

## ACHARYA PRAFULLA CHANDRA RAY: A REVISIT TO HIS LIFE AND WORK

(PART-2)

MANAS CHAKRABARTY\*

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*Continuing from Part-1 (Sci. Cult., 87 (9-10) 338), this second part covers P.C. Ray's laboratory as the nursery of modern Indian chemists, the founding of the Indian Chemical Society and the Indian Science News Association, P.C. Ray's legacy, his further (in addition to BCPW) contributions to the cause of industries, his literary contributions and his possible involvement in revolutionary activities. Since the legacy of P.C. Ray is indisputably his most important contribution, somewhat more emphasis has been given to this aspect in the present write-up. Despite author's earlier commitment to complete the write-up in two parts, it could not be completed in this second part in order to maintain a reasonable and acceptable parity of depiction with that in the first part. The concluding portion of this write-up would appear in Part-3.*

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### **P.C. Ray's Laboratory: Nursery of Modern Indian Chemists**

Researchers started working with P.C. Ray since 1900. In 1909, some brilliant students, including Jnanendra Chandra Ghosh, Jnanendra Nath Mukherjee, Manik Lal Dey, Satyendra Nath Bose, Pulin Behari Sarkar, Rasik Lal Datta, Nilratan Dhar and Meghnad Saha, were studying at various levels in Presidency College. A few of them stayed with their parents, and the rest were residents at the Eden Hostel attached to Presidency College. Very soon they became intimate friends of P.C. Ray who described this relationship as follows: “*The bonds existing between them and me was as subtle as those of chemical affinity. I used to visit them often in their hostel rooms and they were my constant companions in my 'maidan walking' in the evenings* (Ref. 32, p. 167).”

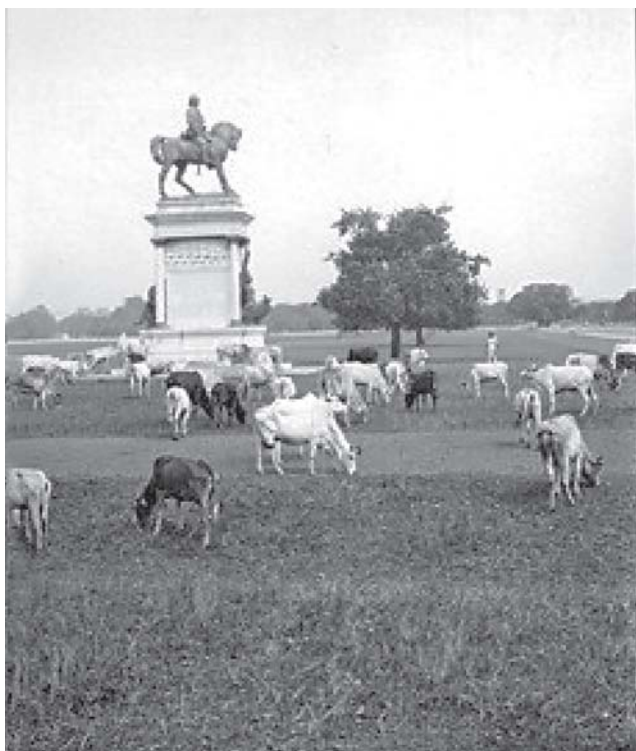
After taking his classes at Presidency College, P.C. Ray used to go to 110, College Street, then popularly

known as ‘the mess of Doctorbabu (i.e. P.C. Ray because he rented it)’, and from there to Maidan with the company of his students, including Meghnad Saha. Sitting under the statue (on horseback and sculpted by Harry Bates) of Field Marshal F. S. Roberts (1<sup>st</sup> Earl Roberts; unveiled in Maidan in March, 1898 and removed to Barrackpore around 1970)<sup>33a</sup>, they used to discuss all sorts of topics – war, politics, culture, football and what not – for about two hours every day. ‘Maidan Club’ is stated to have been founded by P.C. Ray in 1911<sup>33b</sup>. But it is said that Gandhiji was aware of this ‘Adda’ in Maidan and it is he who coined the term ‘Maidan Club’. (Image 1)

In the reception given to P.C. Ray by his colleagues and students of Presidency College after his return from England in 1912, Principal H.R. James said: “*Dr. Ray has trained and is training in his laboratory...a band of young chemists to carry on the work he has begun, so that a distinguished French Professor has written of that laboratory as the nursery from which issue forth the chemists of new India.*” One day the D.P.I. of Behar called upon P.C. Ray and, while conversing, he said, “*I believe you have been instrumental in founding a school of chemistry.*” P.C. Ray always cherished this memory.

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**Image 1** : Statue of Lord Roberts: Site of Maidan Adda  
(Source : Keystone-Mast Collection, UCR/California Museum of Photography)

Referring to the large number of publications of P.C. Ray, *Nature* (97, Issue 2421, March 23, 1916) published: “Some of these papers are of very considerable value and interest, and indicate enthusiastic work on this part of this newly created school, which is mainly due to the work and example of Prof. Ray himself (Ref. 32, p. 186).”

Priyadarshan Ray, an illustrious student of P.C. Ray, wrote in his biography on P.C. Ray: “Ray’s real contribution to the development of chemical research in India rests...on his inspiring and initiating a generation of young workers, who, dedicating themselves to a scientific career succeeded in building up what is known as the Indian School of Chemistry<sup>33c</sup>.”

### **Founding of Indian Chemical Society and its Journal**

Dr. S.S. Bhatnagar disclosed the history of the genesis of the Indian Chemical Society, Calcutta in his Presidential Address (Chemistry Section) of the 15<sup>th</sup> Indian Science Congress, Calcutta (January, 1928). S.S. Bhatnagar, J. C. Ghosh and J. N. Mukherjee, while working for their D.Sc. degree in the University College, London, met sometime in 1919 to discuss the problems that the younger chemists across India were facing in publishing their results in foreign journals in the early 1900s. They decided

to obviate this difficulty by establishing an All India Chemical Society ‘with a Journal as its organ’ (Ref. 32, p. 188). This idea also received support from Professor F.G. Donnan, F.R.S., the Doctoral Guide of S.S. Bhatnagar.

After their return to India, they materialised their dream. **The Indian Chemical Society (ICS) came into being i.e. registered on May 9, 1924 with Sir P.C. Ray as its Founder President.** The three Vice-Presidents were G.L. Fowler, J.L. Simonsen and E.R. Watson, the Honorary Secretary was J.N. Mukherjee, and the Honorary Treasurer was P.C. Mitter. Additionally, there were eight Council Members – H.E. Annett, S.S. Bhatnagar, R.L. Datta, B.B. Dey, H.K. Sen, R.N. Sen, B.K. Singh and B.H. Wilsdon. P.C. Ray became the President of the ICS once again during 1929-’30<sup>33d</sup>. (Image 2)

Professor Wynne, the President of the Chemical Society of London, congratulated the newly formed ICS via a telegram (October 7, 1924), which P.C. Ray acknowledged by replying: “It will always be our endeavour to maintain cordial, nay filial, relationship with the parent society, whose inspiration we shall always highly prize.”



**Image 2:** Indian Chemical Society, Kolkata

The first issue of the *Journal of the Indian Chemical Society (J. Indian Chem. Soc.)*, the organ of ICS, initially a quarterly one, was published in November, 1924. The two Honorary Editors of JICS were N.R. Dhar and A.N. Meldrum. In 1928, it became a bimonthly journal, and since

1930 it started being published as a monthly journal. The journal is being currently published in collaboration with Elsevier.

The office and the library of the ICS are housed on the second floor of the south wing of Palit Building of Science College, Kolkata. In 1924, P.C. Ray donated a sum of Rs. 10,000/- to Calcutta University for the necessary construction. In 1967, the ICS acquired a land of 660 sq. meters from the C.I.T. for the construction of Acharya P.C. Ray Memorial Building there. In 1970, its foundation stone was laid by J.N. Mukherjee, the then Secretary of the ICS. With a supporting grant of Rs. 2 Crores from the D.S.T., Govt. of India, New Delhi, the ICS plans to accomplish the task as soon as sufficient fund is procured. The history of ICS has been aptly covered by J.N. Mukherjee<sup>33e</sup>.

'Acharya P.C. Ray Museum' is on the mezzanine floor of a room on the first floor of Palit Building, Rajabazar Science College. It is a small and 'spartan' bedroom with two beds and a small cupboard containing personal effects of P.C. Ray, a hat stand and a walking stick. There is a small laboratory with old equipment in a part of the large room, in the mezzanine floor of which the museum is situated. Pertinently, the caption of a recent news item on the museum published in The Telegraph - 'Acharya P.C. Ray's museum languishes in neglect' - is conspicuous<sup>33f</sup>. It requires to be mentioned that Gurunath Mukherjee, a former Professor of the Chemistry Department of C.U., used to take utmost care to maintain this museum during his tenure. (Image 3)

### **The Legacy of P.C. Ray**

What exactly should be considered as the legacy of P.C. Ray - BCPW, Indian Chemical Society, Indian Science News Association (discussed later) or the Indian school of chemistry that he created? N.R. Dhar considered P.C. Ray to be "*the intellectual father of most young Indian chemists*<sup>34a</sup>." The answer was better articulated by Mr. Francis V. Fernandes, an erstwhile student of P.C. Ray at the M.Sc. course at Presidency College, who worked with P.C. Ray on the action of monochloroacetic acid on thiocarbamides (*J. Chem. Soc., London*, 1914). In an article entitled 'The Indian School of Chemistry' in the Presidency College Magazine, Mr. Fernandes wrote, "***The development of the school he has created he may now safely trust in the hands of his pupils. They will prize it as their most valuable legacy, and loyally hand it down to posterity***<sup>34b</sup>." **The tree of chemists created by P.C. Ray thus stands out to be his legacy.**

In reply to the valedictory address given to him on the occasion of his retirement from the Presidency College, P. C. Ray said: "*I trust that the fire which it has been our lot dimly to kindle will be kept burning on from generation to generation of our students, gaining in brilliance and volume and intensity till it will have illuminated the whole of our beloved motherland*<sup>34c</sup> (also, ref. 32, p. 190)."

P.C. Ray had many eminent students, a larger number of grandstudents, a still larger number of great-grandstudents and even great-great-grandstudents. Hence the problem is: 'whom to talk about from a galaxy of his offspring? P.C. Ray himself admitted: "*It is a singular fact that with the exception of one or two, almost all the brilliant students of mine who have earned a European reputation were non-research scholars*<sup>35a</sup>." Since Rasik Lal Datta, Nil Ratan Dhar, Jnanendra Chandra Ghosh and Jnanendra Nath Mukherjee amongst P.C. Ray's non-research scholars at Presidency College earned considerable reputation, let us at first briefly go through their achievements.

Rasik Lal Datta, the first recipient of the D.Sc. degree from the Calcutta University, had six publications with P.C. Ray during 1911-1912 (also, see later).

Dr. N.R. Dhar (1892-1986), while a PG student at Presidency College, pursued research with his teacher P.C. Ray (*J. Chem. Soc., London*, 1912). He got the M.Sc. degree (Physical Chemistry) in 1913, earned the D.Sc. degree from the London University (1917), a State Doctorate of Science degree from the University of Sorbonne, Paris, France (1919) and then joined the Indian Educational Service as a Professor of Inorganic and Physical Chemistry at Muir Central College, Allahabad.

Both P.C. Ray<sup>35b</sup> and Dr. S.S. Bhatnagar (Presidential Address, Chemistry Section, 25<sup>th</sup> Indian Science Congress, Calcutta, 1938) considered N.R. Dhar as the founder of physical chemistry and physicochemical researches in India. Dr. Dhar published more than 150 papers (first eight with P.C. Ray, 1912-1913), supervised 20 students for the D.Sc. degree and 130 students for the D.Phil. degree.

At least three students of N.R. Dhar - Dr. Atma Ram (D.Sc., 1936), Dr. R.C. Mehrotra (Ph.D., 1948) and Dr. H.L. Nigam (Ph.D., 1949) - deserve special mention. Dr. Atma Ram became the Founder Director of the Central Glass and Ceramic Research Institute (now C.S.I.R.-C.G.C.R.I.), Kolkata and later became the Director General of the C.S.I.R. Dr. Mehrotra became the Vice-Chancellor of the Universities of Rajasthan, Allahabad and Delhi, and Dr. Nigam went to Rewa University and Allahabad University

and successfully maintained the legacy of P.C. Ray. Two authoritative articles on the life and work of Dr. N. R. Dhar are available<sup>36a,b</sup>.

S.S. Bhatnagar, F.R.S. (1894-1955), in whose honour Shanti Swarup Bhatnagar Prize (the highest scientific award in India) has been instituted since 1958, considered himself as a 'grandstudent of P.C. Ray' because he was a student of Atul Chandra Ghosh, an early student of P.C. Ray. Both Bhatnagar and his Teacher naturally deserve to be discussed here.

Mr. Atul Ch. Ghosh worked with P.C. Ray on the thermal decomposition of dimercurammonium nitrite (*J. Chem. Soc., London*, 1910). He later became a Faculty Member at Dyal Singh College, Lahore, Punjab (now in Pakistan). S.S. Bhatnagar was his student there at the I.Sc. course.

Bhatnagar got the M.Sc. degree (Chemistry, 1919) from the Forman Christian College (then affiliated to Calcutta University), Lahore. Having worked with Professor Donnan at the University College, London, Bhatnagar earned the D.Sc. degree (1921), became a Professor of Chemistry at the newly formed Banaras Hindu University and later (1924) at the University Chemical Laboratories, Punjab University, Lahore (later its Director). There he created and nurtured a school of chemistry teaching and research for 16 years. He was an authority on colloid chemistry and magneto-chemistry.

S.S. Bhatnagar's selfless refusal of a personal gift of Rs. 1.5 Lakh by a drilling Company in London in behalf of Punjab University received profuse appreciation from Sir Tej Bahadur Sapru (Convocation Address, Punjab University, 1936) and Professor M.N. Saha (Allahabad University)<sup>36c</sup>. Bhatnagar, O.B.E. (1941), F.R.S. (1943), Padma Vibhushan (1954) became the Director of the C.S.I.R. (1940). While opening the N.P.L. at New Delhi in 1950, Sir Robert Robinson, F.R.S., the then President of the Royal Society, made the following remark: "*India found in Shanti Bhatnagar an eminent scientist of clear vision, sound judgement in affairs and boundless energy in action*<sup>36c</sup>." What a compliment!

According to P.C. Ray, Dr. Bhatnagar said, "*Dr. Dhar's initiation in Physical Chemistry was infectious and following his example J.C. Ghosh and J.N. Mukherjee enrolled themselves in the service of chemistry as early as 1914-15*<sup>35c</sup>."

Jnan Chandra Ghosh (1894-1959), 1<sup>st</sup> class 1<sup>st</sup> in both B.Sc. (1913) and M.Sc. (1915) from Presidency College, Calcutta, obtained the D.Sc. degree from the University

College of Science, London (1918). He joined the newly established Dacca University (also, Dhaka) (now in Bangladesh) as a Professor and Head of the Department of Chemistry in 1922. He developed an excellent school of physical chemistry there for the next two decades. He worked in the fields of electrochemistry, theory of strong electrolytes and later in photochemistry. He was the pioneer in photochemical and photobiological research in India<sup>37a</sup>. He succeeded C.V. Raman, N.L. in 1939 to become the Director of the Indian Institute of Science, Bangalore. He was Knighted in 1943 mainly for his war services.

J.C. Ghosh, Padma Bhushan (1954), a pioneer of technological education in India, held numerous positions - Member of All India Council of Technical Education<sup>37b</sup>, D.G. of Industry and Supply (1947-1950), Director of Eastern Higher Technical Institute (1950) (renamed as I.I.T., Kharagpur in 1951) and Vice-Chancellor of Calcutta University (1954). He became a Member of the Planning Commission for Science and Technology, Govt. of India. His main contributions are anomaly of strong electrolytes, dissociation-ionisation theory, photocatalysis, Fischer-Tropsch reaction for the synthesis of hydrocarbons and application of differential thermal analysis for studying solid catalysts<sup>37c</sup>. When J.C. Ghosh passed away on January 21, 1959, N.R. Dhar wrote an Obituary on him in *Nature*<sup>37d</sup>.

Notable students of J.C. Ghosh were Sailesh Chandra Roy (M.Sc. student; later a Professor and Head, Department of Biochemistry, C.U.), N.K. Sen (later at State Forensic Science), A.B. Biswas (later at I.I.T., Bombay) and Pulin Behari Sarkar (later a Professor, C.U.), all of whom became famous in their respective fields of work.

Jnanendra Nath Mukherjee (1893-1983), one of the beloved 'Knowledge Trio' (J.C. Ghosh, J.N. Mukherjee and J.N. Ray) of P.C. Ray, earned the B.Sc. (1913) and M.Sc. (1915) degrees from Presidency College, Calcutta. Notably, his Thesis work on the electric synthesis of colloids for the M.Sc. degree was published in the prestigious *J. Amer. Chem. Soc.* in 1915. In 1919, J.N. Mukherjee went to the University College, London and worked on colloids with Professor F. G. Donnan. After returning to India, J.N. Mukherjee (i) became a Professor of Chemistry at the University College of Science, Calcutta, (ii) developed the so called 'Calcutta School of Soil Science', (iii) played a crucial role in developing agricultural research and education in India, and (iv) prepared the Soil Map of India in 1944. Subsequently, he held numerous positions - too many to be cited here. He was an I.N.S.A. Fellow and a Life Member of the Chemical Society, London and received C.B.E. and Padma Bhushan (1964) awards<sup>38</sup>.

Four notable students of J. N. Mukherjee were Professors Sushil K. Mukherjee (C.U.; I.A.C.S.; K.U.; V.C.K.V.; B.I.), B.N. Ghosh (C.U.), Sachindra Nath Mukherjee (Visva-Bharati University) and Baradananda Chatterjee (B.E. College, Sibpore; husband of illustrious Professor Mrs. Asima Chatterjee, the mentor of the present author during Doctoral research), all of whom reigned in the domain of physical chemistry in the academic circle of West Bengal.

P.C. Ray himself highly praised his student Priyadarajan Ray (1888-1982) as a “*silent and unobtrusive worker*”<sup>35d</sup>. In P. Ray, regarded as a great chemist and a greater human being, “*the erudition of a scholar, creativity of a scientist, wisdom of a philosopher and saintliness of an ascetic*” were combined<sup>39</sup>. He earned the B.Sc. (Honours in Physics and Chemistry) (1908) and M.Sc. (1<sup>st</sup> Class 1<sup>st</sup>, Chemistry) (1911) degrees from Presidency College, Calcutta. He started doing research under P.C. Ray in 1911 and developed a method of estimation of hydrazines and ferricyanides<sup>40a</sup>. On August 12, 1912, P. Ray met with an explosion in the laboratory, which damaged his left eye fully and his right eye partially. He had to stay out of active life for two years.

He resumed academic career first in City College, Calcutta (1914) and then in the Chemistry Department of Science College, C.U. (Assistant Palit Professor, 1919; Khaira Professor, 1937; Palit Professor, 1946). P. Ray worked with Professors F. Ephraim in Berne, Switzerland (1929) and F. Emich at Graz, Austria. He supervised many Doctoral students and published around 170 research publications in addition to a few books and nearly three dozens of popular articles mostly in ‘*Jnan-O-Bijnan*’ and ‘*Ujjavalabharat*’. He retired in 1952.

After retirement, P. Ray served I.A.C.S. (Honorary Professor; later its Director), I.S.C.A. (President, Chemistry Section, 1932) and ICS (1947-’48). He became a Foundation fellow of I.N.S.A. (1935) and a Member of a particular Commission of IUPAC (1951, for 8 years). He was also the President of the Indian Science News Association (ISNA, 1958-’59) and a Member of the Editorial Board of *Science and Culture*, the mouthpiece of ISNA, for several years.

In 1956, he published an widely acclaimed book ‘**History of Chemistry in Ancient and Medieval India**’, a revised and edited version of P.C Ray’s ‘*A History of Hindu Chemistry*’<sup>40b</sup>. In 1964, he wrote a comprehensive account of the progress of chemistry during fifty years of science in India<sup>40c</sup>. He also authored a synoptic version of the Ayurvedic texts Charak Samhita and Susruta Samhita in English. Honorary D.Sc. degree was conferred on P. Ray by Calcutta University, Jadavpur University and

Burdwan University. In the words of P.C. Ray, P. Ray was “... *regarded as an acknowledged authority on (coordination) complexes and valency as also on microchemistry*...”<sup>35d</sup>. He was also a pioneer in magnetochemistry. The most significant aspect of P. Ray was that “*His accent was not only on the problems but also on the awakening of the human spirit*”<sup>39</sup>. (Image 3)

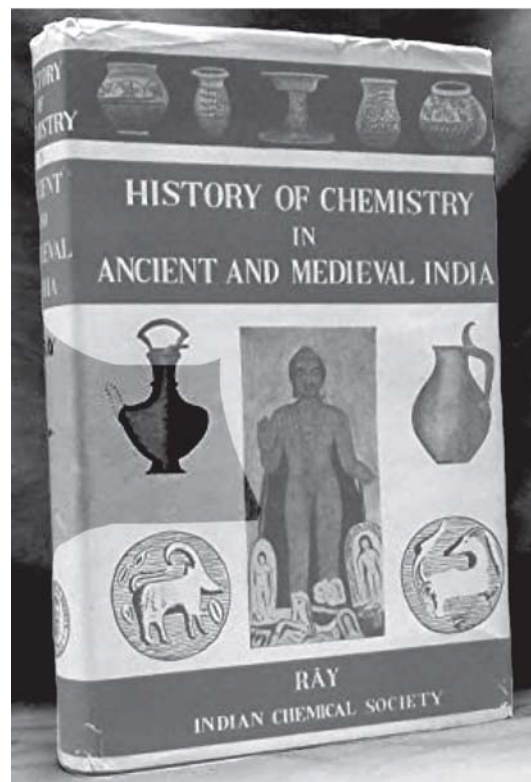


Image 3 : Editor: P. Ray, 1956 (1<sup>st</sup> edn.)

Some of his notable students/co-workers were S.K. Datta, M.M. Ray, K.C. Seal, D. Banerjea, N.N. Ghosh (former Teacher of the present author during the M.Sc. course) (all were Faculty Members at C.U.) and Rabindra Lal Dutta (Burdwan University).

Jitendra Nath Rakshit worked with P.C. Ray on alkylammonium nitrites and had ten publications during 1911-1913. Later an Analytical Chemist in the Opium Department, Govt. of India, he developed a method of estimation of morphine and codeine, which is included in a book on analysis of drugs and chemicals<sup>41</sup>. His method of estimation of acetone in the presence of methanol has been referred to in a manual of organic chemical analysis<sup>42</sup>.

A host of other fruits of the academic tree of P.C. Ray are presented below. The Universities/Institutes where they flourished in their academic career are given within first brackets. For the scarcity of space, they are clubbed together.

(A) P.C. Mitter (C.U.) and his students Phanindra Chandra Dutta (I.A.C.S., Kolkata), Dilip K. Banerjee (I.I.Sc., Bangalore; later its Director), J.C. Bardhan (C.U.; see later), Dukhaharan Chakravarti (C.U.; a teacher of the present author at the M.Sc. course), S.M. Mukherjee (C.U.; I.A.C.S., Kolkata; Punjab U., Lahore; Kurukshetra U.). (B) Hemendra K. Sen (Indian Institute of Natural Resins and Gums) and his graduate students S.R. Palit ('Father of Polymer Chemistry in India'; I.A.C.S., Kolkata) and U.P. Basu (Director, Bengal Immunity Research Institute, Kolkata). (C) Rasik Lal Dutta's students Jogendra Chandra Bardhan (C.U.; reputed for developing Bardhan-Sengupta synthesis of phenanthrenes<sup>43a,b</sup>) and Jogendra Kr. Chowdhury (Bose Institute). After completing his first piece of research work (published in the *J. Amer. Chem. Soc.*, 1923) with Dr. Dutta, Bardhan started (1920) working under Professor P.C. Mitter, the then Rashbehary Ghosh Professor at Calcutta University and obtained the D.Sc. degree twice (C.U., 1924; London University, 1928). (D) Jnanendra Nath Ray (Punjab University, Lahore) and his student M.L. Dhar (B.H.U.). (E) Jagadindra Nath Lahiri (BCPW). (F) Biresh Chandra Guha (BCPW; C.U.: started Department of Biochemistry) and his students Sachhidananda Banerjee (Presidency College), J.J. Ghosh, Sailesh Chandra Roy and I.B. Chatterjee (all three in C.U.). (G) Biman Bihari Dey (Madras University) and his students S. Rangaswami and T.R. Seshadri, F.R.S. (both Delhi University), K. Venkataraman (N.C.L., Pune) and T.R. Govindachari (Presidency College, Chennai; Ciba-Geigy; C.L.R.I.; Amrutanjan). (H) Prafulla Ch. Guha<sup>44</sup> (I.I.Sc., Bangalore) and his students T.N. Ghosh (Bengal Immunity), S.C. Bhattacharyya (Bose Institute), S. Swaminathan (Madras University), Sukh Dev (Multi-Chem Research Centre, Nandesari) and M.V. Bhat (I.I.Sc., Bangalore). (I) P.K. Bose<sup>45</sup> (Bose Institute) and his students Asima Chatterjee (the first lady recipient of D.Sc. degree (C.U.) of any Indian University) and Sadhan Basu (both in C.U.).

Most of these scientists were stalwarts and deserve elaborate discussion on their life and work, and many others could not even be referred to in this article. Atul Ch. Ganguli (the earliest co-author of P.C. Ray<sup>46a,b</sup>), Loknath Misra and S.S. Guha Sarkar belong to the latter class and built up the school of chemistry at Ravenshaw College (now University), Cuttack. Needless to say, the scarcity of space is responsible for the lack of such discussions here. Nevertheless, in the language of P.C. Ray, "*May the torch thus kindled burn with greater brilliance from generation to generation!*" One may go through the article by Mukherjee and Rahaman in ISNA book to gain overall insight into other torchbearers of P.C. Ray's legacy<sup>46c</sup>.

The secret behind P.C. Ray becoming a highly successful teacher was disclosed by one of his anonymous students: "...*he (P.C. Ray), by his simple and humorous method of teaching, could instil a thirst for knowledge into the minds of even ordinary students. ...This is the secret of his success in creating a new school of chemistry out of the young enthusiastic scholars of Bengal*<sup>34d</sup>."

### **Founding of Indian Science News Association<sup>47,48</sup>**

In 1930s, a handful of stalwart scientists, mainly from Calcutta, felt that the fruits of science should be utilised in building modern industries. They "*had a plan of bringing the knowledge of science within easy reach of the public, so that India could be culturally and economically benefitted by the application scientific knowledge to all walks of life.*" Despite the existence of The Asiatic Society (generally regarded as the 'Mother of Indian Scientific Societies' in Calcutta) since 1784, these scientists felt the absence of a proper organisation which could materialise their plan. This led Acharya P.C. Ray and Professor Meghnad Saha, along with others, to establish **Indian Science News Association (ISNA)** in 1935 in the premises of the Science College, University of Calcutta. This was possible through generous donations from Acharya P.C. Ray, Sir U.N. Brahmachari, Dr. S.C. Law, Dr. B. C. Law, Shri G.D. Birla, Shri M.N. Sur, an anonymous donor and others. (Image 4)



**Image 4** : Indian Science News Association, Kolkata

In order to fulfil the objective, they launched a journal ‘*Science and Culture*’, a mouthpiece of ISNA and devoted to natural and cultural sciences, right from the month of June, 1935. Initially a monthly journal, it became a bimonthly one a few years later. In the Editorial of the very first issue of this journal, it was stated that the journal would also “publish articles discussing Government policy in technical matters like rural reconstruction, transport, power development, industrial policy and such others which have their basis on science<sup>47</sup>.” Another objective of ISNA was to express “intelligent and unbiased opinions on such industrial measures which are likely to affect our everyday life<sup>48</sup>.” Additionally, it will have provision for correspondences, short research notes on scientific and cultural topics, reviews of books, and reports of activities in research and technical departments of the Government<sup>47</sup>. Mr. Hari Keshav Ghosh and his brothers, proprietors of the Indian Press Limited in Allahabad and Calcutta (famed for publishing all the works of R.N. Tagore, N.L. during 1908-1914) were committed to printing all the issues of *Science and Culture* free of cost for at least the first two years<sup>48</sup>. In fact, the first two issues had already been printed free of cost by them. (Image 5)

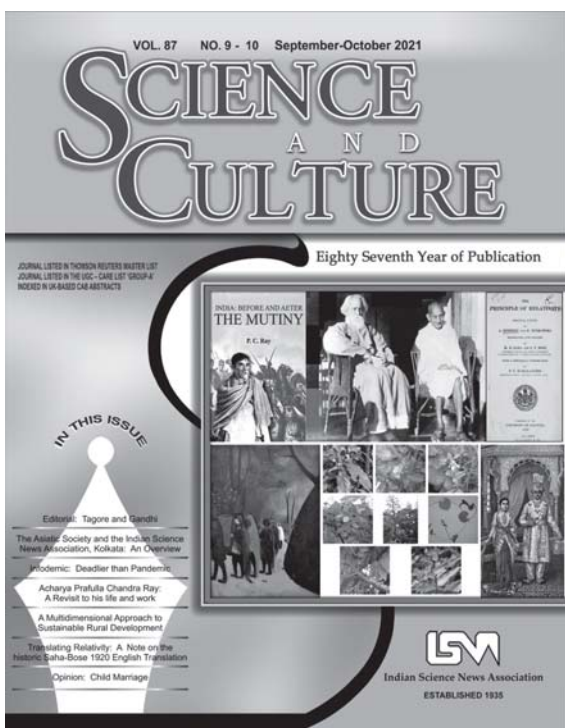


Image 5 : *Sci. Cult.*, 87 (9-10), 2021.

The inaugural meeting of ISNA was held on the 9<sup>th</sup> July, 1935 in the hall of the Calcutta Mathematical Society at Science College, and it was attended by nearly 250 men of eminence from different walks of life<sup>48</sup>. The first provisional Council of ISNA comprised Acharya P.C. Ray

(President), Mr. S.P. Mookerjee (the then Vice-Chancellor of Calcutta University), Sir U.N. Brahmachari (famed for developing urea stibamine, the drug for curing Kala Azar) and Dr. S.C. Law (a millionaire scientist devoted to ornithology) (three Vice-Presidents), Professor Meghnad Saha and Dr. Bidhu Bhusan Ray (two Secretaries) and Dr. Nikhil Ranjan Sen (Treasurer). The first Editorial of *Science and Culture* concluded with the following very important comment: “...science is important only as long as it conduces to the development of culture and serves the cause of human progress<sup>47</sup>.”

For the sake of updation, ISNA has been carrying out a certificate course on ‘Science Communication and Media Practice’ for the last 34 years for training students on science communication with lectures, workshops, hands-on experiments, visits, etc. For the last few years, ISNA has been conducting this course in active collaboration, including financial help, with the Vigyan Prasar, D.S.T., Govt. of India, New Delhi. Professor Meghnad Saha said in the inaugural meeting of ISNA that “It has also got plans for starting vernacular journals, and a school science journal when the funds permit<sup>48</sup>.” Albeit still suffering from financial crunch, ISNA, in collaboration with Vigyan Prasar, has been able to launch two e-Papers – ‘*Scientifica Communica*’ in English language (launched on the 15<sup>th</sup> August, 2021) and ‘*Bigyan Kahon*’ in Bengali language (launched on the auspicious day of Mahalaya, the 6<sup>th</sup> October, 2021). It is a sort of dream-cum-true for ISNA.

### **P.C. Ray’s Further Contributions to the Cause of Industries**

Referring to the graduates and Diploma-holders coming out of the Universities and the Technical Schools, P.C. Ray realised that the Bengalees “are now confronted with the very serious problem of finding suitable careers and outlets for these young men<sup>35f</sup>.” The only way to solve this problem was, in his opinion, to develop entrepreneurship in young, educated minds.

P.C. Ray’s seminal contribution towards the development of industries in India was the establishment of BCPW. A comment made by an anonymous student of P.C. Ray in this regard is worth reiteration: “...but for the initiative, whole-hearted devotion, resourcefulness and business capacity of these two chemists (P.C. Ray’s pupils Raj Sekhar Bose, a.k.a. ‘Parashuram’, and Satis Chandra Dasgupta) the Bengal Chemical and Pharmaceutical Works would never have attained its present prominent position<sup>34e</sup>.” A recent article by Syamal Chakrabarti shades further light on BCPW<sup>49</sup>.

P.C. Ray was also involved as a Patron, a Director, a Donor or an Advisor in the setting up and/or management of many other industries. A notable example is the book-selling and publishing house M/s. Chuckervetty, Chatterjee & Co. Ltd., Calcutta established in 1919<sup>34f</sup>. A few of his students holding M.Sc. degree in Chemistry set up this firm by the financial support and advice of P.C. Ray. A number of valuable books written by P.C. Ray were published by this firm. Some of other business houses backed by P.C. Ray were Calcutta Pottery Works (later changed to Bengal Potteries Ltd.), Bengal Enamel Works, Calcutta Soap Works Ltd., National Tanneries, Bengal Canning and Condiment Works Ltd., Bangiya Inland Steam Navigation Co. Ltd., Bengal Insurance Co., Banga Sree Cotton Mills, etc.<sup>34g,35g,50</sup>. Mention may also be made of Acharya Prafulla Chandra Cotton Mill (renamed as Khulna Textile Mills Ltd. in 1960, nationalised in 1972 and declared closed since 1993) in New Market Area, Boyra, Khulna in 1931<sup>51</sup>.

P.C. Ray's personal reasons for being involved in any effort towards the setting up of new industries can be explained by his following statement: "...*whenever a new industry is to be started in Bengal or anywhere in India I feel a sort of personal concern, as it were, in its infant career and my humble self is often in requisition to stand as its godfather*<sup>52</sup>." Moved by the success of P.C. Ray in the development of many industries in Bengal, Mr. H.R. James, Principal of Presidency College, Calcutta remarked "*where businessman failed, you, a teacher, succeeded so well*<sup>34g</sup>."

### **P.C. Ray's Contribution in Literature: A Glimpse**

P.C. Ray's contributions in literature are also to be reckoned with. Intimately associated with Bengali Literary Conferences right from the first one (Cassimbazar, Murshidabad, 1907; President: R.N. Tagore), he presided over the second Conference at Rajsahi (now in Bangladesh) (1908) and subsequently too. His long association with Bangiya Sahitya Parishad (BSP), first as a Vice-president (nine times between 1901 and 1930) and then as its President twice (1931-1934) was clearly recognition of his literary involvement. In a felicitation to P.C. Ray in 1932, Sri J.N. Basu, the then Secretary of BSP, highly appreciated his contribution to Bengali literature. P.C. Ray's assertion that he '*became a chemist almost by mistake*' and his interest in history, biographies and literature explain his literary interest. His thorough knowledge in Bengali, English and other European literature and his association with the 'Makers of India' influenced his writings.

P.C. Ray was a prolific, bilingual writer. Since his childhood, P.C. Ray was a voracious reader. Even in the 1930s, he used to devote at least one hour every afternoon to the study of his favourite subjects. He penned a large number of books (including textbooks), booklets, pamphlets and articles on a variety of topics in both Bengali and English. Some of the useful sources of writings by P.C. Ray are books (including compilations) and articles by Anil Bhattacharya, Pinak Pani Dutta, Syamal Chakrabarti, Dipak Dan and Subhendu Chattopadhyay<sup>53a-c</sup>. His earliest literary work 'India before and after the Mutiny' (vide Part-1) and the two volumes of his magnum opus 'A History of Hindu Chemistry' bear ample testimony to, *inter alia*, his linguistic attainments and literary ability<sup>54</sup>. P.C. Ray always openly criticised that Bengali literature, albeit rich in novels, poems and playwrightings, lacked contributions in science subjects, music, paintings, etc.

His Bengali book 'Bangalir Mastishka O Tahar Apabyabahaar' was a grand success - three editions were published in a decade<sup>55a-c</sup>. Arnab Nag explained the confusion as to its year of publication - 1909 or 1910 - in the Editorial of the 'Patabahaar' edition<sup>55c</sup>. The original version (written in 1909) and its English version were published in 1910<sup>56</sup>. The book in Bengali language was stated to be indisputably the first manifestation of P.C. Ray's literary ability in Bengali language<sup>57</sup>. However, P.C. Ray wrote a review article in Bengali on the history and status of Bengali prose way back in 1903<sup>58</sup>. From 1920 onwards, P.C. Ray wrote a number of articles on the misuse of Bengali brains in magazines like *Monthly Basumati*, *Bhratbarsha*, *Ananda Bazar Patrika*, *Prabasi* and the like. He also wrote an essay on the tradition of prose in Bengali literature (published serially in *Monthly Basumati*) during 1924-1926<sup>59a-c</sup>.

P.C. Ray wrote in Bengali language (i) a number of textbooks on Zoology, New Chemistry and Its Origin, Chemical Terminology, Indigenous Dye and Food Science, etc., (ii) many books on topical issues like Enthusiasm, Problems on Social Reform, Casteism and Its Problems, Hurdles to Nation Building, Crisis of Cloths, Food Problem and Its Remedies, University and Industrial Commerce, etc., and (iii) many articles on science and nature in magazines like *Prabasi*, *Prakiti*, *Bangabani* and the like. This is in addition to the collections of essays and other writings compiled by persons referred to in the beginning.

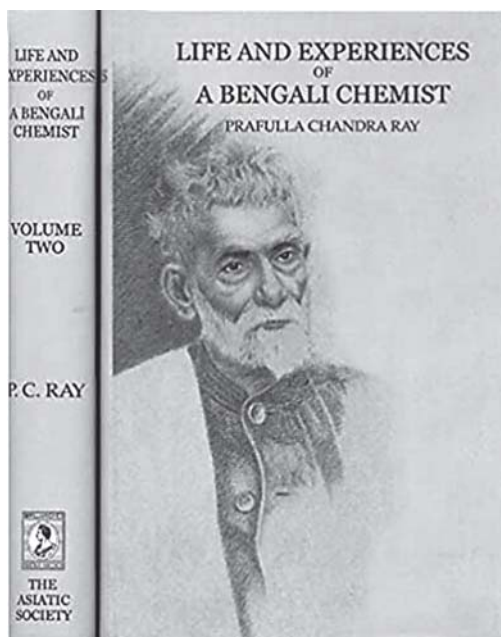
Some of his other books in English are 'Elementary Inorganic Chemistry' (1912), 'Essays and Discourses' (1918), 'Makers of Modern Chemistry' (1925), 'The Discovery of Oxygen' (1926) (its Bengali translation published in three consecutive issues of the magazine



'Prakiti', edited by S.C. Law, in BS 1926-1927) and 'Radha Charan Pal – A Study' (1931) in addition to three Convocation Addresses, 'A Complete Collection of Research Papers of Acharya P.C. Ray' and two other creations detailed below.

### **Life and Experiences of a Bengali Chemist**

In October, 1932, P.C. Ray wrote a two-part 557-page autobiography in English - 'Life and Experiences of a Bengali Chemist' - and dedicated it to 'The Youth of India' with "*the hope that its perusal may in some measure stimulate them to activities*<sup>32</sup>." In its Preface, he made it clear that although the word 'Bengali' "*smacks rather of narrow provincialism, ... most part of the subject matter is applicable to India as a whole.*" Part I of this book was 'Autobiographical', whereas Part II contained 'Educational, Industrial, Economic and Social' issues. The second volume of this book (October, 1935) dealt with the topics 'Impact of West with East', 'Socio-Economic Problems', 'Politico-Economic', 'Communalism' and 'Miscellaneous'<sup>52</sup>. He described this 470-page-creation as his "*swan-song*" (i.e. the final act of a performer) perhaps because he was about to retire from the Palit Professorship of Calcutta University in 1936. (Image 6)



**Image 6** : The Asiatic Society, 2011

The last page of the second volume contains some opinions on the first volume. **The following two opinions constitute priceless compliments to this literary creation of P.C. Ray.** (1) *Nature* wrote, "*A more remarkable career than that of P.C. Ray could not well be chronicled. ... From beginning to end, the message of the book is one*

*of the highest endeavour, pulsating with vitality and intellectual force.*" (2) The *Journal of American Chemical Society* commented: "*This is an inspiring and interesting account of what a chemist's life can be.... To the readers of this autobiography it is clear that ... Sir P.C. Ray has been a great scholar, chemist, teacher and administrator and that he has been first, last and all the time a patriot – a Hindu and a Bengali.*" A review on this book by W.D. Bancroft makes a short critical analysis of this book<sup>60</sup>. Pertinently, both volumes were reprinted in 2011 by The Asiatic Society, Kolkata<sup>61</sup>. In its 'About the Author', the book was stated to be "*a vital document of our intellectual history.*"

### **Atmacharit**

'Atmacharit' (1937), the autobiography of P.C. Ray in Bengali language, deals with the traditional history of chemistry, contemporary economics, educational system and its reforms, social reforms, etc.<sup>62a</sup>. In the 4-page Preface of the second edition of this book (1952/1953), Dr. Jnan Chandra Ghosh, then at I.I.T., Kharagpur, splendidly described the life, philosophy and activity of P.C. Ray in a nutshell<sup>62b</sup>. The first part of this 2-part book deals with his autobiography, and the second part entails discussions on education, industry and commerce, economics and social issues.

### **'Shakespearean Puzzle – Endeavours after Its Solution': A Labour of Love**

The aforesaid sub-heading is misleading. It is simply the title of a collection of seventeen essays on Shakespearean tragedies written by P.C. Ray and published in *Calcutta Review* between November, 1939 and April, 1941. Sukanta Chaudhuri, an Emeritus Professor of Jadavpur University, Kolkata, aptly said, "*The Shakespearean Puzzle is an 'amateur' production in the root sense: a labour of love impelled by no reason beyond intellectual attraction, undertaken ... to satisfy the intensely personal sensibility that drew the author to Shakespeare in the first place*<sup>63a</sup>." The essays have been recently reprinted in the form of a 184-page compilation<sup>63b</sup>. P.C. Ray's approach was not to praise Shakespeare. He tried, from the standpoint of a scientist, to feel the artistic motives behind Shakespeare's writings and sought "*the relation between his (Shakespeare's) life, work and thought and the evolution of his text*<sup>63b</sup>." In a Panel Discussion on 'Shakespeare in Bengal', held at Victoria Memorial Hall, Kolkata in November, 2019, Chaudhuri, one of the Panelists, referred to Shakespearean Puzzle<sup>63c</sup>. The

article by Anil Bhattacharya in the ISNA book is also highly informative in this regard<sup>53a</sup>.

### **P.C. Ray: The Revolutionary in the Garb of a Scientist**

P.C. Ray was a hardcore nationalist and a true patriot. A book in Bengali, titled “Uddipana” (i.e. enthusiasm) (1905) and containing nineteen popular patriotic songs written by famous writers, testifies to the patriotic nature of its author/compiler<sup>64</sup>. But the book did not bear the name of its author. However, since it was printed by the Bengal Chemical Printing Press, it is widely believed that P.C. Ray was the Editor-cum-Publisher of this book. ‘Uddipana’ may, therefore, be construed as yet another pointer to P.C. Ray’s patriotism.

P.C. Ray, albeit a true patriot, hardly participated directly in any revolutionary activity. One may, therefore, wonder if he was a revolutionary too. In his book ‘First Spark of Revolution’, Arun Chandra Guha, a member of the revolutionary Jugantar Samity and thrice (1952-1967) an elected Member of Lok Sabha, wrote, “*The first batch of young scientists who gathered around... Ray came almost exclusively from the ranks of the revolutionaries. ...and others were all directly or indirectly connected with the revolutionary organisation*<sup>65</sup>.” The well known Indologist and Sahitya Akademi awardee Nrisingha Prasad Bhaduri said, “*In the early 1900s, almost all prominent revolutionaries had some association either with Ray or Bengal Chemicals. For the cause of Independence, Ray helped those involved in violent methods to make bombs and supplied them with acid*<sup>66</sup>.”

P.C. Ray undeniably sympathised with freedom fighters. Else he would not have allowed the well known revolutionary ‘Bagha Jatin’ a.k.a. Jatindranath Mukhopadhyay to be a regular visitor at the ‘Doctorbabu’s Mess’ (at 110, College Street) and also accompany him and his students in their Maidan Walking<sup>33a</sup>.

The oft-quoted statement of P.C. Ray to his students during the non-cooperation movement in 1924 that “*Science can afford to wait but Swaraj cannot*” led the then British administration to tag him as a “*revolutionary in the garb of a scientist*<sup>66</sup>.” For a compilation of I.B. records on the nationalist and revolutionary activities of P.C. Ray, one may go through a recent book by Anil Bhattacharya<sup>67</sup>. An article by Manas Pratim Das in the ISNA book is also suggested in this regard<sup>68</sup>.

**Note:** In the portion dealing with the legacy of P.C. Ray, only summary of information has been provided for

each of the members of the academic tree planted by P.C. Ray. Details could not be provided due to space crunch.

**Errata (in Part-1):** (i) p. 341, Left column, line 13 from bottom : Read ‘a’ in place of ‘the first’. (ii) p. 347, Right column, line 6 from top : ‘Rasendrosara Samgraha’ to be read as ‘Rasendra Sara Sangraha (1898)’.

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**Note:** References 2 and 32 have been reproduced here for the convenience of the readers.