS colleagues to sign the nomination certificate. However, an Indian Fellow, who wanted to nominate an Indian, had to write letters to several British peers to find out if they were willing to be signatories and, if they agreed, then one had to circulate the nomination certificate among them to collect the signatures of all of them. In a sense, the preparation of a nomination even for the Nobel Prize involves a simpler process. When a scientist is invited to send a nomination for the Nobel Prize, he or she can in principle prepare the nomination without having to take help of anybody else (since the author of this paper had sent nominations for the Nobel Prize thrice—in 2005, 2008 and 2011—he is well familiar with the procedure of sending nominations for the Nobel Prize). We know that Homi Bhabha took the initiative of nominating D.S. Kothari to the Royal Society in 1961 (unsuccessfully) by writing letters to several Indian and British Fellows requesting them to be signatories in Kothari’s nomination certificate, since these letters have been preserved in the Royal Society Archives. If an Indian Fellow of the Royal Society had to take this initiative, it certainly required a non-trivial amount of coordinating activity on his part. As I have pointed out, S.K. Banerji was the first Indian scientist whose nomination process was

clearly initiated from India—Raman and Saha being the first and second signatories, and the third signatory Gilbert Walker being Banerji's boss stationed in India.

The records of the deliberations which would take place within the Council of the Royal Society regarding a nomination have usually not been preserved, except for a few cases. When Saha's nomination was being considered, discreet enquiries were made whether his connections with the Indian revolutionaries fighting the British Empire during his youth could become an embarrassment for the Royal Society if he were to be elected FRS. These letters have been preserved in the Royal Society Archives and have been studied (DeVorkin, 1993). We know from these letters that often non-academic considerations played a role in Fellowship election decisions. It may be mentioned that P.C. Ray was an ardent admirer of Gandhi and this was openly known. Although we do not know the inside reasons why he was not elected to the Royal Society, it is quite possible that Ray's open support for the Indian freedom struggle might have come in the way of his getting elected to the Royal Society (Choudhuri & Singh, 2018). Among the unsuccessful FRS nominees, only in the case of U.N. Brahmachari, whose nomination was valid during 1942–194, the discussions which took place about his nomination have been preserved in the Archives of the Royal Society (Singh, 2014). For all the unsuccessful FRS nominations discussed in this paper, the official reasons behind their not being elected are not known. Still, the mere fact that these scientists working in a colony far away from the established centres of science were nominated for FRS is reflective of their reasonably high international standing within the scientific community and the nomination certificates of some of them, who are largely forgotten by the present-day Indian scientific community, should be of great interest to historians of science as concise statements showing how their peers viewed their scientific achievements.

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