

THE CONFLICT AND CHANGE-OVER IN INDIAN CHEMISTRY

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Indians saw the new European science through the eyes of medical officers, engineers, surveyors, meteorologists and others of the British East India Company. English chemists in the various departments, laboratories and colleges run by the Colonial Government were responsible for early chemistry. Professors of Indian Education Service disseminated chemistry to the Indian students. Chemical research was started in the laboratories of Presidency College, Calcutta. Their number increased year by year. Indian chemists took over the responsibility of chemistry during twenties of twentieth century. But the change-over was not smooth and easy. The abortive attempt on the part of British chemists for starting Indian Chemical Service, the establishment of Indian Chemical Society by the nationalist scientists set the future of Indian chemistry. These two endeavours were aimed in two different directions. One was to continue the subjugation of British hegemony over the Indians and the other was for the emancipation of an oppressed nation. There was marked difference in the choice of research areas also. The need-based research — a trend observed among the British chemists since the early part of nineteenth century continued even after the Great War (I), while their Indian counterpart, after receiving training from England and other European countries tried to follow the research patterns of their masters. The British chemists were not in a mood of development of Indian chemistry, they were more inclined to fulfill the imperial needs. Indian chemists wanted to follow the self-reliance path—the way that was followed by the chemists of independent European nations. The beginning of industrial research at the initiative of various Provincial Governments made a mark on the development of Indian chemistry. Even there were differences in institutional choice. English chemists were mainly concentrated in Bangalore and Bombay, while the Indian chemists were mostly stationed at Calcutta. The history of the development of Indian chemistry during twenties exposes the untold stories of political, social aspects of Indian science.

Key words: Indian Chemical Service, Indian Chemical Society, Self-reliance.

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I

Modern chemical science was introduced in India by the Europeans, especially English merchants since seventeenth century. The chemical technology used by the Indians at that time were classical in nature and new innovations were practically absent. While the European's alchemy gradually faded away at the beginning of eighteenth century and the pneumatic chemistry flourished, the Indian alchemy remained prisoner at the hands of *Tantrics* resulting a complete decay. However, the chemical technologies of production of dyes, metals, cosmetics, salts etc. were much ahead in India. India could not continue her supremacy for a long time. Soon the industrial revolution helped England in producing goods in large quantity and she forced India to accept her industrial goods. India became a storehouse of raw materials for English industries. At the first quarter of nineteenth century, western science including chemistry became a subject to be taught by the Indian pupil.

The formal introduction of English education in India by the British Government in 1835, the establishment of first three universities in 1857 are the expression of Britain's desire for spreading western education in India. However, the arrangement of science education was very much restricted. There were two reasons behind it. The scientific and technical education did not register substantial progress in Britain in nineteenth century. Again, natives were not encouraged in receiving science education as a tool for advancement, for reasons obviously in favour of colonial interest.

However, a policy of Government research and technical assistance for the colonies had been introduced by Joseph Chamberlain when he moved to the Colonial Office in 1895¹, and the Royal Society had been asked to form an Indian Advisory Committee² in 1898. These were due to a lobby within the British ruling classes that got alarmed at Germany's rising industrial production, and believed that more resources might be devoted in Britain for the scientific education, even in colonies. Contrary to this outlook, the Government of India was more cautious, as the seeds of western education have already been germinated, and the nationalistic aspirations grew among the Indian educated middle class. The early twentieth century saw a criss-cross battle between the two lines among the ruling classes. While the recommendations of Indian

University Commission of 1902 desired for further expansion of western education including promotion of original scientific research³, the Government of India put an obstacle by withholding fund required for opening university science colleges.

The cadres of Indian Education Service, especially the British professors of science took a leading role at this period. The Government owned laboratories of Geological Survey of India, Indian Mint, Forest Research Institute, Imperial Institute of Agricultural Research and other such institutions also acted as instruments for the dissemination of science. There were many fine English teachers in physics, mathematics, chemistry, geology, botany, zoology in Government colleges, like Presidency College of both Calcutta and Madras, Dacca College, Rajsahi College, Patna College, Ravenshaw College, Canning College of Lucknow, Muir Central College of Allahabad, Bombay Wilson College, Lahore College, Central College of Bangalore. Though the first autonomous research institution, Indian Association for the Cultivation of Science was established in 1876 in Calcutta by the nationalists, the second such institution, Indian Institute of Science came up in Bangalore in 1911 and the first director of the Institute was an English chemist, M.W. Travers, FRS.

In order to organise Indian science, as well as for the exchange of ideas and opinions of the Indian scientists, the organizers of science felt it necessary to build up a forum of scientists. At the initiative of P.S. Macmahon, professor of chemistry of Lucknow Canning College and J. L. Simonsen, another professor of chemistry of Madras Presidency College and with the direct help from Sir Asutosh Mukherjee, the Vice Chancellor of Calcutta University, the first Science Congress was organised at Calcutta in 1914 and an organization named as Indian Science Association began to function.

The growth of German industry before the First World War and its after effect during the War, made politicians realize that the military power of a country ultimately rested on its industries rather than the number of soldiers it could marshal in the field. The Montagu-Chelmsford Report for reform stated that :

'Both on economic and military grounds Imperial interests also demand that the natural resources of India should henceforth be better utilized. We cannot measure the access of strength which an industrialized India will bring to the power of the Empire'⁴.

At the end of the War, conferences were held in order to consider the organization of chemical research in India. As Sir Thomas Holland noted in a Presidential Address:

‘The war has shown that the chemist is a more dangerous fighter than either the gunner or the cavalry soldier’.⁵

Then government’s intention was clear. In addition of five universities of nineteenth century, four new universities, some of them based on existing Government colleges, were established between 1916 and 1918. These were at Benares, Mysore, Patna and Hyderabad. In 1917 Alfred Gibbs Bourne, delivering his presidential address to the Fourth Indian Science Congress, reckoned that the annual expenditure from public funds on scientific work in British India is somewhere near Rs. 70-80 lakhs, i.e. say £ 5,00,000⁶.

II

Indian Industrial Commission (1916)

The Imperial Government that ruled India was in trouble during the war. The nationalists steadily increased pressure over the Government for more political and economic benefit and at the same time they expected some form of adjustment from the rulers as the Indians were more or less supportive of the British effort during the war period. Among the benefits what they expected was more measures towards industrialization. India was poor mainly due to devastation of her small scale and artisan based industries. All these happened during nineteenth century. So among the other popular demands, the industrialization was the foremost one.

Government of India decided to set up Indian Industrial Commission in 1916, the terms of references being to look after the causes of deindustrialization, problems of capital, industrial training, procuring raw materials and marketing of the products. As per terms of reference, the Commission will also suggest the ways for industrialization. The noted geologist and once the Director of Geological Survey of India Prof. T. Holland was appointed as the Chairman of the Commission, R. D. Bell acted as Secretary. Among other members of the Commission there were some Indians also—Pandit Madan Mohan Malaviya, the great philanthropist, Mr. R. N. Mukherjee, Mr. D. J. Tata. The industrialists

took active interest in the Commission work. Holland Commission sent questionnaires to industrialists, educationists, scientists, traders, mining experts, reputed individuals and requested them to meet the Commission. The interviews took place in major India cities for two years. Beside written submissions, most of them answered the oral questions put before them by the members of the Commission. Most of them, be Englishmen or Indians complained about difficulties in capital raising, poor infrastructure, insufficient Government support, practically no industrial training facility, tariff barricade for the development of Indian industries. However, all of them said about the immense possibility of Indian industries, as because of easy availability of raw materials and man-power.

The chemical manufacturers naturally stressed upon the chemical industry. Sir P. C. Ray, the Director of Bengal Chemical and Pharmaceutical Works, Calcutta submitted that the government should pioneer the following industries: lac, tobacco, sugar and chemical industries for the manufacture of glass, bleaching powder, alum, bichromate of potash, potassium permanganate, soda etc.⁷ Sir P. C. Ray disfavoured the attempt for establishing a highly developed technological research institution, as because people of an undeveloped country like India are not in a position to gain anything from it. Instead, he wanted a direct encouragement of industrial habit and enterprise amongst the people by starting of pioneer and demonstration factories. So far as industrial research, he preferred to carry on research in laboratories established in Indian industrial centers. Moreover, the research would have the effect of giving opportunities to Indians being trained under proper expert European supervisions. The entrepreneurs of different chemical farms noted the possibility of chemical industries in India. For this, the Government support was needed. They asked to carry on experiments with the following items:

- (i) chemistry, including agricultural, metallurgical, tinctorial, pharmaceutical chemistry;
- (ii) the leather and hide industry;
- (iii) glass making;
- (iv) sugar and alcohol manufacturing;
- (v) paper making;
- (vi) oil seed industries.

B. M. Das, the Manager of National Tannery, Calcutta said before the Commission for setting up a Leather Research Institute like that in Leeds University and Leather Seller's Technical College, London. He also requested for setting up a Government Department of Technology⁸. We may recall that Bengal Government had established a College of Leather Technology at Beliaghata, Calcutta some years later.

W. H. Harrison, the Government Agricultural Chemist of Madras Presidency complained about the paucity of ordinary fuel and mineral resources in South India. J. L. Simonsen of Madras Presidency College stated that with the exception of Department of Agriculture there was any organization in the Presidency that correlates the works of scientific and industrial research. Thus, services of applied chemistry was poor. Harrison opined that utilizing the hydroelectricity some small-scale endeavours, like manufacture of phosphorous, production of carbon bisulphide, production of bleaching agent for use of local textile industries, can be undertaken.

Regarding technical education, most of the industrialists complained about its inadequacy. They said that during the heights of nationalist movement a step in the right direction was taken when Association for the Advancement and Cultivation of Science and Industry of Bengal undertook to send abroad (mainly Japan & Germany) a number of young men for industrial training.

The aspirations of Indian entrepreneurs and high ranking English scientists in Government Laboratories were found to follow different courses. In the interviews, say for instance, R. S. Pearson of Forest Research Institute, Dehra Dun said:

'I am in favour of Imperial Scientific and Technical Departments for chemistry, botany, geology and zoology. All the Technical Research Institutes should be fitted into a general development scheme for the whole India, controlled by an Imperial Government Body'⁹.

Similarly, W. R. Criper of M/S D. Waldie & Co., Hooghly submitted that an Imperial Bureau of Industrial Research be established in India. He suggested that there might have a chief chemist, one for organic chemistry including vegetable dyes, alcohol, another for mineral and metallurgical chemistry, third for agricultural chemistry.¹⁰

Almost all the English chemists of Indian Education Service, Indian Medical Service, Indian Forest Service, different Surveys of India urged for an all-India Chemical Service. However, the Indians remain silent in this respect. We will discuss this part in the later pages.

For the development of industries, different personalities submitted evidences favouring for the establishment of department of industries at the Provincial Government level. Keeping the power and right of the Imperial Government as it was originally, the Commission ultimately opined in favour of giving more autonomy for the Provincial Governments in respect to certain subjects directly linked to the welfare of the people. Health, Education, Industrialisation etc. became the state subjects. In the line of recommendation of the Industrial Commission, the subsequent Montagu-Chelmsford Report (1918) on Indian Constitutional Reforms stated that :

‘On all grounds a forward policy in industrial development is urgently called for, not merely to give India economic stability, but in order to satisfy the aspirations of her people’.¹¹

The industry departments of Bengal, Madras, Bombay Presidencies, Government of United Province, Central Province etc. were organized in the early twenties. Directors of Industries were appointed and above all Industrial Chemists took the charge of chemical research required for chemical industries. Applied oriented researches were undertaken and the results were published in the Departmental Bulletins. However, the elaborate schemes of the Indian Industrial Commission for an Imperial Department of Industries, governing a network of provincial departments to each province, came to nothing. The central organization was not even organized. The Indian Ministers at the Provincial Government level could not do much due to paucity of fund and political will. The Central Bureau of Industrial Intelligence and Research came into existence in 1935—the allocation of fund was meager.

Education was made Provincial Government’s subject. The Indian Education Service was originally organized with English teachers. The Indian Education Service (IES) was made more liberal and more Indians got chance to be selected. At the close of the war, chemists like B. B. Dey, N. R. Dhar, R. C. Ray, B. K. Singh joined Indian Education Service. The recruits to the Indian

Education Service were originally (in the nineteenth century) intended to raise the intellectual standard of Indian higher education through teaching and administration. Moreover, there was shortage of science teachers in India. So Englishmen were recruited for physics, chemistry, zoology, botany, geology etc.

After two years of long deliberations, the Holland Commission submitted its report to the Government. The Commission was in favour of industrialization of the country and for this, Commission asked the Government to involve directly in capital generation, industrial training, research-infrastructure building, changing the tariff barriers etc. Some administrative reforms were also suggested. Most of the European chemists like J. L. Simonsen, J. J. Suddborough, H. E. Watson wanted an Imperial Government controlled Central Chemical Laboratory and the Commission approved it. Commission suggested for setting up an all India Chemical Service for the cause of central functioning of the laboratories.

III

Indian Munition Board:

The World War (I) engulfed India, because India was the most important British colony. The war preparations in India was in full swing. As because the sea route for importing merchandise to India became risky, the Government was forced to speed up the Indian industrial production. New industries were also set up during the war. War had large demands of industrial goods, including ammunitions, food, medicine, etc. To gear up the supply – line of the military as well as for the civilians, Indian Munition Board was set-up. The Indian Munition Board was created as a separate department of the Government of India during the world war of 1914-18. The Indian Munition Board, which was established on 1 April 1917, actually resulted from an enquiry from the Commander-in-Chief in India in 1916, Gen. Sir Charles Munro, as to whether more could be done to develop Indian resources for war purpose, so as to relieve the Ministry of Munitions in the UK as far as possible.

The Indian Munition Board took an active part in industrial production, industrial research of different substances having direct or indirect connection with the war. Board's endeavour was even continued after the war.

As mentioned earlier, chemical knowledge was thoroughly used in the First World War. Moreover, Britain experienced rivalry of Germans, particularly when the Germans utilized their chemical knowledge in her industrial production.

The Indian Industrial Commission also considered the matter with utmost importance. Evidence were submitted before the Commission stating the necessity of centralized research. The Indian industries, being infant, were not in a position to carry industrial research. The science was mainly the state-subject, and Government scientific laboratories, under different services investigated the scientific problems. The Surveys were highly centralized organizations and served the Imperial interests well.

The Indian Muniton Board acted as instrument of Ministry of Muniton, U.K. The Ministry enquired about the ammuniton positions of India, particularly of its raw materials. The Indian saltpetre carried reputation as a good ingredient of gun powder since the early days of East India Company. Though the business, i.e., export of Indian saltpetre gradually diminished over the years, there was sudden rise of export of saltpetre during the war.

In 1858-59, the export of Indian saltpetre was 35,000 tons, in 1913-14 it declined to about 13,400 tons but in 1917 the export was again increased to 40,000 tons.¹² Saltpetre was used not only as military gun power and blasting gun-powder for mining coal and iron ore, and for certain other explosives for mining, another important requirement which had grown up during the war for which saltpetre was extensively employed was the production of smoke mixture.

The Ordinance factories at Jubbelpore, Ichapore (Dum Dum) were developed.

The Indian Muniton Board was fortunate that scientist of repute Sir T. H. Holland had agreed to be its Chairman. The Board's chemical adviser was J. L. Simonsen of Forest Research Institute of Dehra Dun. Earlier when Simonsen was in Madras Presidency College, he took active interest in organizing Indian chemical research.

In order to organise chemical research in India, particularly with the aim of solving problems of substances of commercial importance from Indian

raw materials, a conference was organized by Indian Muniton Board at Lahore in January 8, 1918. Twenty chemists (all Europeans, except one) met to discuss the problem. Sir T. H. Holland, the Chairman of the Board delivered an eloquent address highlighting the need and advantages of research in India. He said:

‘What science can do in Europe, against the disadvantages of a temperate climate, it should be able to do more abundantly by turning tropical advantages to account..... Science is not the monopoly of Europe, but we must do more than transplant the results, if it is to grow in India: we must undertake our own research work.’¹³

Among the noted chemists joined in the conference there were W.H.F. Armstrong of Khalsa College (Amritsar), K. S. Caldwell of Patna College, H. B. Dunicliff of Lahore Government College, G. J. Fowler, J. J. Suddborough, H. E. Waston of Indian Institute of Science (Bangalore), A. R. Normand of Bombay Wilson College, A. N. Meldrum of Gujrat College (Ahmedabad) and J. L. Simonsen of Madras Presidency College. It is strange that Sir P. C. Ray was not included in the list of participants.

The British interest in exploitation of Indian products—be it forest, agricultural, geological, had a long history since the beginning of nineteenth century. In order to be more advantageous in the exploitation, the Imperial Government now bent upon to apply the knowledge of science.

Sir Holland spoke further:

‘In considering the question of co-ordinating chemical research, it is obvious that a systematic investigation of Indian raw materials especially vegetable products, is about the most urgent. In spite of valuable results obtained at Dehra Dun, at the Indian Institute of Science, at the Imperial Institute in London, and in our various colleges, only the fringe of this subject has so far been touched. For this work the chemist requires the co-operation of the departments of agriculture, forest and botany. It thus appears desirable to organize the chemical fraternity for representation on the Board of Scientific Advice.’¹⁴

It was generally agreed in the conference that a Government Chemical Service should be started. The service should include all chemists in Government Service, such as chemists in the Departments of Customs and Excise, in Educational Institutions and in the Forest and Agricultural departments. It was further agreed that such a Government Service should only be Imperial, because

it would not be possible for even the larger provinces to maintain a sufficiently large staff of chemists for work in all branches of science.

The Conference even thought about the place for imperial laboratory—either at Dehra Dun or Bangalore. For administrative purpose the research was thought to be controlled in three groups:

1. agricultural chemistry, with the chief laboratory at Patna,
2. organic chemistry, with chief laboratories at Dehra Dun and Bangalore;
3. mineral chemistry, with the chief laboratory at Kalimati or Calcutta.

Each group might be placed in charge of a senior officer, one of whom will be the Chief Chemist to the Government of India.

The Conference identified the principal chemical problems in connection with Government activities.

These were:

(1) agricultural products related problems, (2) forest products related problems, (3) drugs, perfumes, essential oils and dyes, (4) tanning, (5) sugar and alcohol manufacture, (6) saltpetre refining, (7) salt and khari manufacture, (8) minerology, (9) metallurgical inspection, (10) explosive manufacture.

There was a proposal to establish in India a section of the Society of Chemical Industry, but the idea was not accepted, as it was considered as a premature one. Development of chemical industries and professional chemist was a precondition of such society. It may be recalled that after about ten years Institution of Chemists (India) was established at Calcutta in 1928, the members being mostly analytical chemists in industries.

A list of researches undertaken for Indian Muniton Board in different research institutions and colleges was submitted in the conference. Indian Institute of Science, Forest Research Institute, Department of Industries of UP, Bengal, Madras, Bombay Presidencies, Lucknow Canning College, Drug Manufacturing Committee, Government Colleges, Agricultural Research Centres were the places where researches were carried out.

As decided in the conference, the lists of researches undertaken by the Board were published. The activity of Indian Muniton Board was continued

for several years. The researches were centrally organized, the results were published but few of them were actually applied in the industries. Ultimately the function of the Munition Board ceased and some sort of decentralization of research activity among the various provincial level industry departments took place. No doubt the Board at one time played an important role in organizing chemical research in India.

IV

Among the scientific activities sponsored by the Government, the industrial chemical research was the foremost. The object of the Government was to prepare chemicals in India essential to the textile industry (already established in India) and other chemicals, specially those which can not be imported in sufficient quantities during the War. Also the Government had a desire of preparation, on a relatively small scale for the Medical Service, of the drugs that can be made just as well in the laboratory as in the factory. The war situation was definitely a cause of thinking along the above lines; Britain thought about opening a second front in India.

There were other reasons. The interest of British finance capital, that began to flow in India from the last quarter of nineteenth century, searched new avenues for investment. The government tried to find out the possibility of manufacturing chemicals which were ordinarily imported and might be made in India.

It was found at that time that at the Indian Institute of Science, Hay, Fowler, Suddborough and H. E. Watson took up the electrolytic preparation of white lead, the refining of waste copper, the enzymatic hydrolysis of fats and the preparation of varnish. K. S. Caldwell carried out investigation on the utilization of copper waste at Patna College, A. R. Normand of Wilson College, Bombay investigated methods for preparing soluble chromate from chrome iron ore and for the conversion of acetylene into acetaldehyde and acetic acid. F. L. Usher of Central College, Bangalore submitted the results of the Science Congress about his work on the oxidation of alcohol to acetic acid; he was also engaged in colloidal medicinal preparations. The question of manufacturing citric acid was taken up by W. H. F. Armstrong. P. C. Ray tried to manufacture formaldehyde.¹⁵ R. L. Datta had taken up no less than twenty-two patents for the simple and economic manufacture of chlorine, bromine, iodine, chromate and bichromate.

Barring R. L. Datta and few others, there were distinct differences between Indian and European chemists about the approach and selection of problems. Indians were more interested in so-called pure research and they were more or less followers of the then research chemists of European institutions, especially of universities. On the other hand, Europeans, who had mainly concentrated in I.I.Sc.(Bangalore) and different Government colleges, were busy in 'discovery of India' by the way of analyzing its natural products.

There was a spurt of industrialization in India just after the war. We also notice the encouragement of education and research in applied chemistry at the close of the war. In the Indian Science Congress of 1918, J. Fowler placed a document about the training of students of Applied Chemistry. Departments of Applied Chemistry were soon established at Calcutta and Bombay Universities. H. K. Sen took a lot of pain in organizing this education at Calcutta University. Professor post of Applied Chemistry was founded at I.I.Sc. during the War and Professor Fowler was appointed there.

As recommendation of the Industrial Commission, the Industry Department came out under various Provincial Governments. These Industry Departments organized the post-War industrial chemical research in India. Researchers of government colleges were asked to carry "fruitful" research. During and after the War, we identify several Indian and European chemists who did such 'applied' research. Among them, A. E. Walden of Wilson College, Bombay, Abdus Samad Khan of Patna College, J. A. Pilgrim, the tannin expert of Government of India, D. N. Gupta and B. C. Mukherjee of Department of Industries of Government of United Province, A. J. Turner of Victoria Jubilee Technical Institute of Bombay, B. B. Bhavale, B. M. Das, K. C. Srinivasan of Calcutta Research Tannery, Rev. Father J. F. Calus of St. Joseph's College, Trichinapolly, R. L. Datta, T. K. Basu of Industry Department, Government of Bengal, P. Neogi of Rajsahi College did a lot of work in this period.

V

The Proposed Indian Chemical Service:

When we are discussing about Indian Industrial Commission and Indian Munition Board, we should also discuss about the proposal of formation of an all-India service, namely Indian Chemical Service, because all these are closely interconnected.

As mentioned earlier, many English chemists working in Educational, Agricultural, Forestry Services submitted before the Indian Industrial Commission that an Imperial service is required to organize chemical research in India. Such researches should be well-directed and centralized as because need-based, industry-oriented research with Indian raw materials is absolutely required.

Prof. J. L. Simonsen of Department of Chemistry, Madras Presidency College submitted a well-planned document before the Commission. At the outset he lamented by saying that with the exception of the Department of Agriculture there was no organization in the Madras Presidency that correlated the work of scientific and industrial departments. Prof. Simonsen said that a Department of Chemistry under the direction and control of a Chief Chemist should be instituted. As per suggestions, the functions of the Department would be:

- (1) To investigate on behalf of Imperial and Local Government any problem that may lead to industrial development.
- (2) To provide experts in various subjects whose services may be placed at the disposal of the Local Governments for the solution of problems which can only be attacked on the spot.
- (3) To staff the professional posts in the Government Colleges.
- (4) To investigate problems for private farms.
- (5) To standardise apparatus and analyse materials in the manner of the National Physical Laboratory.

In his lengthy submission, Prof. Simonsen further said:

‘...It has been generally recognized, for the industrial development of a country chemical supervision and chemical research is essential. It appears that such aid can be given in India by the formation of highly centralized department working in a Central Research Institute. It will obviously be necessary to have for certain subjects local laboratories, but these would all be conducted under the control of Central Institute. Although at first sight the idea of central laboratory and the centralisation of the control of chemical work in British India might appear to present objectionable features and to be likely to interfere with the originality of the individual, I do not think that such would prove to be the case, and in my opinion the advantages of such a scheme would outweigh all the more apparent disadvantages’¹⁶.

G. J. Fowler, J. J. Suddborough, H. E. Watson—all of Institute of Science, Bangalore, supported the move of J. L. Simonsen.

However, some lone voices disfavoured the move was also heard. W. H. Harrison, the Government Agricultural Chemist of Coimbatore said that he was not in favour of centralization of chemists.

Similar arguments supporting the central organization were placed in the meetings of Indian Munition Board. Prof. J. L. Simonsen by that time has left the Madras Presidency College and joined the Forest Research Institute of Dehra Dun. He got involved in the entire activity of the Munition Board.

The Industrial Commission ultimately recommended for a Central Imperial Institute for chemical research and branches at local level. The Commission considered that for administrative purpose the chemists employed by the States in India and distributed among the cadres of various services, should be brought together into one service to be called the Indian Chemical Service, and should be under control of a senior officer styled Chief Chemist to the Government of India. The remaining members of the service would be divided into three groups—agricultural, mineral and organic chemists.

The recommendations of Indian Industrial Commission were considered by the Government of India. The Secretary of State decided that large sums of money must be found at the earliest possible moment for possible fostering the development of Indian science. The matter was referred to Viceroy in the session of Imperial Legislature Council at Delhi.

Two policies were holding the field, (1) Centralisation under a proposed Imperial Department of Industries of Government of India in which chemists, botanists, zoologists etc. would be formed into graded services, (2) Decentralisation under which scientific workers at various universities and research institutions will be given free hand as far as possible.

The policy of decentralization ultimately helped to create research schools in the industry department of various Provincial Governments.

For the proposal of Imperial Service, a Committee was formed to examine various aspects of the issue. The Committee was appointed in 1919. Prof. J. F. Thorpe, the renowned English chemist was appointed its chairman.

The other members of the committee were K. S. Caldwell, R. W. Davies, H. Harrison, P. C. Ray, J. L. Simonsen, J. J. Sudborough; the Secretary was J. L. Simonsen. The name of the Committee was Chemical Service Committee.

The terms of reference to the Committee were:

1. To consider whether an all-India Chemical Service is the best and most suitable method of overcoming the difficulties and deficiencies pointed out by the Indian Industrial Commission.
2. In the event of the Committee approving the principle of an all-India Service, to devise terms of recruitment, employment and organization; to indicate the extent to which chemists already in Government employment should be included in that service; and to suggest what should be the relations of the proposed organization with the public and with Departments of the Government of India and of Local Governments.
3. In particular to frame proposals for the location, scope and organization of institutions for chemical research.

Prof. Thorpe came to India in 1919 and toured many cities of India, visited many laboratories—be it Government or non-Government. Prof. Thorpe and the other members talked about chemical research with the working chemists of educational institutions, survey laboratories, and of other services. The Committee generally accepted the arguments for organizing research. The Report of the Chemical Service Committee mentioned that:

‘...the development of chemical industries in India could only be adequately realised through the agency of an efficient Government Chemical Service. Very few of the great natural sources of the country were being exploited to advantage and where, here and there, this was being done, the processes employed were often crude and wasteful. It was evident that if the resources of the country were developed to their fullest extent, India would have taken her place in the front rank of industrial communities and would benefit by all the advantages that this implies.’¹⁷

The complain before the Industrial Commission about the inadequacy of technological training institutes in India was again heard. That in India there was an unquestionable need for technological institutes, was accepted by the members of the Committee. They called the Indian Institutes as Trades

Schools because in them men of the foreman type receive instruction in the techniques of their trade. The post graduate education in the universities has just began with many difficulties. Tremendous shortage of qualified chemists was a major problem in developing chemical research.

The Committee even noted the low standard of chemical education in India. It reported:

‘...the dividing line between pure and applied chemistry has not been reached, but one or two years subsequent training in the method of research coupled with instruction in the principles of engineering and machine drawing, where such training has not been already formed a part of the Honours Course, is necessary both for the industrial and academic chemists.’¹⁸

However, Prof. Thorpe commented that steps were taken in the right direction in Calcutta University, but both Madras and Bombay universities were lagging in the training of chemists.

The Committee also considered the problem of gap between universities and industries. The chemists of university systems possess little knowledge about the problems facing by the industries. The suggestion that post-graduate students should be drafted to some chemical works in order to gain factory experience was also considered by the Committee.

The Committee recorded that appreciable number of working chemists were already serving in India. In the various Services of Government of India, a large member of European chemists were stationed.

The Agricultural Departments of Imperial Government and Local Governments utilized the services of Agricultural Chemists in a large way. The Agricultural Chemists of Bengal Government especially looked after the problems of tea, indigo, tobacco, jute cultivation in eastern India. Similarly sugar cane, rubber plantations and their problems were monitored by chemists of Agricultural Department of Madras. The next highest contingent of European chemists were in Indian Education Service. They served the Government Colleges across India. Appreciable number of chemists were also found in Forest Service, mainly stationed in the Forest Research Institute of Dehra Dun. There were service chemists in Ordnance Departments and ammunition factories. Assay Masters in different mints were chemists by qualification. The Geological Survey

Departments had large number of chemists in their pay-roll. The principal function of these chemists was to analyse various ores, minerals, water samples etc. The Geological Survey of India maintained good analytical laboratories in their Head Quarter at Calcutta. The Chemical Examiners-cum-Forensic Experts were attached to the Medical Colleges. The Professors of Chemistry at Calcutta Medical College functioned as Chemical Examiners for a long time. They carried out investigation of analysis of general type, such as quality analysis of kerosene, oil, sugar, explosives, drinking water; side by side they examined the poisoning cases also. Viscera, stains were also examined by the chemists.

Prof. Thorpe talked with chemists and tried to understand the inherent commonness among them. He thought that appreciable man-power was being lost, as there was practically no coordination among the various services. A section of service chemists welcomed the proposal of setting up an all-India Chemical Service, particularly by those who were outnumbered by large numbers of otherwise qualified members of the service. The service prospect was the driving force of their way of thinking. Again, a section of chemists disfavoured the move also, as the scheme was not very transparent to them.

Ultimately, the Thorpe Committee recommended in favour of formation of all-India Chemical Service. P. C. Ray, however, recorded a note of dissent and he explained also the reasons of not favouring the proposal.

Among the principal recommendations of the Thorpe Committee some were as follows:

1. That a Chemical Service should be constituted.
2. That the Service should be called Indian Chemical Service.
3. That the Service should be controlled by a Director-General.
4. That a Central Chemical Research Institute should be erected at Dehra Dun under the Director-General of the Chemical Service as Director, assisted by a number of Deputy Directors.
5. That each Deputy Director should be in charge of a separate department and that, in the first instance, there should be four Departments, (a) Inorganic and Physical Chemistry, (b) Organic Chemistry, (3) Metallurgical Chemistry, (4) Analytical Chemistry.
6. That a Provincial Research Institute under the control of Local Government should be erected in each province near the chief seat of

industry in that province and that each Provincial Research Institute should be under a Director of Research.

In this way, altogether thirty-five recommendations were submitted.¹⁹

P.C.Ray recorded the following note of dissent:

‘....On principle, I oppose to the creation of an all-India Chemical Service. At the early stages of the foundation of British Empire, there was no doubt need for the erection of Indian Civil Service, the Indian Medical Service. Now after an interval of more than 160 years under the enlightened Government, vast progress has been made. We have graduates of the local universities....The bureaucracy will creep in the system....My own view is that the best results would be achieved by improving the teaching of chemistry in the Indian Universities.....When the Industrial Commission made its recommendations for the creation of a Chemical Service, the Reform Scheme was in a nebulous condition. Now that the bill has been passed and has taken a definite shape with provincial autonomy as its corner stone and industry as a “transferred” subject, the *raison d’etre* for an all India Chemical Service has almost ceased.’²⁰

The Government of India Act, 1919 was a major event of that period. The Reform Scheme that was incorporated in the said Act was aimed to satisfy the popular discontent against the Imperial power. The political aspirations of Indian people reflected in many spheres of their life including education and science. P.C. Ray represented this nationalistic force in the sphere of science. What P. C. Ray and his young followers thought about need of India at that time were:

1. The foundation by the Government of a number of Chairs in various branches of pure and applied chemistry in the universities, and also a large number of Readerships, Assistant Professorships and research scholarships.
2. The establishment of a number of technical institutions and the strengthening of the laboratories and scientific libraries.
3. The organization of the posts so created and of the posts already existent on a professional rather than a service basis.
4. The replacement of the Director by Board of Recruitment composed chiefly by university professors, one official, one or two non-official representative of the public.
5. The encouragement of the foundation of scientific societies.

The Government of India Act, 1919 allowed the transfer of certain subjects previously administered by the bureaucratic regime to the control of popularly elected Ministers in the Provinces. These subjects were agriculture, forests, industries and scientific or technical services attached to these departments.

Sir P. C. Ray actually raised these points in his note. The Thorpe Committee recommendations were submitted to the Government of India. However, the recommendations could not be considered by the authorities due to change in situation. Ultimately the proposal for the creation of an all-India Chemical Service, Imperial Chemical Laboratory etc. were not materialised.

In the twenties, the number of Indian chemists including other scientists was large enough to put pressure on the establishment of science. Calcutta and other important cities of British India witnessed the emergence of a new class of people having training in western education, science. They were in a mood in taking-over the responsibility of India. But the change-over was not smooth and easy. The abortive attempt on the part of British chemists for starting Indian Chemical Service, the establishment of Indian Chemical Society, Institution of Chemists (India) by the nationalistic scientists set-up the future of Indian chemistry. These endeavours were aimed in two different directions. One was to continue the subjugation of British hegemony over the Indians and the other was for the emancipation of an oppressed nation. There was marked difference in the choice of research areas also. The need-based research—a trend observed among the British chemists since the early part of nineteenth century continued even after the first Great War, while their Indian counterpart, after receiving training from England and other European countries tried to follow the research patterns of their masters. The British chemists were not in a mood of development of Indian chemistry. They were more inclined to fulfill the imperial need. Indian chemists wanted to follow the self-reliance path, the way that was followed by the chemists of independent European nations. The beginning of industrial research at the initiative of various Provincial Governments made a mark on the development of Indian chemistry. Even there were differences in institutional choice. English chemists were mainly concentrated in Bangalore, Bombay and Dehra Dun, while the Indian chemists were mostly stationed at Calcutta.

The political and economic struggles by the Indian masses against the British imperialism were at the zenith at this time. The prevailing great economic depression made the people unrest. The nationalist chemists also received the message of freedom movement from the platform of Indian National Congress and others. They carried out their struggle in their own way. The history of the development of Indian chemistry during 'twenties exposes the untold stories of political, social aspects of Indian science.

VI

During 'twenties chemists of repute started their career in different colleges and universities of India. Among them Bawa Kartar Singh, P. Ray, H. K. Sen, B. B. Dey, R. C. Ray, R. L. Dutta, N. R. Dhar, J. C. Ghosh, J. N. Mukherjee, S. S. Bhatnagar, P. B. Sarkar were important.

After his post-graduate studies in the University of Cambridge and London, Bawa Kartar Singh came back to India and began his research on optically active nitrogen compounds under Prof. E. R. Watson in Dacca Government College. He left Dacca in 1918 to join the Government College of Lahore. In 1921 Bawa was selected as Professor in Indian Education Service and joined Patna College, from where he was transferred to Cuttuck Ravenshaw College. During 1925-26 he went to England and France on study leave. In 1936 Bawa Kartar Singh resigned from I.E.S. and became Professor and Head of the Department of Patna University, Bawa was the pioneer worker in stereochemistry in India.

P. Ray was one of the favourite students of Sir P. C. Ray. He was appointed in the post of Assistant Palit Professor of Chemistry in the newly established University Science College of Calcutta University in 1919, subsequently promoted to the post of Khaira Professor in 1937. P. Ray carried out extensive research work in diversive fields of inorganic, analytical and nuclear chemistry.

H. K. Sen received his D.Sc. degree of London University 1915. On returning to India Sen served some chemical farms and then joined the Calcutta University as Professor of Applied Chemistry. With great zeal and conspicuous ability he served the university in this capacity for over fifteen years during which he built up the Department of Applied Chemistry. H. K. Sen was one of the pioneer industrial chemists of India.

B. B. Dey, another student of P. C. Ray, after receiving training in Imperial College of Science and Technology, London came back to India to join the I.E.S. He was at first allowed to join Presidency College, Calcutta and was then transferred to Presidency College, Madras. His contributions in the field of plant products, specially on the chemistry of coumarins, electrochemistry and biochemistry will be remembered by posterity. He built up his career during twenties and thirties.

R. C. Ray, another chemist of repute initially started his research on borohydrate in the Indian Institute of Science, Bangalore. After First World War Ray joined Prof. Donnan's laboratory of University College of London and obtained his D.Sc. He served the Patna University for a long time.

R. L. Dutta, the well known industrial chemist served the Industry Department of Bengal Government in 'twenties and 'thirties. He pioneered the work of industrial research on soap, ink, oil etc. and earned international reputation as soap technologist.

N. R. Dhar, J. C. Ghosh, J. N. Mukherjee, S. S. Bhatnagar—all physical chemists served Indian Colleges and Universities during the same time. N. R. Dhar after receiving D.Sc. degrees both from London and Paris University joined I.E.S. He was appointed in the Muir Central College at Allahabad in 1919. He served both Muir College and Allahabad University as soil chemist. His thesis in photochemical nitrogen fixation was internationally recognized in soil science.

J. C. Ghosh received his doctorate degree from the University of London and came back to India to join the Dacca University in 1921. Ghosh's thesis on strong electrolytes drew the attention of physical chemists of all countries.

J. N. Mukherjee—another physical chemist served the Calcutta University for a long time. His research on colloid chemistry, soil etc. was pioneering in nature.

S. S. Bhatnagar, after receiving his early education in Forman College, Lahore went to England in 1919 to work under Prof. F. G. Donnan. After returning to India Bhatnagar joined the Benaras Hindu University and then Punjab University. His contribution in the fields of colloids, surface chemistry, magnetochemistry drew the attention of all concerned.

P. B. Sarkar was a superb analytical chemist during 'twenties and 'thirties. He served Calcutta University for a long time and built up a school of analytical chemists there.

We see a rapid change in the scenario of Indian chemistry since 1920's. Within a time span of about ten years, all European chemists in colleges, universities, research institutes were gradually replaced by Indian chemists and the dream of Sir P. C. Ray was fulfilled. In the political side we see gradual development of freedom movement. The Government of India Act of 1919 and 1935 slowly Indianised the Government State apparatus also. The distinct nationalistic influence over Indian chemistry started being recognized all over.

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