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Introductory note by the President.

On the 26th of September 1919 I received a letter from the Secretary of State for India in Council asking me to act as President of a Committee about to be appointed by the Government of India "to formulate proposals for the organisation of a Chemical Service for India, and for the location and equipment of research laboratories." I sailed for Bombay on the 17th of October and arrived there on the morning of November 15th.

After remaining for a few days at Delhi, I started on a tour of the Provinces in order to familiarise myself with Indian conditions and during the tour visited Cawnpore, Lucknow, Calcutta, Rangoon, Madras, Coimbatore, Aravankadu, Bangalore, Poona, Bombay, Nasik, Nagpur, Jamshedpur, Pasa, Lahore, Jallo, Amritsar, Dchra Dun and Simla, reaching the last named place on the 2nd of February 1920.

During the tour it soon became apparent that the development of the Chemical Industries of India could only be adequately realised through the agency of an efficient Government Chemical Service. Very few of the great natural resources 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 take her place in the front rank of industrial communities and would benefit by all the advantages that this implies.

In the Provinces visited, there was no lack of appreciation of this fact, but the main trouble seemed to be the absence of any effective organisation to advise and co-ordinate the various efforts which were being made to meet the situation. Moreover, although the need was clear to them, none of the Provinces had as yet formulated a programme of their requirements, nor had they decided what educational methods were necessary to achieve the desired ends.

They did not know, for example, whether the problem could be solved by the erection of technological institutes, schools of technology or research institutes and no very clear ideas were held as to the meaning of these terms. But it was generally agreed that either the one or the other was necessary.

I explained that in a country such as India there was an unquestionable need for technological institutes, but that these should be more properly called Trades Schools because in them men of the foremen type should receive instruction in the technique of their trades. The difference between a pure and an applied chemist is relative only and a chemist, whether he ultimately intends to devote his life to academic or to industrial pursuits, must, in the first instance, receive a thorough training in his subject by passing through a recognised course such as that given in an Honours' School at a British University.

Even then the dividing line between pure and applied chemistry has not been reached, but one or two years' subsequent training in the methods 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 chemist.

After such training, the chemist should be in a position to turn his hand to anything chemical. If he decided to enter industry, he might do so at once because his mind would be in a condition rapidly to assimilate the technical details of the chemical processes underlying the work of the factory into which he entered. It is interesting to note that one of the leading chemical manufacturers in America, and more than one in England, have told me that chemists trained in this way were all they required. If, on the other hand, instead of following industrial pursuits, the chemist decided to enter academic life, he would be, after such training, in a position to teach and instruct others in the methods of chemical research.

In my opinion it is the duty of the Universities and of University Institutions not only to instruct men intended for a chemical career in the theory and practice of chemistry, but also to imbue them with the enthusiasm and initiative which only a training in chemical research can impart. In other words, the Professors of Chemistry in Universities and University Institutions should be researchers in chemistry as well as teachers and, in fact, it is the first duty of a University to advance knowledge, its second duty to impart it.

Steps are being taken in the right direction notably at Calcutta and in Madras. Bombay I found to be strangely behindhand in its training of chemists, but no doubt this state of affairs will be improved when the status of the College of Science has been settled. University education in chemistry in the other Provinces appears to be still largely in the making, although most of them are fully alive to the need for an effective training both in the Science and in Research.

Personally, I am not convinced that true chemical

“ technological ” training can be imparted without actual works experience, such experience being gained by a man who has passed through a course on the lines I have suggested. Engineers gain their practical training by passing through the shops, physicians and surgeons by passing through hospitals, but the chemist is usually considered effectively trained after he has obtained an Honours’ Degree in his University.

In my opinion he is, at this stage, no more proficient than a medical man would be without hospital experience, or an engineer without knowledge of workshop practice. Many attempts have been made to meet this deficiency and in at least one Indian University the suggestion was made to me that post-graduate students should be drafted to some chemical works in order to gain factory experience. This, however, is an old suggestion which has been tried in England, notably by the Board of the 1851 Exhibitioners who have instituted Industrial Bursaries by which, I believe, a post-graduate student is enabled to make arrangements with any works he thinks fit for training him in factory methods. I do not know how this scheme has worked generally, because only one student of mine held a Bursary of this kind and in his case, although he attended a prominent factory for a year, he was allowed to learn nothing of the processes carried out there and spent his time in routine work in the research laboratory. Such a result seems to me inevitable, when we remember that chemical manufacturers are usually loth to give the run of their works to casual students who are not in any way bound to them. In fact the only chemical factory which appears to be open to students is the Municipal gas works and here in India works of this kind are not numerous. There is, however, no doubt that much can be done by improving the general course of training in

chemistry afforded by an Honours' school. For example, at the present time a course of instruction in organic preparations is carried out entirely by means of glass apparatus. There is no reason why students during their course should not also be instructed in the use of large scale appliances, which would supply conditions involving the use of metal apparatus and the connections incidental thereto.

It is, of course, impossible and unnecessary to have laboratories attached to Universities fitted with full scale apparatus, but it is quite possible to erect a laboratory, of comparatively small dimensions, containing types of every kind of plant used in chemical manufacture, of about 1-60th the size of the large scale plant. A laboratory of this kind should, I think, be attached to the chemical department in every University.

So far as the Chemical Service proposed in this Report is concerned, it is intended that such factory experience, as may be required, will be given in one or other of the pioneer or demonstration factories which it is proposed to erect, but it is not suggested that this should obviate the need for University training such as that outlined above.

In the text of the Report the Committee has given its reasons for recommending the establishment of Provincial Research Institutes, at the chief centre of industry in each Province, under the control of the Provincial Governments, and the provision of a Central Research Institute under Imperial control at Dehra Dun. The relationship of the Imperial Institute to the Provincial Institutes is given in detail, but I may add here that there is no intention to confer on the Imperial Institute the power to exercise any administrative control whatever

over a Provincial Institute. The links which bind two are those of good-will and common interest. I hoped that for the common good these links will remain unsevered.

I wish to express my thanks for the help and generous hospitality extended to me throughout my tour of the Local Governments of the Provinces I visited.

JOCELYN THORPE.

Simla, 23th February 1920.

APPENDIX I.

Evidence of Major G. H. Willis, C.I.E., M.V.O.,
M.I. Mech. E., R.E., Mint Master, Bombay.

My views on this question are coloured by my strong conviction that the Assay Department should cease to exist as a separate entity and that it would be a considerable economy and tend to better administration if the assayers formed part of the Mint staff, their technical reports being submitted unedited by the Mint Master to Government with his report. If this were accepted, it might be that a Chemical Service as proposed could supply assayers to the Mints as required, some of the junior chemists of the service being encouraged to qualify themselves for appointment to the Mint as vacancies occur. Some arrangement of this sort would be of great value, as with the present small establishments, leave or sickness vacancies, coinciding with heavy work in the Mints create great difficulty.

Since it is essential that assayers should be men of integrity and meticulously accurate workers, the terms of recruitment should be such as to ensure this. As regards control, they should, in my opinion, be under the Mint Master for all administrative purposes, but should be entitled to correspond direct with the head of the Chemical Service regarding technical matters and regarding their connection with that service. The head of the Chemical Service should be responsible that the Mints are kept supplied with the numbers of assayers

that the Mint Masters inform him are necessary up to the establishment sanctioned by Government. Ordinarily an assayer should find his whole career in the Mint when once he has joined that service permanently.

As far as the Mints are concerned a centrally located institute would be suitable. In busy times such a research institute might be of the greatest use to the Mints, since the assay work is often so heavy, that the Assay Master and his staff are unable to do the miscellaneous analytical work which the Mint Master requires for the efficient working of the Mint.

APPENDIX II.

Note on an intensive engineering course for chemists in the proposed Chemical Service by Mr. C. Graham Smith, A.C.G.I., A.M.I.C.E., Professor of Engineering, College of Engineering, Poona.

I was impressed with the arguments of the Committee that came to the College of Engineering the other day, in which they considered that the chemist could learn all that was necessary in a short course covering a period of, say, six months. I have discussed the question with a number of men, and none of them considered that a course of six months was sufficient, but on examination they came round to the conclusion that what was required could be done in the period already stated.

The time available might be divided more or less as follows:—

	15 per cent. carpentry.
	35 per cent. engineering shops, smithy, etc.
TOTAL ..	50 per cent. shops.
	20 per cent. sketching.
	30 per cent. mechanical and elementary drawing.
TOTAL ..	50 per cent. drawing.
GRAND TOTAL ..	100 per cent.

It should be noted that the sketching and drawing should be combined as much as possible, and these allocations cannot be adhered to rigidly. It is only put

forward as a guide. For example, a student might be required to measure up some engine detail, make a sketch of it, and from his sketch produce an engineering drawing.

A man with a natural aptitude for this kind of work might do all that is required in less than six months, but one with none would require longer.

Design should not be included in this course as it would or might lead to the chemist encroaching on the sphere of the engineer. Design could not be taught in the time, and the chemist does not require to be able to design.

It would be desirable, perhaps, to include a few lectures on materials of construction.

With six months devoted to drawing and shops it will be seen that the total number of hours spent on this work in six months approximates to the time spent by College of Engineering students in drawing and is more than they spend during the three years' course in the shops. Thus :—

$$6 \text{ months} \times 4 \text{ weeks} \times 6 \text{ days} \times 3 \text{ hours per day} = \text{to } 432 \text{ hours.}$$

In the workshop the sub-overseers get approximately :—

$$3 \text{ years} \times 9 \text{ months} \times 4 \text{ weeks} \times 6 \text{ hours per day} = \text{to } 684 \text{ hours.}$$

This is roughly as 2 : 3, and should be sufficient.

It should be remembered, however, that we would be dealing with a much better class of students, and one with a really trained mind.

APPENDIX III.

Extracts from the Civil Service Regulations referred to in paragraphs 37, 93 and 103 of the Report.

Article 89.—If an officer is transferred to duty which is such that he retains no connection with his own appointment and which there is reason to believe will not terminate within three years, the Local Government may, if it thinks fit, suspend his lien upon his own appointment altogether, and fill up that appointment substantively, reserving only the right to reverse the arrangements thus made in case the absent officer at any time reverts to his original appointment.

Article 459 (b).—Officers, other than ministerial, who have attained the age of 55 should ordinarily be required to retire, and should not be retained in service except where unquestionable public grounds for retention exist, and there is no doubt as to the physical fitness of the officer.

Article 85.—An officer of Government, whether paid from General Revenues, a Local Fund, or in Foreign service, who is deputed to, or detained in, Europe on special duty, is entitled to not more than two-thirds of the salary which he would draw were he on duty in India.