ACHARYA PRAFULLA CHANDRA RAY — I

SRI AUROBINDO writes in 'The Renaissance in India':

> In poetry, literature, art, science there have, on the contrary, been definite beginnings. Bengal in these, as in many other directions, has been recently the chief testing crucible or the first workshop of the Shakti of India; . . . she has not only two renowned scientists, one of the two world-famous for a central and far-reaching discovery, but a young school of research which promises to count for something in the world's science. (*SABCL*, Vol. 14, p. 421)

The two renowned scientists alluded to by Sri Aurobindo in 1918 must have been Acharya Jagadis Chandra Bose (1858-1937) and Acharya Prafulla Chandra Ray (1861-1944). Indeed, the resurgence of science research in India began in a serious way after J. C. Bose and P. C. Ray joined the Presidency College, Calcutta, in 1885 and 1889 respectively and made their scientific breakthroughs from around 1894. While J. C. Bose was the pioneer in experimental Physics and Biophysics, P. C. Ray initiated research in Chemistry.

The last decade of the 19th century was a significant decade of the renaissance in India. The year 1893 witnessed Sri Aurobindo's return to India, Swami Vivekananda's tour of the USA and Mahatma Gandhi's visit to South Africa. The research breakthroughs of J. C. Bose and P. C. Ray during the next couple of years were turning points for science in India. The worldwide fame of Bose and Ray as scientists (1895-96), closely followed by Ray's revelations on ancient Indian science (around 1902), boosted the confidence of the Indian youth. Besides, it must have had an impact on the colonial administration whose officials could no longer neglect the development of science education and research in India on the ground of incapability of "natives". Slowly but surely conditions for research improved. The otherwise infamous Universities Act of 1904 made important provisions to make faculty appointments, to equip and maintain laboratories and museums, and to promote research. The Government agreed to give financial support to the Tata scheme for a Research Institute in Science and the Indian Institute of Science (IISc) could be established at Bangalore during 1909-11.[1] A few years later, Sir Asutosh Mukherjee was permitted to open a centre for postgraduate studies and research in science at Calcutta University, a step that created the proper setup for science to flourish in Bengal.

1. More than 3 decades before IISc was set up, Dr. Mahendralal Sircar had founded the Indian Association for the Cultivation of Science (IACS) in 1876, with donations from his countrymen. But the funds procured by Dr. Sircar were inadequate for creating any endowment for faculty appointments.

The year 2011 marked the 150th birth anniversary of P. C. Ray. A pathfinder in chemical research and education as also in chemical and pharmaceutical industries, and a pioneering historian of ancient Indian Chemistry, Prafulla Chandra Ray contributed significantly to the scientific, intellectual, economic and social renaissance in India in general and Bengal in particular. We recall some of these aspects in this 6-part article. We begin with Prafulla Chandra's early life as an inquisitive student. We shall use phrases from his autobiography ([7]) in quotation marks.

The Student Prafulla Chandra

Prafulla Chandra was born on 2nd August 1861 in Raruli, a village in the district of Jessore (subsequently of Khulna), now in Bangladesh. Jessore was the kingdom of the great rulers Raja Pratapaditya and Raja Sitaram Ray.[2] Poet Madhusudan Dutta[3] and dramatist Dinabandhu Mitra[4] also hailed from the district of Jessore. Prafulla Chandra's father Harish Chandra, a student of Ramtanu Lahiri,[5] was a man of refined taste, wide learning and enlightened views; his mother Bhubanmohini Devi too was an accomplished lady. Prafulla Chandra had four brothers and two sisters.[6]

2. Pratapaditya Ray (1561-1611), a valiant warrior and an able administrator, had fought fierce battles to preserve the independence of his kingdom. His bravery and patriotism have inspired many ballads. His legacy, like the legacy of Shivaji and Guru Govind Singh, has been a source of inspiration for Nationalists during the struggle for Independence. Sitaram Ray (1658-1714) too is remembered for his welfare activities and his struggles to preserve the independence of his kingdom. Recall the stanza from Sri Aurobindo's poem 'To The Ganges':

> Yet Pratapaditya's great fierce spirit shall in might awake
> In Jessore he loved and made,
> Sitaram the good and mighty for his well-loved people's sake
> Leave the stillness and the shade. (*Collected Poems*, 2nd Ed. 2009, p. 258)

3. Michael Madhusudan Dutta (1824-73), one of Bengal's greatest poets, introduced the sonnet, the blank-verse and the literary epic in Bengali literature; he has been referred to as the 'Milton of Bengal'. His famous epic *Meghnadbadhkavya* was composed in 1861, the year in which P. C. Ray was born. In the words of Sri Aurobindo (SABCL, Vol. 3, p. 95), "All the stormiest passions of man's soul he expressed in gigantic language." A poem by Sri Aurobindo on Madhusudan Dutta begins with the lines:

> Poet, who first with skill inspired did teach
> Greatness to our divine Bengali speech — (*SABCL*, Vol. 5, p. 27)

4. Dinabandhu Mitra (1830-76), one of the greatest dramatists of his time, is most famous for his play *Nildarpan* (1860) which, by highlighting the plight of indigo cultivators, played a historic role similar to that of *Uncle Tom's Cabin*. The play was translated into English by Madhusudan Dutta.

5. Ramtanu Lahiri (1813-98) was a renowned teacher and social reformer of Derozio's Young Bengal group. "There are few persons in whom the milk of kindness flows so abundantly." — this was a remark on Ramtanu Lahiri by his contemporary Peary Chand Mitra, the author of one of the earliest Bengali novels.

6. Of the five sons of Harish Chandra and Bhubanmohini Devi, the eldest son, Jnanendra Chandra became a pleader; the second, Nalini Kanta a doctor; Prafulla Chandra was the third; the fourth son, Purna Chandra managed the ancestral properties of their joint family; the youngest, Buddhadev (alias Gopal) died at a young age. The names of the daughters are Indumati (Ghosh) and Belamati. Prafulla Chandra's younger sister Belamati died in her childhood when he was in Britain for higher studies.

Prafulla Chandra was admitted to the village school founded by his father. Through conversations with his father, Prafulla Chandra (and his brothers) had an early intellectual training. By the age of nine, Prafulla Chandra "had shown a predilection for history and geography". Having "an inquisitive turn of mind and studious habits", Prafulla Chandra "used to ransack the shelves" of his father's library. Quotations from classical authors like Shakespeare, that he came across in Johnson's *Dictionary*, used to fill him with delight and he would memorise passages like

> "Ignorance is the curse of God,
> Knowledge the wing wherewith we fly to Heaven." — Shak.

though, at that age, the child Prafulla Chandra could not make out what an abbreviation like "Shak" stood for! As he grew, this early acquaintance with Shakespeare "ripened into close friendship".

In 1870, Prafulla Chandra's father shifted to Calcutta mainly for the proper education of his children. Recalling the thrill he experienced on coming to the city as a young boy, P. C. Ray writes ([7], p. 19):

> I spent the month of August [1870] in Calcutta, to my great joy, almost every day seeing new sights. I caught glimpses of a new world. A panorama of gorgeous vistas was opened to me.

However, he used to regularly visit his ancestral home in the village. It was due to this close contact with peasants and villagefolk from his childhood that P. C. Ray could later throw himself "heart and soul into the Famine and Flood Relief Work in 1921 and 1922 respectively". His nephew Jatindranath writes ([10], p. 198) that in his early life Prafulla Chandra came in contact with Pandit Iswar Chandra Vidyasagar.[7]

Prafulla Chandra was admitted at Hare School in 1871. But prescribed textbooks could never quench his intense thirst for knowledge. He became "a voracious devourer of books". Prafulla Chandra "read Chambers' *Biography* right through several times". The lives of Newton, Galileo, William Jones, John Leyden and Benjamin Franklin fascinated him. He writes ([7], p. 30):

> The answer of Jones' mother to his interrogations "Read and you will know" also was not lost upon me.

7. P. C. Ray's autobiography mentions that his father made acquaintance with Vidyasagar and some of the leading men of Calcutta ([7], p. 9); he does not mention his own interactions with Vidyasagar. Ray's educational, social and philanthropic activities (to be discussed in Parts II and VI) show that the life and ideals of Vidyasagar made a deep impression on him.

Benjamin Franklin was his special favourite.

Due to a health problem which emerged in 1874, Prafulla Chandra had to discontinue regular school education for several months. It was "a blessing in disguise": set free "from the tyranny of the dull and dreary routine method followed in the schools", Prafulla Chandra could now freely indulge in his passion for studies without hindrance. From the books of his father and eldest brother, Prafulla Chandra contracted a taste for the rich and copious English literature. He became a witness to a new dawn in Bengali literature as he followed with "intense and breathless interest" Bankim Chandra's masterpiece *Bisabriksha* (The Poison Tree) serialised in the periodical *Bangadarsan*. During this period, Prafulla Chandra developed a taste for antiquarian studies as he read writings like *Valmiki and his Age* (by Prafulla Chandra Banerjee), *Age of Kalidas* (by Ramdas Sen), etc. The seeds of his future blossoming as a researcher and writer on ancient Indian Chemistry can be traced to the antiquarian bent acquired during this period.

Articles on Physics, Zoology and Geology in *Tatwabodhini Patrika* and *Vividhartha Samgraha* grafted in him the seed of science. While reading an issue of *Samachar Darpan*, he was struck with awe at the story of Franklin bringing down electric current to the earth by means of a wet thread connected to a flying kite ([4], pp. 89-90). He also regularly read the newspapers *Somaprakasa*, *Amritabazar Patrika*, the *Hindu Patriot* and the *Indian Mirror*.

One day Prafulla Chandra chanced upon William Smith's *Principia Latina*, a first introduction to Latin. Having already gone through *Vyakarana Upakramanika* (the first step in Sanskrit grammar) of Vidyasagar, Prafulla Chandra was filled with wonder at the remarkable similarity between Sanskrit and Latin. It did not take him long to finish the first and second parts of the *Principia* series and the companion grammar. This was the beginning of his life-long interest in languages; he would later learn, on his own, French and German.

Prafulla Chandra resumed regular studies later at Albert School founded by the Brahmo leader Keshab Chandra Sen and passed the Entrance Examination in 1879. He had fond memories of the Albert School ([7], p. 42):

> . . . I recollect with grateful feelings the obligations I am under to my Albert School teachers and the cordial and happy relations in which I stood with them.

In 1879, Prafulla Chandra joined the recently opened college of the Metropolitan Institution (now named Vidyasagar College) founded by Pandit Iswar Chandra Vidyasagar. Two factors determined his choice of college. First, the Metropolitan was a "national institution and something we could look upon as our own". Second, the Professor of English prose at Vidyasagar's College was none

other than Surendranath Banerjee,[8] an idol of the students in Bengal; English poetry was also taught by another distinguished Professor, Prasanta Kumar Lahiri. However Prafulla Chandra had to attend Chemistry and Physics classes at Presidency College as an external student since Metropolitan College did not have adequate arrangements. During this time, he began to get attracted towards Chemistry. The subject was taught by Alexander Pedler whose manipulative skill in experiments was of a high order.[9] Not content with merely watching classroom experiments, Prafulla Chandra and one of his batchmates set up a miniature laboratory at the lodging of the latter and took delight in reproducing some of the experiments done at college by Prof. Pedler. Apart from his textbook, Prafulla Chandra tried to procure and go through as many works on Chemistry as he could lay his hands on.

In 1882, Prafulla Chandra won the prestigious Gilchrist Scholarship of the University of Edinburgh and sailed for England.[10] He studied Chemistry, Physics and Zoology in the First Year. Again he felt his natural affinity towards Chemistry and took up the pursuit of his favourite science. He had as his teacher Prof. Alexander Crum Brown, one of the most philosophically minded chemists of the time. Prafulla Chandra obtained the B.Sc. degree (1885) and then the D.Sc. degree (1887) of the Edinburgh University.[11] Ray stayed in England for one more year with the Hope Prize Scholarship. Before his return to India, Ray had been given testimonials and letters of introduction by Prof. Crum Brown, Sir William Muir and Prof. C. H. Tawney. Prof. Brown wrote highly of Ray's attainments in chemistry; Prof. Tawney (Principal

8. Surendranath Banerjee (1848-1925) was appointed Professor of English in Metropolitan College in 1876 by Vidyasagar. In 1879, he founded the newspaper *The Bengalee*; in 1884, he established the Ripon College (now Surendranath College). One of the earliest politicial leaders of British India, S. N. Banerjee founded the Indian Association (1876) which later merged with the Indian National Congress (founded in 1885); he was President of the Congress in 1895 and 1902. Such was his all-India popularity that when he was imprisoned (1883) for remarks in the paper *The Bengalee* condemning the Chief Justice of Calcutta High Court (who had ordered a Hindu family to produce the idol of their household deity in the Court), there was a wild outburst of indignation not only in Bengal but also in far-off places like Agra, Faizabad, Amritsar, Lahore and Pune. Famous for his oratory, Surendranath was at the forefront of the agitation against the Partition of Bengal (1905); he vowed to "unsettle" what Curzon had declared as a "settled fact". He earned sobriquets "Rashtraguru", "Surrender not Banerjee" and "uncrowned King of Bengal". Surendranath Banerjee was one of the senior-most Moderate leaders of the Congress. Sri Aurobindo is reported to have revealed (*Evening Talks*, p. 595) that, in private, Surendranath Banerjee would accept the revolutionary movement and that he was full of enthusiasm when a bomb was taken to him.

9. Sir Alexander Pedler was posted as a Professor of Chemistry at Presidency College in 1874. It was here that he did his researches on "Cobra Poison", "Action of Light on Phosphorus", etc., which won for him the distinction of FRS. It is due to the efforts of Pedler, John Eliot and others, that practical classes in Chemistry and Physics were made compulsory for the B.A. degree in Science; and the course content was made more substantial.

10. Bahadurjee from Bombay was the only other Indian recipient of the scholarship that year.

11. Prior to Prafulla Chandra, Aghornath Chattopadhyaya (1850-1915) was the only D.Sc. from Bengal. Aghornath obtained the D.Sc. from Edinburgh in 1875. At the invitation of the Nizam, he joined the educational service of Hyderabad. His children include the revolutionary Virendranath Chattopadhyay, the poet Harindranath Chattopadhyay (who was in Sri Aurobindo Ashram for a few years) and Sarojini Naidu.

of Presidency College who was visiting England) wrote that Dr. Ray would prove to be a valuable acquisition.

P. C. Ray's Academic Affiliations

Dr. P. C. Ray returned to India in 1888 but, in spite of his accomplishments and strong letters of recommendation, he remained without a job for a year. During this period of unemployment, he stayed with his friend Dr. J. C. Bose, spending his time in reading chemical literature and pursuing botany — collecting and identifying specimens of plants around Calcutta. Job opportunities in educational institutions were limited and, when available, were mostly reserved for the British. There were two classes in the Education Service: Imperial and Provincial. The Imperial Service had more pay and privileges, but it was practically reserved for Europeans. Due to the personal intervention of the then Viceroy Lord Ripon,[12] J. C. Bose was reluctantly given an appointment in the Imperial Service (1885). But such was the racial discrimination that Bose was given only a temporary appointment at one-third of the salary given to a European.[13] In 1889, P. C. Ray too got a blatantly unfair appointment at Presidency College as a temporary Assistant Professor in Chemistry under the Provincial Service at the monthly salary of Rs. 250, a ridiculously low pay for someone with his qualifications. Ray protested, but accepted the offer.

When P. C. Ray joined Presidency College in 1889, research facilities were abysmal.[14] The situation began to get worse as the number of students increased. During practical classes, "the atmosphere, especially in the rainy season, thickly laden with fumes, became suffocating and highly injurious to health." Thanks to P. C. Ray's persuasion, and the efforts of A. Pedler backed by A. Croft, the British authorities agreed to construct a new laboratory in a new building. The authorities began discussing the plans with Pedler and Ray in 1892. While at Edinburgh, P. C. Ray had procured a copy of the reprint of the description of Edinburgh University's new chemical laboratory containing detailed drawings and diagrams. Some of the features of Edinburgh's laboratory were incorporated in the plan. Pedler too had

12. Lord Ripon, the Viceroy of India during 1880-84, was the most liberal Viceroy of colonial India. Sympathetic to the cause of the Indians, he was particularly concerned about the sphere of education where he tried to introduce reforms. No other Governor-General or Viceroy was dearer to the Indians. Lord Ripon was still the Viceroy when Bose returned to India in 1884.

13. Bose refused to accept the salary and taught for three years *without salary*. Finally the authorities, realising the value of his teaching and the loftiness of his character, made Bose's appointment permanent and gave him the *full salary* for the past three years.

14. It is now difficult to imagine the conditions in which both J. C. Bose and P. C. Ray began their research. Jagadis Bose had undertaken his pioneering experiments on millimeter waves in a small enclosure in Presidency College which he converted into a laboratory (1894), devising new instruments which he constructed with his own money with the help of an untrained tinsmith.

some designs of German laboratories. The new laboratory became operational from 1894.[15]

Till 1916, the research activities of P. C. Ray and his research students flourished in the laboratory of Presidency College with its limited facilities. In 1916, Asutosh Mukherjee, the visionary Vice-Chancellor of Calcutta University, opened the University College of Science (popularly known as "Science College") at Rajabazar in Calcutta. Posts in Chemistry and Physics were created at Science College from a donation of Rs 15 lakhs given by Taraknath Palit.[16] Sir Asutosh invited P. C. Ray and C. V. Raman to join the Science College as the Palit Professor in Chemistry and Physics respectively.

P. C. Ray resigned from his Government job at Presidency College to join the Science College. The chemical research work of his team now continued with renewed vigour. The Science College was shaped by P. C. Ray and his students. It was around this time that he became known as the "Acharya". Even when Ray was in his sixties, he continued to work hard in his laboratory from 9 a.m. to 4 p.m. with an hour's break for lunch and rest. Except for a month's break during the summer vacation (when he would stay in his native village), Ray would not deviate from this routine even during Sundays and holidays ([8], p. 3).

About one year after the Rajabazar Science College began to function, Acharya Ray, a life-long bachelor, came to reside in a room in its premises. P. C. Ray breathed his last in this room on 16th June 1944. The road on which the Rajabazar Science College is located is now named "Acharya Prafulla Chandra Road".

15. Amidst the various obstacles and adverse conditions in the career of P. C. Ray, Pedler seems to have acted as an instrument of Providence at crucial junctures. Pedler's attractive lectures and experiments kindled the student Prafulla Chandra's interest in Chemistry. It was Pedler who moved the Government for an additional post in Chemistry during the 1880s, which was sanctioned eventually and in which P. C. Ray got an appointment (even if in the lower Service); Pedler had spoken highly of P. C. Ray to the authorities. The new laboratory, built in 1894 at Pedler's initiative, enabled P. C. Ray to carry out his chemical research and build the nucleus of the Indian School of Chemistry. During his landmark research on "History of Hindu Chemistry" (to be discussed in Part III), P. C. Ray was given a liberal grant for meeting his expenses (chiefly for collecting rare manuscripts) by the Bengal Government at the recommendation of Pedler who had become the Director of Public Instruction. When Ray wished to visit some of the laboratories of renowned scientists of Europe in 1904, there was a difficulty as technically he belonged to the Provincial and not the Imperial Service. Again, at the initiative of Pedler, the DPI, the Curzon Government issued a minute declaring that an Indian who has shown the capacity for original research should not be denied study leave simply because he was a member of the Provincial Service. In preparing the case for Ray, Pedler had written in glowing terms about Ray's contributions including his "History of Hindu Chemistry".

16. The eminent lawyers Sir Taraknath Palit (1831-1914) and Sir Rashbehari Ghose (1845-1921) donated their life-long earnings to the University for the cause of science. The building of Science College at 35, Ballygunge Circular Road was also donated by Sir Taraknath. An anonymous pupil of P. C. Ray remarks in 1924 ([8], pp. 12-13): "It is not too much to say that the great munificence of the two lawyer-sons of Bengal in the founding of the College of Science with an endowment of about 30 lacs may be attributed to the painstaking, steady and whole-hearted devotion of Sir P. C. Ray to the cause of science and education extending over more than 30 years."

P. C. Ray, The Investigator of Chemistry

Prafulla Chandra's research in Chemistry began with his D.Sc. thesis in Inorganic Chemistry titled "Conjugated Sulphates of the Copper-Magnesium Group: A study of Isomorphous Mixtures and Molecular Combinations". In the words of Crum Brown ([6], p. iv), the thesis was "a piece of excellent analytical work, well arranged, and thoroughly and conscientiously carried out". The work impressed his professors and examiners and he was elected Vice President of the Chemical Society of the Edinburgh University during the session 1887-88.

Pained at the growing evil of adulteration of food-stuffs, P. C. Ray's first research work after his return to India was a chemical examination of certain fats and oils like ghee and mustard oil. He wished to create standards and identify the adulteration of foodstuffs in Indian cities. After a stupendous labour for nearly three years, Ray published his findings in the *Journal of the Asiatic Society of Bengal* in 1894.

P. C. Ray's subsequent research work spanned a period of 40 years from 1894 to 1934 during which he published more than 150 research papers in journals like the *Journal of the Chemical Society* (London), *Proceedings of the Chemical Society* (London), *Zeitschrift für anorganische allgemeine Chemie* (Germany), *Annalen der Chemie* (Germany), Nature (UK), the *Journal of the Indian Chemical Society* (after its establishment in 1924), and other internationally reputed journals. Around half of this research was done in collaboration with his research students. Indeed, it was his mission to create an enthusiasm for research among his young students and to bring into the atmosphere of Indian Universities an urge towards research.

Along with his students, P. C. Ray prepared many new interesting families of compounds and examined their properties to the extent possible at that time. He became particularly famous for his work on inorganic and organic nitrites; he was regarded as the "Master of Nitrites". Among metals, Prafulla Chandra Ray had a special fascination for mercury, which is an important element in Ayurveda.

In the very second sentence of his autobiography ([7]), P. C. Ray mentions that the year of his birth (1861) is memorable in the annals of Chemistry for the discovery of the element thallium by Crookes. After the new chemical laboratory was set up at Presidency College in 1894, P. C. Ray attempted a chemical analysis of certain rare Indian minerals to see if they contain one or two undiscovered elements which would fill up the gaps in Mendeleev's Periodic Table (1869). He soon made an unexpected discovery (1895) which "opened a new chapter" in his life. He reported the first synthesis of the hitherto unknown compound mercurous nitrite $Hg_2(NO_2)_2$, a moderately stable yellow crystalline solid formed by a chemical reaction between metallic mercury and dilute aqueous nitric acid. Thus, although he did not come across any new element to fill up any blank in the Periodic Table, in the words of his former teacher Alexander Pedler in 1896 ([6], p. ix):

> Dr. P. C. Ray, by his discovery of the method of preparation of this compound, has filled up a blank in our knowledge of the mercury series.

The reactions of nitric acid with mercury have fascinated chemical researchers since the 15th century. The discovery of mercurous nitrite, a compound of unexpected stability composed of two relatively unstable ions, attracted immediate international attention. Ray began to receive congratulatory letters from eminent chemists like Roscoe, Divers, Berthelot, Victor Meyer and Volhard. Inspired by their appreciations, Ray was stimulated to further activity. In a series of significant publications, P. C. Ray reported the chemical properties of mercurous nitrite and its derivatives. The investigations on nitrites and related areas that Ray launched with his students heralded the birth of the first research school of chemistry in modern India.

Ray published interesting findings on the chemistry of hyponitrites. The hyponitrites of mercury were found to be thermally more stable than the corresponding nitrites and nitrates. Ray also synthesised numerous nitrites of alkali, alkaline earth and coinage metals, and double nitrites containing both mercury and alkaline earth metals, and investigated their thermal decomposition and physio-chemical properties like relative stability, molecular volume and molecular conductivity.

One of P. C. Ray's most significant contributions to the chemistry of nitrites was his isolation of ammonium nitrite in pure form and determination of its vapour density in vacuum. Before Ray's synthesis, it was believed that ammonium nitrite readily breaks up into nitrogen gas and water with the evolution of heat, and hence the isolation of this extremely unstable substance is not possible. Ray showed in 1907 that the compound can not only be isolated but also sublimated in vacuum, without decomposition, even at 60°C. Ray's findings, which he presented in a meeting of the London Chemical Society in 1912, impressed Sir William Ramsay,[17] Sir Henry E. Roscoe and other eminent chemists. The high esteem in which his work was regarded by them can be seen from the following concluding words of a speech that Sir Ramsay made after a lecture by Ray ([8], p. 6):

> We had the privilege and pleasure of listening to-night to that eminent Indian chemist whose name is already familiar to us for his most interesting researches on nitrites, and who unaided has kept the torch burning for years in that ancient land of civilization and learning.

Prior to his research on ammonium nitrite (1907), P. C. Ray had published his much-acclaimed monumental treatise *History of Hindu Chemistry Volume I* (1902). At the Chemical Society meeting, Dr. V. H. Veley welcomed Prof. Ray as "an

17. Sir William Ramsay (1852-1916) was a Scottish chemist most famous for his discovery of the noble (or inert) gases for which he received the Nobel Prize for Chemistry in 1904.

illustrious representative of a great Aryan nation which had attained a high degree of civilisation and discovered many chemical processes when this country [England] was but a dismal swamp". Paying a warm tribute to Dr. Ray and his pupils for their valuable researches, Veley pointed out ([7], p. 174):

> Prof. Ray has shown, contrary to text book statements, that ammonium nitrite could be obtained in a stable crystallised condition and volatilised.

Nature, the most famous scientific journal of UK, reported on August 15, 1912:

> Prof. P. C. Ray has added to his success in preparing ammonium nitrite in a tangible form, a further accomplishment in determining the vapour density of this very fugitive compound.

Prof. Armstrong remarked in 1914 ([7], p. 114):

> The way in which you have gradually made yourself 'master of nitrites' is very interesting and the fact that you have established that as a class they are far from being the unstable bodies chemists had supposed, is an important addition to our knowledge.

P. C. Ray and his team at the University College of Science also made major contributions to the chemistry of organic sulphur compounds. He synthesised new compounds and studied their interactions with salts of mercury. His work on long-chain sulphur compounds acquired a new significance after the development in the knowledge about high polymers. He also made extensive contributions to the coordination chemistry of the heavier transition metal ions like platinum, iridium and gold.

The article [3] gives an account of P. C. Ray's research in Chemistry. During his time, the study of structural principles was still in its infancy. A recent paper [12] discusses the molecular structure of mercurous nitrite and a nitrate derivative.

In his tribute 'Sir P. C. Ray, The Man and His Work', the noted Irish physical chemist F. G. Donnan of University College, London, remarks ([9], p. 67):

> I hope that future ages will cherish his name as one of the band of self-denying and devoted men who have revived and handed on the flame that once burned so brightly in India, the search for truth and the hidden mysteries of things.

In the next instalment of the article, we will highlight the role of P. C. Ray as Teacher.

(To be continued)

AMARTYA KUMAR DUTTA

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Every child is a lover of interesting narrative, a hero-worshipper and a patriot. Appeal to these qualities in him and through them let him master without knowing it the living and human parts of his nation's history. Every child is an inquirer, an investigator, analyser, a merciless anatomist. Appeal to these qualities in him and let him acquire without knowing it the right temper and the necessary fundamental knowledge of the scientist.

Sri Aurobindo

(*Early Cultural Writings*, CWSA, Vol. 1, p. 395)