

CHEMICAL RESEARCH IN BRITISH INDIA (1788-1900)

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Abstract

Sources for searching of chemical literature produced from British India in the 19th century are scant. Delhi is especially poor as far as old sources are concerned. Still a sincere attempt has been made to retrieve as much literature as possible and to present a holistic scenario. Chemical papers that generated from India in modern times could be traced back to 1788. Initially facilities for chemical research were practically non-existent in India. Hence the papers were based on observations. Gradually as facilities for chemical analysis ensued, papers on chemical analysis also started appearing. Finally, the establishment of a chemical laboratory at Presidency College, Calcutta in late 19th century paved the way for sustained chemical research in India. The present paper shows chronologically the development of chemical research in India from 1788 to 1900. A list of 121 papers, the details of which could be traced has been appended.

Key words: Chemical papers – India – 18th century; Chemical papers – India – 19th century; Chemical research – India – 19th century.

1. INTRODUCTION

Literature is scant on chemical research and related activities in the 19th century British India. Prasad¹ in his Introduction to *Progress of Science in India during the Past Twenty-five Years* has written the following few lines about the 19th century chemical research in India. “Pedlar and Waterhouse contributed papers on the Volatility of some Compounds of Mercury and the Action of Light on Silver and its Haloid compounds. Pedlar and Warden published a valuable paper on the Toxic Principle of the Aroidae in 1890. In 1894 Ray (later Sir Prafulla Chandra Ray) read a paper on the Chemical Examination of Indian Foodstuffs following by other papers on mercury salt from 1898 to 1900. The chemical papers by Nag, Pedler, Bhaduri and Bhaduri (1898), and Mukherjee (1900) should also be mentioned”. The statement throws some light on the chemical research work

done in 1890s. It does not reveal anything about the chemical literature of the earlier period.

In the book *Science in India –50 Years of the Academy*² there is a section on chemistry. The section starts with the sentence “Chemical research has been pursued in the country for the past several decades”. The book was published in 1985. Hence, it may be assumed that the description of chemical research in India given in the Section belongs to the post-independent period. It is difficult to pinpoint the period as no references are given.

Indian National Science Academy brought out *A Concise History of Science in India*³ wherein appeared a chapter called ‘Western Science in India up to the end of the Nineteenth Century’. The book is also practically silent about 19th century chemistry in India.

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2. Methodology

The searching of the chemical literature pertaining to the 19th century is but a daunting task, inasmuch as indexing and abstracting services in the 19th century were hard to come by. Internet or World Wide Web were even beyond the dream. *Chemical Abstracts* started only in 1907. Even *The International Catalogue of Scientific Literature* brought out by the Royal Society of London indexed the literature of the period 1901-1914.

Though journals in various fields of science like medicine and agriculture started in India in 19th century, there was no journal exclusively devoted to chemistry. As a result, papers on chemistry were being published in such journals as *Asiatick Researches*, *Gleanings of Science* (a short-lived journal) and *Journal of the Asiatic Society of Bengal*. In such a situation it was decided to go through *Index to the Publications of the Asiatic Society 1788-1953*, vol. 1, part 1. The *Index*⁴ has listed 5139 entries. The bibliography is without a subject index. As a result, each entry of the bibliography had to be checked to ferret out the articles on chemistry. This provided a substantial number of articles. A chemical laboratory (possibly the first chemical laboratory of India) was established in late 1880s at Presidency College, Calcutta. The *Centenary Volume* of the Presidency College⁵ brought out in 1956, included the publications by the teachers of the College. Hence, the volume proved to be a good source for this work. 'Bibliography of the works of Acharya Prafulla Chandra Ray' compiled by Santimay Chatterjee and Amitabha Sen⁶ appended to the book *Acharya Prafulla Chandra Ray* also proved to be a good source of information.

Using the sources the bibliography has been compiled, which might not have covered all the relevant items. However, it is hoped that not much has been left out.

3. Chronological Scenario

3.1 1788 to 1820s

Papers on chemistry started appearing right from 1788 itself when *Asiatick Researches* came into being.

From 1788 to 1797, in all five papers appeared, of which four were descriptive papers and one experimental. The descriptive papers were on the method of distillation as was practiced by the natives of Chatra in Ramgur and other provinces [31]*, on the gold of Limong (Sumatra) [32], on the process of making attar [74], and on the manufacture of indigo at Ambore [34]. In the only experimental paper of the period, Howison [24] gave an account of the experiment conducted with the milky juice of elastic gum vine of Prince of Wales's Island and its possible use.

From 1798 to 1824, there was no paper. During 1825 to 1829 three papers appeared. The paper on analysis of a mineral water was by James Prinsep [79]. Piddington's paper reported the results of the analysis of some specimen of iron ore from Burdwan [54]. Ure's paper [114] presented the results of experiments on indigo.

3.2 1830s

The surge in the production of papers is observed from 1830s when as many as 44 papers appeared. It is difficult to explain without further research how this had happened. Of the papers, 29 were descriptive, 10 pertained to examination and analysis, and only five were experimental.

3.2.1 Descriptive account

The descriptive papers are related to manufacture of Sylhet lime [2], mode of extracting gold dust from river sand [19], native method of making paper [23], Chinese vermilion [30], native manufacture of steel in southern India [117], salt works of Panchadder (Marwar) [9], method of

*NB: References given within square brackets [] belong to the Appendix.

preparation of strychnia [44], mode of dyeing Kharwa cloth [101], manufacture of saltpeter in Tirhut [102], native sulphate of alumina from the aluminous rocks of Nepal [103], native sulphate of iron from hills of Behar [104], means employed by the natives of Bengal for making ice [121], mode of extracting salt from the damp sand beds of the river Jumna [111], the Nepalese method of refining gold [14], saline nature of Ghazipore soil, and manufacture of common salt by natives of various places [106], efflorescence of sulphate of soda as found in the soil of Tirhut and Sarun [107], Nepalese spirit still [15], method of washing of gold of Gumti river [18], composition of Rangoon petroleum [20], preparation of opium [13], soil and salt specimen of Sambhur Lake Salt Works [108], coal specimen [10], manufacture of Salumbha salt of Upper India [21], gold washing of Assam [22, 36], cultivation of roses and manufacture of rose water and attar [26], mode of preparing the perfumed oils of jasmine and bela [27], smelting of iron ore of the district of Burdwan [29].

It may be noted that of the descriptive papers, as many as five are related to gold washing and gold refining. There are also several papers on salt.

3.2.2 Examination and analysis

In all there are seven papers on examination and analysis. The papers are devoted to examination of minerals [80, 81], analysis of Chinese varnish [78], analysis of the ashes of four Indian plants [105], chemical analysis in general [82], analysis of copper ore from Nellore [36], and Indian coal analysed at the Calcutta Assay Office [86].

3.2.3 Experiments

Ure experimented with indigo [114]. G A Prinsep conducted a study on the temperature and saltiness of the river Hooghly, from Calcutta to the sea [15], another study on the continuous heating of brine [45], O'Shaughnessy's experiment related

to the detection of arsenical poisons by Marsh's process, its inapplicability to the sulphurets of arsenic, and the mode of obviating the fallacy occasioned by antimonial compounds [39], and explosion of gun powder under water by the Galvanic battery [40].

3.3 1840s

This decade witnessed the appearance of 19 papers of which eight were descriptive papers, seven related to examination and analysis, and the remaining were experimental studies.

3.3.1 Descriptive account

These papers related to manganese of the Mergui province [111], manufacture of steel in southern India [16], chemistry [17], tin of the province of Mergui [112], artificial fuel [113], iron works of Beerbhoom [28], and process employed for obtaining gold from the sand of Beyass [1].

3.3.2 Examination and analysis

The papers of this category dealt with the process of detecting the adulteration of government salt [55], qualitative examination of the native copper found on Round Island, analysis of iron ores from Tavoy and Mergui, and of limestone from Mergui [116], examination of some atmospheric dust from Shanghee [33], analysis of mineral Newboldite [56], Ball coals of Burdwan mines [59], and large mass of meteoric iron from the Kurruckpore hills, near Monghyr [57].

3.3.3 Experiments

There are four papers on this category. Two of the papers presented the results of experiments conducted by O'Shaughnessy on the effects of sea water on iron [41], and large scale refining of brittle or under-standard silver by means of nitre for coinage purposes [42]. The third paper contains a few observations by R H Irvine on the probable results of a scientific research after metalliferous deposits in the Sub-Himalayan range around

Darjeeling [25]. Henry Piddington's paper reported the results of spontaneous combustion of coal wetted with salt water on board of a ship [58].

3.4 1850s

The papers published in this period number 14 of which four were descriptive papers and the rest related to chemical analysis. There is no paper on chemical experiments. All the papers were by Henry Piddington. His papers were on the examination and/or analysis of orange-yellow earth brought from the Sikkim territory [67]; new mineral Haughtonite – a compound of lead carbonate and sulphate of barytes [61]; Shalka meteorite of West Burdwan [62]; Indian coals and coals from Darjeeling, Ava, Cuttack, Cherrapunji [63, 68, 69, 70, 73]; copper ores from the neighbourhood of Darjeeling [67]; and Bengal mineral water [71].

The descriptive papers were on the argentiferous ores of Deoghur [66], Hircine – a new resin [65], apparatus for distilling of the mercury from an amalgam of gold and silver [69], Kunkurs of Burdwan as a flux for melting the iron ores [72]

3.5 1860s to 1880s

The year 1857 saw a huge upheaval in the country in the form of Sepoy Mutiny. In 1958 the Crown took over the control of India from East India Company. These two and might be other factors led to a less productive period. Only 10 papers of the three decades could be traced, of which four were descriptive, four experimental and two analytical papers. It is to be noted that Rai Bahadur Dr Kanailal Dey (1831–1899) joined Calcutta Medical College as a professor of chemistry in 1869. There he carried out chemical analysis of a number of indigenous drugs. The results of his analysis were published. The details of his papers could not be traced. He also produced a book called the *Indigenous Drugs of India*. Research is needed to trace the papers⁷.

The descriptive papers were on the method of assaying silver adopted in the Assay Offices of H M Indian Mints [12], spirituous drinks of ancient India [35], muddy water of Hooghly during rainy season and its purification [119], the nature of the toxic principle of Aroideae [47].

The analytical papers related to Khettree meteorite [118], and cobra poison [45].

The three experimental papers studied the corrosion of lead linings on Indian tea chests by Pedler [46], effects produced by the small quantities of bismuth on the ductility of silver by Scully [93], the volatility of some of the compounds of mercury and of the metal itself by Pedler [95].

3.6 1890 -1900

Alexander Pedler was appointed professor of chemistry at Presidency College in 1874. Gradually facilities for practical classes of chemistry started developing. Prafulla Chandra Ray was appointed professor of chemistry at the Presidency College in 1889. Before 1890, systematic and sustained research was practically nonexistent. Thus Prafulla Chandra Ray directed all his efforts to remedy the situation and started original investigation in collaboration with his senior pupils. This paved the way for the Indian School of Chemistry to come into being and open the wide vista of modern chemical research in India⁸. Alexander Pedler, Prafulla Chandra Ray, Jyotibhushan Bhaduri, Indubhushan Bhaduri, Chandrabhushan Bhaduri and a few others were in the arena. It was Ray who spearheaded the chemical research. As a result, all the 25 papers published during 1890 to 1900 were experimental.

Of the papers, Ray contributed as many as 12 papers. His first paper was on the chemical examination of Indian foodstuffs published in 1894 in two parts [88]. This apart he published 10 papers on nitrites of mercury [89-96, 98-99]. Also, there were one paper on mercurous iodide [97]. It may be noted that Ray's first research work on

chemistry was his DSc thesis submitted to University of Edinburgh in 1887. Alexander Pedler singly or jointly contributed five papers [49-53] experimenting with chlorine, phosphorous and nitric oxide

Three Bhaduris either singly or jointly experimented on transformation of hypochlorites to chlorates, decomposition of mercurous chloride and estimation of free chlorine, action of nitric acid on alkalies, conversion of hypochlorites to chlorates, and decomposition of mercurous chloride, double thiosulphates of copper and sodium [3-8, 53].

Other authors who figured in this period are as follows. Waterhouse studied the electrical action of light upon silver and its haloid compound [120], Nag's paper was on new salts of cobalt and nickel [38], Ranking studied the nature of the substance formed during fermentation from which indigo blue is formed [87].

It is worth mentioning here that Rai Bahadur Dr Chunilal Basu (1861-1930) was appointed as the Chemical Examiner to the Government of Bengal in 1889. He also carried out analysis of Indian foodstuff. His paper on the chemical action and poisonous action of oleander flower was considered an important contribution⁹. The details of the paper could not be traced.

4. Authors

Now we can have a look at the authors who contributed the papers. Of the 121 papers that could be traced, the name of one author could not be ascertained, and one paper emanated from Jessop & Co. The rest of the papers (N=119) were contributed by 52 authors. Of the authors Henri Piddington is found to be most prolific with 20 papers, followed by Prafulla Chandra Ray (14 papers); Alexander Pedler (9 papers); James Prinsep (8 papers); J Stephenson (7 papers); Jyotibhushan Bhaduri (5 papers jointly); W B O'Shaughnessy (4 papers); G A Prinsep, G B Tremenheere, and A Ure (3 papers each);

Chandrabhushan Bhaduri, Indubhushan Bhaduri, Alexander Burnes, Dr A. Campbell, J Campbell, Dr Jackson, and D Waldie (2 papers each). Authors like James Abbott, T S Burt, H E Busted, D Buster, P T Cautley, Capt. F.T Grant, William Gregory, Charles Gubbins, S F Hannay, Brian Houghton Hodgson, James Howison, R.H Irvine, Welby Jackson, Stanislas Julien, Archibald Keir, John Macdonald, D J Macgowan, Claude Martin, Rajendra Lal Mitra, Moneerram, S Mornay, Nagendra Chandra Nag, J.H Ouseley, J T Pearson, Lt. Col Polier. I. Macaire Prinsep, George Ranking, J Scully, Harimohan Sen, J.F Tenant, G Twemlow, H.H Voysey, C J H Warden, J Waterhouse, and T A Wise contributed one paper each.

As can be expected, up to the end of 1880s, all were European authors except Harimohan Sen, who translated a Persian paper on the mode of dyeing Kharwa cloth practiced in Bundelkhand [101]. It may be noted that the paper was published in 1833., and is one of the earliest chemical papers published in English in which the name of an Indian appears. The other Indian who figures during the period is Rajendra Lal Mitra who wrote on the spirituous drinks in ancient India [35]. The situation dramatically changed during 1890-1900 when out of 27 papers as many as 20 were contributed by Indians. Most of the papers by the Indians resulted from experiments conducted at Presidency College, Calcutta.

Of the authors, chemists were but few. Alexander Pedler, Prafulla Chandra Ray, W B O'Shaughnessy were definitely chemists. O'Shaughnessy was also a physician and a physicist. Possibly Jyotibhushan Bhaduri, Chandrabhushan Bhaduri, Indubhushan Bhaduri, Nagendra Chandra Nag were also chemists. When we look at the others we find that Henry Piddington¹⁰ (1797-1858) initially was a confirmed British sailor, afterwards he turned into a scientist and contributed papers in geology, botany, mineralogy, chemistry, etc. James Prinsep¹¹⁻¹² (1799) was an English scholar,

orientalist and antiquary as well as the founder editor of *Journal of the Asiatic Society of Bengal*. His contributions encompassed chemistry, mineralogy, meteorology, numismatics, archaeology; and more subjects. This was the trend. Authors belonging to different fields contributed one or two papers on chemistry as the number of chemists in the country in 19th century were but few.

5. Conclusion

Facilities for chemical research in 18th and 19th centuries in India were but scarce. India Government Mint, Calcutta¹³ (popularly known as Calcutta Mint) was established in 1757. The 2nd and 3rd Mint in Calcutta were established in 1790 and 1824 respectively. The Mint provided some facilities for chemical research work. Calcutta Medical College established in 1835 started teaching chemistry giving rise to facilities for chemical analysis¹⁴. Chemical Examiner's Laboratory was founded at Madras around 1850 to investigate various cases of poisoning¹⁵. This Laboratory also added to the facility of chemical analysis. The foundation of the Geological Survey of India in 1851 generated facilities for collecting ores, fossil fuels, minerals, etc. In this way bit by bit facilities for chemical analysis developed in the 19th century. As mentioned earlier, finally the facilities for chemical research on a sustained basis took root in Presidency College, Calcutta around 1890s.

This being the situation, the initial papers on chemistry were generally based on observation. As facilities for chemical analysis developed, papers based on chemical analysis started appearing. Finally in the last decade on the 19th century, papers based on chemical experimentation started appearing in substantial number. Hereafter, there was no looking back. Chemical research in India progressed at a steady rate and earned a niche among the top chemical paper producing countries of the world.

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APPENDIX

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